LONE STAR
GROUNDWATER CONSERVATION DISTRICT

May 10, 2022

MINUTES OF PUBLIC HEARING ON PERMIT APPLICATIONS

The Board of Directors of the Lone Star Groundwater Conservation District ("District") met in regular session, open to the public held in person in the Lone Star GCD – James B. "Jim" Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, and remotely via the publicly accessible webinar/telephone conference call within the boundaries of the District on May 10, 2022.

CALL TO ORDER:

President Hardman called to order the Public Hearing on Permit Applications at 6:00 PM announcing the meeting open to the public.

ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

Jon Paul Bouché
Harry Hardman
Larry Rogers
Jonathan Prykryl
Janice Thigpen
Stuart Traylor

Six members of the Board were present, while Director Spigener was absent, thus constituting a quorum of the Board of Directors. Also, in attendance at said meeting were Samantha Reiter, General Manager; Stacey V. Reese, District Counsel (virtual); District staff; and members of the public. *Copies of the public sign-in sheets and comment cards received are attached hereto as Exhibit "A" to the Regular Board of Directors Meeting minutes.*

PRAYER AND PLEDGES OF ALLEGIANCE:

President Hardman called on Vice President Traylor for the opening prayer and Secretary Rogers to lead the Pledge of Allegiance and the Pledge of Allegiance to the state flag.

PUBLIC COMMENTS:

No comments were received.

Ms. Reiter briefed the Board on permit applications received for the month and reported that there were seven applications received for this month. Applications for consideration and recommended for possible approval included the below:

1. **TPHTL HBL, LLC (Future MUD #152)**

Applicant is requesting registration of two new wells and production authorization in the amount of 3,000,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

2. **Clover Creek MUD**

Applicant is requesting an amendment to an Operating Permit for registration of a new well and an increase in production authorization in the amount of 5,478,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

3. **David Valdos Mendoza**

Applicant is requesting registration of a new well and production authorization in the amount of 2,709,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

4. **Korolev Tennis, LLC**

Applicant is requesting registration of a new well and production authorization in the amount of 109,500 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

5. **Affordable Storage**

Applicant is requesting registration of a new well and production authorization in the amount of 250,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

6. **Dox Aquas Water System**

Applicant is requesting an amendment to an Operating Permit for registration of a new well and an increase in production authorization in the amount of 64,000,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

7. **Blue Horizon RV**

Applicant is requesting registration of a new well and production authorization in the amount of 255,000 gallons for 2022 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is requested.

Following Ms. Reiter's report, Vice President Traylor motioned to approve items #1-7, as recommended by the General Manager. Director Prykryl seconded. Motion passed.

President Hardman adjourned the public hearing on permit applications at 6:04 PM.

PASSED, APPROVED, AND ADOPTED THIS 10th DAY OF MAY 2022.

Larry Rogers, Board Secretary

LONE STAR
GROUNDWATER CONSERVATION DISTRICT

May 10, 2022

MINUTES OF SHOW CAUSE HEARING

The Board of Directors of the Lone Star Groundwater Conservation District ("District") met in regular session, open to the public, held in person in the Lone Star GCD – James B. "Jim" Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, and remotely via the publicly accessible webinar/telephone conference call within the boundaries of the District on May 10, 2022.

CALL TO ORDER:

President Hardman called to order the Show Cause Hearings at 6:04 PM.

ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

Jon Paul Bouché
Harry Hardman
Jonathan Prykryl
Larry A. Rogers
Janice Thigpen
Stuart Traylor

Six members of the Board were present, while Director Spigener was absent, thus constituting a quorum of the Board of Directors. In attendance at said meeting were Samantha Reiter, General Manager; Stacey V. Reese, District Counsel; District staff; and members of the public. *Copies of the public sign-in sheets and comment cards received are attached hereto as Exhibit "A".*

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Fisherman's Cove Resort** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to remit 2022 water use fees and associated penalty fines and failure to submit the 2021 annual water production report and associated penalty fines. 2021 water use fees are invoiced in early to mid-November of the prior year and due January 1st of the current year, while production

reports are due annually on or before February 15th. Multiple attempts to contact the permittee have not been successful that of which included emails, phone calls and notice of violation. The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) failure to remit 2022 annual water use fees and/or fines associated with timely submission.
2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorney's fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and
3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Director Bouche seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Kampgrounds of America** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit 2021 water production report (due February 15th) and associated penalty fines. Multiple attempts to contact the permittee have not been successful that of which included emails, phone calls and notice of violation. The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) failure to remit 2022 annual water use fees and/or fines associated with timely submission.
2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorney's fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and
3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Secretary Rogers seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (Bear Branch) / Aqua Texas, Inc. (Greenfield Forest)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount. The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorney's fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (Black Oak)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount. The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorneys' fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (Laird)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or less than the authorized amount.

The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or less than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorneys' fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (Lake Conroe Village)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or less than the authorized amount.

The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or less than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorneys' fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (Walnut Springs)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorneys' fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman announced a Show Cause Hearing pursuant to District Rule 2.5, directing **Aqua Texas, Inc. (West Lane)** to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why proposed enforcement action should not be pursued by the District. He asked if anyone was present to represent the permittees, none of which were present.

Ms. Reiter stated that the respondents had been requested to appear before the Lone Star Groundwater Conservation District to show cause why the District should not take action for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

The following actions were voted on by the Board:

1. issue a cease-and-desist order pursuant to District Rule 12.6(c) for failure to submit the Consent Order and/or remit the overproduction fees and fines associated with the 2021 withdrawal of groundwater in an amount which exceeded the specific amount authorized for withdrawal by ten percent (10%) or greater than the authorized amount.

2. file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties, and attorneys' fees and court costs incurred by the District in the prosecution of claims against Respondent for its violations of District Rules; and

3. take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Director Prykryl motioned to approve District staff to initiate further enforcement actions. Vice President Traylor seconded the motion. The motion passed.

President Hardman adjourned the Show Cause Hearing at 6:15 PM.

PASSED, APPROVED, AND ADOPTED THIS 8th DAY OF JUNE 2022.

Larry Rogers, Board Secretary

LONE STAR
GROUNDWATER CONSERVATION DISTRICT

May 10, 2022

MINUTES OF REGULAR MEETING

The Board of Directors of the Lone Star Groundwater Conservation District ("District") met in regular session, open to the public, held in person in the Lone Star GCD – James B. "Jim" Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, and remotely via the publicly accessible webinar/telephone conference call within the boundaries of the District on May 10, 2022.

CALL TO ORDER:

President Hardman presided and called to order the regular Board of Directors meeting at 6:16 PM, announcing that it was open to the public.

ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

Jon Paul Bouché
Harry Hardman
Jonathan Prykryl
Larry A. Rogers
Janice Thigpen
Stuart Traylor

Six members of the Board were present, while Director Spigener was absent, thus constituting a quorum of the Board of Directors. In attendance at said meeting were Samantha Reiter, General Manager; Stacey V. Reese, District Counsel; District staff; and members of the public. *Copies of the public sign-in sheets and comment cards received are attached hereto as Exhibit "A".*

PUBLIC COMMENTS:

Betty Boren Avery spoke to praise the district regarding a class that was given on promoting gathering rainwater. She sent the event information on to a group of people who did attend, and they were impressed with the class and the quality of information. She would like for this to occur more often. She stressed the importance of this type of education that needs to get into to schools and the general public. It needs to start small to gather awareness and support from the constituents in Montgomery County.

APPROVAL OF THE MINUTES:

President Hardman stated the Board would consider the meeting minutes as listed for approval on today's agenda. Without further discussion, upon a motion by Vice-President Traylor to approve and seconded by Director Prykryl, the Board approved the meeting minutes as presented.

a) April 12, 2022, Public Hearing on Permit Applications
b) April 12, 2022, Regular Board of Directors Meeting

COMMITTEE REPORTS:

A. **Budget & Finance Committee – Jim Spigener, Chair**

1) Brief the Board on the Committee's activities since the last regular Board meeting- Ms. Reiter reported that the budget committee has not met, as they are waiting on final information for next year's budget. She anticipates the committee will meet later in June.

2) Review of unaudited financials for the month of April 2022 – Ms. Reiter reported that for the month of April 2022, income was $223,208.49 and expenses were $107,259.52 resulting in a net income of $115,948.97. Year-to-date net income is $724,027.36. Total cash on hand was $4,086,001.49.

B. **Communications Committee – Harry Hardman, Chair**

1) Brief the Board on the Committee's activities since the last regular Board meeting- President Hardman stated there was nothing to report other than regular communications taking place.

C. **DFC & Technical Committee – Stuart Traylor, Chair**

1) Brief the Board on the Committee's activities since the last regular Board meeting Nothing to report at this time.

D. **Legislative Committee – Harry Hardman, Chair**

1) Brief the Board on the Committee's activities since the last regular Board meeting – President Hardman apprised the board that an initial meeting was held with our legislative consultants. They understand the issues facing the district. He stated the committee will continue to work with the team as they brief our legislators on the issues concerning groundwater in Montgomery County.

E. **Rules, Bylaws & Policies Committee – Larry A. Rogers, Chair**

1) Brief the Board on the Committee's activities since the last regular Board meeting – Director Rogers reported that the committee met on April 27th, 2022, and Ms. Reese and Ms. Fancher would be presenting on the proposed changes to the District's rules and policies.

2) Discuss, consider, and take action regarding approval of Resolution #22-002 amending the District's Personnel Policy – Kristen Fancher (Virtual Presentation)
Ms. Fancher provided a presentation on the proposed revisions to the District's Personnel Policy, many of which were necessary to bring the policy into compliance with state and federal guidelines. Following the presentation, Director Thigpen motioned to approve the proposed amendments to the District's Personnel Policy and Director Prykryl seconded. The motion passed. *A copy of the Resolution is attached hereto as Exhibit "B".*

3) Discuss and consider proposed draft rules and possible action approving draft rules for public comment and review – Stacey V. Reese (Presentation)
Ms. Reese gave a brief presentation on the proposed revisions recommended to the District rules. She explained that it was the Rules committee's recommendation that the draft rules be released for public comment. It was noted that the recommended changes were non-substantive and the deadline for public comment would be 5:00pm on June 6th. Director Prykryl motioned to approve the rules and Secretary Rogers seconded. The motion passed. *A copy of the proposed draft rules are attached hereto as Exhibit "C".*

RECEIVE INFORMATION FROM DISTRICT'S TECHNICAL CONSULTANTS REGARDING SUBSIDENCE STUDIES AND/OR DISCUSSION REGARDING THE SAME:

a) Receive presentation on the Subsidence Study Phase 2 Draft Report -
Ms. Reiter stated there is no formal presentation on this item and a final draft of Phase 2 report is included in the packets and presented for approval today. Ms. Reiter noted that there were not many comments received and changes were minimal. Following approval, Phase 3 Scope of Work will be developed and presented to the DFC & Technical Studies committee and ultimately board. The Phase 2 final report does include recommendation for Phase 3, but this will be further developed in the coming weeks and months before approval. Mike Keester, District's Technical Consultant joined virtually and was available for questions.

b) Discussion consideration, and possible action regarding approval of the Subsidence Study Phase 2 Draft Report for public comment –
Ms. Reiter stated that following discussions with the committee, it was recommended that there was not a need for additional public comment as the draft report had already undergone a 60-day public comment period that received only 1 comment. She reminded the board that the changes made since the comment period closed warranted

only non-substantive changes being made to the final report. Director Prykryl motioned to approve the rules and Vice-President Traylor seconded. The motion passed. *A copy of the Subsidence Study Phase 2 Report is attached hereto as Exhibit "D".*

GROUNDWATER MANAGEMENT AREA 14 - UPDATE THE BOARD ON THE ISSUES RELATED TO JOINT PLANNING ACTIVITIES AND DEVELOPMENT OF DESIRED FUTURE CONDITIONS IN GMA 14:

Samantha Reiter stated there is nothing new to report and GMA 14 was still waiting to hear back from TWDB on GMA 14's submitted Explanatory Report.

GENERAL MANAGER'S REPORT:

Ms. Reiter stated that her report was included in the board packets. The only items to add is a reminder that the District has an election cycle that will be opening up in July. She noted that the District's Tinker representative is planning on meeting with Jennifer Thayer in the next month to brief her on the final data from the year's education program and she anticipated a presentation from Tinker at the July board meeting. Lastly, Ms. Reiter stated the Woodlands Chamber has invited the District to a Water Forum this summer. Previously this was planned for May 25th, but as of this afternoon they are looking at the week of July 21st or 28th. She advised that the forum would be virtual, and questions would be presented in advance of the forum.

GENERAL COUNSEL'S REPORT:

Ms. Reese stated she had nothing to report.

NEW BUSINESS:

No new business.

EXECUTIVE SESSION:

The Board recessed at 6:50 PM into a closed Executive Session pursuant to Texas Government Code, Sections 551.071, to consult with the District's attorney regarding pending or contemplated litigation, settlement offers, or on matters in which the duty of the attorney to the governmental body under the Texas Disciplinary Rules of Professional Conduct of the State Bar of Texas clearly conflicts with the Texas Open Meetings Act, Chapter 551, Government Code regarding any agenda item on any of the board meetings or hearing posted for today.

RECONVENE IN OPEN SESSION:

Following Executive Session, the Board reconvened in Open Session and President Hardman declared it open to the public at 7:46 PM

ADJOURN:

There being no further business, Director Traylor motioned to adjourn the meeting and Director Prykryl seconded. The meeting was adjourned at 7:46 PM.

PASSED, APPROVED, AND ADOPTED THIS 8th DAY OF JUNE 2022.

Larry Rogers, Board Secretary

SIGN IN SHEET

June 8, 2022

Do you wish to speak on an agenda item?	NAME	CITY, STATE, ZIP	E-Mail	Would you like to receive LSGCD updates & information?
N	Doug Miller	Pinehurst TX 77362	dfmiller@gmail.com	Y

Exhibit "A"

RESOLUTION NO. #22-003

RESOLUTION OF THE BOARD OF DIRECTORS OF THE LONE STAR GROUNDWATER CONSERVATION DISTRICT AMENDING AND ADOPTING DISTRICT RULES

THE STATE OF TEXAS §
§
LONE STAR GROUNDWATER CONSERVATION DISTRICT §

WHEREAS, the Lone Star Groundwater Conservation District ("District") was created by the Texas Legislature through the enactment of House Bill 2362, Chapter 1321, Acts of the 77th Legislature, Regular Session, 2001 (the "Act"), pursuant to the authority of Article XVI, Section 59 of the Texas Constitution, as a groundwater conservation district operating under Chapter 36 of the Texas Water Code, Section 59, Article XVI of the Texas Constitution, and the Act;

WHEREAS, the Act and Chapter 36 of the Texas Water Code assign certain duties, rights, powers, privileges, authorities, and functions to the District;

WHEREAS, Section 36.101 of the Texas Water Code authorizes the District, after notice and hearing, to adopt and enforce rules to carry out the powers and duties provided by Chapter 36 of the Texas Water Code;

WHEREAS, following publication of notice and public hearing, the District's Board of Directors ("Board") adopted new District Rules on September 8, 2022 ("District Rules"). The District Rules repealed and superseded all prior versions of rules and the District Regulatory Plan as result of the May 17, 2019 Final Judgment declaring that certain large volume groundwater user rules under the DRP were adopted "without legal authority and consequently are, and have been, unlawful, void and unenforceable.";

WHEREAS, in May 2022, the Board held a board meeting where proposed amendments to the District Rules were discussed and approved for public comment and review; and

WHEREAS, the District issued notice in the manner required by state law and held a public hearing on June 8, 2022 to receive public and written comments on the proposed amendments to the District Rules. The District did not receive any written comments on the proposed amendments to the District Rules, and no changes were made to the proposed amendments to District Rules at the public hearing.

NOW, THEREFORE, BE IT ORDERED BY THE BOARD OF DIRECTORS OF THE LONE STAR GROUNDWATER CONSERVATION DISTRICT THAT:

1. The above recitals are true and correct;

2. The Board of Directors hereby approves and adopts with amendments the District Rules, which are included as "Attachment A" to this Resolution;

3. The attached Rules are authorized to be made available for use and inspection at the District's office, and are provided on the District's website;

4. The attached Rules shall take effect June 8, 2022; and

5. The District's Board, its officers, District staff, and legal counsel are further authorized to take any and all actions necessary to implement this Resolution.

AND IT IS SO ORDERED.

PASSED AND ADOPTED on this 8th day of June 2022.

LONE STAR GROUNDWATER CONSERVATION DISTRICT

By: _____
Board President

ATTEST:

_____
Board Secretary

RULES OF THE LONE STAR GROUNDWATER CONSERVATION DISTRICT

ADOPTED: September 8, 2020

As amended, _____, 2022

Deleted: effective September

Deleted: 8

Deleted: 0

TABLE OF CONTENTS

Deleted: 19

Deleted: 31

Deleted: 32

Deleted: 35

Deleted: 36

Deleted: 42

Deleted: 45
Deleted: 46
Deleted: 49
Formatted: French
Field Code Changed
Deleted: 50
Formatted: French
Deleted: 50
Deleted: 51
Deleted: 52
Deleted: 52
Deleted: 53
Deleted: 55
Deleted: 56
Deleted: 56
Deleted: 57
Deleted: 57
Deleted: 60
Deleted: 61
Deleted: 61
Deleted: 63
Deleted: 63
Deleted: 63

Deleted: 66
Deleted: 67
Field Code Changed
Deleted: 77
Deleted: 77
Deleted: 78
Deleted: 79
Deleted: 80
Deleted: 89
Deleted: 90
Deleted: 90
Deleted: 91
Deleted: 95
Deleted: 95

PREAMBLE

The Lone Star Groundwater Conservation District ("District") was created in 2001 by the 77th Legislature with a directive to conserve, protect and enhance the groundwater resources of Montgomery County, which comprise the boundaries of the District. A confirmation election was held on November 6, 2001, with 73.85% approval.

The original rules of the District were first adopted on August 26, 2002, at a duly posted public meeting in compliance with the Open Meetings Act and following notice and hearing in accordance with Chapter 36 of the Texas Water Code ("Chapter 36"). The original rules were subsequently amended, in accordance with all legal requirements, in 2002, 2004, 2005, 2006, 2008, 2009, 2010, 2013, and 2015. Beginning in 2006, the District adopted a multi-phased District Regulatory Plan.

The new rules and regulatory plan below (hereinafter referred to individually as a "Rule" and collectively as "Rules") specifically repeal, supersede, and replace all previously adopted rules and regulatory plans including the last adopted District Regulatory Plan Phase II(B), and are adopted to comply with the final judgment in *City of Conroe, et. al. v. Tramm,* No. 15-08-08942, in the 284th District Court of Montgomery County, Texas. These Rules were adopted on September 8, 2020, at a duly posted public meeting in compliance with the Open Meetings Act and following notice and hearing in accordance with Chapter 36, and subsequently amended, in accordance with all legal requirements, on _____, 2022.

Formatted: Highlight

The District is committed to providing a regulatory program that encourages the best practicable conservation and development practices for the groundwater resources of Montgomery County by developing, promoting, and implementing water conservation, augmentation, and management strategies to both conserve and utilize groundwater resources for the benefit of the citizens, economy, and environment. The District's mission includes honoring and protecting private property rights by affording an opportunity for a fair share to every owner of each common, subsurface reservoir underlying, in whole or in part, in Montgomery County as authorized under state law. The District will protect both public and private interests through programs designed for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and by adopting and enforcing these Rules as authorized by Chapter 36 and consistent with state law.

SECTION 1 DEFINITIONS, CONCEPTS, & GENERAL PROVISIONS

Rule 1.1 Definitions

In the administration of its duties, the District strictly follows the definitions of terms set forth in Chapter 35 and Chapter 36 of the Texas Water Code, 31 Texas Administrative Code, Chapter 356, Chapter 357 and Chapter 358, and other definitions as set forth below. To the extent any definitions below conflict with the statutes, the statutes prevail.

"**Abandoned well**" (or "abandoned well") means a well not in use. A well is considered to be in use if:

(1) the well is not a deteriorated well and contains the casing, pump, and pump column in good condition;

(2) the well is not a deteriorated well and has not been capped;

(3) the water from the well has been put to an authorized beneficial use, as defined by the Water Code;

(4) the well is used in the normal course and scope and with the intensity and frequency of other similar users in the general community; or

(5) the owner is participating in the Conservation Reserve Program authorized by Sections 1231-1236, Food Security Act of 1985 (16 U.S.C. Sections 3831-3836), or a similar governmental program.

"**Acre-feet**" (or "acre-feet") means the standard measurement of groundwater necessary to cover one acre of land to the depth of one foot, or 325,851 U.S. gallons of water.

"**Administratively Complete**" means (1) that all information requested by the District has been fully and accurately provided; and (2) that all applicable fees have been paid.

"**Affected Person**" means, for any contested application for which a hearing is required under these Rules, a person who has a personal justiciable interest related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and is affected by Board's action on the application. An interest common to members of the general public does not qualify as a personal justiciable interest.

"**Aggregate withdrawal**" (or "aggregate withdrawal") means the total pumpage measurement of the amount of water withdrawn from two or more wells in a well system from the same Aquifer of the District.

"**Agriculture**" (or "agriculture") means any of the following activities:

(1) cultivating the soil to produce crops for human food, animal feed, or

planting seed or for the production of fibers;

(2) the practice of floriculture, viticulture, silviculture, and horticulture, including the cultivation of plants in containers or nonsoil media, by a nursery grower;

(3) raising, feeding, or keeping animals for breeding purposes or for the production of food or fiber, leather, pelts, or other tangible products having a commercial value;

(4) planting cover crops, including cover crops cultivated for transplantation, or leaving land idle for the purpose of participating in any governmental program or normal crop or livestock rotation procedure;

(5) wildlife management; and

(6) raising or keeping equine animals.

"**Agricultural use**" or ("agricultural use") means any use or activity involving Agriculture, including irrigation.

"**Animal Feeding Operation**" (AFO) means: (1) a lot or facility (other than an aquatic animal production facility) where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and where the animal confinement areas do not sustain crops, vegetation, forage growth, or postharvest residues in the normal growing season over any portion of the lot or facility; or (2) any other facility regulated as an AFO or as a Concentrated Animal Feeding Operation by the TCEQ.

"**Annual Production Limitations**" means the maximize quantity of groundwater authorized to be produced on an annual basis under a permit subject to proportional adjustments or other alterations as authorized under these Rules.

"**Aquifer**" (or "aquifer") means a groundwater reservoir or a specific subsurface water-bearing reservoir having ascertainable boundaries containing groundwater.

"**Aquifer of the District**" means one of the strata of the District by which groundwater production is regulated. The three regulatory strata include: (i) the Chicot-Evangeline aquifers (considered one aquifer for regulatory purposes); (ii) the Jasper aquifer; and (iii) the Catahoula aquifer.

"**Aquifer Storage and Recovery**" means the injection of water into a geologic formation and the subsequent recovery and beneficial use by the project operator, as defined by TCEQ rules.

"**Aquifer subdivision** (or "aquifer subdivision") means a definable part of a groundwater reservoir or aquifer in which the groundwater supply will not be appreciably affected by withdrawing water from any other part of the reservoir, as indicated by known geological

and hydrological conditions and relationships and on forseeable economic development at the time the subdivision is designated or altered.

"**Beneficial Use**" (or "beneficial use") or means use of groundwater for:

(1) agricultural, gardening, domestic (including lawn-watering), stock raising, municipal, mining, manufacturing, industrial, commercial, or recreational purposes, or pleasure purposes;

(2) exploring for, producing, handling, or treating oil, gas, sulfur, lignite, or other minerals; or

(3) any other purpose that is useful and beneficial to the user.

"**Best Available Data and Science**" (or "best available data and science") means conclusions that are logically and reasonably derived using statistical or quantitative data, techniques, analyses, and studies that are available for peer review by scientists in the field and can be employed to address a specific scientific issue.

"**Board**" means the Board of Directors of the District.

"**Brackish Groundwater**" (or "brackish groundwater") means groundwater containing between 1,000 and 10,000 milligrams per liter (mg/L) total dissolved solids (DS) and is used to describe either slightly or moderately saline groundwater.

"**Brackish Groundwater Production Zone**" (or "brackish groundwater production zone") means an aquifer, subdivision of an aquifer, or geologic stratum designated by the TWDB under Chapter 16 of the Texas Water Code.

"**Cap**" (or "capped well") means covering a well with a securely fixed, removable device that will prevent the entrance of surface pollutants into the well. A well that is closed or capped must have a covering capable of preventing surface pollutants from entering the well and sustaining weight of at least 400 pounds. The cap must be constructed in such a way that the covering cannot be easily removed by hand.

"**Casing**" (or "casing") means a tubular, watertight structure installed in the excavated or drilled hole to maintain the well opening and, along with cementing, to confine groundwater to its zone of origin and to prevent the entrance of surface pollutants.

"**Chapter 36**" refers to Chapter 36 of the Texas Water Code.

"**Closed loop geothermal well**" (or "closed loop geothermal well") means a well used for domestic use purposes that recirculates water or other fluids inside a sealed system for heating and/or cooling purposes, and where no water is produced from the well or used for any other purpose of use.

"**Completed well,"** (or "completed well" or well that has been "completed") means a well,

the construction of which has been completed, with sealed off access of undesirable water or constituents to the well bore by utilizing proper casing and annular space positive displacement or pressure tremie tube grouting or cementing (sealing) methods.

"**Contested Case**" (or "contested case") shall mean an application or other matter for which the Board has granted a request for a contested case hearing.

"**Desired Future Condition(s)**" or "DFC(s)" is the desired, quantitative condition of groundwater resources within a Management Area at one or more specified future times as defined the participating groundwater districts within a groundwater management as part of the joint planning process and adopted in accordance with Section 36.108 of Chapter 36.

"**Deteriorated well**" (or "deteriorating well" or "deteriorating well") means a well that, in the discretion of the District, because of its condition will cause or is likely to cause property damage, personal injury, or risk to health, safety, or life and/or the contamination of groundwater.

"**Dewatering well**" (or "dewatering well") means a well used to remove water from a construction site or excavation, or to relieve hydrostatic uplift on permanent structures.

"**Director**" means a person elected to serve on the Board of Directors of the District per amendment to the District Act, Acts of the 85th Leg., R.S., H.B. No. 1982.

"**District**" means the Lone Star Groundwater Conservation District created in accordance with Section 59, Article XVI, Texas Constitution, Chapter 36, and the District Act.

"**District Act**" means Act of June 16, 2001, 77th Leg., R.S., ch. 1321, 2001 Tex. Gen. Laws 3246, as may be amended from time to time.

"**District office**" means the office of the District located in Conroe, Montgomery County, Texas. The location of the District office may be changed from time to time by resolution of the Board.

"**Domestic use**" means the use of groundwater by an individual or a household to support essential domestic activity. Such use includes water for: drinking, washing, or culinary purposes; residential landscape watering of no more than one (1) acre contiguous to one (1) residence; irrigation of a family garden and/or orchard; for watering of domestic animals; recreation limited to the filling of residential swimming pools and hot tubs. Domestic use does not include the following type of use: water used to support activities for which consideration is given or received or for which the product of the activity is sold; irrigation of crops in fields or pastures; use by or for a public water system; or water used for open-loop residential geothermal heating and cooling systems, but does include water used for closed-loop residential geothermal systems.

"**Early conversion credit"** (or "early conversion credit") means the credit issued by the District under the repealed regulatory plan for meeting the conversion requirement before

it took effect. The District no longer issues early conversion credits but will honor those unused credits as set forth in these Rules.

"**Effective Date**" means September 8, 2020, which is the date of original adoption of these Rules.

Deleted: most recent

Deleted: or amendments thereto

"**Emergency Permit**" means a permit issued by the District for emergency purposes, as set forth under Rule 2.15.

"**Exempt Well**" (or "exempt well") means a new or an existing well that is exempt from permitting, metering and fee requirements under Chapter 36 or these Rules and is not required to have a permit to withdraw water from an Aquifer of the District.

"**Existing Well**" (or "existing well") is a groundwater well within the District's boundaries that was in existence, or for which drilling commenced, or for which drilling was approved, or for which the Administratively Complete well registration or permit or permit amendment application was filed, before the Effective Date.

"**Gallons per minute**" or "gpm" means the maximum production capacity or flow rate of a well as equipped, which can be measured by the District in accordance with these Rules.

"**General Manager**" is the chief administrative officer of the District, as set forth in the District's bylaws.

"**Groundwater**" (or "groundwater") means water percolating below the surface of the earth.

"**Groundwater Transport Fee**" means the fees referred to in Rule 8.3.

"**Hearing Examiner**" means a person appointed in writing by the Board to conduct a hearing or other proceeding including but not limited to an administrative law judge employed by SOAH, and who has the authority granted to a Party under these Rules, except as that authority may be limited by the Board or pursuant to the appointment.

"**Historic Use**" means the amount of production and type of beneficial use of groundwater from an Aquifer of the District during the Historic Use Period.

"**Historic Use Period**" (or "Existing and Historic Use Period") means the time period of January 1, 1992, through August 26, 2002.

"**Historic Use Permit**" means a permit issued by the District under the then applicable rules for the operation of any non-exempt, existing water well or well system that produced groundwater during the Historic Use Period and has not been abandoned and not had its type of use changed or authorized production increased.

"**Hydrogeological Report"** means the report described in Rule 2.6(b)(15).

"**Impounded irrigation water**" means groundwater produced from a well that is discharged into or otherwise held in a Surface Impoundment for subsequent withdrawal and use for irrigation or any other beneficial use.

"**Leachate well**" (or "leachate well") means a well used to remove contamination from soil or groundwater.

"**Livestock or Poultry**" (or "livestock or poultry") means the use of groundwater associated with watering, raising, feeding, or keeping non-commercial livestock and/or poultry, of any variety, for subsistence or labor. The term also includes domesticated horses, cattle, goats, sheep, swine, poultry, and other similar animals involved in farming or ranching operations, on land recorded and taxed in the county as an agricultural land use. The term does not include any animal that is stabled, confined, or fed at a facility that is defined herein as an Animal Feeding Operation. The term does not include a bird defined by section 64.001 of the Parks and Wildlife Code as a "game bird" or any other indigenous bird regulated by the Texas Department of Parks and Wildlife as an endangered or threatened species.

"**Livestock Use**" (or "livestock use") means the use of groundwater for the open-range watering of livestock.

"**Management Area**" means an area designated and delineated by the TWDB as an area suitable for management of groundwater.

"**Management Plan**" means the District's Management Plan required under Section 36.1071 of Chapter 36, and as further described in these Rules.

"**Management Zone**" means one or more of the management zones into which the Board may or has divided the District, as set forth in Rule 6.2.

"**Maximum Allowable Pumping Rate**" means the maximum, instantaneous pumping rate in gallons per minute for a well.

"**Maximum Historic Use**" (MHU) means the amount of groundwater from an Aquifer of the District as determined by the District that, unless proportionally adjusted or otherwise altered by the District, an applicant for a Historic Use Permit is authorized to withdraw equal to the greater of the following, as may be applicable:

(1) for an applicant who has beneficial use during the existing and Historic Use Period for a full calendar year, the applicant's actual maximum beneficial use of groundwater from an Aquifer of the District excluding waste during any one full calendar year of the Historic Use Period; or

(2) for an applicant who has beneficial use during the existing and Historic Use Period but due to the applicant's activities not having been commenced and in operation for the full final calendar year of the

existing and Historic Use Period the applicant does not have beneficial use for a full calendar year. The applicant's extrapolated maximum beneficial use will be calculated as follows: the amount of groundwater that would normally have been placed to beneficial use without waste by the applicant for the last full calendar year during the existing and Historic Use Period for the applied-for purpose had the applicant's activities been commenced and in operation for the full final calendar year during the existing and Historic Use Period.

"**Meter**" (or "meter" or "measurement device") means a water flow measuring device that can measure within plus or minus five percent (+/- 5%) of accuracy the instantaneous rate of flow and record the amount of groundwater produced or transferred from a well or well system during a measure of time, as specifically set forth in Section 10.

"**Miscellaneous Impoundment Losses**" means the exfiltration losses or percolation losses of water through the bottom and sides of a Surface Impoundment, excluding evaporative losses.

"**Modeled Available Groundwater**" means the amount of water that the Executive Administrator of the TWDB determines, based on a model, that may be produced on an average annual basis to achieve a Desired Future Condition established for the groundwater resources in the District.

"**Modify**" (or "modify" or "modified") means performing work on the physical or mechanical components of the wellhead assembly or downhole portion of a well.

"**Monitoring well**" ("or monitoring well") means a well used solely for the purpose of measuring some property of the groundwater or the aquifer that it penetrates, and is not equipped with a pump. Wells with other uses can still be used to collect aquifer data in the District's monitoring program but are not considered a monitoring well for purposes of these Rules.

"**New well**" (or "new well") means a water well for which an Administratively Complete registration or application is filed with the District on or after the Effective Date, substantial alteration of an existing well, or conversion of another type of well or artificial excavation of a water well on or after the Effective Date, including but not limited to a well originally drilled for hydrocarbon production activities that is to be converted to a water well.

"**New non-exempt well**" (or "new non-exempt well") means a new well that does not qualify for exempt well status under Chapter 36 or these Rules.

"**Non-compliance penalty"** means a penalty imposed for major and minor violations of the Rules as set forth in Rules 2.1(n) and 12.8. The non-compliance penalty is in addition to Water Use Fees and any applicable overproduction disincentive penalty per Rule 8.1(c).

"**Non-exempt well**" means an Existing or New Well that does not qualify for exempt well

status under Chapter 36 or these Rules.

“**Notice to Proceed**” means the official registration approval, written authorization form issued by the District for new exempt wells.

“**Nursery grower**” means a person who grows more than 50 percent of the products that the person either sells or leases, regardless of the variety sold, leased, or grown. For the purpose of this definition, “grow” means the actual cultivation or propagation of the product beyond the mere holding or maintaining of the item prior to sale or lease and typically includes activities associated with the production or multiplying of stock such as the development of new plants from cuttings, grafts, plugs, or seedlings.

“**Open Meetings Act**” means Chapter 551, Texas Government Code, as it may be amended from time to time.

“**Operating Permit**” means a permit issued by the District to produce groundwater from an Aquifer of the District from any non-exempt water well for which a Historic Use Permit has not be issued by the District.

“**Overproduction disincentive penalty**” (or “overproduction disincentive penalty”) is a penalty imposed per Rule 8.1(c) for withdrawing or causing to be withdrawn groundwater from a non-exempt well in excess of the amount authorized in the applicable permit calculated at $6.00 per each 1,000 gallons of water overproduced, not to exceed $10,000 per day for each day that overproduction occurs. The disincentive penalty is in addition to Water Use Fees and any applicable non-compliance penalty provided for in Rule 12.8.

“**Owner**” (or “owner”) means the owner or holder of the right to produce groundwater from a tract of land.

“**Party**” means a person who is an automatic participant in a proceeding as set forth under Rule 13.3.2 or a person who has been designated as an Affected Person and admitted to participate in a contested case, except where the usage of the term clearly suggests otherwise.

“**Performance bond**” (or “performance bond”) means a bond issued to the District by a bank or insurance company as a guarantee against the failure of an applicant to meet obligations specified in these Rules.

“**Production**” (or “production” or “producing”) means the act of extracting groundwater from an aquifer by pumping or other method.

“**Property Line”** (or “property line”) means a line at which the ownership of the right to produce groundwater changes.

“**Proportional Adjustment Order**” an order the Board adopts by resolution under Section 6 to proportionally adjust the Annual Production Limitations applicable to permits.

"**Public Information Act**" means Chapter 552, Texas Government Code, as it may be amended from time to time.

"**Person**" (or "person") means an individual, corporation, limited liability company, organization, government, governmental subdivision, agency, business trust, estate, trust, partnership, association, or other legal entity.

"**Pollution**" (or "pollution") means the alteration of the physical, thermal, chemical, or biological quality of, or the contamination of any groundwater in the District that renders the groundwater harmful, detrimental, or injurious to humans, animal life, vegetation, property, or to public health, safety, or welfare, or impairs the usefulness or public enjoyment of the water for any lawful or reasonable use.

"**Poultry Use**" means the use of groundwater to provide water for poultry.

"**Pre-existing well**" (or "pre-existing well") means a well drilled before August 26, 2002.

"**Presiding Officer**" means the President, Vice-President, Secretary, or other Board member presiding at any hearing or other proceeding or a Hearing Examiner appointed by the Board to conduct or preside over any hearing or other proceeding.

"**Public water system**" (or "public water system") means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, which includes all uses described under the definition for "drinking water" in 30 Texas Administrative Code, Section 290.38.

"**Pump**" (or "pump") means any facility, device, equipment, material, or method used to obtain water from a well.

"**Purpose of use**" (or "purpose of use") means the type of beneficial use of the groundwater produced from a well.

"**Qualifying Major Violation**" means a violation listed in Rule 12.3(a) that has been made the subject of a written notice of violation issued under Rule 12.4(b) and has not been dismissed by the Board following a formal protest.

"**Qualifying Minor Violation**" means a violation listed in Rule 12.3(b) that has been made the subject of a written notice of violation issued under Rule 12.4(b) and has not been dismissed by the Board following a formal protest.

"**Registrant**" (or "registrant") means a person required to submit a registration.

"**Registration**" (or "registration") means an Owner or Well Owner providing certain information about a well to the District for the District's records, as more particularly described under Rule 2.3.

"**Replacement well**" (or "replacement well") means a new well drilled to replace an

existing registered well that meets the requirements set forth in Rule 2.13.

"Respondent" shall mean a person to which a notice of violation has been directed, or who is the subject of an enforcement order issued by the Board, and who has submitted a request for a contested case hearing on the matter under Rule 13.4.1.

"**Rule" or "Rules"** refers to, a specific Rule herein, or collectively, to all these Rules, as finally adopted by the Board.

"**SOAH**" shall mean the State Office of Administrative Hearings.

"**Subsidence**" (or "subsidence") means the lowering in elevation of the surface of the land caused by the withdrawal of groundwater.

"**Substantially alter**" (or "substantially alter" or "substantial alteration") with respect to the size or capacity of a well or pump means to increase the size of the inside diameter of the pump discharge column pipe of a well in any way, to increase by modification or replacement the maximum designed production capability of a pump or pump motor, or to modify the depth or diameter of a well bore.

"**Surface Impoundment**" means an artificially dug or natural occurring hole or other land surface depression used for holding groundwater produced from a non-exempt well.

"**Swimming pool**" (or "swimming pool") means, in the singular or plural, an artificial basin, chamber or tank, constructed with a complete lining of impermeable material, that is designed to hold water intended for swimming.

"Tamper" (or "tamper") means to interfere with, alter, or manipulate in a manner that undermines the accuracy, integrity, functionality, or intended purpose of the thing described.

"**TCEQ**" refers to the Texas Commission on Environmental Quality.

"**TDLR"** refers to the Texas Department of Licensing and Regulation.

"**Temporary Permit**" means any permit issued under Rule 2.16.

"**Transfer of Well Ownership**" (or "transfer") means a change to a registration or permit as follows, except that the term "transfer" shall have its ordinary meaning as read in context when used in other contexts: (a) ownership; or (b) the person authorized to exercise the right to make withdrawals and place the groundwater to beneficial use.

"**TWDB**" refers to the Texas Water Development Board.

"**Waste**" (or "waste") means one or more of the following:

(1) withdrawal of groundwater from an aquifer at a rate and in an amount that

causes or threatens to cause an intrusion into the aquifer unsuitable for agricultural, gardening, domestic, or stock raising purposes;

(2) the flowing or producing of water from an aquifer if the water produced is not used for a beneficial use;

(3) the escape of groundwater from an aquifer to any other reservoir or geologic stratum that does not contain groundwater;

(4) pollution or harmful alteration of groundwater in an aquifer by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of the owner of the well unless such discharge is authorized by permit, rule, or other order issued by TCEQ under Chapter 26 of the Texas Water Code;

(6) groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge; or

(7) for water produced from an artesian well, "waste" also has the meaning assigned by Section 11.205, Texas Water Code.

"**Water Use Fee**" refers to the fee described in Rule 8.1.

"**Well**" (or "well") means any artificial excavation located within the boundaries of the District that causes groundwater to be withdrawn or removed from an aquifer or Aquifer of the District within the District.

"**Well Completion Report"** is the form provided by the District or created by the well owner that includes all the information in Rule 11.2(c).

"**Well Owner**" (or "well owner" or "owner of well") means the owner of the right to produce groundwater from a Well, or an owner of the well if that person is not the owner of the right to produce groundwater from a well.

"**Well Report**" is a form provided by TDLR or the District that includes all the information in Rule 11.2(a)-(b).

"**Well spacing"** (or "well spacing") means the lateral, straight-line distance between two wells completed and producing from the same Aquifer of the District.

"**Well system**" (or "well system") means two or more non-exempt wells including back-up wells that are owned by the same Well Owner in the same Aquifer of the District and are

connected by piping, storage, or that share or are tied to the same water collection or distribution system. Examples of a well system include, but are not limited to, a well or group of wells connected to the same ground storage tank, distribution system piping, or swimming pool.

"**Withdraw**" (or "withdraw") means the act of extracting or producing groundwater by pumping or any other method.

"**Year**" (or "year") means a calendar year (January 1 through December 31) except where the usage suggests otherwise.

Rule 1.2 Authority of District

The District is a political subdivision of the State of Texas organized and existing under Section 59, Article XVI, Texas Constitution, Chapter 36, and the District Act.

Rule 1.3 Purpose of District and Rules

The District was created to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of aquifers or their subdivisions, and to control subsidence caused by the withdrawal of water from those aquifers or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, Chapter 36, and the District Act. Per Chapter 36, the District is the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater. These Rules are adopted under the authority in Chapter 36, the District Act and Texas law to carry out all of the District's purposes.

Rule 1.4 Use and Effect of Rules

These Rules are used by the District in the exercise of the powers conferred on the District by law and in the accomplishment of the purposes of the law creating the District. These Rules may be used as guides in the exercise of discretion, where discretion is vested. However, under no circumstances and in no particular case will they, or any part therein, be construed as a limitation or restriction upon the District to exercise powers, duties and jurisdiction conferred by law. These Rules create no rights or privileges in any person or water well, and shall not be construed to bind the Board in any manner in its promulgation of the District Management Plan or amendments to the Rules.

The accurate and timely reporting to the District of activities governed by these Rules is a critical component to the District's ability to effectively and prudently manage the groundwater resources that it has been charged by law with regulating. The purpose of these Rules is to require the submission, by the appropriate person or persons, of complete, accurate, and timely registrations, permit applications, records, reports, and logs as required throughout these Rules. Because of the important role that accurate and timely reporting plays in the District's understanding of past, current and anticipated

groundwater conditions within the District, the failure to comply with these Rules may result in the assessment of additional fees, civil penalties, or any combination of the same, as specifically set forth in these Rules.

Rule 1.5 Ownership of Groundwater

The ownership and rights of the owners of land within the District, and their lessees and assigns, in groundwater are hereby recognized, and nothing in Chapter 36, shall be construed as depriving or divesting those owners or their lessees and assigns of that ownership or those rights.

Rule 1.6 Construction

A reference to a title or chapter without further identification is a reference to a title or chapter of the Texas Water Code. A reference to a section or rule without further identification is a reference to a section or rule in these Rules. Construction of words and phrases is governed by the Code Construction Act, Subchapter B, Chapter 311, Texas Government Code. The singular includes the plural, and the plural includes the singular. The masculine includes the feminine, and the feminine includes the masculine.

Rule 1.7 Methods of Service Under the Rules

Except as provided in these Rules, any notice or document required by these Rules to be served or delivered may be delivered to the recipient or the recipient's authorized representative in person, by agent, by courier receipted delivery, by certified or registered mail sent to the recipient's last known address, by fax to the recipient's current fax number or by e-mail and shall be accomplished by 5:00 p.m. (as shown by the clock in the District's office in Conroe, Texas) on the date which it is due. Service by mail is complete upon deposit in a post office depository box or other official depository of the United States Postal Service. Service by fax or e-mail is complete upon transfer, except that any transfer commencing after 5:00 p.m. (as shown by the clock in the District's office in Conroe, Texas) shall be deemed complete the following business day. If service or delivery is by mail and the recipient has the right or is required to do some act within a prescribed period of time after service, three days will be added to the prescribed period. If service by other methods has proved unsuccessful, service will be deemed complete upon publication of the notice or document in a newspaper of general circulation in the District or by such other method approved by the General Manager.

Rule 1.8 Severability

If a provision contained in these Rules is for any reason held to be invalid, illegal, or unenforceable in any respect, the invalidity, illegality, or unenforceability does not affect any other Rules or provision of these Rules, and these Rules shall be construed as if the invalid, illegal, or unenforceable provision had never been contained in these Rules.

Rule 1.9 Regulatory Compliance with Other Governmental Entities

All permittees and registrants of the District shall comply with all applicable Rules and regulations of all governmental entities referenced herein. If the District's Rules are more stringent than those of the other referenced herein governmental entities, these Rules control.

Rule 1.10 Computing Time

In computing any period of time prescribed or allowed by these Rules, order of the Board, or any applicable statute, the day of the act, event, or default from which the designated period of time begins to run is not included, but the last day of the period so computed is included, unless it is a Saturday, Sunday, or legal holiday, in which event the period runs until the end of the next day which is neither a Saturday, Sunday, or legal holiday.

Rule 1.11 Time Limits

Applications, requests, or other papers or documents required or permitted to be filed under these Rules or by law must be received for filing in the District office within the time limit for filing, if any. The date of receipt, not the date of posting, is determinative of the time of filing. Time periods set forth in these Rules shall be measured by calendar days, unless otherwise specified.

Rule 1.12 Request for Reconsideration and Appeal

To appeal a determination made by the General Manager where an appeal is provided for in these Rules, a request for an appeal may be filed with the District within twenty (20) calendar days of the date a person is provided notice of the decision. This appeal is a pre-requisite to filing suit against the District to overturn the General Manager's decision. Such appeal must be in writing and must state clear and concise grounds for the request. The Board will hear the applicant's appeal at the next available regular Board meeting. On the motion of any Board member, and a majority concurrence in the motion, the Board may overrule the action of the General Manager.

To appeal a decision of the Board concerning any matter not specifically covered under any other section of these Rules, a request for reconsideration may be filed with the District within twenty (20) calendar days of the date of the Board's decision. Such request for reconsideration must be in writing and must state clear and concise grounds for the request. The Board will make a decision on the request for reconsideration within sixty (60) calendar days thereafter. The failure of the Board to grant or deny the request for reconsideration within sixty (60) calendar days of the date of filing of the request for reconsideration shall constitute a denial of the request.

Rule 1.13 Amending of Rules

The Board may, following notice and hearing, amend these Rules or adopt new Rules from time to time.

Rule 1.14 Falsification or Records or Documents

Falsification of any document or record submitted to the District pursuant to a requirement under the Rules is hereby prohibited and shall be subject to enforcement under Section 12 as a major violation of these Rules.

Rule 1.15 Board of Directors and General Manager

(a) The Board was created to determine policy and regulate the withdrawal of groundwater, protect and recharge groundwater, prevent pollution or waste, control subsidence caused by groundwater withdrawal within the boundaries of the District, and to regulate the transport of groundwater outside of the District, as well as exercise the rights, powers, and duties of the District in a way that will effectively and expeditiously accomplish the purpose of the District has defined in Chapter 36, the District Act and these Rules. The Board's responsibilities include, but are not limited to, the adoption and enforcement of fair and impartial rules, among other responsibilities.

(b) The Board may employ or contract with a person to serve as General Manager of the District and to perform such services as the Board may from time to time specify.

(c) The District Act and District's bylaws direct the Board's governance, structure, management and operations.

Rule 1.16 Minutes and Records of the District

All documents, reports, records, and minutes of the District are available for public inspection and copying under the Public Information Act. Upon written request of any person, the District will furnish copies of its public records subject to any exceptions to disclosure under the Public Information Act. The Board will set a reasonable charge for such copies and will provide a list of copying charges.

Rule 1.17 District Management Plan

Following notice and hearing in accordance with Rule 13.2(b), the District shall adopt a Management Plan. The Management Plan shall specify the acts and procedures and performance and avoidance measures necessary to prevent waste, the reduction of artesian pressure, or the drawdown of the water table using the best available data and science. The District shall use the Rules to implement the Management Plan. The Board will review the Management Plan annually to determine whether the plan and Rules are working effectively and whether amendments are necessary. Upon adoption of Desired Future Conditions under Section 36.108 of Chapter 36, the District shall update its Management Plan within two years of the date of the adoption of the Desired Future Conditions by the Management Area. The District shall thereafter update its rules as needed to implement the Desired Future Conditions within one year of the date the Management Plan is updated to include the adopted Desired Future Conditions. If the

Board considers a new Management Plan necessary or desirable based on evidence presented at a hearing, a new Management Plan will be developed and adopted. A Management Plan, once adopted, remains in effect until the subsequent adoption of another Management Plan.

Rule 1.18 Procedure, Conduct and Decorum at Board Meetings

(a) Public participation at Board meetings is limited to that of observers unless the Board requests a member of the public to address the Board or unless the person who wishes to address the Board submits a completed Speaker Request Form prior to the beginning of the meeting. The Speaker Request Form must list each agenda item the person wishes to address or any item the person would like the Board to consider adding to a future agenda.

(b) The Presiding Officer of the meeting may limit the total amount of time each member of the public has to address the Board. The time limit, if any, will be listed on the agenda or Speaker Request Form or will be announced at the beginning of the meeting. The time limit per speaker may not be pooled or given to other speakers. The Board will not typically limit the number of speakers on any given topic, but reserves the right to do so if necessary to ensure an efficient and orderly meeting.

(c) Members of the public in attendance at any meeting or hearing shall conduct themselves with the proper respect and decorum. Disruptive conduct, and profane, insulting or threatening language directed toward any person or racial, ethnic, or gender slurs or epithets will not be tolerated during public comments. Disruptive conduct includes without limitation physical violence, throwing objects, yelling, talking out of turn, using and/or making obscene gestures, ignoring time limits, refusing to leave the microphone, and/or any other obstructive physical action or verbal utterance.

(d) These Rules do not prohibit public criticism of the District, including criticism of any act, omission, policy, procedure, program, or service.

(e) Violation of these rules may result in the following sanctions:

(1) cancellation of a speaker's remaining time;

(2) removal from the Board meeting; and/or

(3) such other civil or criminal sanctions as may be authorized under the Constitution, Statutes and Codes of the State of Texas.

(f) From time to time, the Board may conduct public workshops and hearings. These rules of procedure, conduct and decorum shall also apply to public workshops and hearings.

SECTION 2 WELL REGISTRATIONS AND PERMITTING

Rule 2.1 General Provisions Applicable to Registrations and Permits

(a) No person may:

(1) drill a well without first obtaining from the District either a permit, which serves as the Notice to Proceed, or a separate Notice to Proceed for registrations;

(2) alter the size of a well or pump such that it would bring that well into the jurisdiction of the District, or would disqualify the well from a permitting exemption, without first obtaining a permit from the District;

(3) drill or operate a non-exempt well without first obtaining a permit from the District;

(4) substantially alter the size of a well or pump or increase the maximum instantaneous pumping rate of a well or pump without first obtaining a permit or permit amendment, or other express written authorization from the District; or

(5) produce water from any non-exempt well without first having obtained from the District a valid permit, or amendment thereto, that authorizes the withdrawal of the amount produced; or

(6) transport groundwater out of the District without first obtaining approval from the District as required under these Rules.

(b) A violation of any of the prohibitions in Subsection (a) of this Rule occurs on the first day that the prohibited drilling, alteration, operation or production begins and continues each day thereafter as a separate violation until appropriate authorization from the District is formally granted. Drilling or operating a well or wells without a required permit in violation of these Rules is illegal, wasteful per se, and a nuisance.

(c) A permit confers only the right to use the permit under the provisions of these Rules and according to its terms. A permit's terms may be modified or amended pursuant to the provisions of these Rules. The Board may revoke or amend a permit at any time in accordance with these Rules when reasonably necessary to accomplish the purposes of the District, the Rules, Management Plan, or Chapter 36.

(d) An application pursuant to which a permit or registration has been issued is incorporated in the permit or registration, and the permit or registration is granted on the basis of and contingent upon the accuracy of the information supplied in that application. A finding that false information has been supplied in the application may be grounds to refuse or deny the application or for immediate revocation of the permit or registration.

(e) All permits are granted in accordance with the Rules, and acceptance of a permit

Deleted: or

Deleted: .

constitutes an acknowledgment of receipt of the Rules and agreement that the permit holder will comply with all of the Rules.

(f) A registrant, permit holder or new well owner shall provide written notice to the District of any change of ownership, name of any authorized representative, well operator, mailing address or telephone number in accordance with these Rules.

(g) The well site shall be accessible to District representatives and/or agents for inspection during business hours and during emergencies. The well owner and/or permit holder agrees to cooperate fully in any reasonable monitoring or sampling of the wells.

(h) Produced groundwater shall be put to a beneficial use at all times. Operation of the well(s) shall be conducted in a manner so as to avoid waste, pollution or harm to groundwater resources.

(i) Violation of a permit's terms, conditions, requirements, or special provisions is a violation of these Rules and shall be grounds for enforcement.

(j) For any applications submitted to the District and for which the applicant has requested in writing that such applications be processed concurrently, the District will process, and the Board will consider such applications concurrently according to the standards and Rules applicable to each.

(k) All permits are subject to these Rules, including without limitation the Management Zone and proportional adjustment authority in Section 6, and the Management Plan. All exempt wells and/or registrations are subject to these Rules except for the permitting, metering and fee requirements as set forth in these Rules.

(l) By undertaking any permitted activity once a permit has been issued by the Board, the holder of each permit issued by the District binds itself to adhere at all times to the terms and conditions listed within each respective permit.

(m) The District may amend any permit, in accordance with these Rules, to accomplish the purposes of the Rules, Management Plan, the District Act, or Chapter 36.

(n) No person may withdraw, or cause to be withdrawn, groundwater from within the District's boundaries in an amount that exceeds the amount specifically authorized by these Rules, or in any valid permit issued by the District.

(1) Persons withdrawing, or causing to be withdrawn, groundwater in an amount that exceeds the specific amount authorized for withdrawal under these Rules or in the applicable District permit by ten percent (10%) or greater of the authorized amount shall be subject to a non-compliance penalty for major violations and may be subject to additional enforcement measures as provided for in these Rules or as determined by the Board.

(2) Persons withdrawing, or causing to be withdrawn, groundwater in an amount that exceeds the specific amount authorized for withdrawal under these Rules or in the applicable District permit by less than ten percent (10%) of the authorized amount shall be subject to a non-compliance penalty for minor violations and may be subject to additional enforcement measures as provided for in these Rules or as determined by the Board.

(o) A violation of Subsection (n) of this Rule occurs on the day that the production limit is first exceeded in a calendar year of authorized production and continues thereafter as a separate violation for each day of continued production, until such time that additional production authorization is granted by the Board. The non-compliance penalties provided for in Subsection (n) of this Rule and Rule 12.8 will be assessed in addition to the overproduction disincentive penalty provided for in Rule 8.1(c).

(p) After authorization to drill a well has been granted under the District's registration Rules or a permit, the well, if drilled, must be drilled within thirty (30) feet of the location specified in the permit, and not elsewhere. If the drilling of the well is commenced at any other location than what is provided for in this Rule, the Board may take action to enjoin the drilling activity or operation of the well pursuant to Chapter 36, and these Rules, and the Board may, pursuant to Rules 12.6 and 12.9, order that the well be plugged.

(q) Any groundwater withdrawals made from a non-exempt well after the applicable permit has been suspended by the Board, in an order issued pursuant to Rule 12.6(c), will be considered to be withdrawals made from an unpermitted, non-exempt well for purposes of Rules enforcement.

Rule 2.2 Wells Exempt from Obtaining Permits

(a) The permitting, metering, and fee requirements of these Rules do not apply to:

(1) for wells completed before April 14, 2009, a well to be used solely for domestic use or livestock use with the capacity to produce more than 25,000 gallons of water per day that will produce a total of less than 9,125,000 gallons of water per year;

(2) a well that was completed on or before April 14, 2009, and equipped so that it is incapable of producing more than 25,000 gallons of groundwater a day and that is used solely for domestic use, livestock use or poultry use, regardless of tract size, so long as the well or water use is not subsequently altered so that it no longer qualifies under this exemption;

(3) wells, including replacement wells, completed on or after April 14, 2009, with an inside casing diameter of five inches (5") or less to be used solely for domestic use or livestock use, regardless of the tract size on which the well is drilled;

Moved down [1]: <#>wells, including replacement wells, completed on or after April 14, 2009, with an inside casing diameter of five inches (5") or less to be used solely for domestic use or livestock use, regardless of the tract size on which the well is drilled;¶

Moved (insertion) [1]

Deleted: ¶

(4) a well, including replacement wells, completed after April 14, 2009, that is incapable of producing more than 25,000 gallons of groundwater a day and that is used solely for domestic, livestock or poultry use, on a tract of land larger than ten acres;

(5) the drilling or operation of a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is responsible for drilling and operating the water well and the well is located on the same lease or field associated with the drilling rig;

(6) the drilling of a water well authorized under a permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code, or for production from such a well to the extent the withdrawals are required for mining activities regardless of any subsequent use of the water; or

(7) leachate wells, monitoring wells, and dewatering wells.

(b) A well exempted under Subsection (a) will lose/forfeit its exempt status and/or does not qualify as exempt if:

(1) the well is subsequently used for a purpose or in a manner that is not exempt under Subsection (a);

(2) while the well was classified as an exempt well, the District determines that the groundwater withdrawals are no longer used solely for domestic use or to provide water for livestock or poultry, no longer used solely to supply water for a rig that is actively engaged in drilling or exploration operation, or are no longer necessary for mining activities;

(3) the capacity of the replacement well is increased from that being replaced; or

(4) if the groundwater withdrawn is used to supply water for a subdivision of land for which a plat approval is required by Chapter 232, Local Government Code.

(c) The owner of a well that is exempt from permitting under this Rule shall register the well with the District as an exempt well, if required under Rule 2.3.

(d) If exempt well status is lost under Subsection (b), the District may initiate an enforcement action against the owner of the well for violating these Rules.

Rule 2.3 Exempt Well Registration Required

Deleted: ;¶

Deleted: <#>for wells completed before April 14, 2009, a well to be used solely for domestic use or livestock use with the capacity to produce more than 25,000 gallons of water per day that will produce a total of less than 9,125,000 gallons of water per year; or¶

(a) Registration applications may be submitted to the District in person, by mail, by fax, or by internet submission, using the registration form provided by the District. Well owners of the following wells shall file an application for well registration with the District and the District shall register:

(1) all new, exempt wells, except those wells exempt under Subsections (a)(5) or (7) of Rule 2.2;

(2) all existing exempt wells, except those wells exempt under Subsections (a)(5) or (7) of Rule 2.2; and

(3) all pre-existing exempt wells with an inside casing diameter measuring larger than 4 inches in diameter except those wells exempt under Subsections (a)(5) or (7) of Rule 2.2.

(b) Exempt wells that are required to be registered under these Rules but have not yet been registered are not subject to enforcement under these Rules so long as the well is registered within 60 days of the Effective Date or by November 8, 2020. Any subsequent failure to register or amend the registration is subject to enforcement under these Rules.

(c) Exempt wells that are not required to be registered are exempt wells under Subsections (a)(5) or (7) of Rule 2.2 regardless of when they are/were drilled and pre-existing exempt wells with an inside casing diameter measuring 4 inches or less in diameter. Exempt wells that are not required to be registered by the District are encouraged to register to receive the benefits of being classified as an existing well under these Rules, including but not limited to a consideration of the registered well in a review of a proposed new well's spacing requirements and during the permitting process for proposed new non-exempt wells. Wells not registered with the District are not considered in review of a proposed new well's impacts on existing wells.

(d) Except for subsection (b), failure of a well owner to timely register or amend the registration of a well under this Rule shall be subject the well owner to enforcement under these Rules. A violation of this rule occurs on the first day that the drilling, alteration, modification, or operation occurs, and continues each day thereafter as a separate violation until cessation of the prohibited conduct, or until the well is registered or the registration is amended, as applicable.

(e) A person seeking to register a well shall provide the District with the following information in the registration application:

(1) the name and mailing address of the registrant and the owner of the property, if different from the registrant, on which the well is or will be located and the legal description of the property on which the well is or will be located;

(2) if the registrant is other than the owner of the property, documentation establishing the applicable authority to file the application for well registration, serve as the registrant in lieu of the property owner, and construct and operate a well for the proposed use;

(3) a statement of the nature and purpose of the existing or proposed use and the amount of water used or to be used for each purpose;

(4) the location of the well, identified with latitudinal and longitudinal coordinates measured from a properly functioning and calibrated global positioning system unit, and the estimated rate at which water is or will be withdrawn;

(5) the location or proposed location of the use of the water from the well, if used or proposed to be used at a location other than the location of the well;

(6) the production capacity or proposed production capacity of the well, as equipped in gallons per minute, and the horsepower rating of the pump, as assigned by the pump manufacturer;

(7) a water well closure plan or a declaration that the applicant will comply with well plugging guidelines and report closure to the District;

(8) a statement that the water withdrawn from the well will be put to beneficial use at all times; and

(9) a statement that the applicant agrees to comply with the Administrative Rules of the TDLR and will contact the Montgomery County Health Department if the well is to be drilled on less than 1 ½ acres; and

(10) a statement that the applicant agrees to comply with all other applicable local, state, and federal rules.

(f) The General Manager shall review a registration application and issue a Notice to Proceed if the registration is Administratively Complete and the new exempt well will comply with the applicable spacing requirements in Rule 3.2. If the registration is for an exempt pre-existing well that was drilled before August 26, 2002 or an exempt well that was not otherwise required to be registered, the General Manager shall approve the registration if the information provided is Administratively Complete. A new exempt well must be drilled and completed within 120 days following issuance of the Notice to Proceed.

(g) The person who drills or completes an exempt well shall file the well report with the District within 60 days after the date the well is completed as required by Rule 11.2. Upon receipt of the well report required by Rule 11.2, the registration of the well shall be perpetual in nature, subject to being amended or transferred and subject to enforcement and/or cancellation for violation of these Rules.

Deleted: and

Deleted: .

Formatted: Font: (Default) Arial, 12 pt, Complex Script Font: Arial, 12 pt

Formatted: Indent: Before: 0.07", Hanging: 0.5", After: 0.07", Space Before: 0 pt, Line spacing: single, No bullets or numbering, Tab stops: Not at 0.5" + 6.5"

(h) Notwithstanding any other rule to the contrary, the owner, driller, pump installer, or well service company that is authorized by the owner to complete or operate a new well, substantially alter an existing well, or modify or operate an existing well are jointly responsible for ensuring that a well registration required by this section, or well registration amendment required by subsection (i), is timely filed with the District and contains only information that is true and accurate. Each will be subject to enforcement action if a registration or registration amendment required by this section is not timely filed by either, or by any other person legally authorized to act on his or her behalf.

(i) Amendment of Registration: A registrant of an exempt well shall file an application to amend an existing registration and obtain approval by the District of the application prior to engaging in any activity that would constitute a substantial change from the information in the existing registration. For purposes of this rule, a substantial change includes a change that would substantially alter the pump or well, a change in the type of use of the water produced, a change in location of a well or proposed well, a change of the location of use of the groundwater, or a change in ownership of a well. Failure of a well owner or transferee per Rule 2.17 to timely register or amend the registration of a well under this Rule shall subject the well owner or transferee per Rule 2.17 to enforcement under these Rules. Substantial changes may require a well owner to file an application for an operating permit.

Rule 2.4 Historic Use Permits; Terms and Renewals

The District previously issued Historic Use Permits during the Historic Use Period. In connection with each Historic Use Permit, the District determined the Maximum Historic Use, which effectively served as the Annual Production Limitations for each Historic Use Permit subject to any proportional adjustments. Any changes to a Historic Use Permit as set forth in Rule 2.5 will require the permit holder to file an application for an Operating Permit. If no changes are made to a Historic Use Permit, the Historic Use Permit shall be reissued and reviewed in accordance with Rule 2.11 and include all the conditions in Rule 2.9(c). Any changes to Historic Use Permits are subject to Rule 2.12 and the considerations for Operating Permits in Rule 2.6 including a Hydrogeological Report Requirement for certain wells or well systems in Rule 2.6(b)(15).

Rule 2.5 Operating Permits

(a) The owner of a new, non-exempt well must obtain an Operating Permit from the District prior to the drilling, construction, or operation of the well or well system. The owner of a new or existing well that is exempt from the District's permitting requirements, but is subsequently substantially altered in a manner that causes the well to lose its exempt status, must obtain an Operating Permit. In addition, the owner of an existing well or well system that has obtained a Historic Use Permit for the well must obtain an Operating Permit if any of the following apply:

(1) The permit holder intends to produce or has produced groundwater in

excess of the amount authorized in a Historic Use Permit;

(2) The well or well system has been substantially altered in a manner that causes the well or well system to be capable of producing more groundwater than authorized; or

(3) The purpose of use of the groundwater produced changes to another type of use other than that authorized in the Historic Use Permit.

(b) An Operating Permit is required for all new non-exempt production from the District and is applicable to only one Aquifer of the District. A separate Operating Permit must be obtained to produce from a different Aquifer of the District.

(c) New or existing wells for which an Administratively Complete permit or permit amendment application has not been filed with the District prior to the Effective Date will be presumed to be wells not in existence prior to the Effective Date. Those wells that are not deemed existing wells under these Rules are considered to be new wells that are required to comply with the spacing requirements under Rules 3.2 and 3.3.

Deleted: y

Rule 2.6 Application Requirements for Operating Permits

(a) Each application for an Operating Permit or an Amended Operating Permit must contain all of the information as set forth below. Application forms will be provided on the District's website and can be furnished to the applicant upon request. Applications may be submitted to the District in person, by mail, by fax, or by internet submission. For well systems, the applicant shall provide the information required in this subsection for each well that is part of the well system.

(b) The application shall be in writing and sworn to and shall include the following:

(1) the name, telephone number, fax number, and mailing address of the applicant and the owner of the land on which the well is or will be located and a legal description of the property on which the well is or will be located;

(2) if the applicant is other than the owner, a map of the service area of a retail water public utility, and/or documentation establishing the applicable authority to construct and operate a well on such property for the proposed use;

(3) a statement of the nature and purpose of the proposed use, the amount of water to be used for each purpose, and how the amount of water requested addresses an existing or projected water supply need or demand;

(4) a declaration that the applicant will comply with the District's Management Plan and Rules and all groundwater permits promulgated pursuant to the Rules;

(5) the location or proposed location of each well, including a location map showing the proposed well location detailed by latitude and longitude or by GPS coordinates, and a description of the Aquifer of the District, depth and diameter;

(6) the location or proposed location of the use of the water from the well, if used or proposed to be used at a location other than the location of the well;

(7) the maximum instantaneous pumping rate requested in gallons per minute for each well and the production capacity of the well as equipped if different from the maximum instantaneous pumping rate requested, and the horsepower rating of the pump, as assigned by the pump manufacturer;

(8) a water well closure plan or a declaration that the applicant will comply with well plugging guidelines and report closure to the District and the appropriate state agencies;

(9) a drought contingency plan, if the applicant is required by other law to have a drought contingency plan;

(10) a water conservation plan, if the applicant is required by law to have a water conservation plan;

(11) a statement by the applicant that the water withdrawn under the permit will be put to beneficial use at all times;

(12) if the groundwater is to be resold, leased, or otherwise transferred to others, whether inside or outside of the District, provide the location to which the groundwater will be delivered, the purpose for which the groundwater will be used, and a copy of the legal documents establishing the right for the groundwater to be sold, leased, or otherwise transferred, including but not limited to any contract for the sale, lease, or transfer of groundwater;

(13) a statement that the applicant will equip the permitted well(s) with a flow measurement device under Section 10.

(14) if groundwater is proposed to be transported out of the District, the applicant shall describe the following issues and provide documents relevant to these issues:

(A) the availability of water in the District and in the proposed receiving area during the period for which the water supply is requested;

(B) the projected effect of the proposed transport on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District; and

(C) how the proposed transport is consistent with the approved regional water plan and District Management Plan; and

(15) a Hydrogeological Report that is completed in accordance with the District's Hydrogeological Report Guidelines for:

(A) a request to modify or increase an existing well or well system that would result in the existing well(s) being equipped to produce 700 gallons per minute or greater;

(B) a request to drill and operate a proposed new well or well system with a proposed aggregate production capacity of 700 gallons per minute or greater; and/or

(C) a request for an exception to the spacing requirements in Rule 3.2 or Rule 3.3.

Hydrogeological Reports required under this subsection, Rule 2.12, and Rule 3.4 shall be sealed by a licensed professional engineer or geoscientist in Texas and submitted simultaneously with an application and shall include all of the required elements of the District's Hydrogeological Report Guidelines in order for the permit or permit amendment application to be deemed Administratively Complete.

Rule 2.7 Administrative Completeness of Applications for Operating Permits

(a) An application shall be accompanied by payment by the applicant of any administrative fees required by the District for permit application.

(b) An application may be rejected as not Administratively Complete if the District finds that substantive information required by the permit application is missing, false, or incorrect.

(c) An application will be considered Administratively Complete if it complies with all requirements set forth under the Rules, including all information required to be included in the application.

(d) The General Manager shall determine whether an application is Administratively Complete.

(e) The District shall promptly consider and act on each Administratively Complete application for an Operating Permit that meets the requirements of Rule 2.6, includes the application fee established by the District, and for which the applicant is in compliance with District Rules. If an application is not Administratively Complete, the District may request the applicant to complete the application as required by these Rules. The application will expire if the applicant does not complete the application within 60 (sixty) days of the date of the District's request or

upon conclusion of an extension granted by the General Manager.

Rule 2.8 Considerations for Granting or Denying an Operating Permit

(a) Before granting or denying an Operating Permit or an application to amend a permit, the District shall consider whether:

(1) the application contains accurate information, all the information requested, and is accompanied by the subscribed administrative fees;

(2) the water well(s) complies with Chapter 36 and these Rules, including but not limited to the spacing and production limitations identified in these Rules;

(3) the proposed use of water unreasonably affects existing groundwater and surface water resources or existing permit holders;

(4) the proposed use of water is dedicated to any beneficial use;

(5) the proposed use of water is consistent with the District's Management Plan;

(6) the applicant agrees to avoid waste and achieve water conservation;

(7) the applicant has agreed that reasonable diligence will be used to protect groundwater quality and that the applicant will follow well plugging guidelines at the time of well closure; and

(8) for those hearings conducted by SOAH, the Board shall consider the proposal for decision issued by the State Office of Administrative Hearings.

(b) The District, to the extent possible, shall issue permits up to the point the total volume of exempt and permitted groundwater production will achieve the applicable Desired Future Conditions established for the aquifer or Aquifers in the District. In issuing permits, the District shall manage total groundwater production on a long-term basis to achieve the applicable Desired Future Conditions and shall consider:

(1) the Modeled Available Groundwater determined by the Executive Administrator of the TWDB;

(2) the Executive Administrator of the TWDB's estimate, as may be provided by the District, of the current and projected amount of groundwater produced under the exemptions in the Rules;

(3) the amount of groundwater authorized under permits previously issued by the District;

(4) a reasonable estimate of the amount of groundwater that is actually produced under permits issued by the District; and

(5) yearly precipitation and production patterns.

Rule 2.9 New or Amended Operating Permits Issued by District

(a) Upon the Board's grant of an Operating Permit application and prior to issuance of the permit, the General Manager shall promptly provide an invoice to the permit applicant for Water Use Fees due and owing to the District.

(b) An Operating Permit shall not be issued by the District until the District has received from the permit applicant at least the first quarterly payment of the invoiced Water Use Fee, along with full payment of any applicable administrative fees invoiced by the District for permit applicants.

(c) All permits issued by the District shall state the following:

(1) the name and address of the person to whom the permit is issued;

(2) the location of the well, the Aquifer of the District, depth and diameter

(3) the Maximum Allowable Pumping Rate for each well;

(4) the Annual Production Limitations for each permit;

(5) the date the permit is issued;

(6) the date the permit is to expire if no well is drilled;

(7) a statement of the purpose for which the well is to be used;

(8) a requirement that the water withdrawn under the permit be put to beneficial use at all times;

(9) a declaration that the applicant will comply with well plugging guidelines and report closure to the commission;

(10) a requirement that the permit holder shall reduce water production as required by the Rules and orders of the Board, including without limitation Proportional Adjustment Orders issued based on achievement of the District's Desired Future Conditions, other adjustments or a Management Zone;

(11) The permit contains all matters approved by the District related to the permittee's authority to use groundwater, and all other matters requested by the permit holder not included in the permit are denied;

(12) If groundwater is to be transported outside the District, the amount of water

that may be transferred and the period for which the water may be transferred;

(13) In the event of a conflict between the terms of the permit and the application and information pursuant to which the permit was granted, the terms of the permit shall prevail.

(14) any other conditions or restrictions the District prescribes; and

(15) any other information the District determines necessary.

Rule 2.10 Aggregation of Withdrawal Among Multiple Wells

Multiple wells that are part of a well system that are owned and operated by the same person and serve the same subdivision, facility, or a certified service area may be requested to be aggregated under a single permit by either the owner or the General Manager. Multiple wells that are not part of an aggregate well system but that are located on a single tract of land and owned and operated by the same owner may be requested to be aggregated under a single permit by either the owner or the General Manager. The determination of aggregation shall be made at the sole discretion of the District. Wells owned by the same person that produce from different Aquifers of the District shall not be aggregated under a single permit.

All aggregated wells under a single permit shall be subject to the Maximum Allowable Production Rate for each well, Annual Production Limitations for the permit in accordance with Rule 4.1, and Management Zones and Proportional Adjustment Orders in accordance with Section 6, from which the well system produces. When wells are aggregated under a single permit, each well shall have a Maximum Allowable Production Rate; however, the Annual Production Limitations shall apply to the aggregated system of wells under the single permit and a prorated share of the Annual Production Limitations shall not be allocated on a pro rata basis to each well.

Rule 2.11 Historic Use and Operating Permit Terms; Administrative Review

(a) **Term:** Historic Use Permits and Operating Permits are perpetual in nature unless revoked or amended, and shall be subject to a formal administrative review at least once every five years and an informal review from time-to-time as set forth below in Subsection (d).

(b) **Reissuance of Existing Permits**: The District shall reissue existing Historic Use Permits and Operating Permits as soon as practicable after the Effective Date using a process similar to what the District has used for annual renewals. All reissued permits shall state that the permit is perpetual; contain the information in Rule 2.9(c) including without limitation a Maximum Allowable Pumping Rate for each well and Annual Production Limitations for each permit; and subject the permit to proportional adjustments in accordance with Rule 6.3 and Management Zones in accordance with Rule 6.2. For all permits issued before the Effective Date, the

District shall designate the approved maximum instantaneous pumping rate in effect on the Effective Date as the Maximum Allowable Pumping Rate based on the District's records and/or information provided by the permit holder. For all permits issued before the Effective Date, the District shall identify which Aquifer(s) of the District the production is occurring and associate the permit(s) with those particular Aquifer(s) of the District. For Historic Use Permits, the District shall designate the Maximum Historic Use as the Annual Production Limitations for each Historic Use Permit subject to any proportional adjustments. For Operating Permits issued before the Effective Date, the District shall designate the authorized annual allocation in effect on the Effective Date as the Annual Production Limitations subject to proportional adjustments.

(c) **Issuance of New Permits:** All permits issued after the Effective Date shall state that the permit is perpetual and contain the information in Rule 2.9(c) including without limitation a Maximum Allowable Pumping Rate for each well and Annual Production Limitations for each permit, and are subject to proportional adjustments in accordance with Rule 6.3 and Management Zones in accordance with Rule 6.2.

(d) **Formal and Informal Administrative Review**: The formal and informal review processes may entail inspections and requests for information from a permit holder as required to ensure the accuracy and integrity of the District's information, and to enforce compliance with these Rules, the District Act, and Chapter 36. The District shall conduct a formal administrative review at least once every five years. The formal review shall include without limitation a review of all terms and conditions of the permit, a certification from the permit holder that there are no changes to the information currently on file with the District or in the permit, a field inspection of all wells associated with the permit, and a review of the permit holder's compliance with all Rules. Upon receipt of information that necessitates a permit amendment under Rule 2.12, the District shall notify the well owner in writing that a permit amendment is required prior to initiation of the permit amendment process. The General Manager shall inform the Board of any permit amendments initiated at the next scheduled Board meeting.

Deleted: any reviews conducted and

(e) If the holder of a permit requests a change that requires an amendment to the permit under these Rules, the permit as it existed before the permit amendment remains in effect until the later of the conclusion of the permit amendment or review process, as applicable or final settlement or adjudication on the matter of whether the change to the permit requires a permit amendment. If the permit amendment process results in the denial of an amendment, the permit as it existed before the permit amendment process shall be renewed as provided for under this Rule.

(f) The General Manager may initiate an amendment to a permit, in connection with the review of a permit or otherwise, in accordance with these Rules. If the General Manager initiates an amendment to a permit, the permit as it existed before the permit amendment process shall remain in effect until the conclusion of the permit amendment process, as applicable.

(g) An applicant may appeal the General Manager's ruling in the manner provided for in Rule 1.12.

Rule 2.12 Operating Permit Amendments and Limited Authorized Amendments to Historic Use Permits

(a) A permit amendment is required prior to any deviation from the permit terms regarding the maximum amount of groundwater to be produced from a well, ownership of a well or permit, the location of a proposed well, the purpose of use of the water, the location of use of the groundwater, or the drilling and operation of additional wells, even if aggregate withdrawals remain same. A permit amendment is not required for maintenance or repair of a well if the maintenance or repair does not increase the production capabilities of the well. All applications for permit amendments shall be reviewed under the Rules in effect at the time the application is filed. All applications for amendments to any permit issued by the District are subject to the considerations for Operating Permits in Rule 2.6 including a Hydrogeological Report Requirement for certain wells or well systems in Rule 2.6(b)(15) and exceptions to the spacing requirements in Rules 3.2 and 3.3, and are subject to the notice and hearing procedures set forth in Rule 13.3. An approved amendment to a permit applies prospectively and cannot be applied retroactively on a one-time basis. Changes requested to the purpose of use or to increase the amount of annual production under a Historic Use Permit require the issuance of an Operating Permit prior to the changes being made.

(b) A major amendment to a permit includes, but is not limited to, a change that would increase the maximum instantaneous pumping rate or Maximum Allowable Pumping Rate of a well, an increase in the annual quantity of groundwater authorized or Annual Production Limitations to be withdrawn under a permit, a change in the type of use or location of use of the water produced, the addition of a new well to be included in the permit, or a change of location of groundwater withdrawal, except for a replacement well authorized under Rule 2.13(b).

(c) A major amendment to a permit shall not be made prior to notice and hearing.

(d) Amendments that are not major, as determined by the General Manager and these Rules, such as an amendment sought by the permittee for a decrease in the quantity of groundwater authorized for withdrawal and beneficial use, or a change in ownership of a well, are minor amendments and may be made by the General Manager or referred to the Board at the General Manager's discretion.

(e) The General Manager is authorized to deny or grant in full or in part a minor permit amendment and may grant minor amendments without public notice and hearing. Such decision by the General Manager may be appealed to the Board as provided by Rule 1.12. Any minor amendment sent to the Board for consideration shall be set on the Board's agenda and shall comply with the notice requirements of the Open Meetings Act.

Rule 2.13 Replacement Wells and Substantial Alteration of Existing Wells

(a) No person may substantially alter a well or pump, or replace an existing well, without first having obtained authorization for such work from the District. Authorization for substantial alterations or replacement wells may only be granted following the submission of an application for such authorization to the District.

(b) For replacement wells, information submitted in the application must demonstrate to the satisfaction of the General Manager each of the following:

(1) the location of the replacement well will be within fifty feet of the location of the well being replaced and shall be drilled in the same Aquifer of the District as the well being replaced;

(2) The application for registration of a replacement well shall include a diagram of the property that depicts both the proposed replacement well and the well being replaced, and any other structures on the property.

(3) the replacement well will not be located any closer to any other registered or permitted well or authorized well site than the well being replaced, unless the new location complies with the minimum spacing and location requirements of these Rules;

(4) the replacement well and pump will not be larger in size or designed capacity than the well and pump being replaced; and

(5) immediately upon commencing operation of the replacement well, the well owner will cease all production from the well being replaced and will begin efforts to plug the well being replaced within ninety (90) days from the date that the replacement well is completed.

(c) For substantial alteration of existing wells and for those applications submitted to replace a well that also include a request to increase the capacity of the replacement well beyond that of the well being replaced, the applicant must provide the following information:

(1) a description of the features of the well or pump that the applicant proposes to substantially alter, and a description of the same features of the well or pump as they currently exist; and

(2) the reasons for the proposed substantial alterations.

(d) Applications for replacement wells submitted under Subsection (b) may be granted by the General Manager without notice or hearing.

(e) The General Manager shall review applications submitted under Subsection (c) to determine whether the proposed substantial alteration or increased capacity would

constitute a major or minor permit amendment under Rule 2.12, or would disqualify an exempt well from the applicable permitting exemption under Rule 2.2 and would require an application for an Operating Permit. Increasing the capacity of the replacement well from that being replaced will result in the forfeiture of any applicable exemptions under Rule 2.2(b). The spacing requirements of Rule 3.3 shall apply to a well whose alteration would result in an increase in the Maximum Allowable Pumping Rate. An Operating Permit or permit amendment shall also be required for the alteration or increase in capacity over that of the well replaced if required by Rule 2.5 or Rule 2.12.

(f) An applicant may appeal the General Manager's ruling in the manner provided for in Rule 1.12.

Rule 2.14 Test Hole Permit

(a) A person may apply for a permit to drill exploratory boreholes for the purposes of obtaining necessary and reliable information regarding aquifer characteristics and other relevant subsurface conditions for use in evaluating groundwater resources and potentially subsequently applying to the District for an Operating Permit. To the extent practicable, all test bores shall be drilled in accordance with the spacing requirements set forth in Section 3. Any test bore hole later drilled to serve as a well will require an Operating Permit and compliance with spacing requirements in Section 3.

(b) An application for a Test Hole Permit shall be submitted using a form approved by the District and shall include information listed in Rule 2.6, as applicable.

(c) Within 60 days of the date that an application for a Test Hole Permit is determined to be Administratively Complete, the General Manager may either approve the application or refer it to the Board for its consideration.

(d) A Test Hole permit is valid for one year from date of issuance. The term may be extended if, before the expiration of the one-year permit term, the permit holder submits to the District in writing a request for an extension that includes a basis for the requested extension and a reasonably detailed explanation of why the test hole drilling could not be completed within the one-year permit term. The General Manager may approve the extension or refer it to the Board for consideration.

(e) Except as provided in subsection (g), once testing of water source has been completed or upon expiration of the permit term, whichever occurs first, all test holes shall be permanently sealed with cement slurry containing up to six percent gel by placing the material into the test bore from the bottom up to the surface in a manner that:

(1) avoids dilution or segregation of the material; and

(2) prevents co-mingling between aquifers or Aquifers of the District or other

deleterious matter admitted from another stratum or from the surface.

(f) Within 60 days of completion of the Test Hole drilling, the applicant shall report all required information as described in Rule 11.2.

(g) The permit holder is not required to install a permanent seal on the test hole if it has been selected for completion as a producing groundwater well and if:

(1) the test hole has been temporarily cased or otherwise completed as much as economically practicable to prevent wellbore bridging or collapse;

(2) within 90 days of completion of the test hole, an administratively complete application for an Operating Permit for the well has been submitted to the District; and

(3) prior to approval or denial of an Operating Permit, the Test Hole Permit holder takes all appropriate measures in accordance with the Texas Water Well Drillers and Pump Installers Administrative Rules, Title 16, Part 4, Chapter 76, Texas Administrative Code, to protect groundwater quality; and

(4) within one year after the issuance of an Operating Permit for the well, the test bore has been further drilled to serve as a well, cased, completed and otherwise made capable of producing water.

(h) If the Board denied an application for an Operating Permit for the well, the Test Hole permit holder shall seal the test hole in accordance with subsection (e) within 30 days of the date the decision on the denial becomes effective.

Rule 2.15 Emergency Permits

(a) Upon receiving an Administratively Complete application, the General Manager may grant an emergency permit that authorizes the drilling, equipping, completion, substantial altering with respect to size or capacity, or operation of a well and production therefrom as set forth under this Rule.

(b) An application for an Emergency Permit shall contain the information set forth in Rule 2.6 and present sufficient evidence that:

(1) no suitable surface water or permitted groundwater is immediately available to the applicant; and

(2) an emergency need for the groundwater exists such that issuance of the permit is necessary to prevent the loss of life or to prevent severe, imminent threats to the public health or safety.

(c) The General Manager may rule on any application for an Emergency Permit without notice, hearing, or further action by the Board, or with such notice and

hearing as the General Manager deems practical and necessary under the circumstances. The General Manager may deny an application for an Emergency Permit on any reasonable ground, including, but not limited to, a determination that the applicant is currently in violation of these Rules or Chapter 36, that the applicant has a previously unresolved violation on record with the District, or that the application does not meet the requirements of this Rule. Notice of the ruling shall be given to the applicant. An applicant may appeal the General Manager's ruling as provided by Rule 1.12.

(d) The permit fee to be assessed for an Emergency Permit under this Rule shall be $1,500 per well or application.

Deleted: the same as an Operating Permit

(e) Emergency Permits may be issued for a term determined by the General Manager based upon the nature and extent of the emergency, such term not to exceed 60 days. Upon expiration of the term, the permit automatically expires and is cancelled.

Rule 2.16 Temporary Permit for Construction Projects and Drilling Supply

(a) The District may grant a Temporary Permit to drill and operate a water well for the purpose of either supplying water to a construction project or supplying water for the drilling process of a permanent well.

(b) The General Manager may rule on any Administratively Complete application for a Temporary Permit without notice, hearing, or further action by the Board, or with such notice and hearing as the General Manager deems practical and necessary under the circumstances. The General Manager may deny an application for a Temporary Permit upon a determination that the applicant is currently in violation of these Rules or Chapter 36, that the applicant has a previously unresolved violation on record with the District, or that the application does not meet the requirements of this rule. Notice of the ruling shall be given to the applicant. An applicant may appeal the General Manager's ruling as provided for in Rule 1.12.

(c) Temporary Permits may be issued for the term requested in the application; provided however that no term for a Temporary Permit shall exceed one year from the date of approval by the General Manager. Upon expiration of the term, the Temporary Permit automatically expires and is canceled. Temporary Permits shall not be subject to renewal.

(d) An applicant for a Temporary Permit is limited to a maximum production authorization of 5 million gallons.

(e) A well(s) for which a Temporary Permit is issued must be plugged no later than one year from the date of issuance of the Temporary Permit for the term of the permit. Wells shall be plugged in accordance with the rules and procedures established by the TDLR. Not later than the 30th day after the date the well is plugged, the permit holder shall submit a plugging report to the District. The District shall furnish

plugging forms on request.

(f) The Temporary Permit holder shall equip the well with a meter prior to producing from the well and shall submit a Permit Production Report in accordance with Rule 11.3 to the District no later than one year from the date of permit issuance.

(g) Notwithstanding anything to the contrary in these Rules, an applicant for a Temporary Permit must provide to the District:

(1) a completed Temporary Permit application form, which shall be provided by the District;

(2) an application fee in the amount of $250 and any necessary administrative fees pursuant the fee schedule of the District and these Rules;

(3) a flat rate Water Use Fee of $500; and

(4) evidence of a lawful performance bond paid by the applicant and issued in the name of the District in an amount of $50,000 to cover all costs associated with plugging the well as required by this rule; the permit holder's failure to properly plug the well in accordance with this rule shall result in the District's utilization of the performance bond to cover all costs of the District related to plugging the well.

(h) The District shall name the licensed water well driller as the Temporary Permit holder, who shall be responsible for compliance with all rules applicable to the permit.

(i) Ownership of a well drilled pursuant to a Temporary Permit granted under this rule may be transferred to the owner where the permitted well is located if:

(1) the owner obtains the proper registration or Operating Permits, whichever is applicable, for the well, as established in these Rules, prior to the expiration of the Temporary Permit; and

(2) the transfer is completed and approved by the District prior to expiration of the Temporary Permit.

(j) If ownership of a well is transferred in accordance with Subsection (i) and an Operating Permit or registration for the well is approved by the District, as applicable, the holder of the Temporary Permit shall be released from the obligation to plug the well and the performance bond shall be released by the District.

Rule 2.17 Transfer of Well Ownership

(a) Within sixty (60) days after the date of a change in ownership of a well that is required to be registered or permitted under these Rules, the new owner or well

owner (transferee) shall file with the District a Transfer of Well Ownership form that provides the name, daytime telephone number, mailing address of the new owner or well owner, documents evidencing and supporting change along with any other contact or well-related information reasonably requested by the General Manager. The requirement under this rule to transfer well ownership shall also apply to capped or inactive wells.

(b) If a registrant or permittee conveys by any lawful and legally enforceable means to another person the real property interests in one or more wells or a well system that is recognized in the registration or permit so that the transferring party (the transferor) is no longer the owner or well owner, as defined herein, and if the form for Transfer of Well Ownership under Subsection (a) has been approved by the District, the District shall recognize the person to whom such interests were conveyed (the transferee) as the legal owner or owner of the well, subject to the conditions and limitations of these Rules.

(c) Upon approval of the Transfer of Ownership Form, the new owner or transferee shall amend the well registration in accordance with Rule 2.3 or file an application to amend a permit in accordance with Rule 2.12, which shall be treated as a minor amendment.

(d) The burden of proof in any proceeding related to a question of well ownership or status as the legal holder of a registration or permit issued by the District and the rights thereunder shall be on the person claiming such ownership or status.

(e) Notwithstanding any provision of this rule to the contrary, no application made pursuant to Subsection (a) of this rule shall be granted by the District unless all outstanding fees, penalties, and compliance matters have first been fully and finally paid or otherwise resolved by the transferring party (transferor) for all wells included in the application or existing registration, and each well and registration or permit made the subject of the application is otherwise in good standing with the District.

(f) The new owner or new owner of a well that is the subject of a transfer described in this rule (transferee) may not operate or otherwise produce groundwater from the well after ninety (90) days from the date of the change in ownership until the new owner has submitted a Transfer of Well Ownership if required under this rule.

(g) Transfer of well ownership of wells associated with a Historic Use Permit are subject to Rules 2.4 and 2.5 requiring the permit holder to file an application for an Operating Permit if any changes are made to a Historic Use Permit other than a decrease in the amount authorized or a transfer of well ownership under this Rule.

(h) Transfers of well ownership of wells associated with an Operating Permit are subject to Rule 2.12 regarding amendments to Operating Permits.

SECTION 3 SPACING AND LOCATION OF WELLS

Rule 3.1 Spacing and Location of Existing Wells

Existing Wells shall be drilled in accordance with state law and the District rules in effect on the date such drilling commenced or the Administratively Complete registration or permit application was filed, are exempt from the spacing, location and completion requirements of these Rules to the extent they were drilled lawfully. The owner of a well or well system for which significant plans or funding related to the drilling thereof have been developed prior to the Effective Date may submit evidence to the District in order for the District to consider whether the well or well system qualifies under Rule 3.1 for spacing purposes only.

Deleted: and

Deleted:

Rule 3.2 Spacing Requirement for All New Wells (Exempt and Non-Exempt)

(a) All New Wells (Exempt and Non-Exempt) for which a registration or permit application is filed after the Effective Date may not be drilled within 50 feet of the nearest adjacent property line.

(b) After authorization to drill a well has been granted under the District's registration rules or a permit, the well, if drilled, must be drilled within thirty feet of the location specified in the permit while still ensuring the well is not drilled within 50 feet of the nearest adjacent property line, and not elsewhere. If the drilling of the well is commenced at any other location than what is provided for in this Rule, the Board may take action to enjoin the drilling activity or operation of the well pursuant to Chapter 36, and these Rules, and the Board may, pursuant to Rules 12.6(c) and 12.9, order that the well be plugged.

(c) A person who drills a well in violation of the applicable spacing requirements of this Rule may be required to recomplete or reconstruct the well in accordance with the Rules, and may be ordered to plug the well deemed to be in violation.

Rule 3.3 Spacing Requirements for All New Non-Exempt Wells

(a) New, non-exempt wells shall be spaced from all registered and permitted wells completed in the same Aquifer of the District based upon the capacity of the proposed new, non-exempt well. New, non-exempt wells will be spaced from registered and permitted wells completed in the same Aquifer of the District as follows:

(1) For the Chicot/Evangeline aquifer – new, non-exempt wells shall be spaced from all registered and permitted wells a distance not less than 2.0 feet multiplied by the Maximum Allowable Pumping Rate;

(2) For the Jasper aquifer – new, non-exempt wells shall be spaced from all registered and permitted wells a distance not less than 1.5 feet multiplied by the Maximum Allowable Pumping Rate;

(3) For the Catahoula aquifer – new, non-exempt wells shall be spaced from all

registered and permitted wells a distance not less than 1.0 foot multiplied by the Maximum Allowable Pumping Rate;

(b) After authorization to drill a well has been granted under the District's registration rules or a permit, the well, if drilled, must be drilled within thirty (30) feet of the location specified in the permit, and not elsewhere. If the drilling of the well is commenced at any other location than what is provided for in this Rule, the Board may take action to enjoin the drilling activity or operation of the well pursuant to Chapter 36, and these Rules, and the Board may, pursuant to Rules 12.6 and 12.9, order that the well be plugged.

(c) A person who drills a well in violation of the applicable spacing requirements of this Rule may be required to recomplete or reconstruct the well in accordance with the Rules, and may be ordered to plug the well deemed to be in violation.

(d) Existing Wells that may or may not comply with the spacing requirements set forth in Rule 3.3, and for which a request to replace the well per Rule 2.13 and/or for which a permit amendment is requested that would result in an increase in the Maximum Allowable Pumping Rate, the well spacing regulation in Rule 3.3(a) will be applied. If a requested increase in Maximum Allowable Pumping Rate cannot be granted without violating the applicable well spacing rule, then exceptions per Rule 3.4 may be requested and considered.

Rule 3.4 Exceptions to Spacing Requirements

(a) If an exception to the spacing requirements in Rule 3.2 or Rule 3.3 of the District is desired, a person shall submit an application on a form provided by the District. In the application, the applicant must explain the circumstances justifying an exception to the spacing requirements of the District, including certifying that there is no place on the property where the proposed well can be placed that complies with these Rules, and a boundary survey or sketch, drawn to scale, one inch equaling two-hundred (200) feet. The boundary survey or sketch must show the property lines in the immediate area and show accurately, to scale, all the registered and permitted wells within the applicable spacing distance under Rule 3.2 or 3.3 of the proposed well site. The application and boundary survey or sketch must be certified by a person acquainted with the facts who shall state that the facts contained in the application are true and correct. If the proposed well is non-exempt and a person is requesting an exception to the spacing requirements in Rule 3.2 or Rule 3.3, the applicant shall also provide a Hydrogeological Report that meets the requirements of Rule 2.6(b)(15) and the District's Hydrogeological Report Guidelines. If the well is exempt and a person is requesting an exception to the spacing requirement in Rule 3.2, the applicant is not required to provide a Hydrogeological Report.

(b) An exception to the applicable spacing requirement shall be automatically granted upon receipt of an application under Subsection (a) that includes evidence and a sworn statement by the owner or well owner, as applicable, that the abutting land or

Deleted: ,

Deleted: and include a Hydrogeological Report

Deleted: The Hydrogeological Report must

Deleted:

Deleted: the property line and existing well spacing requirements shall be automatically granted upon

registered and permitted well(s) to which a spacing exception is requested is owned or controlled by the same person as the proposed well.

(c) If all registered and permitted well owners and/or property owners within the applicable spacing distance for which an exception is sought execute a certified waiver in writing, stating that they do not object to the granting of the exception, the District may proceed, upon notice to the applicant only and without hearing, and take action to grant or deny the exception in full or in part.

(d) If an applicant cannot provide signed and notarized waivers from all registered and permitted well owners or all adjacent property owners, as applicable, within the applicable spacing distance, then the applicant must notify all registered and permitted well owners and adjacent property owners, as applicable, within the applicable spacing distance and the District will hold a public hearing for each request of an exception to the spacing requirements. An exception may be granted by the Board after written notice has been given by the applicant by mailing notice by certified mail, return receipt requested, to all registered and permitted wells and/or all adjacent property owners, as applicable, located within the minimum required distance from the proposed well site, after a public hearing at which all interested parties may appear and be heard, except as provided in Subsections (b) and (c). Proof of the mailed notice shall be given to the General Manager by the applicant no less than twenty (20) days prior to the date of the public hearing on the spacing exception request. If, at any time prior to the public hearing, all registered and permitted well owners and/or adjacent property owners, as applicable, within the applicable spacing distance sign waivers, then the exception will be granted without a public hearing. The District may require any interested person that appears or submits information protesting the spacing exception request to provide additional information in order for the Board to further evaluate the interested person's protest including whether the interested person is within the applicable spacing distance.

(e) Grounds for granting a spacing exception from a registered or permitted well may include evidence that the well proposed in the application will produce groundwater from a different aquifer subdivision than the registered and permitted well(s) within the minimum required distance from the proposed well. Grounds for granting a spacing exception may include evidence that the exception is necessary to provide the applicant an opportunity to produce groundwater.

Deleted: other

Deleted: that from

(f) The Board may grant the variance, deny the variance, or approve the variance with terms other than those requested at the noticed Board meeting or any subsequent and appropriately noticed Board meeting. If the Board approves a spacing exception for a non-exempt well, the Board may limit the production of the well under the permit to prevent or limit injury to existing well owners or the applicable aquifer or subdivision thereof. This right to limit production is in addition to the proportional adjustment authority in Rule 6.3.

SECTION 4 ANNUAL PRODUCTION LIMITATIONS

To accomplish the purposes of Chapter 36, and to achieve the stated purposes and goals of the District, including managing the aquifers to encourage the best practicable conservation and development practices while also honoring and protecting private property rights by affording an opportunity for every owner to produce groundwater, the District shall manage total groundwater production on a long-term basis to achieve the applicable Desired Future Conditions.

Rule 4.1 Annual Production Limits for Permits

The Annual Production Limitations shall be designated in each permit issued by the District pursuant to the conditions of the District Act, Chapter 36, and these Rules. Except as otherwise provided in these Rules, the quantity withdrawn under a permit shall not exceed the Annual Production Limitations designated in the permit issued by the District. For Historic Use Permits issued before the Effective Date, the District shall designate the Maximum Historic Use as the initial Annual Production Limitations for each Historic Use Permit subject to any proportional adjustments. For Operating Permits issued before the Effective Date, the District shall designate the authorized annual allocation in effect on the Effective Date as the initial Annual Production Limitations. For a new or amended permit, the Board will determine the Annual Production Limitations at the permit hearing and will do so by considering the information provided and requested in the application, the General Manger's permit recommendation, and the considerations in Rule 2.8.

All permits are subject to Management Zones in Rule 6.2 and any future proportional adjustments in accordance with Rule 6.3 and any other adjustments or reductions authorized under these Rules. The District may reissue any applicable permits after a proportional adjustment in accordance with Section 6. Producing groundwater in violation of the Annual Production Limitations is illegal, wasteful per se, and a nuisance.

If the Board issues a Proportional Adjustment Order, the General Manager shall apply the proportional adjustment factor to each permit affected by the Proportional Adjustment Order reducing the Annual Production Limitations in each affected permit on a pro rata basis. The General Manager shall administratively reissue the affected permits containing the adjusted Annual Production Limitations to all affected permit holders. Each affected permit holder will have five years from the date the permit is reissued to comply with the Proportional Adjustment Order and the adjusted Annual Production Limitations.

Rule 4.2 Temporary Drought Buffer

(a) The Board may by resolution adopt a temporary drought buffer temporarily increasing the Annual Production Limitations in all permits for a given period if the TWDB reports certain drought stages in all or part of the District's boundaries for a prolonged period of time in its Water Weekly reports found at https://waterdatafortexas.org/drought/twdb-reports as follows:

(1) DO abnormally dry conditions: an upward adjustment up to 5%;

(2) D1 drought-moderate or D2 drought-severe: an upward adjustment up to 10%; and

(3) D3 drought-extreme or D4 drought-exception: an upward adjustment up to 15%.

(b) Any resolution shall state how long the temporary drought buffer shall remain in place and can be based on improvement of the drought status according to TWDB report.

(c) All persons with permits where the Annual Production Limitations have been temporarily increased shall pay the Water Use Fees for all amounts produced over the Annual Production Limitations.

SECTION 5 WELL COMPLETION AND OPERATION

Rule 5.1 Responsibility to Protect Groundwater Quality

All owners or operators shall use reasonable diligence and conform to these Rules in order to prevent the pollution or harmful alteration of groundwater in the Aquifer(s) of the District. In addition to the well completion and operation rules, all well owners shall comply with the District's metering and reporting requirements in Sections 10-11.

Rule 5.2 Responsibility for Well Construction and Management

(a) Owners shall be responsible for the installation, equipping, operation, maintenance, and closure of their wells, and all costs associated therein.

(b) All wells shall be installed, equipped, operated, maintained, and closed consistent with Chapters 1901 and 1902, of the Texas Occupations Code, and Chapter 16 of the Texas Administrative Code, as may be amended, relating to the TDLR's rules on well drillers and well pump installers, regardless of whether the well is required to obtain a permit from the District.

(c) Any existing well or pump that is altered, re-worked, re-drilled, re-equipped or replaced must be done in compliance with the standards in this rule, regardless of whether the owner is required to obtain a permit from the District.

(d) Well construction and maintenance issues may be investigated by the District.

Rule 5.3 Standards of Completion for All New Wells

(a) All new wells must be completed in accordance with the well completion standards set forth under the Texas Water Well Drillers and Pump Installers Administrative Rules, Title 16, Part 4, Chapter 76, Texas Administrative Code, and under these Rules. New wells completed for a public water system (PWS) use must comply with the standards of 30 Texas Administrative Code Chapter 290 Subchapter D

entitled *Rules and Regulations for Public Water System*. All new wells must comply with the location standards of TDLR rules at 16 Texas Administrative Code Section 76.1000, as amended, and with the minimum required separation distance for on-site sewage facilities under Texas Commission on Environmental Quality rules at 30 Texas Administrative Code Section 285.91(10), as amended.

(b) In addition to the requirements under Subsection (a), all new wells, re-completed wells, and wells that are re-worked in a manner that involves removal of the pump from the well for any reason shall be equipped in such a manner as to allow the measurement of the water level in the aquifer supplying water to the well. The driller or well owner is responsible for ensuring that the completed well complies with this subsection.

(c) After the Notice to Proceed or permit has been issued by the District, the well may only be drilled at a location that is within 30 feet of the location specified in the registration and must be drilled within 120 days following issuance of the Notice to Proceed or permit. Extension of the time period to drill a well may be granted at the sole discretion of the General Manager.

(d) Water well drillers shall indicate the method of completion in the well report and shall indicate the water level upon completion of the well as required by Rule 11.2.

(e) Any well must be constructed with proper selection of screen zones applicable to only the Aquifer of the District that is specified in the application. In the event a test hole was first drilled to a depth that penetrates a deeper Aquifer of the District, the borehole shall be first plugged back, in accordance with State plugging standards, to within 20 feet of the total depth of the well.

(f) To prevent the commingling of water between the Aquifer(s) of the District which can result in a loss of artesian (or static) head pressure or the degradation of water quality, each well penetrating more than one Aquifer of the District must be completed in a manner so as to prevent the commingling of groundwater between aquifers or between subdivisions of an aquifer if required by the Texas Water Well Drillers and Pump Installers Administrative Rules, Title 16, Part 4, Chapter 76, Texas Administrative Code. The driller shall indicate the method of completion used to prevent the commingling of water on the well report. The well driller may use any lawful method of completion calculated to prevent the commingling of groundwater.

(g) In order to protect water quality, the integrity of the well, or loss of groundwater from the well, the District may impose additional well completion requirements on any well as determined necessary or appropriate by the Board.

Rule 5.4 Open, Uncovered, Abandoned or Deteriorated Wells Prohibited

(a) The District may require the owner or well owner on which an open or uncovered well is located to keep the well permanently closed or capped with a covering capable of sustaining weight of at least four hundred pounds except when the well is in actual

use.

(b) The owner or well owner on which an open or uncovered well is located must close or cap the well within 10 days of receiving notice from the District that the well must be closed or capped.

(c) Deteriorated or abandoned wells are prohibited. The District shall require the owner or operator to plug, repair or destroy said well according to District policy and procedures.

(1) A driller who knows of an abandoned or deteriorated well shall notify the owner or well owner that the well must be plugged or capped to avoid injury or pollution. Not later than the 180th day after the date an owner or other person who possesses an abandoned or deteriorated well learns of its condition, the owner or other person shall have the well plugged or capped under standards and procedures adopted by the Texas Commission of Licensing and Regulation.

(2) Not later than the 30th day after the date the well is plugged, a driller, licensed pump installer, or well owner who plugs an abandoned or deteriorated well shall submit a plugging report to the District. District staff shall furnish plugging report forms on request.

(d) As used in this section, “open or uncovered well” means an artificial excavation dug or drilled for the purpose of exploring for or producing water from the aquifer that is not capped or covered as required by this Rule.

(e) If an owner or well owner fails or refuses to close or cap the well in compliance with this Rule, any person, firm, or corporation employed by the District may go on the land and close or cap the well safely and securely.

(f) Reasonable expenses incurred by the District in closing or capping a well under this Rule constitutes a lien on the land on which the well is located.

(g) The lien arises and attaches upon recordation of an affidavit in the deed records of the county where the well is located. The affidavit may be executed by any person conversant with the facts and must state:

(1) the existence of the well;

(2) the legal description of the property on which the well is located;

(3) the approximate location of the well on the property;

(4) the failure or refusal of the owner or lessee to close or cap the well within 10 days after receiving notification from the District to do so;

(5) the well was closed or capped by the District, or by an authorized agent, representative, or employee of the District; and

(6) the expense incurred by the District in closing or capping the well.

(h) Nothing in this Rule affects the enforcement of Subchapter A, Chapter 756, Texas Health and Safety Code.

(i) The driller, licensed pump installer, or well owner who plugs, seals, or caps a well must provide the report required in Rule 11.2(d).

Rule 5.5 Sealing or Plugging of Wells

(a) The District may seal wells that are prohibited from withdrawing groundwater by District rules or Board order when the District determines that such action is: (1) reasonably necessary to assure that a well is not operated in violation of District rules or Board orders, and (2) the owner has failed to take corrective action following notice from the district. A well may be sealed when (1) no application has been made for a permit to drill a new well; (2) misrepresentations have been made by the owner, orally or in writing, regarding the well; (3) the owner has violated any provision of the state law or these Rules; (4) it is operated at a higher rate of production than the maximum allowable production granted for the well; (5) the well was not drilled within thirty feet of the proposed well site specified in the permit; or (6) the Board has denied, cancelled, or revoked a permit.

(b) The well may be sealed by physical means, including plugging or rendering inoperable, and tagged to indicate that the well has been sealed by order of the District. The District may recover costs incurred for sealing a well under this Rule from the owner. Other appropriate action may be taken as necessary to preclude operation of the well or to identify unauthorized operation of the well.

(c) Tampering with, altering, damaging, or removing the seal of a sealed well or in any other way violating the integrity of the seal or pumping groundwater from a well that has been sealed constitutes a violation of these Rules and subjects the person performing that action, as well as, any owner who authorizes or allows that action, to such penalties as provided by state law and these Rules.

(d) The owner may appeal the decision of the District to seal the well by filing a written request for a hearing before the Board, in which case the Board will hear the owner's appeal at the next regular Board meeting for which notice has not already been published. The owner may also take corrective action to address the cause for which the District sealed the well and thereafter request the District to remove the seal.

(e) Nothing in this Rule affects the enforcement of Subchapter A, Chapter 756, Texas Health and Safety Code.

SECTION 6 MANAGEMENT ZONES; PROPORTIONAL ADJUSTMENTS

Rule 6.1 Purpose and General

(a) All permits issued by the District are subject to the terms, conditions and provisions of this Section 6.

(b) At least once every two years, the District will examine the collected monitoring well data for the Aquifers of the District from all available sources and analyze the historical data. Based on collected monitoring and reported pumping data demonstrating trends in reservoir conditions, the District will review annually whether the Management Plan and rules are working effectively and whether amendments are needed. The District will share the collected data with the GMA 14 districts and use it to inform possible amendments to the desired future conditions.

(c) At least once every five years, the District will evaluate whether it is on track to achieve the Desired Future Conditions by ascertaining water levels from the collected monitoring well data and comparing those water levels to the water levels of the desired future conditions and take into consideration the reported pumping data and trends in reservoir conditions. Before designating a Management Zone, the District shall hold a hearing in accordance with Rule 13.2 on the proposed Management Zone. Before instituting a proportional adjustment, the District may designate an Aquifer of the District or another geographic or hydrogeologically defined area, geological strata, aquifer, or aquifer subdivisions as a Management Zone and shall hold a hearing in accordance with Rule 13.2 on the proposed proportional adjustment.

Rule 6.2 Authority to Establish Management Zones

(a) For better management of the groundwater resources and if the District determines that conditions in or use of an aquifer differ substantially from one geographic area of the District to another, the Board, by resolution, may create specific Management Zones within the District. Management Zones will be developed using the best available data and science, including without limitation, information received in Hydrogeological Reports and other hydrogeologic and scientific studies, Management Zone(s) may be based on geographic or hydrogeologically defined areas, geological strata, aquifers, or aquifer subdivisions, in whole or in part, within which the District may:

(1) assess water availability;

(2) assess water quality;

(3) establish more restrictive spacing requirements;

(4) authorize total production and make proportional adjustments to Annual

Deleted: Using the best available data and science, including without limitation, information received in Hydrogeological Reports and other hydrogeologic and scientific studies, …

Production Limitations; and

(5) otherwise undertake efforts to manage the groundwater resources in a manner that is consistent with the District Act, Chapter 36, and that aids in the attainment of all applicable Desired Future Conditions established for the aquifers or Aquifers of the District.

(b) In creating Management Zones, the Board shall attempt to consider hydrogeologically defined areas, geological strata, Aquifers of the District, and/or aquifer subdivisions to help promote fairness and efficiency by the District in its management of groundwater, while considering hydrogeologic conditions and the Desired Future Conditions established for any Aquifer of the District.

Rule 6.3 Proportional Adjustment

(a) Using the best available data and science, including without limitation, information received in Hydrogeological Reports and other hydrogeologic and scientific studies, the Board, by resolution, may establish proportional adjustment reductions to alter the Annual Production Limitations for all permits producing from a particular Aquifer of the District or Management Zone if reductions are necessary to avoid impairment of and to achieve the applicable Desired Future Conditions established for a particular Aquifer of the District or Management Zone or to achieve to the purposes of these Rules, Chapter 36 or the District Act.

(b) When establishing proportional adjustment restrictions, the Board shall first set aside an amount of groundwater equal to an estimate of actual exempt use for the particular Aquifer of the District or Management Zone.

(c) After first setting aside an amount of groundwater for exempt use for the particular Aquifer of the District or Management Zone, the Board shall determine how much water remains to be allocated to permits for the particular Aquifer of the District or Management Zone without impairing achievement of the applicable Desired Future Condition(s) established for a particular Aquifer of the District or Management Zone.

(d) When establishing proportional adjustment restrictions that contemplate the reduction of authorized production, the Board may choose to proportionately reduce permits for the particular Aquifer of the District or Management Zone on a pro rata basis.

(e) A Proportional Adjustment Order shall identify the Aquifer of the District or Management Zone and a proportional adjustment factor to be applied to the applicable Annual Production Limitations under Rule 4.

(f) In the event the Board elects to issue a Proportional Adjustment Order, then the procedures in Rule 4.1 shall apply to set new Annual Production Limitations under each permit issued for that particular Aquifer of the District or Management Zone.

(g) All affected permits shall comply with any adjusted maximum allocation limits within 5 years of the date of the Proportional Adjustment Order.

(h) In order to provide an opportunity for every owner to produce groundwater, new Operating Permits may be issued by the District for production in an Aquifer of the District or Management Zone subject to a Proportional Adjustment Order. Any new Operating Permits issued for production in an Aquifer of the District or Management Zone subject to a Proportional Adjustment Order shall be proportionally adjusted consistent with the Proportional Adjustment Order.

(i) Any unused early conversion credits issued before the Effective Date can be applied to offset the proportional adjustment in a given year; however, the Water Use Fees for the amount produced in excess of the adjusted Annual Production Limitations shall be paid.

SECTION 7 TRANSPORTING GROUNDWATER OUT OF DISTRICT

Rule 7.1 General Provisions

(a) A person who produces or wishes to produce water from a registered or permitted well located or to be located within the District and transport such water for use outside of the District must obtain an Operating Permit, or amendment to an Operating Permit or Historic Use Permit.

(b) The District may not impose more restrictive permit conditions on a permit applicant who seeks to transport water for use outside of the District than the District imposes on other permittees of the District, but the District shall impose a Groundwater Transport Fee on such a permittee as set forth under Rule 8.3 for any water transported out of the District and shall require the permittee to install any meters necessary to report the total amount of groundwater transported outside of the District for reporting purposes and for purposes of calculating the Groundwater Transport Fee.

Rule 7.2 Transport Fee for Exempt Wells for Discharge Under Other Permit

(a) The owner of an exempt well is not excused from paying a Groundwater Transport Fee if the groundwater produced from the exempt well is transported for use outside the District except as provided under Subsection (b).

(b) A Groundwater Transport Fee will not be assessed on groundwater that is transported by natural means outside of the boundaries of the District if the groundwater is discharged pursuant to authorization by the TCEQ and the discharged groundwater is not subject or part of an overall water transfer or sale.

SECTION 8 FEES AND PAYMENT OF FEES

Rule 8.1 Water Use Fees

(a) Each person producing, or causing to be produced, water from a non-exempt well within the District shall pay to the District a Water Use Fee. A Water Use Fee rate schedule shall be established by Board resolution annually at least 60 days before the end of the calendar year. The rate shall be applied to the Annual Production Limitations in a Historic Use Permit and Operating Permit. Water Use Fees for agricultural use in a Historic Use Permit or Operating Permit shall not exceed $1.00 per acre-feet per year. The District will review the account of any permittee changing the use of a well from non-exempt to exempt or vice versa to determine if additional Water Use Fees are due or if a refund of Water Use Fees is warranted under Subsection (e) of this Rule.

(b) Wells exempt from permitting under Rule 2.2 shall be exempt from payment of Water Use Fees. However, if exempt well status is withdrawn or lost under Rule 2.2(b), the District may assess fees and penalties in accordance with these Rules.

(c) In addition to the Water Use Fees assessed under Subsection (a) of this Rule, each person withdrawing, or causing to be withdrawn, groundwater from a non-exempt well in excess of the amount authorized in the applicable permit issued by the District shall pay to the District an overproduction disincentive penalty of $6.00 per each 1,000 gallons of water overproduced, not to exceed $10,000 per day for each day that overproduction occurs, and any applicable non-compliance penalty provided for in Rule 12.8. Adjustment Order. Any unused early conversion credits issued before the Effective Date can be applied to offset an overproduction disincentive penalty in a given year; however, the Water Use Fees for the amount produced over the Annual Production Limitations shall be paid.

(d) The permit holder may receive a refund of Water Use Fees paid on water authorized to be produced under the terms of the applicable Historic Use Permit or Operating Permit but not actually produced for the period of production between issuance of a new Operating Permit and the end of the first year of the initial permit term only.

(e) Application for a refund under this Rule must be filed with the District no later than 180 days from the end of the permit term and must be for an amount equal to or greater than $100.00. Any application filed for a refund of less than $100.00 will not be considered or granted. The District upon request will provide refund application forms.

(1) An applicant for a Water Use Fee refund under this Rule must present sufficient evidence that:

(A) a water meter was installed and operating during the entirety of the permit term;

(B) the amount of actual groundwater withdrawal during the permit term

was less than the amount authorized to be withdrawn under the terms of the applicable Operating Permit; and

(C) the amount of fees eligible for refund under this Rule equal or exceed $100.00.

(2) For purposes of a refund sought under this Rule only, in instances where an Operating Permit is issued for a well or well system currently permitted by a valid Historic Use Permit, water produced under such authorizations will be counted first toward the Historic Use Permit until all production authorized under the terms of the Historic Use Permit is accounted for, with any remaining production counted toward the initial term of the Operating Permit that serves as the basis for the refund.

(3) The General Manager may rule on applications for Water Use Fee refund applications made pursuant to this Rule without notice, hearing, or further action by the Board. Once a ruling is made by the General Manager, notice of the ruling shall be provided to the applicant. An applicant may appeal the General Manager's ruling in the manner provided for in Rule 1.12.

(b) Any well that is subject to fee payment under this Rule and that provides water for both agricultural and non-agricultural purposes shall pay the Water Use Fee rate applicable to non-agricultural purposes for all water authorized to be produced under the permit, unless the applicant can demonstrate through convincing evidence to the satisfaction of the District that a system is or will be in place so as to assure an accurate accounting of water for each purpose of use and the District authorizes separate amounts for each purpose in the permit.

Rule 8.2 Application and Other Fees

The Board, by resolution, shall establish a schedule of fees for administrative acts of the District, including the cost of reviewing and processing permits and the cost of hearings for permits, and such administrative fees shall not unreasonably exceed the cost to the District for performing such administrative acts. In addition to such fees, the District shall assess a fee against permit applicants in the amount of $35.00 or in an amount otherwise set by Board resolution to help reimburse the District for the costs of publishing notice of a hearing related to a permit matter for each notice published for a particular application.

Rule 8.3 Groundwater Transport Fee

(a) The District may impose a reasonable fee or surcharge in accordance with the authority set forth in Section 36.122(e) of Chapter 36 for transportation of groundwater out of the District using one of the following methods:

(1) a fee negotiated between the District and the transporter; or

(2) a fifty percent (50%) export surcharge in addition to the District's Water Use

Fee for in- District use.

(b) The procedures, requirements, and penalties related to payment of the Water Use Fee shall also apply to payment of the Groundwater Transport Fee. A Groundwater Transport Fee shall not be assessed against production in a service area of a retail public utility, as that term is defined under Section 13.002 of the Water Code, located inside the District that is transported for use to the service area of the same retail public utility that is located outside the District. Groundwater Transport Fees shall also not be imposed on a person that produces groundwater from a well located in the District, but who uses the water outside the boundaries of the District, only if the property where the well is located and the water is used is on property that is contiguous and owned by the same person.

Rule 8.4 Returned Check Fee

The fee for checks returned to the District for insufficient funds, account closed, signature missing, or any other reason causing a check to be returned by the District's depository, is $50.

Rule 8.5 Well Report Deposit

The Board, by resolution, may establish a Well Report or Well Completion Report deposit to be held by the District. The District shall return the deposit to the depositor if all relevant reports are timely submitted to the District in accordance with these Rules. In the event the District does not timely receive all relevant reports, or if rights granted within the registration or permit are not timely used, the deposit shall become the property of the District.

Rule 8.6 Payment of Fees

(a) All fees are due at the time of application or permitting as set forth under these Rules. At the election of the permittee, the annual Water Use Fee for a permit shall be paid annually or in quarterly installments. Permittees whose annual Water Use Fee is $500.00 or less are required to pay annually. Upon the Board's grant of a permit application and prior to issuance of the permit, the General Manager shall promptly provide an invoice to the new permittee for Water Use Fees and any applicable administrative fees required by the District for permit applicants and permittees. A permit shall not be issued by the District until the District has received from the new permittee the annual Water Use Fee or the first quarterly payment, as applicable, of the invoiced Water Use Fee, along with full payment of any applicable administrative fees invoiced by the District for permit applicants. New permittees electing to pay by quarterly installments shall make the first installment at the time of permit issuance with subsequent payments due as described in this Rule.

(b) Annual Water Use Fees other than the initial Water Use Fee are due and shall be paid on or before the first day of January of each year, depending upon the nature of the permit, or in quarterly installments in accordance with Subsection (c) of this

Rule. The initial Water Use Fee is due and shall be paid on or before the 30th calendar date after the date the invoice is mailed by the General Manager.

(c) Quarterly Water Use Fee payments of four equal installments shall be due on or before the first day of the months of January, April, July, and October.

(d) All fees other than Water Use Fees are due at the time of assessment and are late after 30 days beyond the date of assessment.

Rule 8.7 Failure of New Permittees to Make Initial Water Use Fee Payment

Failure of a permittee to make the initial annual Water Use Fee payment or the initial installment payment will result in the District's withholding issuance of the permit until receipt of the outstanding fees plus late payment fees due and constitutes grounds for the District to declare the permit void after 45 days.

Rule 8.8 Failure to Make Fee Payments

(a) Payments not received within 30 days following the date that Water Use Fees are due and owing to the District pursuant to Rule 8.6(b) or (c) will be subject to a late payment penalty of the greater of the following:

(1) $25.00; or

(2) ten percent (10%) of the total amount of annual Water Use Fees due and owing to the District.

(b) Persons failing to remit all Water Use Fees due and owing to the District within 60 days of the date such fees are due pursuant to Rule 8.6(b) or 8.6(c) shall be subject to a non- compliance penalty for a major violation, in addition to the late fee penalty prescribed in Subsection (a) of this Rule, and may be subject to additional enforcement measures provided for by these Rules or by order of the Board.

Rule 8.9 Well Registration and Permit Fees

The Board, by resolution, shall establish a non-refundable well registration fee and permit application fee. The owner of any new well shall submit the non-refundable well registration fee payment to the District per well, which is due by the same deadline established under these rules for registration of the well. The owner of a non-exempt well that requires a permit shall also be required to pay the permit application fee established by the Board. A fee required under this rule and established by the Board must be received by the District in order for the District to find the application Administratively Complete. The purpose of such fees is to cover the administrative costs to the District associated with registering and permitting the well, where applicable, and administering the rules of the District related to the well.

Rule 8.10 Meter Sealing Fee

The Board, by resolution, may establish a fee to recover all or part of its costs for removing and reapplying a District seal and verifying relevant well and meter information in situations where a well owner or operator submits a request to move a meter from one well to another.

SECTION 9 WATER USE FEE REBATE PROGRAM

Rule 9.1 General Provisions

(a) At the discretion of the Board, subject to annual appropriation of the District's operating budget, beginning January 1, 2010 rebates may be offered to permit holders who have paid Water Use Fees to the District for all water authorized to be produced under the applicable permit, but have produced a total amount of groundwater annually that is less than the total amount of groundwater authorized annually by the permit to be produced.

(b) If eligible under Rule 9.2, permittees may receive reimbursement of paid Water Use Fees based on the difference between the amount of groundwater authorized to be produced annually through a Historic Use Permit or through an Operating Permit issued by the District and the amount of groundwater actually withdrawn by the permittee and demonstrated to the District, up to an amount not to exceed ten percent (10%) of the total paid Water Use Fees. Any applicable reimbursement may, at the discretion of the Board, be made in the form of a direct rebate or as a credit toward Water Use Fees accrued for the next year following the year for which the rebate is sought.

Rule 9.2 Eligibility

(a) To qualify for participation in the rebate program described in Rule 9.1, a person must:

(1) seek a refund for Water Use Fees paid in association with a Historic Use Permit or an Operating Permit issued by the District;

(2) have submitted all Water Use Fees due and owing to the District no later than the date such fees are due pursuant to Rule 8.6(b);

(3) have, on or before February 15 of the applicable year, submitted all reports required under Rule 11.3 that evidence the water use that serves as the basis for the rebate request; and

(4) have no outstanding, unresolved enforcement matters pending before the District, not including matters awaiting a final dispensation by the Board following the initiation of a formal protest.

(b) Applications for Water Use Fee rebates under Section 9 must be filed with the District no later than 90 days from the date that annual Water Use Fees are due.

(c) Each applicant seeking a Water Use Fee rebate under this Section must provide sufficient evidence in the application to demonstrate, to the satisfaction of the General Manager or Board, as applicable, that:

(1) the water production that serves as the basis for the rebate request was measured and recorded by a properly installed water meter that was calibrated in accordance with these Rules, and that was competently operating at all times during the applicable production year; and

(2) the total amount of actual groundwater withdrawn during the applicable production year was less than the total amount of groundwater authorized to be withdrawn under the terms of the applicable permit.

(d) Applications for Water Use Fee rebates must be for amounts that equal or exceed $10.00. Any applications filed under this Section 9 seeking a refund of less than $10.00 will not be considered.

(e) The District will make applications for Water Use Fee rebates available in electronic or other forms. Such applications may, in addition to any other information required under this Section, require the submission of water use information deemed necessary by the General Manager or by the Board, including without limitation and where applicable:

(1) information describing the number of connections served by each applicable well;

(2) total water use history for the previous two years;

(3) system loss information; and

(4) production authorization amounts requested for the previous two permit terms.

(f) The General Manager may rule on applications for Water Use Fee rebates without notice, hearing, or further action by the Board. Once a ruling is made by the General Manager, notice of the ruling shall be provided to the applicant. An applicant may appeal the decision of the General Manager under this section as provided in Rule 1.12.

(g) Rebates authorized under this Rule may not be combined with any refund of fees provided for under Rule 8.1 for the same permit.

SECTION 10 METERING

Rule 10.1 Water Meter Required

(a) Except as provided in Rule 10.2, the owner of a registered or permitted well located in the District shall equip the well with a flow measurement device meeting the specifications of these Rules and shall operate the meter on the well to measure the flow rate and cumulative amount of groundwater withdrawn from the well.

(b) A mechanically driven, totalizing water meter, an ultrasonic meter, and electromagnetic flow meters are the only types of meter that may be installed on a well permitted by or registered with the District. The totalizer must not be resettable by the permittee and must be capable of a maximum reading greater than the maximum expected pumpage during the permit term. Battery operated registers must have a minimum five-year life expectancy and must be permanently hermetically sealed. Battery operated registers must visibly display the expiration date of the battery. All meters must meet the requirements for registration accuracy set forth in the American Water Works Association standards for cold-water meters as those standards existed on the date of adoption of these Rules.

(c) The water meter must be installed according to the manufacturer's published specifications in effect at the time of the meter installation, or the meter's accuracy must be verified by the permittee in accordance with Rule 10.4. If no specifications are published, there must be a minimum length of five pipe diameters of straight pipe upstream of the water meter and one pipe diameter of straight pipe downstream of the water meter. These lengths of straight pipe must contain no check valves, tees, gate valves, back flow preventers, blow-off valves, or any other fixture other than those flanges or welds necessary to connect the straight pipe to the meter. In addition, the pipe must be completely full of water throughout the region. All installed meters must measure only groundwater.

(d) Each meter shall be installed, operated, maintained, and repaired in accordance with the manufacturer's standards, instructions, or recommendations, and shall be calibrated to ensure an accuracy reading range of ninety-five percent (95%) to one hundred-five percent (105%) of actual flow.

(e) The owner of a well is responsible for the installation, operation, maintenance, and repair of the meter associated with the well.

(f) All water produced from a well must go through a single meter that must record all production from the well.

Rule 10.2 Water Meter Exceptions

(a) Wells exempt under Rule 2.2 shall be exempt from the requirement of metering groundwater withdrawals under Rule 10.1.

(b) Following notice and hearing, the Board may grant an exception from the water meter requirements of these Rules for a non-exempt well with a column pipe inside

diameter of one inch or less.

(c) If evidence is presented at a hearing indicating that the well does not meet the casing diameter, pumpage, or purpose requirements of this exception, or where there is not reasonable basis for determining the pumpage (such as wells serving ponds, irrigation, landscaping, or car washes), the Board may require that water meters be installed within a specified time period. In addition, verification of well size may be required in accordance with Rule 10.4.

(d) Water Use Fee: The Water Use Fee to be assessed permittees granted a water meter exemption shall be the fee rate multiplied by one million gallons per year.

Rule 10.3 Metering Aggregate Withdrawal

Where wells are permitted in the aggregate, one or more water meters may be used for the aggregate well system if the water meter or meters are installed so as to measure the groundwater production from all wells covered by the aggregate permits. The provisions of Rule 10.1 apply to meters measuring aggregate withdrawal pumpage.

Rule 10.4 Meter Accuracy Verification

(a) The General Manager may require the permittee, at the permittee's expense, to test the accuracy of a water meter and submit a certificate of the test results. The certificate shall be on a form provided by the District. The General Manager may further require that such test be performed by a third party qualified to perform such tests. The third party must be approved by the General Manager prior to the test. Except as otherwise provided herein, certification tests will be required no more than once every three years for the same meter. If the test results indicate that the water meter is registering an accuracy reading outside the range of ninety-five percent (95%) to one hundred-five percent (105%) of the actual flow, then appropriate steps shall be taken by the permittee to repair or replace the water meter within 90 calendar days from the date of the test. The District, at its own expense, may undertake random tests and other investigations at any time for the purpose of verifying water meter readings. If the District's tests or investigations reveal that a water meter is not registering within the accuracy range of ninety-five percent (95%) to one hundred-five percent (105%) of the actual flow, or is not properly recording the total flow of groundwater withdrawn from the well or wells, the permittee shall reimburse the District for the cost of those tests and investigations, and the permittee shall take appropriate steps to bring the meter or meters into compliance with these Rules within 90 calendar days from the date of the tests or investigations. If a water meter or related piping or equipment is tampered with or damaged so that the measurement of accuracy is impaired, the District may require the permittee, at the permittee's expense, to take appropriate steps to remedy the problem and to retest the water meter within 90 calendar days from the date the problem is discovered and reported to the permittee.

(b) Meter Testing and Calibration Equipment: Only equipment capable of accuracy

results of plus or minus two percent (+/- 2%) of actual flow may be used to calibrate or test meters.

(c) Calibration of Testing Equipment: All approved testing equipment must be calibrated every two years by an independent testing laboratory or company capable of accuracy verification. A copy of the accuracy verification must be presented to the District before any further tests may be performed using that equipment.

Rule 10.5 Removal of Meter for Repairs

A water meter may be removed for repairs and the well remain operational provided that the District is notified prior to removal and the repairs are completed in a timely manner. The readings on the meter must be recorded immediately prior to removal and at the time of reinstallation. The record of pumpage must include an estimate of the amount of groundwater withdrawn during the period the meter was not installed and operating.

Rule 10.6 Water Meter Readings

The permittee of a well must read each water meter associated with the well and record the meter readings and the actual amount of pumpage in a log at least monthly. The logs containing the recordings shall be available for inspection by the District at reasonable business hours. Copies of the logs must be included with the Permit Production Report as required by Rule 11.3. The permittee of a well shall read each water meter associated with the well within 15 days before or after the date the permit expires and within 30 days after the date of expiration of the permit report the readings to the District on a form provided by the District.

Rule 10.7 Installation of Meters

Except as otherwise provided by these Rules, a meter required to be installed under these Rules shall be installed before producing water from the well under a permit issued by the District

Rule 10.8 Tampering Prohibited

No person may tamper with any meter installed, or that is required to be installed, on any well within the District's boundaries.

Rule 10.9 Conservation Requirements for Impoundments

(a) Surface Impoundments used or designed to hold groundwater produced within the District shall be constructed, and at all times maintained, such that the Miscellaneous Impoundment Losses do not exceed 10 percent of the total volume of groundwater discharged annually in the surface impoundment.

(b) Groundwater produced from a non-exempt well may be held as impounded irrigation water only if, in addition to other applicable requirements imposed by this section, beginning not later than January 1, 2010, all volumes of water impounded and actually withdrawn from the surface impoundment for subsequent use are separately measured and recorded at all times using a properly installed, functioning and calibrated flow measurement device as otherwise prescribed by this rule.

(c) Meters used to satisfy the flow measurement requirements of Subsection (b):

(1) shall conform to the American Water Works Association (AWWA) Standard M6, "Water Meters-Selection Installation, Testing, and Maintenance", as that standard may be revised by the AWWA from time to time;

(2) must be capable of being calibrated and maintaining calibration for no fewer than 90 contiguous days; and

(3) must be capable of reliable measurement within a margin of error not to exceed the standards specified in AWWA Standard M6.

(d) Each permit holder authorized to produce groundwater that will be impounded and subsequently withdrawn for use shall, no less frequently than once each month or such other interval required in the terms of the applicable permit, inspect the meter required by this rule and record in a log the total volume registered on the meter at the time of the inspection.

(e) Each meter required by Subsection (c) must be calibrated upon installation. The person who installs any meter required by this Rule shall submit to the District a certificate of calibration for each installed meter. Any meter that is not calibrated to achieve the accuracy standards specified in AWWA M6 cannot be used and must be replaced.

(f) The calibration of each meter required under Subsection (c) shall be tested no less than once every three years. Before any such calibration testing, the permit holder shall notify the District verbally or in writing no fewer than 48 hours before the scheduled testing shall take place. District staff or any authorized representative of the District may be present to observe the calibration testing. If the calibration testing shows a variance greater than the variation allowed in AWWA M6, the District may require the permit holder to correct all monthly readings conducted since the most recent previous calibration to account for any inaccuracies in the readings.

(g) A true and correct copy of the log required under Subsection (d) shall be submitted to the District with the Permit Production Report required by Rule 11.3 by the deadline set forth under Rule 11.3, along with a copy of the meter readings production log required under Rule 10.6.

SECTION 11 REPORTING REQUIREMENTS

Rule 11.1 Purpose and Policy

The accurate and timely reporting to the District of activities governed by these Rules is a critical component to the District's ability to effectively and prudently manage the groundwater resources that it has been charged by law with regulating. The purpose of Section 11 is to require the submission, by the appropriate person or persons, of complete, accurate, and timely records, reports, and logs as required throughout these Rules. Because of the important role that accurate and timely reporting plays in the District's understanding of past, current and anticipated groundwater conditions within Montgomery County, the failure to comply with these Rules may result in the assessment of penalties, permit suspension or revocation, or both.

Rule 11.2 Records of Drilling and Pump Installation and Alteration Activity, Plugging and Capping

(a) Each person who drills, deepens, completes or otherwise alters a well shall make, at the time of drilling, deepening, completing or otherwise altering the well, a legible and accurate Well Report recorded on forms provided by the District or by the TDLR. The person who drilled, deepened, completed or otherwise altered a well pursuant to this Rule shall, within 60 days after the date the well is completed, file a Well Report described in Subsections (a) and (b) of this Rule with the District.

(b) Each Well Report required by Subsection (a) of this Rule shall contain:

(1) the name and physical address of the well owner;

(2) the location of the drilled, deepened, completed or otherwise altered well, including the physical address of the property on which the well is or will be located, and the latitudinal and longitudinal coordinates of the wellhead location, as measured by a properly functioning and calibrated global positioning system unit;

(3) the type of work being undertaken on the well;

(4) the type of use or proposed use of water from the well;

(5) the diameter of the well bore;

(6) the date that drilling was commenced and completed, along with a description of the depth, thickness, and character of each strata penetrated;

(7) the drilling method used

(8) the borehole completion method performed on the well, including the depth, size and character of the casing installed;

(9) a description of the annular seals installed in the well;

(10) the surface completion method performed on the well;

(11) the location of water bearing strata, including the static water level and the date the level was encountered, as well as the measured rate of any artesian flow encountered;

(12) the type and depth of any packers installed;

(13) a description of the plugging methods used, if plugging a well;

(14) the type of pump installed in the well, including the horsepower rating of the pump motor and the designed production capability of the pump, as assigned by the pump manufacturer;

(15) the type and results of any production test conducted on the well, including the yield, in gallons per minute, of the pump operated under optimal conditions during a pumping test of the well; and

(16) a description of the water quality encountered in the well.

(c) In addition to the Well Report required in Subsections (a)-(b) for all well owners, non-exempt well owners shall provide the District with a Well Completion Report that includes the following information, if available and applicable, within 60 days after well completion or drilling:

(1) Geophysical logs required to be submitted upon completion of the well.

(A) Geophysical logs to consist of a resistivity or induction curve and a spontaneous potential or gamma ray curve at a minimum.

(B) Geophysical logs performed in the initial open-borehole are required and will consist of resistivity (self potential and gamma ray at a minimum).

(C) Wells cased with PVC require induction and gamma ray logs.

(D) All digital log files to be submitted in LAS format as well as printed.

(2) Digital or tabulated data of water levels measured during drawdown, specific capacity, or pumping test;

(3) measurements of specific conductivity, temperature and pH made during the drawdown or pumping test, or well sampling; and/or

(4) Any laboratory analysis completed on samples collected from the well after construction and development.

(5) All public water supply sampling completed in accordance with TCEQ/EPA requirements must be submitted to the District.

(A) Geophysical logs;

(B) As-built well completion diagrams;

(C) Pumping test data;

(D) Pump and motor information including pump setting, column pump diameter, pump horsepower/number of stages, and head-capacity curve; and

(E) Water quality sampling.

(d) Not later than the 30th day after the date a well is plugged, a driller, licensed pump installer or well owner who plugs the well shall submit a plugging report to the District that meets TDLR reporting requirements.

Rule 11.3 Permit Production Report

(a) Not later than February 15th of each year the holder of a permit issued by the District must submit, on a form provided by the District, a permit production report containing the following:

(1) the name of the permittee;

(2) the well numbers of each well that produces under the permit;

(3) the total amount of groundwater produced by each well or well system during the immediately preceding calendar year;

(4) the total amount of groundwater produced by each well or well system during each month of the immediately preceding calendar year;

(5) all purposes for which the water was used;

(6) the amount and source of surface water used; and

(7) any other information requested by the District.

(b) The report required by Subsection (a) must also include a true and correct copy of the meter log required by District Rule 10.6.

(c) Persons failing to submit to the District a Permit Production Report by March 1 of

the year such reports are due under Subsection (a) of this Rule shall be subject to a non-compliance penalty and may be subject to additional enforcement measures provided for by these Rules or by order of the Board.

(d) If a non-exempt well owner is not using an existing well and would like to be exempt from the Permit Production Report requirement, the well owner can enter the well into the District's monitoring program. The well owner must contact the District to see if the well is a candidate for the monitoring program. By entering the well into the program, the well owner agrees that District staff will visit the site at least annually to collect data and to confirm no usage on the meter during the visit(s).

Rule 11.4 Groundwater Transport Report

(a) Not later than February 15 of each year, the holder of any permit issued by the District that authorizes the transport of groundwater for use outside of the District shall submit to the District a Groundwater Transport Report describing the amount of water transported and used pursuant to the terms of the applicable permit.

(b) Each Groundwater Transport Report required by Subsection (a) above shall be submitted on a form made available by District staff and shall contain, at a minimum, the following information:

(1) the name of the permittee;

(2) the well number of each well and the Operating Permit(s) that are utilized for the transport permit;

(3) the total amount of groundwater transported outside of the district from each well, well system, or surface impoundment during each month of the immediately preceding calendar year;

(4) the purposes for which the water was transported; and

(5) any other information reasonably requested by the District.

(c) Persons failing to submit to the District a Groundwater Transport Report by March 1 of the year such reports are due under Subsection (a) of this Rule shall be subject to a non- compliance penalty and may be subject to additional enforcement measures provided for by these Rules or by order of the Board.

SECTION 12 INSPECTIONS AND ENFORCEMENT

Rule 12.1 Purpose and Policy

The District's ability to effectively and efficiently manage the limited groundwater resources of Montgomery County depends entirely upon the adherence to the Rules

promulgated by the Board to carry out the District's purposes. Without the ability to enforce these Rules in a fair, effective manner, it would not be possible to accomplish the District's groundwater management purposes. The enforcement rules and procedures that follow are consistent with the responsibilities delegated to the District by the Texas Legislature through the District Act, and through Chapter 36.

Rule 12.2 Inspection, Information Gathering, and Compliance Monitoring

(a) The District, through its officers, employees or agents, is entitled to enter at reasonable times any public or private property within the boundaries of the District for the following purposes:

(1) to carry out technical and other routine investigations necessary for the implementation of these Rules, or for certain studies beneficial to the district's purposes

(2) to conduct inspections or otherwise comply with the requirements, obligations and authority provided in section 36.123 of Chapter 36;

(3) to inspect or otherwise investigate conditions relating to the quality of water in the State; and

(4) to determine whether the purpose of these Rules, Chapter 36 and any well or permit or order lawfully issued by the District pursuant to the same, is being met and whether the appropriate persons are complying with all requirements thereof.

(b) District officers, employees or agents acting under the authority provided by this Rule shall:

(1) at all times observe the establishment's rules and regulations concerning safety, internal security, and fire protection;

(2) notify any occupant or management of their presence upon entry; and

(3) exhibit proper credentials upon entry.

(c) For properties secured by measures that require proper identification and clearance before entry into its premises, the occupant, management, or possessor of the property shall make necessary arrangements with all appropriate personnel so that, upon demonstration of identification, District officers, employees or agents will be permitted to enter the property without delay for purposes of carrying out their official District duties.

(d) The requirement in Subsection (b)(1) of this Rule that District officers, employees or agents observe at all times the establishment's rules and regulations concerning safety, internal security, and fire protection is not grounds for denial or restriction of entry to any part of the facility, but merely describes the District's duty to observe the appropriate rules and regulations during any inspection conducted

pursuant to this Section.

(e) No person shall:

(1) cause or substantially contribute to any unreasonable delay in allowing District officers, employees, or agents access to property within the District for purposes of carrying out Subsection (a) of this Rule, or

(2) otherwise unreasonably interfere with any District inspection conducted pursuant to Subsection (a) of this Rule or otherwise comply with the requirements, obligations, and authority provided in Section 36.123 of the Texas Water Code.

(f) Inhibiting or prohibiting access to District personnel attempting to conduct an investigation under District rules constitutes a violation of these Rules and subjects the person inhibiting or prohibiting access, as well as any other person authorizing or allowing such action, to penalties allowed in Texas Water Code §36.102.

(g) An application for a permit may be suspended or cancelled by the Board if the applicant refuses to grant District personnel access to real property to gather information necessary to complete an application.

(h) The operation of any well may be enjoined by the Board immediately upon the refusal to allow the gathering of information as provided above from such well.

Rule 12.3 Rules Violations

(a) The following acts and omissions each separately constitute a major violation of these Rules:

(1) falsification of any documents or records submitted to the District in response to requirements of these Rules [Rule 1.14];

(2) drilling a non-exempt well without first obtaining a permit for such activity from the District [Rule 2.1(a)];

(3) drilling a new exempt well without first obtaining a well registration [Rule 2.1(a)];

(4) substantially altering a well without first receiving from the District the required express authorization for the alterations made [Rule 2.1(a), 2.13];

(5) for each well operating pursuant to these Rules or a valid permit issued by the District, in addition to the overproduction disincentive penalty provided for in Rule 8.1(c) for non-exempt wells, the withdrawal of groundwater from a well authorized under these Rules or a validly permitted, non-exempt well in an amount that exceeds the authorized permitted amount by ten percent

(10%) or greater [Rule 2.1(n)];

(6) drilling a well at any location on the property identified in the registration or permit other than where authorized by these Rules or by the terms of the applicable District permit [Rules 2.1(o), 3.2(c), 3.3(b)];

(7) engaging in conduct that causes an exempt well to lose its exempt status [Rule 2.2(b)];

(8) failure to timely register or permit a well as required by these Rules or amend the registration or permit of a well where mandated by rules, including drilling, equipping, completing or altering or operating a well without an approved registration, as evidenced by a Notice to Proceed, or permit issued by the District [Rules 2.3-2.5, 2.12-2.17];

(9) producing any amount of groundwater from a non-exempt well without first having obtained an approved Operating Permit or permit amendment issued by the District [Rules 2.5, 2.12];

(10) failure to close, plug or cap an open, uncovered, abandoned or deteriorated well in a manner and within the time limits prescribed by law [Rule 5.4];

(11) the failure to remit all Water Use Fees owed to the District within 60 days after the date any such fees are due pursuant to the terms of these Rules [Rule 8.8(b)];

(12) failure to timely meter a well when required [Rules 10.1. 10.2];

(13) the failure to maintain at all times a properly functioning and calibrated meter installed and operational on a non-exempt well, where such a requirement is imposed by these Rules or by order of the District [Rule 10.1];

(14) the failure to file the water meter readings log [Rule 10.6];

(15) tampering with any meter installed, or required to be installed, on any well in the District [Rule 10.8];

(16) failure to maintain any Surface Impoundment Losses to 10 percent or less of the total volume of groundwater discharged annually in the Surface Impoundment [Rule 10.9];

Deleted:

(17) the withdrawal for subsequent use of impounded water without measuring and recording at all times all such withdrawn volumes using a properly installed, functioning and calibrated flow measurement device, or failure to comply with all calibration testing, installation, notification, and certification requirements [Rule 10.9];

(18) the failure to file with the District a water or permit production report by March 1st of the calendar year in which it is due [Rule 11.3(c)];

(19) the failure to file with the District a Groundwater Transport Report by March 1st of the calendar year in which it is due [Rule 11.4(d)];

(20) failure to limit or suspend groundwater production in accordance with any applicable Rules or Orders of the District [Rules 3.4, 4.1, 6.3, 12.4, 12.6];

(21) tampering with, removing, or disabling a District seal [Rule 12.9(c)]

(22) withdrawing or attempting to withdraw water from a sealed well [Rule 12.9(d)];

(23) the occurrence of any three minor violations of the District Rules within a period of three consecutive years—for purposes of this subsection only, a minor violation is incurred when a person receives notice of such by the General Manager by any method listed in Rule 12.4; and

(24) any other act or omission not listed in this subsection that is determined by order or resolution of the Board to constitute a major violation.

(b) The following acts and omissions each separately constitute a minor violation of the District Rules:

(1) for each well authorized under these Rules or permit issued by the District, the withdrawal of groundwater over the authorized or permitted amount that exceeds the authorized or permitted amount by less than ten percent (10%) [Rule 2.1(n)];

(2) the failure to amend a well registration that does not involve a substantial change [Rule 2.2(b)];

(3) the failure to timely file a Transfer of Ownership under these Rules [Rule 2.17];

(4) the failure to timely file with the District each well report required to be completed [Rule 11.2];

(5) all other acts or omissions that both:

(A) constitute violations of these Rules; and

(B) do not qualify as major violations under Rule 12.3(a).

Rule 12.4 Notices of Violation

Whenever the General Manager determines that any person has violated or is violating any provision of these Rules, including the terms of any permit or order issued by the District, the General Manager may use any of the following means of notifying the person or persons of the violation:

(a) **Verbal notice of violation**: The General Manager, or members of her/his staff or agents of the District acting on behalf of the General Manager, or the Board, may inform the person of the violation by telephone by speaking or attempting to speak to the appropriate person to explain the violation and the steps necessary to satisfactorily remedy the violation. The information received by the General Manager through this informal notice concerning the violation will be documented and will be kept on file with the District. Nothing in this subsection shall limit the authority of the District to take action, including emergency actions or any other enforcement action, without first providing notice under this subsection.

(b) **Written notice of violation**: The General Manager may inform the person of the violation through a written notice of violation issued pursuant to this Rule. Each notice of violation issued hereunder shall explain the basis of the violation, identify the Rule, permit term, and order term that has been violated or is being violated, and list specific required actions that must be satisfactorily completed—which may include the payment of applicable civil penalties—to address each violation raised in the notice. Notices of violation issued hereunder shall be tendered by a delivery method that complies with Rule 1.7. Nothing in this Rule subsection shall limit the authority of the District to take action, including emergency actions or any other enforcement action, without first issuing a notice of violation.

(c) **Compliance meeting:** The General Manager may hold a meeting with any person whom the General Manger believes to have violated, or to be violating, a District Rule, or a term of any District permit or order, to discuss each such violation and the steps necessary to satisfactorily remedy each such violation. The information received by the General Manager through any meeting conducted pursuant to this Rule subsection concerning the violation will be documented and will be kept on file with the District. Nothing in this Rule subsection shall limit the authority of the District to take action, including emergency actions or any other enforcement action, without first conducting a meeting under this subsection.

Rule 12.5 Show Cause Hearing

(a) Upon recommendation of the General Manager to the Board or upon the Board's own motion, the Board may order any person that it believes has violated or is violating any provision of the Rules, or any term of a District permit or order, a District notice to appear before the Board at a public meeting called for such purpose and show cause why a proposed enforcement action, including without limitation permit suspension and the initiation of a suit in a court of competent jurisdiction, should not be pursued by the District against the person or persons made the subject of the show cause order.

(b) A show cause order issued under Subsection (a) of this Rule shall be served on each Respondent named in the order and shall include:

(1) the time and place for the hearing;

(2) the basis of each asserted violation;

(3) the proposed enforcement action;

(4) the Rule, permit term, or order term that the District believes has been violated or is being violated; and

(5) a request that the person cited duly appear and show cause why the proposed enforcement action should not be taken.

(c) An order issued under Subsection (a) shall be served on each Respondent by depositing the same with the United States Postal Service for delivery by certified mail at least 20 days before the date of the ordered hearing.

(d) All documents that a Respondent intends to rely upon in support of his position at the hearing must be submitted to the District no later than 5 days prior to the date of the hearing. No documents submitted after this deadline will be considered by the Board, unless good cause for their untimely filing is shown as determined by the Board.

(e) The District may pursue immediate enforcement action against the person cited to appear in any show cause order issued by the District where the person so cited fails to appear and show cause why an enforcement action should not be pursued.

(f) Nothing in this Rule shall limit the authority of the District to take action, including emergency actions or any other enforcement action, against a person at any time regardless of whether the District holds a hearing under this section.

Rule 12.6 Enforcement Orders

(a) **Consent orders:** The General Manager is hereby authorized to enter into consent orders, assurances of voluntary compliance, or other similar orders establishing a voluntary compliance agreement with any person whom the General Manager believes is responsible for non-compliance of any provision of the District's Rules or any term of a District permit or order. Such orders must be signed by all parties agreeing to the terms. Orders entered into under this subsection shall have the same force and effect as a final order of the Board.

(b) **Compliance orders:** When the Board determines that a person has violated or is violating any provision of the District's Rules, or any term of a District permit or order, the Board may issue a compliance order directing the person or persons named in the order to attain full compliance within the time specified in the order. If

each person named in the order does not come into full compliance within the allotted time, additional enforcement action may result, including permit suspension or revocation. Compliance orders issued pursuant to this subsection may also contain other requirements to address the violation or violations at issue, including additional monitoring requirements and management practices designed to reduce the likelihood of future similar recurring violations. A compliance order does not release any person of liability for any violation of any provision of the District's Rules, or any term of a District permit or order, or for continuing violations of the same. Issuance of a compliance order under this subsection shall not be a prerequisite to any District action, including without limitation permit suspension and the institution of a lawsuit in a court of competent jurisdiction, against any person for violations of the District's Rules, or any term of a District permit or order.

(c) **Cease and desist orders**: When the Board determines that a person has violated or is violating any provision of the District's Rules, or any term of a District permit or order, or that the person's past violations are likely to reoccur, the Board may issue an order directing the person to cease and desist all such violations by suspending the person's groundwater Operating Permit, sealing all affected wells, and directing the person to take any appropriate action, including to immediately comply with all requirements identified in the order, to take all appropriate remedial or preventative action to satisfactorily address a continuing or threatened violation—including halting operations that require the use of groundwater—and to immediately stop illegal or unauthorized withdrawals of groundwater. Issuance of a cease and desist order under this subsection shall not be a prerequisite to any District action, including the institution of a lawsuit in a court of competent jurisdiction, against any person for violations of the District's Rules, or any term of a District permit or order.

Rule 12.7 Demonstrated Repeat Non-Compliance of District Rules

(a) For purposes of this Rule, a person has demonstrated repeat non-compliance of the District's Rules upon the commission of a second Qualifying Major Violation within a period of three consecutive years.

(b) Notwithstanding a provision of any other Rule to the contrary, until compliance has been demonstrated pursuant to Subsection (e) below, persons who have demonstrated repeat non-compliance under Subsection (a):

(1) shall not be eligible to receive a Water Use Fee rebate under Rule 9.1;

(2) shall not be eligible for installment option payments under Rule 8.6(b); and

(3) shall be required to report water use quarterly by the 1st day of April, July, October, and January, on a form made available by the District for such purposes.

(c) Persons who commit one Qualifying Major Violation after they have demonstrated repeat non-compliance under Subsection (a), but before the conclusion of the time

period provided for in Subsection (e), shall be subject to a penalty of three times the Water Use Fee rate established by the District under Rule 8.1 for all water authorized to be produced by the terms of each applicable permit.

(1) The penalties incurred under this subsection shall be assessed in addition to any penalty provided for in Rule 12.8.

(2) Payment of all penalties incurred under this subsection shall be submitted to the District in the manner provided for payment of Water Use Fees under Section 8.

(3) All penalties incurred under this subsection shall be assessed in addition to all other Water Use Fees due and owing to the District for the same permit or permits.

(d) Persons who commit two or more Qualifying Major Violations after they have demonstrated repeat non-compliance under Subsection (a), but before the conclusion of the time period provided for in Subsection (e), shall be required to show cause, pursuant to Rule 12.5, why all applicable permits shall not be suspended. All action taken by the Board under this subsection shall be in addition to all other penalties incurred pursuant to applicable Rules.

(e) Persons will be considered to have demonstrated repeat non-compliance until the conclusion of the 24th consecutive month with no Qualifying Major Violation committed.

Rule 12.8 Non-Compliance Penalties

(a) Except as otherwise provided for in these Rules, penalty ranges for violations of the District's Rules shall be as follows:

Penalty		
	Minor	Major
First Violation	$75 - $275	$300 - $5,000

(1) For purposes of the penalties listed in this subsection, a person who commits a second violation within the same category of violations (Minor / Major) within the three previous years shall be assessed a penalty for that violation within the corresponding range listed in Subsection (a) plus an additional fifty percent (50%) of the base penalty amount.

(2) For purposes of the penalties listed in this subsection, a person who commits a third violation within the same category of violations (Minor / Major) within the three previous years shall be assessed two times the penalty for that violation within the corresponding range listed in Subsection (a).

(b) Penalty ranges for persons who are currently subject to the compliance measures provided for in Rule 12.7(b) shall be as follows, unless otherwise specified in these Rules:

Penalty Schedule – Demonstrated Repeat Non-compliance		
	Minor	Major
Second or Repeated	$250 - $500	$1,000 -$10,000

Formatted: Left, Indent: Before: 0"

(1) For purposes of the penalties for minor violations listed in this subsection, a person who commits a minor violation before the conclusion of the time period provided for in Rule 12.7(e), shall be assessed a penalty for that violation within the corresponding range listed in Subsection (b) of this Rule plus an additional one hundred percent (100%) of the base penalty amount.

(2) For purposes of the penalties for minor violations listed in this subsection, a person who commits a second minor violation before the conclusion of the time period provided for in Rule 12.7(e) shall be assessed a penalty for that violation within the corresponding range listed in Subsection (b) of this Rule plus an additional one hundred-fifty percent (150%) of the base penalty amount.

(c) In determining the penalty amount to be assessed within the ranges presented in Subsections (a) and (b) of this Rule, the District shall consider the following factors:

(1) compliance history;

(2) the severity or seriousness of the violation;

(3) efforts to correct the violation and whether the violator makes a good faith effort to cooperate with the District;

(4) the penalty amount necessary to ensure future compliance and deter future noncompliance;

(5) any enforcement costs related to the violation; and

(6) any other matters deemed necessary by the Board.

(d) A penalty under this section is in addition to any other penalty provided by law and may be enforced by filing a complaint in a court of competent jurisdiction in the county in which the District's principal office or meeting place is located.

(e) A violation of any of the prohibitions in these Rules occurs on the first day that the prohibited action begins and continues each day thereafter as a separate violation.

(f) Multiple violations by the same person or entity shall result in escalated fines assessed in order to deter such continued noncompliance.

(g) In addition to the applicable penalty, persons who drill a well in violation of applicable spacing requirements may be required to plug the well.

(h) In addition to the applicable penalty, persons who do not submit all Water Use Fees and Groundwater Transport Fees due and owing within 60 days of the date the fees are due pursuant to Section 8 will be assessed a civil penalty equal to three times the total amount of outstanding Water Use Fees, Groundwater Transport Fees, or both, that are due and owing.

(i) In addition to the Water Use Fee assessed under Rule 8.1, each person producing, or causing to be produced, water from a non-exempt well in excess of the amount authorized in the applicable permit issued by the District shall pay to the District an overproduction penalty of $6.00 per each 1,000 gallons of water overproduced, not to exceed $10,000 per day for each day that overproduction occurs.

Rule 12.9 Sealing of Wells

(a) The District may seal or plug wells that are prohibited from withdrawing groundwater within the District when the Board determines, pursuant to Rule 12.6(c), that such action is reasonably necessary to assure that a well is not operated in violation of these Rules or any order of the Board.

(b) A well ordered sealed under this Section shall be sealed by the installation of a seal or tag on the pump, the pump's electrical panel, the meter, or other conspicuous location by authorized District personnel to indicate that the well has been sealed by order of the District. Other appropriate action may be taken as necessary to preclude operation of the well or to identify unauthorized operation of the well.

(c) No person shall remove or otherwise tamper with, nor shall any well owner allow to be removed or otherwise tampered with, a tag or any other seal installed pursuant to this Section.

(d) No person shall produce, nor shall any well owner allow to be produced, any groundwater from a well that has been sealed pursuant to this Section.

Rule 12.10 Judicial Relief

(a) Notwithstanding any Rule to the contrary, if it appears to the Board that a person has violated, is violating, or is threatening to violate any provision of Chapter 36, the District Act, these Rules, any Order or Resolution of the Board, or any term of a District permit, the Board may institute and prosecute a suit in the name of the District for all relief made available by the District Act and by the general law.

(b) If the District prevails in any suit to enforce its Rules, the District may seek, in the same action, recovery for attorney's fees, costs for expert witnesses, and other costs incurred by the District before the court.

SECTION 13 HEARINGS OF THE DISTRICT

Rule 13.1 Hearings Generally

(a) A public hearing may be held on any matter within the jurisdiction of the Board, or if the Board deems a hearing to be in the public interest or necessary to effectively carry out the duties and responsibilities of the District. The District conducts four general types of hearings under this Section:

(1) rulemaking or Management Plan hearings;

(2) hearings involving the issuance of a permit for which a hearing is required or authorized under these Rules, in which the rights, duties, or privileges of a Party a determined after an opportunity for an adjudicative hearing;

(3) show cause and enforcement hearings, in which the obligation and authority of the District to impose civil penalties is considered under specific relevant circumstances, as set forth in Rule 12.6; and

(4) hearings on the Desired Future Conditions proposed for the District.

(b) Any matter designated for hearing before the Board may be heard by a quorum of the Board, referred by the Board for hearing before a Hearing Examiner, or heard by a quorum of the Board along with an appointed Hearing Examiner who officiates during the hearing, or by SOAH if required under Rule 13.3.1.

(c) Any hearing may be scheduled during the District's regular business hours at regular or special meetings, Monday through Friday of each week, except District holidays. All hearings shall be held at the location set forth in the notice. Any hearing may be continued from time to time and date to date without notice after providing the initial notice.

(d) Every person, representative, witness, and other participant in a proceeding must conform to ethical standards of conduct and must exhibit courtesy and respect for all other participants and comply with Rule 1.18. No person may engage in any activity during a proceeding that interferes with the orderly conduct of District business. If in the judgment of the Presiding Officer, a person is acting in violation of this provision, the Presiding Officer will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, the Presiding Officer may exclude that person from the proceeding for such time and under such conditions as the Presiding Officer deems necessary.

(e) A person participating in a hearing shall complete a hearing registration form

stating the person's name, address, and whom the person represents, if applicable.

(f) After the Presiding Officer calls a hearing to order, the Presiding Officer shall announce the subject matter of the hearing and the order and procedure for presentation.

Rule 13.2 Rulemaking Hearings

(a) Rulemaking hearing notice shall include a brief explanation of the subject matter of the hearing, the time, date, and place of the hearing, location or internet site at which a copy of the proposed rules may be reviewed or copied, if the District has a functioning internet site, and any other information deemed relevant by the General Manager or the Board.

(b) Not less than 20 calendar days prior to the date of the hearing, the General Manager shall:

(1) Post notice in a place readily accessible to the public at the District office;

(2) Provide notice to the county clerks within the District;

(3) Publish notice in one or more newspapers of general circulation in the District;

(4) Provide notice by mail, facsimile, or electronic mail to any person who has requested rulemaking hearing notice; and

(5) Make available a copy of all proposed rules at a place accessible to the public during normal business hours, and post an electronic copy on the District's internet site.

(c) A person may submit to the District a written request for notice of a rulemaking hearing. A request is effective for the remainder of the calendar year in which the request is received by the District. To receive notice of a rulemaking hearing in a later year, a person must submit a new request. An affidavit of an officer or employee of the District establishing attempted service by first class mail, facsimile, or e-mail to the person in accordance with the information provided by the person is proof that notice was provided by the District.

(d) Failure to provide notice under Subsection (c) does not invalidate an action taken by the District at a rulemaking hearing.

(e) The District shall prepare and keep a record of each rulemaking hearing in the form of an audio or video recording or a court reporter transcription.

(f) The District may use an informal conference or consultation to obtain the opinions and advice of interested persons about contemplated rules and may appoint

advisory committees of experts, interested persons, or public representatives to advise the District about contemplated rules.

Rule 13.2.1 Hearings on Rules Other Than Emergency Rules

(a) **General procedures**: The Presiding Officer will conduct the rulemaking hearing in the manner the Presiding Officer determines most appropriate to obtain all relevant information pertaining to the subject matter of the hearing as conveniently, inexpensively, and expeditiously as possible. The Presiding Officer may follow the guidelines of *Parliamentary Procedure at a Glance, New Edition,* O. Garfield Jones, 1971 revised edition, or as amended.

(b) **Submission of documents:** Any interested person may submit to the Presiding Officer written statements, protests, comments, briefs, affidavits, exhibits, technical reports, or other documents relating to the subject matter of the hearing. Such documents must be submitted no later than the time period stated in the notice of hearing given pursuant to Rule 13.2. The Presiding Officer may grant additional time for the submission of additional documents.

(c) **Oral presentations:** Any person desiring to testify on the subject matter of the hearing must so indicate on the registration form provided at the hearing. The Presiding Officer establishes the order of testimony and may limit the number of times a person may speak, the time period for oral presentations, and the time period for raising questions. The Presiding Officer may limit or exclude cumulative, irrelevant, or unduly repetitious presentations.

(d) **Conclusion of the hearing; closing the record;** Hearing Examiner's report: At the conclusion of testimony and after the receipt of all documents, the Presiding Officer may close the record or keep it open to allow the submission of additional information. If the Presiding Officer is a Hearing Examiner, the Hearing Examiner must, after the record is closed, prepare a report to the Board. The report must include a summary of the subject matter of the hearing and the public comments received, together with the Hearing Examiner's recommendations for action. Upon completion of the Hearing Examiner's report, the Hearing Examiner must submit a copy to the Board. Any interested person who so requests in writing will be notified when the report is complete and furnished a copy of the report.

(e) **Exceptions to the Hearing Examiner's report; reopening the record**: Any interested person may make exceptions to the Hearing Examiner's report, and the Board may reopen the record in the manner prescribed in Rule 13.2.1(b).

(f) If the Board decides to consider substantial changes to the proposed Rules, the Board will provide new notice of the proposed rules and hold an additional hearing on the proposed Rules in accordance with this Rule.

(g) The Board shall issue a written order or resolution reflecting its decision. The proposed Rules that the Board has approved shall be an attachment to that written

order or resolution.

(h) The effective date of the written order or resolution shall be the date on which the President or his designee signs the order or resolution. The order or resolution shall include the date upon which the proposed Rules will become effective. Any appeal authorized by Chapter 36, subchapter H shall run from the effective date of the written order or resolution.

Rule 13.2.2 Hearing Procedures on Emergency Rules

(a) The Board may adopt an emergency rule without following the procedures in Rules 13.2 and 13.2.1 if the Board: (1) finds that a substantial likelihood of imminent peril to the public health, safety, or welfare, or a requirement of state or federal law, requires adoption of a rule on less than 20 days' notice; and (2) prepares a written statement of the reasons for its finding under this subsection.

(b) An emergency rule under this Rule 13.2.2 must be adopted at a meeting of the Board subject to the requirements of the Open Meetings Act. Notice required by the Open Meetings Act shall be provided.

(c) Except as provided by Rule 13.2.2.(d), a rule adopted under this section may not be effective for longer than 90 days.

(d) If notice of a hearing under 13.2. is given not later than the 90th day after the date the rule is adopted, the rule is effective for an additional 90 days.

Rule 13.3 Permit Applications Requiring Public Hearings

(a) “Application” defined in Rules 13.3 (inclusive of Rules 13.3.1-13.3.5) refers to an application for a permit or permit amendment for which a hearing is required or authorized under Section 2.

(b) The District shall hold a permit hearing for each Application for an Operating Permit or Operating Permit amendment except that the District shall hold a hearing for minor amendments only if the General Manager determines that a hearing is required. The District may hold hearings on permit renewals and on any other Application for which a hearing is required or authorized under these Rules.

(c) If the General Manager or Board schedules a hearing on an Application, the General Manager shall give notice of the hearing as provided in this section. The General Manager or Board may schedule more than one permit Application for consideration at a hearing.

(d) Any person having an interest in the subject matter of a permit hearing on an Application may receive written notice of the hearing if the person submits to the District a written request to receive notice of the hearing. The request remains valid for a period of one year from the date of the request, after which time a new

request must be submitted. Failure by the District to provide written notice to a person under this Subsection does not invalidate any action taken by the Board.

(e) Not later than the 10th day before the date of a permit hearing, the General Manager shall:

(1) Post notice at a place readily accessible to the public in the District office;

(2) Provide notice to the county clerk of all counties within the District, whereby the county clerks must post the notice on a bulletin board at a place convenient to the public;

(3) Provide notice by regular mail to the applicant; and

(4) Provide notice by mail, fax, or email to any person who has specifically requested to receive notices of permit hearings.

(f) The notice provided under Subsection (e) must include:

(1) the name and address of the applicant;

(2) the address or approximate location of the well or proposed well;

(3) a brief explanation, including any requested amount of groundwater, the purpose of the proposed use, and any change in use, if applicable;

(4) a general explanation of the manner by which a person may contest the Application;

(5) the time, date, and location of the hearing; and

(6) any other information the Board or General Manager deems relevant and appropriate to include in the notice.

(g) **Technical review**: Upon receipt of an Application, the General Manager will conduct a technical review as follows:

(1) Within 60 days of the receipt of the Application, the General Manager will notify the applicant if the Application is incomplete or if any additional information or documentation is useful or necessary to address the factors that the Board will consider in making a decision on the Application under these Rules. If the applicant has not supplied the additional information or documentation within 60 (sixty) days following the date that the General Manager notified the applicant of the need for the additional information or documentation or upon conclusion of an extension granted by the General Manager, the Application shall expire. Any additional information or documentation timely submitted by an applicant will be considered a part of

the Application.

(2) Within 60 days of the later of the date the District receives an Application or the date that the applicant supplies the additional information or documentation requested under Rule 13.3(f)(1), the General Manager will complete the technical review of the Application, and notify the applicant in writing that the Application has been declared Administratively Complete. The written notice will contain a summary of the General Manager's recommendation on the Application, and, if the General Manager recommends that a permit, an amendment, or a renewal be granted, may include a draft permit. The General Manager may extend the 60-day period for technical review for a reasonable period upon written notice to the applicant if the General Manager determines that some specific aspect of the application requires a technical review period of more than 60 days.

(h) An Administratively Complete Application requiring a hearing shall be set for a hearing within sixty (60) days after the date the Application is determined to be Administratively Complete. The initial hearing shall be held within thirty-five (35) days after the setting of the date, and the District shall act on the Application within sixty (60) days after the date the final hearing on the Application is concluded.

(i) **Public Comment**: Documents that are filed with the Board that comment on an Application, but that do not request a hearing will be treated as public comment. The Presiding Officer may allow any person, including the General Manager or a District employee, to provide comments at a hearing on an uncontested Application.

Rule 13.3.1 Request for a Contested Case Hearing on an Application

(a) **Filing of Request**: The General Manager, the applicant, or an Affected Person may request a contested hearing on an Application in writing no later than the 5th day before the date of the public hearing described in the notice in Rule 13.3. If the applicant requests a contested case hearing on its Application, then the Application shall be considered contested and a contested case hearing on the Application will be held in accordance with Rules 13.3.2 and 13.3.4. If the General Manager requests a contested case hearing, then the Board, in its discretion shall determine whether a contested case hearing on the Application shall be held in accordance with Rules 13.3.2 and 13.3.4. A request for a contested hearing is distinguished from public comment on an Application, and shall be filed not later than five (5) calendar days before the scheduled hearing date, and shall include the following information:

(1) The name, address, telephone number and email address of the person filing the request. If the request is made by a group or association, the request must identify the primary contact person responsible for receiving all official communications on behalf of the group or association;

(2) The person or entity's personal justiciable interest affected by the application and proposed withdrawal, including a statement demonstrating how that interest is not common to members of the general public; and

(3) Specifically request a contested hearing.

(b) **Hearing Conducted by SOAH**: A request for a contested hearing to be conducted by SOAH pursuant to Section 36.416 of Chapter 36 shall be made not later than five (5) calendar days before the scheduled hearing date. If timely requested by the applicant or other Party to a contested case, the District shall contract with SOAH to conduct a preliminary hearing or the hearing on merits of an Application.

(c) **Action on contested case hearing requests**: the written or oral submittal of a hearing request is not, in itself, a determination of a contested case. The Presiding Officer will evaluate the contested case hearing request at the hearing and may:

(1) determine that a hearing request does not meet the requirements of Rule 13.3.1 and deny the request;

(2) determine that the person requesting the hearing is not an Affected Person related to the Application and deny the hearing request;

(3) determine that a hearing request meets the requirements of Rule 13.3.1, and designate the matter as a contested hearing upon determining that the person is an Affected Person; and/or

(4) refer the case to a preliminary hearing.

(d) The Presiding Officer may hold a hearing on any issue related to the determination of whether to declare a matter as a contested case.

(e) Any case not declared a contested case under this section is an uncontested case.

Rule 13.3.2 Preliminary Hearing for Contested Application

(a) Upon the timely filing of a contested hearing request that meets the requirements of Rule 13.3.1, the District shall schedule a preliminary hearing to hear the request. The preliminary hearing may be conducted by a quorum of the Board, a Hearing Examiner, or SOAH (if the applicant, General Manager, or a person requesting a contested case hearing request it to be conducted by SOAH under Rule 13.3.1(b)).

(b) The District shall mail notice of the preliminary hearing to the applicant, any person who filed a request for a contested case hearing, and persons requesting notice under Rule 13.3(d) no later than the 10th day before the date of the preliminary hearing. Failure to provide notice to a person requesting notice under Rule 13.3(d) does not invalidate an action taken by the District at the preliminary hearing.

(c) The sole issues at the preliminary hearing shall be:

(1) whether the person requesting a contested case hearing is an Affected Person and has standing to make the request to protest the Application; and

(2) whether the person requesting a contested case hearing has raised a justiciable issue related to the Application.

(3) if the Presiding Officer referred the issue of whether a request for a contested case hearing was timely for the preliminary hearing, the Presiding Officer shall first determine whether the request for a contested case hearing was timely, and only decide issues (i) and (ii) of this subsection for requests for contested case hearings that were timely filed.

(d) A person other than the applicant or the General Manager has standing if that person is an Affected Person under these Rules who has a personal justiciable interest that is related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and that is affected by the Board's action on the Application, not including persons who have an interest common to members of the public. The General Manager and applicant have standing and are automatic participants and parties to a contested hearing.

(e) Parties to a contested hearing shall be designated at the preliminary hearing. Unless the District is required to contract with SOAH to conduct the contested hearing, the District may, but is not required, to conduct the preliminary hearing on the same day and immediately before the evidentiary hearing on an Application.

(f) **Decision on Request for Contested Case Hearing**. Following the preliminary hearing, the Board shall determine whether any person requesting a contested case hearing has standing to make that request and whether a justiciable issue relating to the Application has been raised. If the Board determines that a person requesting a contested case hearing has standing and has raised a justiciable issue related to the Application, the Board shall grant that person's request for a contested case hearing, and a contested case hearing on the Application will be held in accordance with Rule 13.3.4. If the District determines that no person requesting a contested hearing has standing or that no justiciable issues are presented, then the Application shall be considered uncontested, and the Board may take any action authorized under Rule 13.3.3.

Rule 13.3.3 Action on Uncontested Applications

(a) If the District does not receive a timely-filed request for a contested case hearing on the Application, or if the Board denies all requests for a contested case hearing, then the Application shall be considered uncontested. The Board may take action on any uncontested Application at a properly noticed public meeting held at any time after the public hearing at which the Application is scheduled to be heard. The

Board may issue a written order to:

(1) grant the permit Application;

(2) grant the permit Application with special conditions; or

(3) deny the permit Application.

(b) An applicant may, not later than the 20th day after the date the Board issues an order granting the Application, request a contested case hearing if the order:

(1) includes special conditions that were not part of the Application as finally submitted; or

(2) grants a maximum amount of groundwater production that is less than the amount requested in the Application.

(c) The Presiding Officer shall prepare and keep a record and may substitute minutes for an audio or video recording.

Rule 13.3.4 Contested Case Permit Hearings

(a) **Hearings Conducted by SOAH:** If timely requested by the applicant or other party to a contested case hearing, the District shall contract with SOAH to conduct a preliminary hearing or a hearing on the merits of the Application. The Board shall determine whether the hearing held by SOAH will be held in Travis County or at the District office or other regular meeting place of the Board.

(1) The General Manager, applicant or other Party requesting a contested case hearing must request that the preliminary hearing or hearing on the merits be conducted by SOAH in writing no later than the 5th day before the date of the public hearing described in notice required by Rule 13.3.

(2) The Party requesting that the hearing be conducted by SOAH shall pay all costs associated with the contract for the hearing and shall make a deposit with the District in an amount that is sufficient to pay the estimated contract amount no later than 20 days before the preliminary hearing. If the total cost for the contract exceeds the amount deposited by the paying Party at the conclusion of the hearing, the Party that requested the hearing shall pay the remaining amount due to pay the final price of the contract. If there are unused funds remaining from the deposit at the conclusion of the hearing, the unused funds shall be refunded to the paying Party. The District may assess other costs related to hearings conducted under this rule as authorized under Chapter 36, or the District Rules.

(3) A hearing before a SOAH Administrative Law Judge shall be conducted as provided by Texas Government Code chapter 2001, subchapters C, D and

F, the procedural rules of SOAH, and this Rule to the extent this Rule is consistent with SOAH's procedural rules. The SOAH Administrative Law Judge will be the Presiding Officer for purposes of this Rule. The administrative law judge who conducts a contested case hearing shall consider applicable District rules or policies in conducting the hearing. The District shall provide the administrative law judge with a written statement of applicable rules or policies.

(b) **Hearings Conducted by the Board or Hearing Examiner** Except as provided in Rule 13.3.4(a), a contested case hearing shall be conducted by a quorum of the Board, or the Board, at its sole discretion, may appoint a Hearings Examiner to preside at and conduct the hearing on the Application. The appointment of a Hearings Examiner shall be made in writing. If the contested case hearing is conducted by a quorum of the Board, the President shall preside. If the President is not present, the Board shall select one of the Directors who are present to preside. If the hearing is conducted by a Hearing Examiner, the Hearing Examiner shall be the Presiding Officer.

(c) **Powers of Presiding Officer**: The Presiding Officer may conduct the hearing or other proceeding in the manner the Presiding Officer deems most appropriate for the particular hearing. The Presiding Officer has the authority to:

(1) set additional hearing dates, other than the hearing date set by the General Manager or Board under Rule 13.3;

(2) convene the hearing at the time and place specified in the notice for public hearing;

(3) designate the parties to a hearing; align the parties and/or number of representatives to be heard;

(4) admit evidence that is relevant to an issue at the hearing, exclude evidence that is not relevant, immaterial, or unduly repetitious, and rule on motions and on the admissibility of evidence. The Texas Rules of Evidence shall apply in a contested case, except that evidence inadmissible under those rules may be admitted if the evidence is: (a) necessary to ascertain facts not reasonably susceptible of proof under those rules; (b) not precluded by statute; and (c) of a type on which a reasonably prudent person commonly relies in the conduct of the
person's affairs.

(5) Allow or require testimony to be submitted in writing and may require that written testimony be sworn to. On the motion of a Party to the hearing, the Party may exclude written testimony if the person who submits the testimony is not available for cross-examination by phone, a deposition before the hearing, or other reasonable means.

(6) Allow any discovery that is authorized by the Texas Rules of Civil Procedure.

(7) Rule on motions, on discovery issues, on the admissibility of evidence, and on other interlocutory matters.

(8) Refer the parties to an alternative dispute resolution (ADR) procedure on any matter at issue in the hearing, apportion costs for ADR, and appoint an impartial third Party as provided by Section 2009.053 of the Government Code to facilitate that procedure.

(9) establish the order for presentation of evidence and prescribe reasonable time limits for the presentation of evidence and oral argument;

(10) administer oaths to all persons presenting testimony;

(11) examine witnesses;

(12) ensure that information and testimony are introduced as conveniently and expeditiously as possible, without prejudicing the rights of any person participating in the proceeding;

(13) Conduct public hearings in an orderly manner in accordance with these Rules;

(14) continue any hearing from time to time and place to place without providing notice under Rule 13.3. If the continuance is not announced on the record at the hearing, the Party shall provide notice of the continued hearing by regular mail to the parties. If the hearing is being conducted by a quorum of the Board, Open Meetings notice also shall be provided;

(15) exercise any other appropriate powers necessary or convenient to effectively carry out the responsibilities of Party;

(16) Apportion among the parties the costs related to: (a) a contract for the services of the Party; and (b) the preparation of the official hearing record; and

(17) If the Board has not acting on the Application, allow at witness at a hearing to supplement the testimony in accordance with section 36.406(a) of Chapter 36.

(d) **Ex parte communications**. A Board member, or a Hearings Examiner or Administrative Law Judge assigned to render a decision or to make findings of fact and conclusions of law in a contested case, may not directly or indirectly communicate in connection with an issue of fact or law in the contested case with a state agency, person, Party, or a representative of those entities, except on notice and opportunity for each Party to the contested case to participate. A Board

member may communicate ex parte with another Board member in connection with an issue of fact or law in the contested case, if a quorum is not present. All ex parte communications that are not prohibited by Rule 13.3.4(d) are expressly permitted.

(e) **Official Hearing Record.** A record of a hearing in the form of an audio or video recording or a court reporter transcription shall be prepared and kept by the Party in a contested hearing. The Party shall have the hearing transcribed by a court reporter upon a request by a Party to a contested hearing. The Party may assess court reporter transcription costs against the Party requesting the transcription or among the parties to the hearing. The Party may exclude a Party from further participation in a hearing for failure to pay in a timely manner costs assessed against that Party under this rule, unless the parties have agreed that the costs assessed against such Party will be paid by another Party. The Party may substitute a proposal for decision for the method of recording.

(f) **Consideration of Proposal for Decision.** If a proposal for decision is submitted to the Board by the Party, the Board shall consider the proposal for decision at a final hearing. Additional evidence may not be submitted during the final hearing. The parties may present oral argument at a final hearing to summarize evidence, present legal arguments, or argue an exception to the Proposal for Decision. The Party may continue the final hearing from time to time and from place to place without providing notice under Rule 13.3.1(b). If the continuance is not announced on the record at the hearing, the Party shall provide notice of the continued hearing by regular mail to the parties. If the hearing is being conducted by a quorum of the Board, Open Meeting Act notice also shall be provided.

(g) **Board Action on Permits.** The Board shall issue a written order or resolution reflecting its decision. The Board's decision on the contested Application shall be made within 60 days after the final hearing on the Application is concluded. For hearings conducted by SOAH, the Board shall make the final decision on the Application within 60 days after the issuance of the proposal for decision by SOAH. In a hearing in which the District has contracted with SOAH to conduct the contested case hearing, the Board has the authority to make a final decision on consideration of a proposal for decision issued by SOAH administrative law judge consistent with Section 36.4165 of Chapter 36, and Section 2001.058, Texas Government Code.

(h) The District Board may change a finding of fact or conclusion of law made by the administrative law judge, or may vacate or modify an order issued by the administrative judge, only if the Board determines:

(1) that the administrative law judge did not properly apply or interpret applicable law, District rules, written policies provided under Section 36.416(e) of the Texas Water Code, or prior administrative decisions;

(2) that a prior administrative decision on which the administrative law judge relied is incorrect or should be changed; or

(3) that a technical error in a finding of fact should be changed.

Rule 13.3.5 Request for Rehearing or Findings and Conclusions

(a) **Request for Written Findings and Conclusions.** An applicant in a contested or uncontested hearing on an Application or a Party to a contested hearing may administratively appeal a decision of the Board on an Application by requesting written findings of fact and conclusions of law within twenty (20) calendar days of the date of the Board's decision. On receipt of a timely written request, the Board shall make written findings of fact and conclusions of law regarding a decision of the Board on a permit or permit amendment Application. The Board shall provide certified copies of the findings and conclusions to the Party who requested them, and to each designated Party, not later than the 35th day after the date the Board receives the request.

(b) **Request for Rehearing.** A Party who receives a certified copy of the findings and conclusions from the Board may request a rehearing before the Board not later than the 20th day after the date the Board issues the findings and conclusions. In a contested case, a Party must first make a request for written findings and conclusions under District Rule 13.3.5(a) before any Party to the contested case may submit a request for rehearing under this rule.

A request for rehearing must be filed with the District in writing and must state clear and concise grounds for the request. The person requesting a rehearing must provide copies of the request to all parties to the hearing. With respect to any decision or action of the Board in a contested case, such a request for rehearing is mandatory before any appeal to District Court may be brought. Any appeal to District Court shall be limited to the issues and grounds raised in the motion for rehearing.

If the Board grants a request for rehearing, the Board shall schedule the rehearing not later than the 45th day after the date the request is granted. Hearings on Motions for Rehearing will be heard by the Board pursuant to Rule 13.1 and 13.3.

The failure of the Board to grant or deny a request for rehearing before the 91st day after the date the request is submitted is a denial of the request.

(c) **Final Decision on Permits and Finality of Board Decision.** A decision by the Board on an Application is final:

(1) If a request for rehearing is not timely filed, then on the expiration of the period for filing a request for rehearing; or

(2) If a request for rehearing is timely filed, on the date:

(A) the Board denies the request for rehearing either expressly or by operation of law; or

(B) the Board renders a written decision after rehearing.

An applicant or a Party to a contested hearing may file suit against the District under Section 36.251, Texas Water Code, to appeal a decision on an Application not later than the 60th day after the date on which the decision becomes final if a request for rehearing was filed on time. An applicant or a Party to a contested hearing may not file suit against the District under Section 36.251, Texas Water Code, if a request for rehearing was not filed on time.

Rule 13.4 Show Cause and Enforcement Hearings

Show cause hearings shall be conducted in accordance with Rules 12.5, 12.6, and 13.1.

Rule 13.4.1 Contesting an Enforcement Action

(a) A person in receipt of a written notice of violation from the District, or an order of the Board involving a matter for which an opportunity for a contested enforcement action has not previously been provided, may formally contest the enforcement action or actions at issue by submitting to the District a written petition contesting the actions or proposed actions and seeking a hearing on the merits of the same.

(b) A petition filed pursuant to Subsection (a) of this Rule must be filed within 45 days following the date the notice of violation or order is delivered. For purposes of this Rule only, the date a notice of violation or order will be considered delivered is the date of delivery as evidenced by a return receipt or written delivery confirmation generated by the United States Postal Service. In the absence of either a return receipt, a delivery confirmation, or other convincing evidence indicating otherwise, a notice of violation or order is considered delivered on the third business day following the date such notice or order was deposited by the District for delivery with the United States Postal Service.

(c) Petitions filed under Subsection (a) shall be addressed directly to the Board, and shall contain the following:

(1) the name, physical address, daytime telephone number and, if available, the facsimile number of the Respondent;

(2) the name and contact information of all other known parties;

(3) a concise statement of the facts relied upon in defense of each violation asserted by the District to which a contest is being filed;

Rule 13.4.2 Notice and Scheduling of Contested Enforcement Matters

(a) This Rule applies to all enforcement matters for which a contested hearing has been requested in accordance with Rule 13.4.1.

(b) Not later than the 20th day before the date of a hearing, the General Manager, as instructed by the Board, shall notify the Respondent of the hearing by providing notice of the same:

(1) in a place readily accessible to the public at the District's office; and

(2) by first class regular mail to the Respondent or the Respondent's designated representative.

(c) The notice provided under Subsection (b) must include:

(1) the name of the Respondent;

(2) the mailing address of the Respondent;

(3) the date or dates of all notices of violation or Board orders that will be the subject of the hearing, along with a description of the violations noticed in each pertinent notice of violation or Board order;

(4) the date that the request for a contested case hearing on the proposed enforcement action was received by the District;

(5) a statement informing the Respondent of the need to appear at the hearing and if a continuance of the hearing date is sought, to submit a written request for a continuance to the General Manager within 7 days of receipt of the notice of hearing;

(6) the time, date, and location of the hearing; and

(7) any other information the Board or General Manager deems relevant and appropriate to include in the notice.

(d) A hearing on the merits of the enforcement matters noticed under this Rule shall begin within 60 days after the date that the request under Rule 13.4.1 is received by the District.

(e) Requisites for notice of show cause hearings ordered by the Board shall be governed by Rule 12.5(b).

Rule 13.4.3 Contested Enforcement Hearings Procedures

(a) **Procedural hearing**: A procedural hearing may be held to consider any matter that

may expedite the hearing or otherwise facilitate the hearing process in contested matters.

(b) **Matters considered**: Matters that may be considered at a procedural hearing include:

(1) the designation of parties;

(2) the formulation and simplification of issues;

(3) the necessity or desirability of amending applications or other pleadings;

(4) the possibility of making admissions or stipulations;

(5) the scheduling of depositions, if authorized by the Party;

(6) the identification of and specification of the number of witnesses;

(7) the filing and exchange of prepared testimony and exhibits; and

(8) the procedure at the evidentiary hearing.

(c) **Notice**: A procedural hearing or evidentiary hearing may be held at a date, time, and place stated in a notice, given in accordance with Rule 13.4.2, or at the date, time, and place for hearing stated in the notice of public hearing, and may be continued at the discretion of the Party.

(d) **Procedural hearing action**: Action taken at a procedural hearing may be reduced to writing and made a part of the record or may be stated on the record at the close of the hearing

(e) **Written testimony**: The Party may allow testimony to be submitted in writing, either in narrative or question and answer form, and may require the written testimony be sworn to. On the motion of a Party to a hearing, the Party may exclude written testimony if the person who submits the testimony is not available for cross-examination in person or by phone at the hearing, by deposition before the hearing, or other reasonable means**.**

(f) **Cross-examination**: The opportunity for cross-examination shall be provided for all testimony offered in a contested case hearing.

(g) **Evidence**: The Party shall admit evidence if it is relevant to an issue at the hearing. The Party may exclude evidence that is irrelevant, immaterial, or unduly repetitious.

(h) **Burden of Proof**:

(1) The General Manager has the burden of proving by a preponderance of the

evidence the occurrence of any violation and the appropriateness of any proposed remedial provisions and penalties. The Respondent has the burden of proving by a preponderance of the evidence all elements of any affirmative defense asserted.

(2) Except as provided by Paragraph (1) of this subsection, the burden of proof is on the moving Party by a preponderance of the evidence.

(i) **Determination of merit in enforcement hearings**:

(1) Following the closing of a hearing, the Board shall consider the evidence admitted on each issue in contest and shall, based upon the preponderance of the credible evidence admitted, render a decision on the matter that shall include provisions requiring remedial relief, where appropriate, and one of the following findings:

(A) that a violation has occurred and that a specific amount of penalties should be assessed;

(B) that a violation has occurred but that no penalty should be assessed; or

(C) that no violation has occurred.

(1) When assessing a penalty, the Board shall analyze each factor prescribed by the applicable statute or Rule to be considered by the Board in determining the amount of the penalty.

(2) The Board shall act on contested enforcement matters no later than the 60th day following the date of submission of closing arguments, or within 30 days following receipt of any hearings report submitted by the Party, whichever is later.

Rule 13.5 Desired Future Conditions Hearings

(a) Hearings on Desired Future Conditions shall be held in accordance with Sections 13.1, Chapter 36, and this Rule.

(b) After Desired Future Conditions for the District are proposed by a two-thirds vote of all the district representatives in the Management Area, the 90-day public comment period begins on the day the proposed Desired Future Conditions are mailed to the District. During the public comment period and after posting notice, the District shall hold a public hearing on any proposed Desired Future Conditions relevant to the District. During the public comment period, the District shall post on its website and make available in its office a copy of the proposed Desired Future Conditions and any supporting materials, such as the documentation of factors considered under

Deleted: approved

Deleted:

section 36.108(d) of Chapter 36 and groundwater availability model run results. After the close of the public comment period, the District shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed Desired Future Conditions, and the basis for the revisions.

(c) At least 10 days before a hearing under section 36.108(d-2) of Chapter 36 or a meeting at which the District will adopt a Desired Future Condition under section 36.108(d-4) of Chapter 36, the Board shall post notice that includes:

(1) the proposed Desired Future Conditions and a list of any other agenda items;

(2) the date, time, and location of the meeting or hearing;

(3) the name, telephone number, and address of the person to whom questions or requests for additional information may be submitted;

(4) the names of the other districts in the District's Management Area; and

(5) information on how the public may submit comments.

(d) Not less than 10 calendar days prior to the date of the hearing, the General Manager shall:

(1) Post notice in a place readily accessible to the public at the District office;

(2) Provide notice to the county clerks within the District;

(3) Publish notice in one or more newspapers of general circulation in the District;

(4) Provide notice by mail, facsimile, or electronic mail to any person who has requested rulemaking hearing notice; and

(5) Make available a copy of all proposed rules at a place accessible to the public during normal business hours, and post an electronic copy on the District's internet site.

SECTION 14 AQUIFER STORAGE AND RECOVERY WELLS

Rule 14.1 Registration Required

A project operator of an Aquifer Storage and Recovery project shall register the injection and recovery wells associated with the project with the District, and shall provide the District with all reports required to be submitted to TCEQ under Sections 27.155-.156 of the Texas Water Code.

Rule 14.2 No Permit Required; No Water Use Fee on Authorized Recovery

Except as provided by Rule 14.3, no permit is required for the drilling, equipping, or operation of an Aquifer Storage and Recovery injection or recovery well authorized by TCEQ. Similarly, no Water Use Fee or Groundwater Transport Fee will be imposed on the volume of groundwater authorized by TCEQ to be recovered under an Aquifer Storage and Recovery project. The District may, however, assess a well registration fee or other similar administrative fee for an Aquifer Storage and Recovery well.

Rule 14.3 Exceeding Authorized Recovery Volume

(a) If an Aquifer Storage and Recovery project recovers an amount of groundwater that exceeds the volume authorized by the TCEQ to be recovered under the project, the project operator shall immediately report to the District the volume of groundwater recovered that exceeds the volume authorized to be recovered in addition to providing the reports required by Rule 14.1.

(b) The recovery wells associated with an Aquifer Storage and Recovery project are subject to the District's spacing, permitting, metering, production limitations, and fee payment requirements if the amount of groundwater recovered from the wells exceeds the authorized volume to be recovered under the project. The District's spacing, permitting, metering, production limitations, and fee payment requirements only apply to the volume of groundwater recovered that exceeds the recovery volume authorized by the TCEQ.

(c) A project operator may not recover groundwater by an Aquifer Storage and Recovery Project in an amount that exceeds the volume authorized by TCEQ to be recovered under the project unless the operator first obtains an Operating Permit in accordance with Section 2 and pays all fees in accordance with Section 8 for the amount that exceeds the volume authorized by TCEQ to be recovered under the project.

Rule 14.4 Desired Future Conditions Planning

The District may consider hydrogeologic conditions related to the injection and recovery of water as part of an Aquifer Storage and Recovery project in the planning related to, and monitoring of the achievement of, a Desired Future Condition for an Aquifer of the District in which the injection and recovery wells associated with the project are located.

SECTION 15 BRACKISH GROUNDWATER PRODUCTION ZONES

Rule 15.1 Rules for Permits for Brackish Groundwater Production Zones

If a brackish groundwater production zone is designated over any part of the District, the District may adopt rules to govern the issuance of permits. The District shall adopt rules within 180 days of the District receiving a petition from a person with a legally defined

interest in groundwater.

A person may obtain a permit under rules adopted for a (1) municipal project designed to treat brackish groundwater to drinking water standards for the purpose of providing a public source of drinking water; and (2) an electric generation project to treat brackish groundwater to water quality standards sufficient for the project needs.

Any rules adopted shall be in accordance with section 36.1015 of Chapter 36.

Phase 2 Subsidence Investigations

Prepared for

LONE STAR GROUNDWATER CONSERVATION DISTRICT

Prepared by

LSGCD TECHNICAL CONSULTING TEAM

AGS
Advanced Groundwater Solutions, LLC

R W HARDEN & ASSOCIATES INC
GROUNDWATER RESOURCE PROFESSIONALS

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

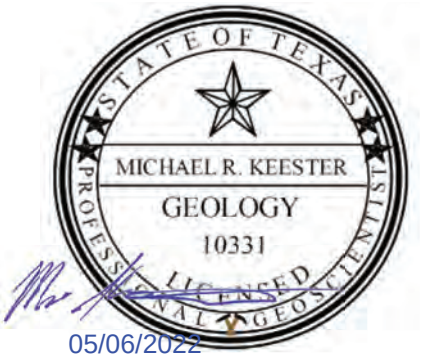
May 6, 2022

GEOSCIENTIST SEALS

This report documents the work of the following licensed professional geoscientists.

Michael R. Keester, P.G.

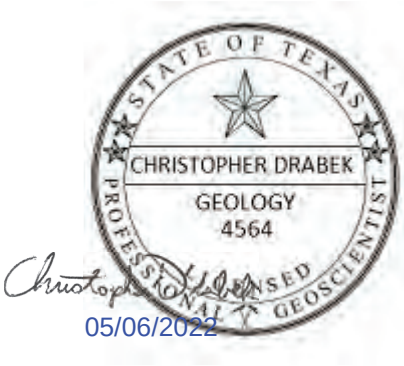
Mr. Keester was primarily responsible for preparing report sections on the Brackish Jasper Aquifer Conceptual Model Review and Phase 3 Drilling and Testing Plan along with the related summary and conclusions. Mr. Keester was also responsible for finalizing the project summary report.



Principal | Hydrogeologist – R. W. Harden & Associates, Inc. (TX Geoscientist Firm License #50033)

Christopher Drabek, P.G.

Mr. Drabek was primarily responsible for preparing the report section on the Gulf Coast Aquifer System Geologic Structure along with the related summary and conclusions. He also provided review and QA/QC of the final report.



Senior Hydrogeologist – Advanced Groundwater Solutions, LLC (TX Geoscientist Firm License #50639)

Michael Thornhill, P.G.

Mr. Thornhill was primarily responsible for preparing the report sections on Other Considerations related to compaction of subsurface clays and the Summary of Clay Layer Thickness Based on Geophysical Log Analysis. He also provided review and QA/QC of the final report.

Principal – Thornhill Group, Inc. (TX Geoscientist Firm License #50346)

James Beach, P.G.

Mr. Beach was primarily responsible for providing review and QA/QC of the final report.

Principal – Advanced Groundwater Solutions, LLC (TX Geoscientist Firm License #50639)

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICIES

INTRODUCTION

Chapter 36 of the Texas Water Code requires Lone Star Groundwater Conservation District (LSGCD) to consider several factors when developing long-term goals and finding the balance between providing fair and impartial access to groundwater production and conservation of groundwater resources. One of LSGCD's considerations is the ability to control subsidence within Montgomery County. In order to thoughtfully consider the ability to control subsidence, the District is developing a robust understanding of the local conditions effect on compaction of the subsurface formations which can cause land surface subsidence.

During Phase 1 of the subsidence investigations, Thornhill and Keester (2020) focused on developing an understanding of existing research. During the initial phase, the focus was not so much on the validity or applicability to Montgomery County; rather, it was on compiling existing studies and determining questions that may need further investigation. In Phase 2 of the District's subsidence investigations, the LSGCD technical consulting team has worked collaboratively to investigate two of the most applicable questions.

One of these questions involved a review of a subsidence study titled: *Subsidence Risk Assessment and Regulatory Considerations for the Brackish Jasper Aquifer* (Kelley and others, 2018). Thornhill and Keester (2020) discussed and summarized this study as part of the Phase I study. However, because information from this study has direct relevance to LSGCD's current and future management of groundwater resources, we conducted a more detailed evaluation of the information provided in the report.

The other question related to the hydrostratigraphy and clay layers within the subsurface units in Montgomery County. To address the question, we conducted an in-depth evaluation of the subsurface geology of Montgomery County. Our work aimed to improve the mapping of the elevation of the top and bottom of the subsurface hydrogeologic formations and to improve the understanding of the thicknesses of sand and clay intervals within the formations in the study area. Our approach for completing the work followed the long-standing approach taken by groundwater professionals of combining an extensive understanding of practical local hydrogeology with geophysical log analysis.

BRACKISH JASPER AQUIFER CONCEPTUAL MODEL REVIEW

Kelley and others' (2018) work focuses on the Jasper Aquifer. As shown on Figure 1, Kelley and others (2018) included all of Brazoria, Fort Bend, Galveston, and Harris counties with portions of the neighboring counties included in the study area. Within Montgomery County, the study area extends to the southern end of Lake Conroe.

Kelley and others (2018) identified their work as an estimate of "the relative risk of subsidence associated with development of brackish groundwater in the Jasper Aquifer of the Gulf Coast Aquifer System within the [Harris-Galveston and Fort Bend Subsidence] Districts." The two objectives of their risk assessment were to:

1. "Assess potential risk of subsidence that may result from development of brackish groundwater resources in the Jasper Aquifer within the [Harris-Galveston and Fort Bend Subsidence] Districts; and
2. Provide the [Harris-Galveston and Fort Bend Subsidence] Districts with guidance regarding the types of activities and data that would benefit the consideration as special provisions to Jasper Aquifer brackish production permits."

To meet the first objective, Kelley and others (2018) developed a numerical model using the MODFLOW code (version not identified). To simulate compaction of the subsurface units, they used the MODFLOW subsidence package developed by Hoffman and others (2003). The development of the numerical model of groundwater flow and use of the MODFLOW subsidence package is common practice for assessing the potential for compaction and is reasonable approach for addressing the first objective. The numerical model is simply a mathematical representation of the conceptual model of the aquifer. The information developed for the conceptual model dictates the development of the numerical model. Therefore, our work focused primarily on the conceptual model described by Kelley and others (2018).

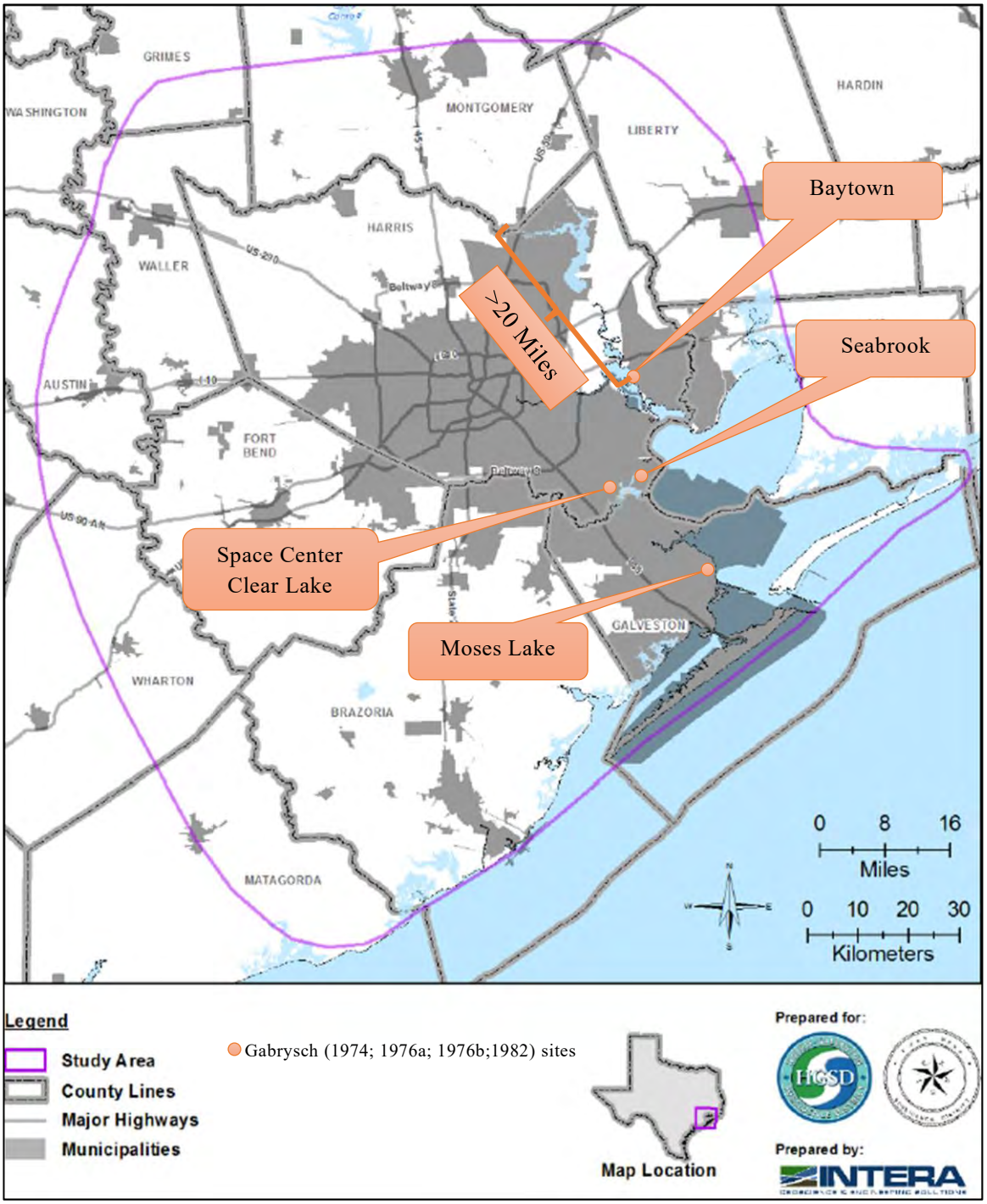


Figure 1. Study area identified by Kelley and others (2018) along with the sites discussed by Gabrysch and Bonnet (1974, 1976a; 1976b) and Gabrysch (1982). Modified from Kelley and others (2018).

Review of Compaction Parameterization

Kelley and others (2018) begin their discussion of the conceptual model with a brief introduction to consolidation theory. Their discussion highlights the mathematics behind the numerical model package used to predict compaction and subsidence. Of particular importance to the equations are the following clay bed properties:

- Geostatic stress (σ), hydrostatic stress (u), and effective stress (σ')
- Thickness
- Specific storage
- Vertical hydraulic conductivity
- Preconsolidation stress

Kelley and others (2018) point out that "none of the physical measurements presented [in their report]… have been collected at depths representative of the brackish Jasper Aquifer in the [Harris-Galveston and Fort Bend Subsidence] Districts.… Properties controlling compaction of the brackish Jasper Aquifer should be considered uncertain." To our knowledge the statement would also have been accurate if it more generally referred to the Jasper Aquifer in the Gulf Coast region.

Much of the analyses discussed by Kelley and others (2018) used data obtained and discussed by Gabrysch and Bonnet (1974; 1976a; 1976b). The locations where these data were collected are shown on Figure 1. As shown on Figure 1, the nearest location is more than 20 miles from Montgomery County. Also, the depth from which the data were collected represents the shallower and younger sediments that make up the Chicot and Evangeline aquifers. As such, we agree with Kelley and others (2018) that the application of results from analyses of these data to the Jasper Aquifer is uncertain.

With regard to the first compaction property listed above, geostatic stress is essentially a combination of the weight of the sediments and fluids above a specified depth in the subsurface. The hydrostatic stress is the pressure within the pore space of the sediments above a specified depth in the subsurface. Effective stress is the difference between the geostatic stress and the hydrostatic stress. Terzaghi (1925) identified this relation which allows effective stress within an aquifer to be expressed as (Leake and Galloway, 2007):

$$\sigma' = \sigma - u \tag{1}$$

Commonly, the geostatic stress is considered to be 1.0 pounds per square inch (psi) per foot (ft) of burial (psi/ft). For fresh water, the hydrostatic stress is 0.433 psi/ft which results in an effective stress gradient of 0.467 psi/ft assuming the geostatic stress gradient of 1.0 psi/ft and a water level equal to the depth of burial. These are the stress values used by Kelley and others (2018). However, Tiab and Donaldson (2016) indicate the geostatic gradient in the Gulf Coast region increases with depth being about 0.85 psi/ft near the surface and increasing to 1.0 psi/ft at about 20,000 feet in depth (see Figure 2). They indicate the reason for the curvature of the trend shown on Figure 2 is due to "sediments being younger and more compressible near the surface but being less compressible and more plastic with depth." For depths up to about 2,000 feet, the geostatic stress gradient presented by Tiab and Donaldson (2016) results in an effective stress gradient of about 0.407 to 0.437 psi/ft.

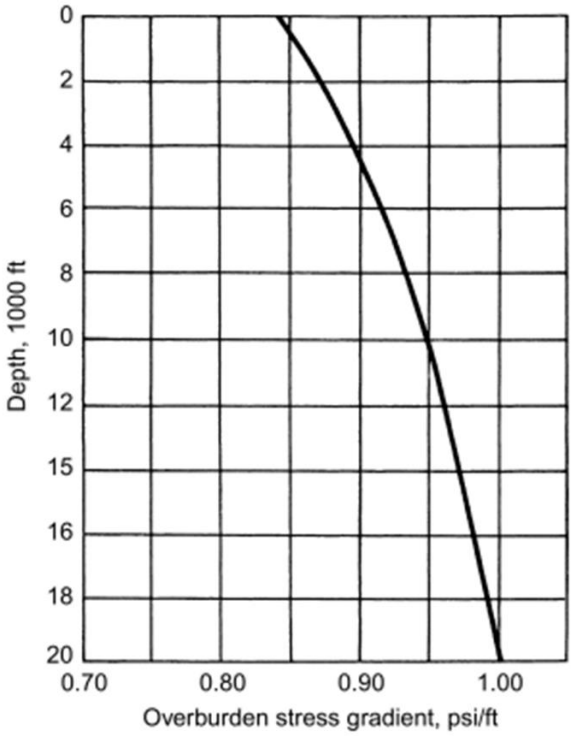


Figure 2. Overburden (geostatic) stress gradient in the Gulf Coast region. Reproduced from Tiab and Donaldson (2016)

The thickness of the clay units also affects compaction of the sediments, particularly the rate of compaction. The local stratigraphy and thickness of clay units is discussed below.

Specific Storage

The specific storage (S_s) of aquifer sediments is the volume of water released from or added to storage in a unit volume of aquifer per unit decline or rise in water level (Bear, 1979). The specific storage value may be further defined as the sum of the elastic (S_{ske}) and inelastic (S_{skv}) components (Hoffman and others, 2003) with the inelastic component being approximately 100 times greater than the elastic component (Leake and Prudic, 1991; Young and others, 2006). Due to the difference between the elastic and inelastic components, we can generally assume (as did Kelley and others (2018)) the inelastic specific storage is essentially equal to the total specific storage. Calculation of the specific storage compents is then as follows:

$$S_{skv} \approx S_s = \rho g(\alpha + n\beta) \tag{2}$$

$$S_{ske} = \frac{S_{skv}}{100} \tag{3}$$

where:

$S_{skv} = inelastic\ specific\ storage\ (m^{-1})$ – multiply by 0.3048 to get per foot (ft^{-1})

$S_{ske} = elastic\ specific\ storage\ (m^{-1})$ – multiply by 0.3048 to get per foot (ft^{-1})

$\rho = density\ of\ water\ \left(\frac{kg}{m^3}\right) \cong 1{,}000\frac{kg}{m^3}\ for\ fresh\ water$

$g = gravity\ \left(\frac{m}{s^2}\right) = 9.80665\frac{m}{s^2}$

$a = sediment\ compressibility\ \left(\frac{m^2}{N}\right)$

$n = porosity$

$\beta = water\ compressibility\ \left(\frac{m^2}{N}\right)$

$Units: ft = foot;\ m = meter; kg = kilogram; s = second;\ N = Newton = \frac{kg \cdot m}{s^2}$

Kelley and others (2018) state that Gabrysch and Bonnet (1974; 1976a; 1976b) report laboratory measurements of porosity and compressibility for the Baytown, Seabrook, and Moses Lake sites shown on Figure 1. However, these measurements are not actually reported by Gabrysch and Bonnet (1974; 1976a; 1976b); rather, Gabrysch and Bonnet (1974; 1976a; 1976b) report measurements of void ratio at various levels of pressure for clay samples collected at various depths within the Chicot and Evangeline aquifers. While not stated, we assume Kelley and others (2018) calculated porosity and compressibility from reported data using the following equations:

$$n = \frac{e}{1+e} \tag{4}$$

$$\alpha = \frac{\Delta n}{\Delta \sigma_v'} \tag{5}$$

where:

$e = void\ ratio$

$\sigma_v' = applied\ stress$

The Δ in equation 5 represents a change in the value. That is, compressibility is calculated as the change in porosity divided by the change in applied stress to the sample. We performed the same calculations we assume were performed by Kelley and others (2018) to determine porosity and compressibility from the data reported by Gabrysch and Bonnet (1974; 1976a; 1976b). Our results appeared to agree reasonably well with the results presented by Kelley and others (2018).

One of the requirements Kelley and others (2018) applied to their analysis was to only use measurements of the void ratio where the applied stress was greater than the effective depth of burial. Kelley and others (2018) state that they calculated the effective burial depth "by dividing the pressure applied to the core sample by a geostatic gradient of 0.467 pounds per square inch (psi) per foot of burial depth." As noted above, the value of 0.467 psi/ft represent the effective stress gradient assuming a geostatic stress gradient of 1.0 psi/ft. We inquired about the reported value and received an email

response from Dr. Steve Young on July 28, 2021 that the sentence should read "net effective stress gradient" rather than "geostatic gradient." As of December 11, 2021 a corrected report had not been posted to the Harris-Galveston Subsidence District website.

For our evaluation of the data, we used the lower and variable geostatic stress gradient identified by Tiab and Donaldson (2016). To calculate the effective burial depth, we followed the same assumptions as Kelley and others (2018) except that the geostatic stress is lower. The following equation illustrates the calculation:

$$Effective\ burial\ depth = \frac{\sigma_v'}{\sigma - u} \tag{6}$$

Using the lower geostatic gradient allows for additional data points to be included in the calculation of porosity and compressibility. Figure 3 and Figure 4 show porosity and compressibility plotted versus effective burial depth. The calculated values reflect the values determined from the Gabrysch and Bonnet (1974; 1976a; 1976b) data. The modeled value reflects the best fit trend line through the data. We selected a logarithmic trend through the data as it provided the best fit through data representing effective burial depths of less than 5,000 feet. Beyond 5,000 feet of depth, the logarithmic trend is not applicable. The equation shown on the chart represents the modeled values.

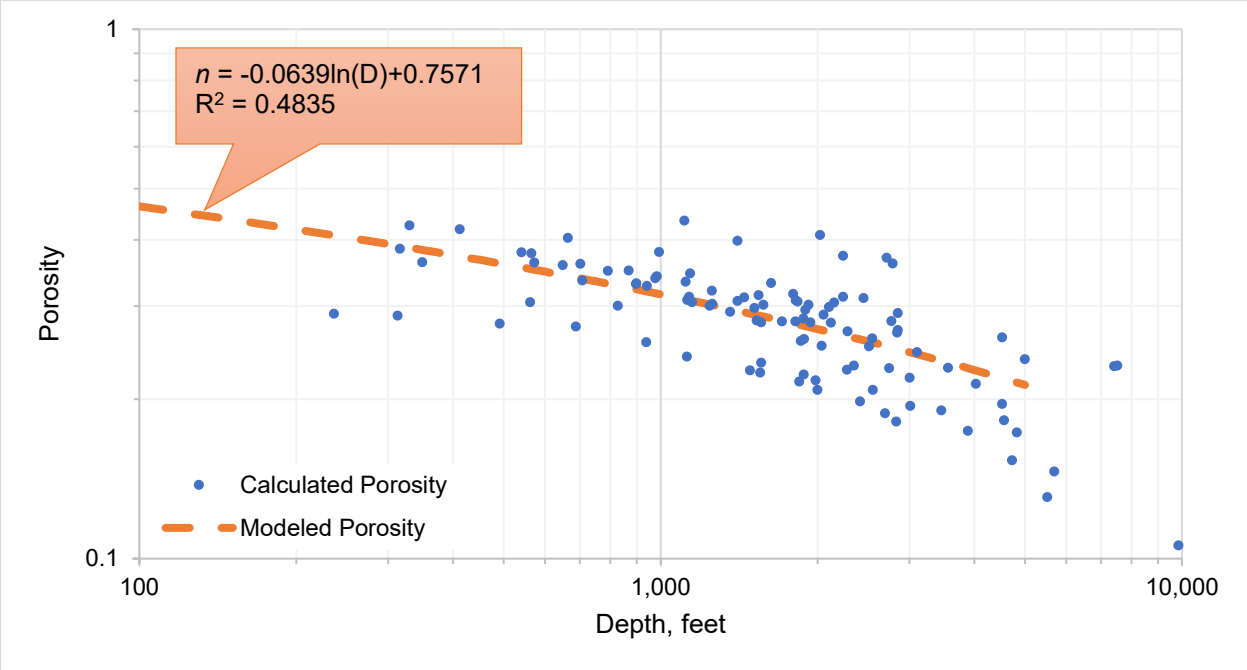


Figure 3. Calculated and modeled porosity with depth based on data reported by Gabrysch and Bonnet (1974; 1976a; 1976b)

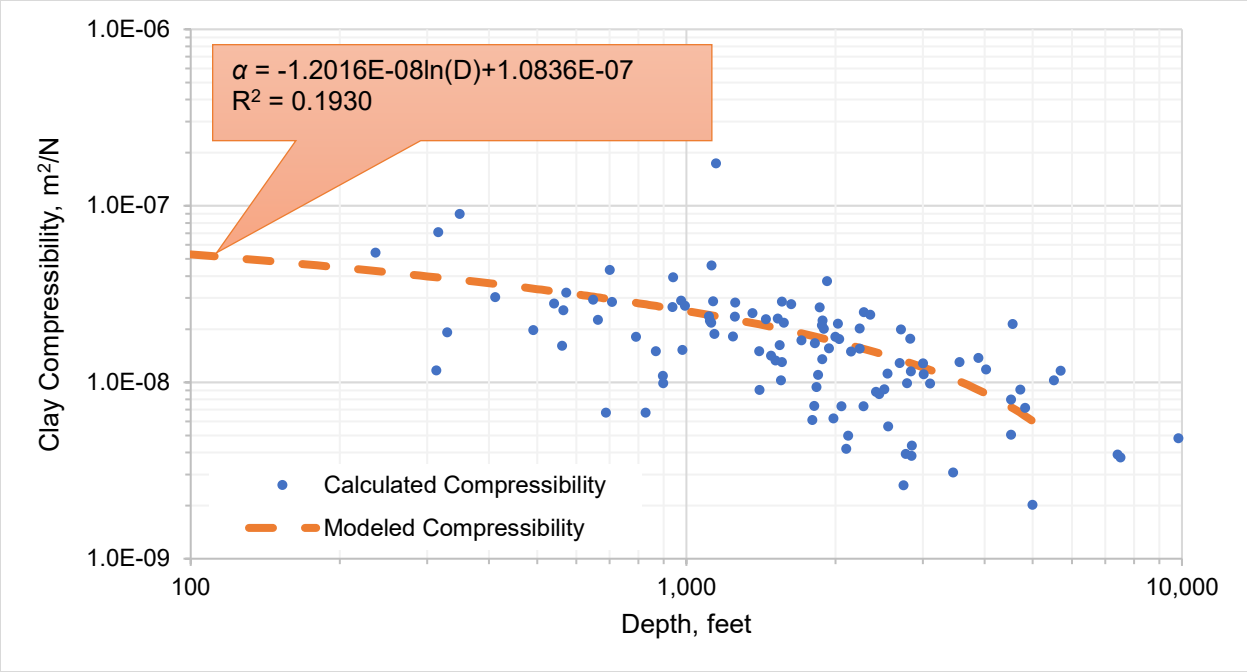


Figure 4. Calculated and modeled clay compressibility with depth based on data reported by Gabrysch and Bonnet (1974; 1976a; 1976b).

Per Equation 2, we also need the compressibility of water to calculate specific storage. Kelley and others (2018) used a constant value of 4.4E-10 m^2/N for the compressibility of water. However, the compressibility of water is not a constant value, and it varies with the temperature of the water. We can estimate the temperature of water at depth based on the average annual air temperature of 20°C (Long, 2020) and a geothermal gradient of about 9°C per 1,000 feet of depth (Young and others, 2016). We can then use Kell's (1975) equation for the isothermal compressibility of water:

$$\beta = \frac{5.088496\times10^{-10}+6.163813\times10^{-12}t+1.459187\times10^{-14}t^2}{+2.008438\times10^{-16}t^3-5.847727\times10^{-19}t^4+4.10411\times10^{-21}t^5} \quad (7)$$
$$1+0.01967348t$$

where

$\beta = isothermal\ compressibility\ (Pa^{-1} \equiv \frac{m^2}{N})$

$t = temperature$ (℃)

Using each of the calculated parameters, we then applied Equation 2 and Equation 3 to calculate the inelastic and elastic specific storage, respectively, for the clay samples.

Figure 5 and Figure 6 illustrate the calculated and modeled clay inelastic and elastic specific storage, respectively. Like the porosity and compressibility values, the specific storage values decrease with depth.

All other factors being equal, lower values of clay specific storage result in less predicted compaction. Overall, our modeled values of clay specific storage based on the Gabrysch and Bonnet (1974; 1976a; 1976b) data are similar in magnitude to the modeled values of Kelley and others (2018). Table 1 provides a comparison of our calculated values and those of Kelley and others (2018).

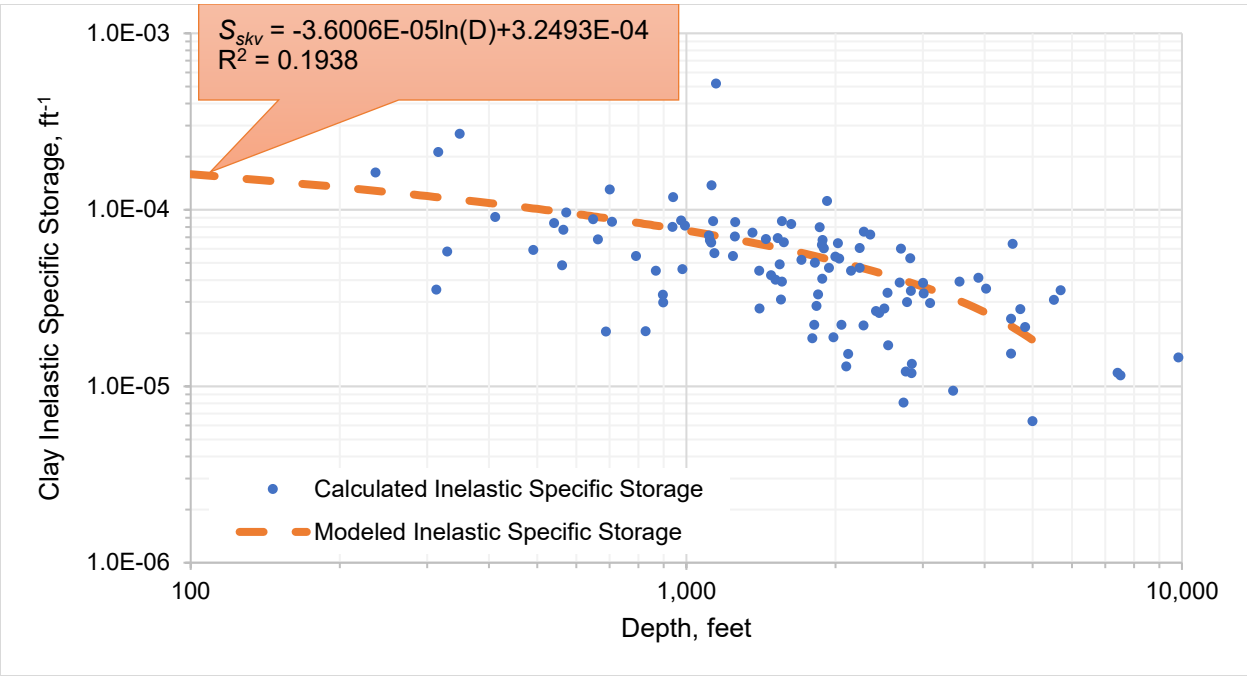


Figure 5. Calculated and modeled clay inelastic specific storage with depth based on data reported by Gabrysch and Bonnet (1974; 1976a; 1976b).

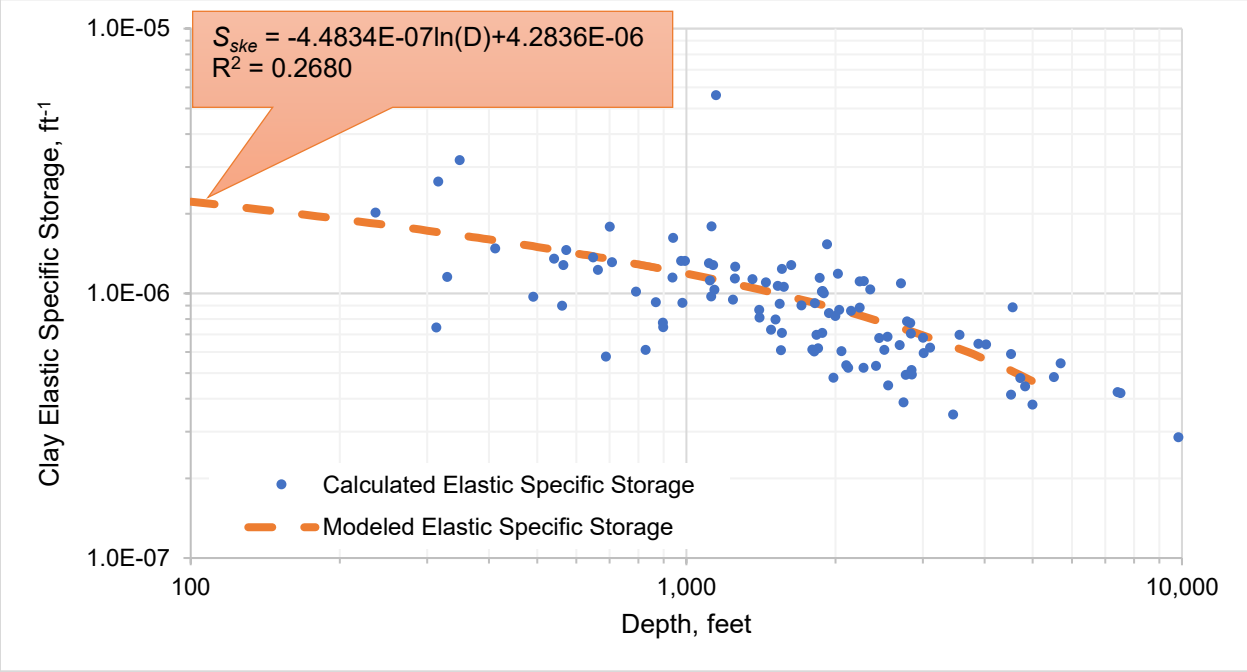


Figure 6. Calculated and modeled clay elastic specific storage with depth based on data reported by Gabrysch and Bonnet (1974; 1976a; 1976b)

Table 1. Comparison of estimated specific storage of clay beds.

Burial Depth (ft)	Clay Inelastic Specific Storage (ft^{-1})			Clay Elastic Specific Storage (ft^{-1})		
	HGSD	LSGCD	Difference	HGSD	LSGCD	Difference
100	3.5E-04	1.6E-04	1.9E-04	4.2E-06	2.2E-06	2.0E-06
250	1.9E-04	1.3E-04	5.9E-05	2.4E-06	1.8E-06	5.7E-07
500	1.1E-04	1.0E-04	1.3E-05	1.6E-06	1.5E-06	8.6E-08
750	8.6E-05	8.7E-05	-7.5E-07	1.3E-06	1.3E-06	-5.4E-08
1,000	7.0E-05	7.6E-05	-6.1E-06	1.1E-06	1.2E-06	-1.1E-07
1,500	5.3E-05	6.2E-05	-8.8E-06	8.7E-07	1.0E-06	-1.3E-07
2,000	4.3E-05	5.1E-05	-8.1E-06	7.5E-07	8.8E-07	-1.2E-07
2,500	3.7E-05	4.3E-05	-6.3E-06	6.7E-07	7.8E-07	-1.0E-07
3,000	3.3E-05	3.7E-05	-4.1E-06	6.2E-07	6.9E-07	-7.7E-08

HGSD = Kelley and others (2018)
LSGCD = This report

The biggest differences are at shallower depths of 500 feet or less. These differences at shallower depths are due to the type of mathematical trend. Using the functions with Microsoft Excel, we applied a logarithmic trend which appears to follow a curved trend in the data whereas Kelley and others (2018) applied a power trend which results in a straight-line on the plots. Also, while both the power and logarithmic trends result in unrealistic porosity values at shallow depths, the logarithmic trend more closely reflects the expected maximum of about 60 percent (Fetter, 1994). For example, the trend line of Kelley and others (2018) results in a clay porosity of 85 percent at a depth of 10 feet while the logarithmic trend we applied results in a clay porosity of 61 percent for the same depth.

Importantly, the values calculated are for samples collected the Chicot and Evangeline aquifers. While our calculated results for specific storage are similar to those of Kelley and others (2018), like those of Kelley and others (2018) they do not represent samples collected from the Jasper Aquifer. While we are able to determine a trendline through the calculated values on

Figure 5 and Figure 6, there is more than an order of magnitude difference in the values for similar depths. This variability should be considered when applying the modeled values to compaction in the Chicot and Evangeline. With the Jasper being an older formation, it is possible the lower bounds of the variability should be considered as a starting point or possibly favored during evaluations using these results.

Vertical Hydraulic Conductivity

The specific storage values of the clay beds control the amount of compaction that can occur under a given amount of stress. However, to determine the rate at which compaction occurs we also need to know the vertical hydraulic conductivity and thickness of the clay beds (discussed below) along with the specific storage.

The thickness and vertical hydraulic conductivity of individual clay beds affects the rate at which compaction may occur. When pumping from the aquifer occurs, water will preferentially move through the coarser-grained sediments (that is, sand) causing a pressure (that is, water level) decline in those layers of coarser-grained sediments. The decrease in pressure within the coarser-grained sediment layers creates a pressure gradient between the coarser-grained sediment layers and the finer-

grained (that is, clay) sediment layers. This pressure gradient causes water to move from the finer-grained sediment layers into the coarser-grained sediment layers resulting in a decrease in pressure (and increase in effective stress) within the finer-grained sediment layers.

The decrease in pressure in a finer-grained sediment layer occurs immediately at the interface between that layer and the coarser-grained sediment layer. The decrease in pressure in the finer-grained sediment layer then propagates toward the center of the layer. Assuming consistent hydraulic properties of the layer, as the thickness of the finer-grained sediment layer increases, the time it takes for the pressure decrease to propagate to the center of the layer also increases. The amount of time it takes for full compaction to occur can be expressed as a "time constant" in the compaction calculations (Hoffman and others, 2003). The time constant (τ_0) in Equation 8 represents the amount of time at which about 93 percent of the ultimate clay bed compaction will occur. As illustrated in Figure 7, approximately 50 percent of the compaction occurs relatively rapidly (within about 20 percent of the time constant) and then gradually slows over time.

$$\tau_0 = \frac{\left(\frac{b_0}{2}\right)^2 S_s}{K_v} \tag{8}$$

where:

$b_0 = initial\ thickness\ of\ the\ clay\ bed$

$S_s = specific\ storage\ of\ the\ clay\ bed$

$K_v = vertical\ hydraulic\ conductivity\ of\ the\ clay\ bed$

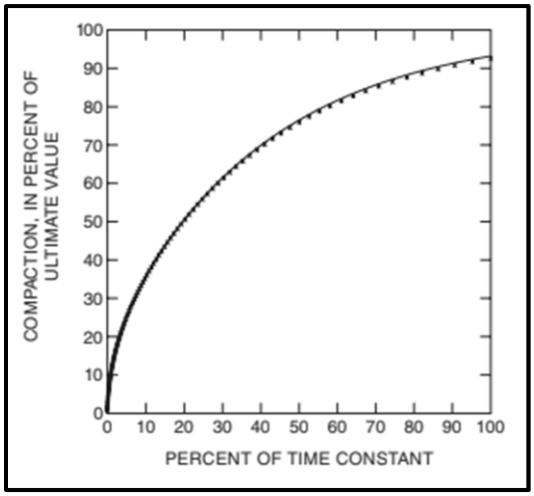


Figure 7. Illustration of compaction as a function of the compaction time constant. Reproduced from Hoffman and others (2003).

Kelley and others (2018) report using vertical hydraulic conductivity values as measured by Gabrysch and Bonnet (1974). However, Gabrysch and Bonnet (1974) only report measured hydraulic conductivity values and do not specify whether those values are horizontal or vertical. Analysis of the data reported by Gabrysch and Bonnet (1974), for samples where the effective stress was greater than the sample depth, provides a range of hydraulic conductivity values from 5.95E-07 to 6.5E-05 feet

per day (ft/d). Table 2 provides representative values of the horizontal and vertical hydraulic conductivity of clay.

Table 2. Representative values for horizontal and vertical hydraulic conductivity of clay (Walton, 1987).

Horizontal Hydraulic Conductivity (ft/d)	2.66E-05 – 2.66E-04
Vertical Hydraulic Conductivity (ft/d)	6.52E-09 – 1.33E-07

Comparing the clay hydraulic conductivity results from Gabrysch and Bonnet (1974) to the representative values, the data from Gabrysch and Bonnet (1974) are similar to the representative horizontal hydraulic conductivity values and greater than the representative vertical hydraulic conductivity. While it is possible that the samples from Gabrysch and Bonnet (1974) are outliers to the representative values, we should not assume the values are measurements of the vertical hydraulic conductivity when they were not reported as such.

Kelley and others (2018) developed a model of the vertical hydraulic conductivity with depth based on their analysis of the Gabrysch and Bonnet (1974). To provide a lower bound on their vertical hydraulic conductivity estimates, Kelley and others (2018) also developed a depth dependent model using parameters from PRESS models which are used to simulate one-dimensional compaction in the area. The PRESS vertical hydraulic conductivity values are calibrated model parameters for prediction of compaction within the Chicot and Evangeline aquifers. Figure 8 illustrates the two models developed by Kelley and others (2018) for estimating the vertical hydraulic conductivity of clays within the brackish Jasper Aquifer.

Kelley and others (2018) used the average of the PRESS input model and the core data model to define the vertical hydraulic conductivity of clays in the brackish Jasper Aquifer model. As shown on Figure 8, the use of this average of the two models results in consistently higher vertical hydraulic conductivity values for the clays in the brackish Jasper Aquifer than for clays in the shallower and younger formations. As depth increases the disparity between the models increases with modeled vertical hydraulic conductivity values at a depth of 2,000 feet being an order of magnitude greater for the Jasper than the PRESS models would assume for Chicot and Evangeline. The effect of this difference may be illustrated through a comparison of the representative value for vertical hydraulic conductivity (Table 2) and the model developed by Kelley and others (2018) using the Gabrysch and Bonnet (1974) data.

All other factors being equal, a lower vertical hydraulic conductivity results in a greater time constant. With vertical hydraulic conductivity as the denominator in Equation 8, each decrease in the order of magnitude in the value causes a corresponding increase in the order of magnitude in the time constant. For example, at a depth of 1,000 feet a 10-foot thick clay bed with a specific storage of 7.74E-05 ft^{-1} (sum of LSGCD values in Table 1) the time constant would be 520 days based on Kelley and others (2018) analysis of the Gabrysch and Bonnet (1974) data (K_v = 3.72E-06 ft/d) but would be more than 14,500 days based on the maximum representative value (K_v = 1.33E-07 ft/d).

The approach by Kelley and others (2018) results in vertical hydraulic conductivity values for the clays of the Jasper Aquifer that are higher than those used in modeling of the younger stratigraphic units. Their approach would result in modeled compaction occurring at a much higher rate in the

Jasper than would occur in the Chicot and Evangeline, despite the Jasper being at greater depth than the overlying units. Assuming similar lithologic compositions, it is unlikely that the older and deeper clay units within the Jasper Aquifer would compact at a higher rate than younger and shallower sediments and the conceptualization of this parameter should not be applied within the regional model of the Gulf Coast Aquifer System.

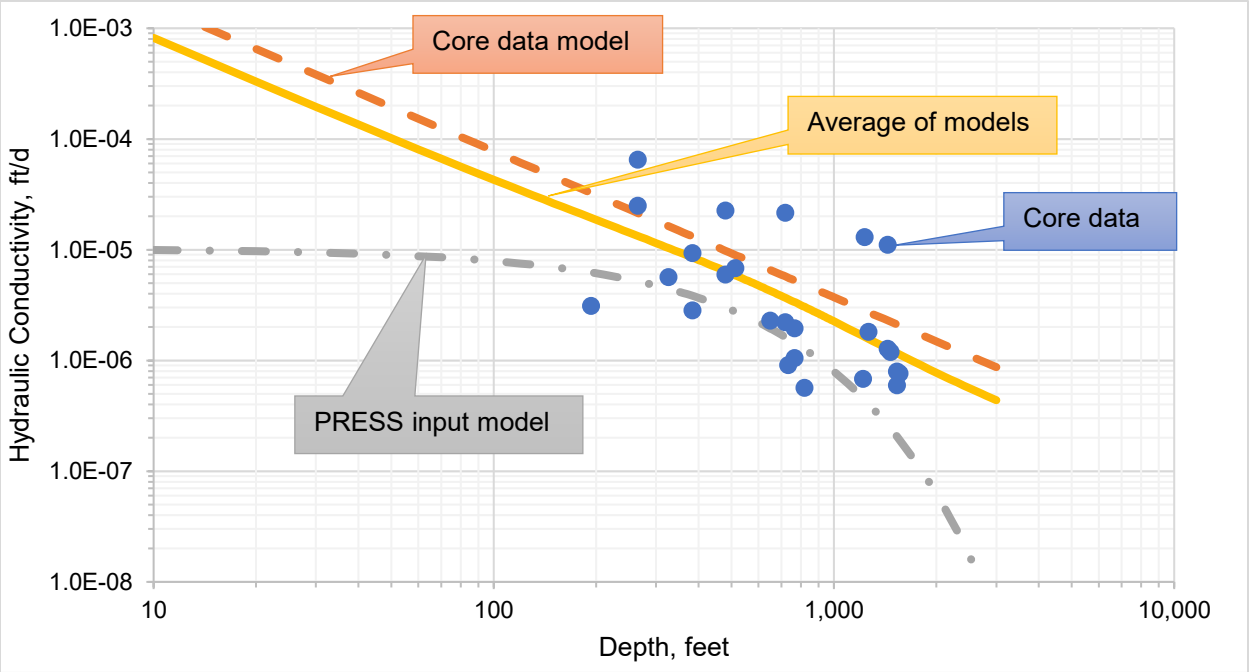


Figure 8. Comparison of the depth dependent vertical hydraulic conductivity models developed by Kelley and others (2018) for the brackish Jasper Aquifer.

Preconsolidation Stress

Irreversible compaction of subsurface sediments begins when sediments are not fully consolidated and the effective stress is greater than the preconsolidation stress (that is, maximum effective stress). Commonly, the preconsolidation stress is synonymous with the preconsolidation head (that is, water level) of the aquifer (Leake and Prudic, 1991; Hoffman and others, 2003). While a single head value is not necessarily sufficient for calculating the effective stress (Leake and Galloway, 2007), for most analyses it provides a reasonable approximation.

Another way to describe the preconsolidation stress is relative to the amount of drawdown that needs to occur before permanent compaction begins. That is, how much do water levels need to decline before the effective stress is greater than the preconsolidation stress? For the Jasper Aquifer, Kelley and others (2018) conceptualized this "drawdown at preconsolidation stress" to be about 75 feet at ground level and decreasing linearly to zero (0) feet at 870 feet below ground level. That is, they conceptualized that compaction would occur immediately with pressure (that is, water level) decline in sediments at depths at or below 870 feet.

For the drawdown at preconsolidation stress, Kelley and others (2018) indicate the value near land surface (75 feet) is consistent with the Houston Area Groundwater Model (Kasmarek, 2013). In that model, Kasmarek (2013) set the preconsolidation head for the clay units as 70 feet below the starting

head (that is, water levels) for the model. These starting heads represented his best estimate of water levels in 1890. Within the model, "for changes in head in which head declines below preconsolidation head, an inelastic response is computed, permanent clay compaction is calculated, and the preconsolidation head is reset to the new head value" (Kasmarek, 2013). That is, per Kasmarek (2013) if the simulated water level declines below the 1890 estimated water level minus 70, then compaction occurs and the new water level becomes the preconsolidation head.

Kelley and others (2018) indicate their conceptualization of drawdown at preconsolidation stress is consistent with current PRESS models. As noted above, the PRESS values are calibrated model parameters for prediction of compaction within the Chicot and Evangeline aquifers and we should exercise caution in assuming the values are applicable to the deeper formations. As Kelley and others (2018) state: "the relationship describing drawdown at preconsolidation stress is very uncertain."

As discussed by Keester and others (2021), the conceptualization of drawdown at preconsolidation stress by Kelley and others (2018) may be inconsistent with observed water-level declines, extensometer measurements, and GPS-modeled vertical displacement at the Lake Houston extensometer site (shown on Figure 9). However, Kelley and others (2018) did not consider these data during their analyses.

The Lake Houston extensometer was completed in 1980 and the reported cumulative compaction within the Chicot and Evangeline aquifers at the end of 2019 was about 7.5 inches. For sediments below the Evangeline, the Lake Houston extensometer and GPS-modeled vertical displacement suggest no measurable compaction occurred. However, during the period of measured compaction in the Chicot and Evangeline aquifers, water levels in the Jasper Aquifer nearly 2,600 feet below ground level have declined by more than 150 feet. Figure 10 illustrates the cumulative compaction of the Chicot and Evangeline aquifers (that is, extensometer data), Jasper Aquifer water level change, and compaction of the formations below the Evangeline (GPS).

One possible reason why no measurable compaction occurred in the units below the Chicot and Evangeline aquifers is that the effective stress in the Jasper at the Lake Houston site has not increased to the point where compaction would occur; that is, the water level is still above the preconsolidation head. If the Jasper water level is above the preconsolidation head despite having declined more than 150 feet since 1980 and the depth of the measurement interval being nearly 2,600 feet below ground level, then the drawdown at preconsolidation stress for the Jasper Aquifer as conceptualized by Kelley and others (2018) must be reconsidered. As indicated above, Kelley and others (2018) conceptualized that any drawdown in the Jasper at depths greater than 870 feet would immediately result in inelastic compaction; however, reported data from the Lake Houston site appear to contradict this conceptualization.

Similarly, Gabrysch (1982) noted that deeper layers of the Evangeline at the Clear Lake site (see Figure 1) were not compacting due to water level declines. In his opinion, "Data from the Clear Lake site, where no appreciable compaction of the lower part of the Evangeline aquifer was occurring even though artesian-head declines were occurring, indicate that compaction of the deeper clay layers needs to be excluded in estimating largescale subsidence." Like the Lake Houston site, the lack of observed compaction in the deeper intervals may be due to the water levels not yet declining to preconsolidation head but the observations should be considered and addressed as part of the conceptual model.

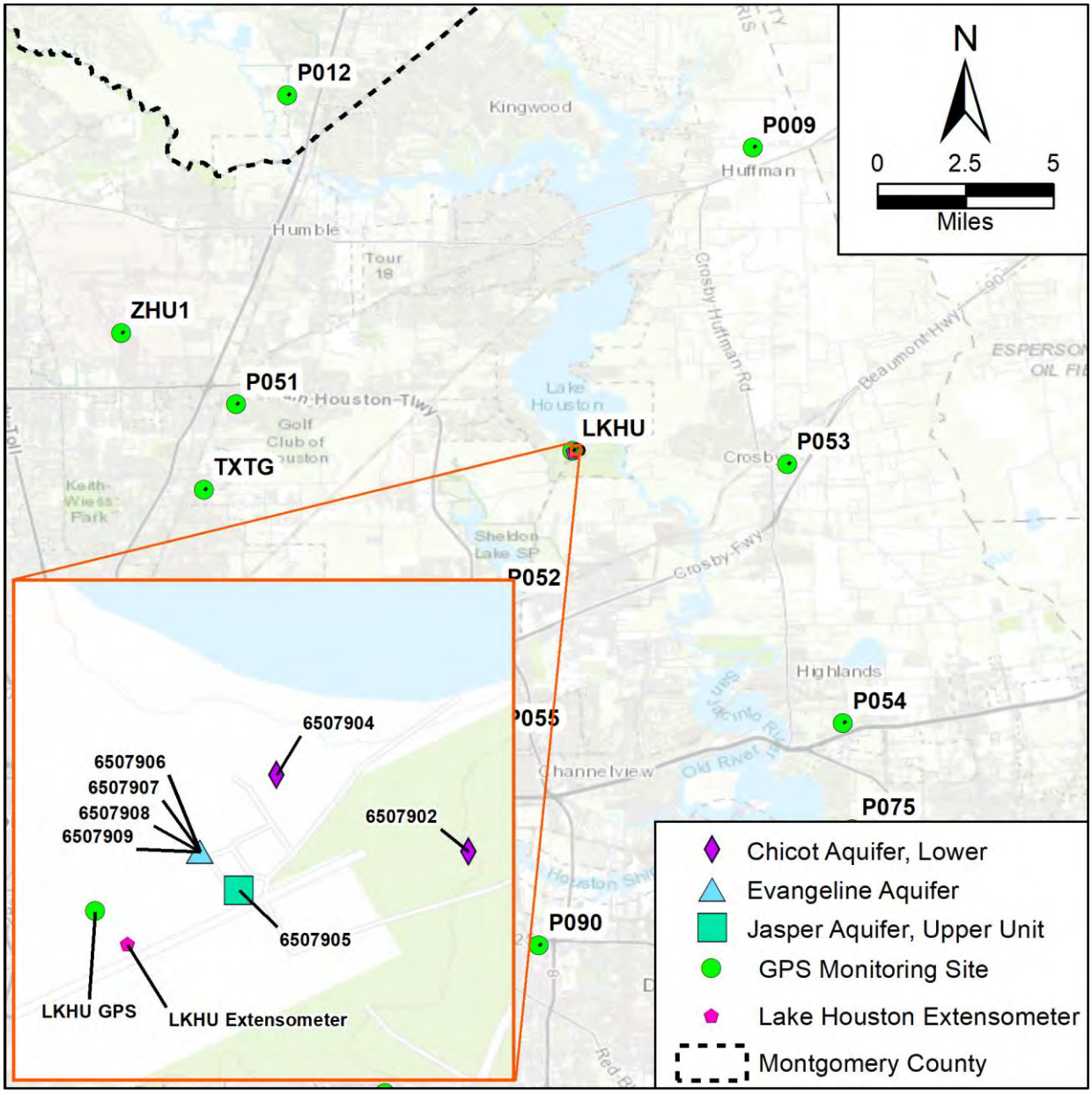


Figure 9. Wells associated with the Lake Houston extensometer site and nearby GPS monitoring sites

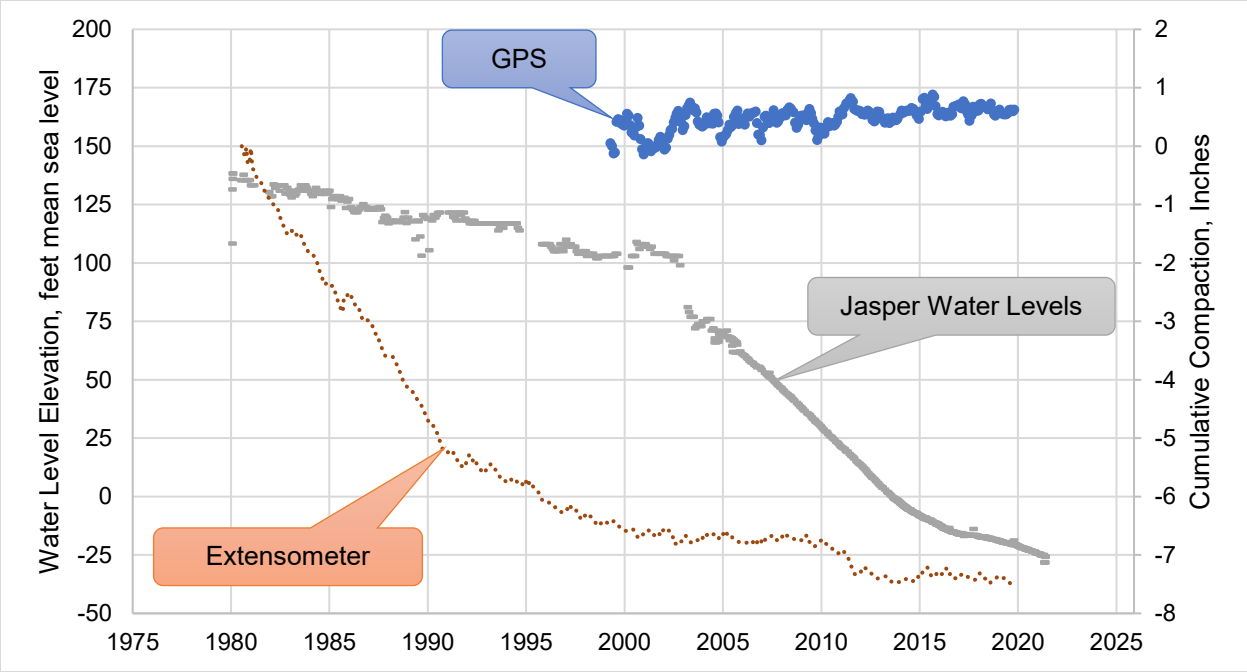


Figure 10. Hydrograph of reported water level measurements from the Lake Houston site Jasper Aquifer monitoring well (TWDB, 2021b), reported cumulative compaction of the Lake Houston extensometer (Ramage and Shah, 2019), and GPS modeled vertical displacement of the subsurface units below the Evangeline Aquifer (https://hgsubsidence.org/GPS/)

Other Considerations

In the conceptual model section of their report, Kelley and others (2018) state that they will review the available data for estimating the properties governing compaction. They identify four properties that are important for their conceptual model of the Jasper Aquifer: specific storage, the thickness of clay beds, the vertical hydraulic conductivity of the clays, and the drawdown at preconsolidation stress. Other interrelated considerations which may influence the conceptualization of compaction and, certainly, the parameterization values and distributions of the factors Kelly and others (2018) identified, derived, or estimated in the Jasper Aquifer include:

- Geometry of geologic units – structural geology maps, model layers, and hydrogeologic cross sections all show that the formations that comprise the Gulf Coast Aquifer System form a "wedge" shape that thickens toward the Gulf of Mexico. Young and others (2012) provide a schematic dip cross section that illustrates older (that is, deeper) beds dipping steeper than the overlying younger beds. Similarly, Popkin (1971) reports that within Montgomery County the Catahoula (which is below the Jasper) dips at 90 feet per mile, while the formations that comprise the Chicot dip at about 10 feet per mile, and intermediate beds dip from between 40 to 85 feet per mile. So far, this study has not discovered any literature that discusses whether variations in geologic dip can affect compaction.

  Additionally, the sediments in each formation thicken toward the coastline and generally, depending on the distribution of depositional systems, the clay interbeds become more numerous and total clay thickness and percentages increase toward the Gulf of Mexico. As the geologic units thicken, the arrangement and distribution of sand and clay beds vary. Also, the dip, depth and thickness of sands and clays also determine the amount of artesian head reduction that can occur in a particular producing interval. Therefore, updip formations generally have less overall potential for compaction if all other factors are equal.

- Depositional environments and associated sediment characteristics and lithologies – Young and others (2012) provide a thorough discussion of depositional systems and related facies. For example, lithology of geologic units at land surface is a key factor in the resulting topography. Approximately the northwestern half of Montgomery County is characterized by topography with rolling hills and incised drainages, while the southeastern part of the county is generally flat and gently sloping toward the coast. Popkin (1971) reports that land surface elevations range from about 45 feet above mean sea level in southeastern parts of the county to about 440 feet above mean sea level in the northwestern corner. Popkin (1971) also notes that the younger geologic units at land surface form a plain while the older units cropping out farther inland and at higher elevations form cuestas or sand hills. Such features can be important in more precisely delineating depositional distributions and formation characteristics. Also, sediment characteristics such as particle size, roundness, mineral composition, and sorting also factor into compaction characteristics of fine-grained layers. These characteristics vary by deposition setting. Young and others (2012) provided depositional facies definitions and predicted flow characteristics. Reasonable parameterization of models should be based on the most accurate representation of geologic conditions possible. Baker (1979) outlined selected faunal markers for various geologic layers, particularly for the Burkeville Confining System and deeper units. As LSGCD moves

into subsequent study phases and collects core samples, such markers should be identified where present in order to accurately determine the geologic layers and aquifer stratigraphy.

- Mineralogy, geochemistry, and diagenesis – the properties of clay, mudstones and shale vary greatly depending on the mineralogy and textural characteristics. With respect to clay deposits, the type of clay mineral can affect the compaction characteristics of the interbeds. For example, montmorillonite retains more water than illite which retains more water than kaolinite (Meade, 1964). Kelley and others (2018) note that clays composed of montmorillonite have the highest compressibility.

  Wilson (1962) referring to a field trip stop south of LaGrange, Texas on Highway 71 notes that "…X-ray analyses show that the Catahoula in Central Texas is a calcium-montmorillonite without illite. The Oakville and Fleming clay is sodium-rich, mixed-layer montmorillonite with illite". Gabrysch and Bonnet (1976a; 1976b) report that samples collected from the sites shown on Figure 1 indicate the clays in the Chicot and Evangeline aquifers are a mix of clay minerals with the Baytown and Johnson Space Center sites being predominantly montmorillonite.

  The ionic composition of interstitial fluids (that is, water) and the clay minerals also play a part in the rate of draining of clay porosity and resulting compaction. The American Geological Institute defines diagenesis as "the process involving physical and chemical changes in sediment after deposition that converts it to consolidated rock; includes compaction, cementation, recrystallization, and perhaps replacement as in the development of dolomite (American Geological Institute, 1976). Such factors can only be assessed by detailed sedimentation and geochemistry models, which are beyond the scope of this study, or on a site-by-site basis by collecting core samples of the formations.

- Thickness and distributions of individual clay interbeds – particularly as related to the sand intervals that form primary producing zones for wells in Montgomery County. Kelley and others (2018) provided a general summary comparing and contrasting thicknesses of individual clay beds in the various layers of the Gulf Coast Aquifer System. In the subsequent section we discuss our data collection and analysis of clay layer distribution within Montgomery County. In particular, we begin an assessment of the vertical and lateral distributions of clay interbeds and the positioning with respect to producing intervals in the Gulf Coast Aquifer System.

- Geologic age of clay layers – Gabrysch (1982) stated, "It is suspected that compressibility of the material is related to the age of sediments and the depth of burial." Similarly, the U.S. Geological Survey did not simulate compaction in the original Northern Gulf Coast groundwater availability model noting that the clay layers in the Jasper and Burkeville "…are geologically older, more deeply buried, and therefore more consolidated relative to the sediments of the Chicot and Evangeline aquifers" (Kasmarek, 2013). Prozorovich (1964) states that geologic age is not a controlling factor with respect to compaction. However, more recently Puttiwongrak and others (2021) concluded that geologic time does affect compaction. As additional information is gathered, particularly subsurface samples, relative importance of various factors can be evaluated.

Along with the parameters discussed by Kelley and others (2018), these additional types of factors must be carefully considered in three-dimensional space when developing concepts and parameters associated with compaction assessments and models. Gabrysch and Bonnet (1976a) note the importance of understanding the variability of distributions and characteristics of clay layers and their properties because the ratio of subsidence to water-level declines "…is not constant in time or uniform in space". Additionally, Gabrysch offers that such variations are "…caused primarily by the difference in total clay thickness, individual clay-bed thickness, and clay characteristics. The depth of the overburden and the amount of load to which the material has been previously subjected must also be considered" (Gabrysch and Bonnet, 1976a).

GULF COAST AQUIFER SYSTEM GEOLOGIC STRUCTURE

Our evaluation of the geologic structure aimed to improve the mapping of the elevation of the top and bottom of the subsurface hydrogeologic formations and to improve the understanding of the thicknesses of sand and clay intervals within the formations within Montgomery County. For decades a common approach was taken by groundwater professionals towards the delineation of water bearing units of the Gulf Coast Aquifer System in Montgomery and surrounding counties (Popkin, 1971; Gabrysch and Bonnet, 1974; 1976a; 1976b; Baker, Jr., 1979; Espey, Huston & Associates, Inc., 1979; Carr and others, 1985; Kasmarek and Robinson, 2004; Kasmarek, 2013). The delineation of the hydrogeologic units in this study continues that approach, combining an extensive understanding of practical local hydrogeology with geophysical log analysis.

Hydrostratigraphy

The Gulf Coast Aquifer System is comprised of, from shallowest (youngest) to deepest (oldest), the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit, the Jasper Aquifer, and the Catahoula Formation. The principal aquifers that provide groundwater in Montgomery County include the Chicot, Evangeline, and Jasper aquifers.

Figure 11 shows the surface geology with the estimated outcrop areas and updip extent of the Chicot, Evangeline, and Jasper aquifers and Burkeville Confining Unit within Montgomery County. The aquifer outcrops shown on Figure 11 were adopted from LBG-Guyton Associates (2016). Montgomery County has a surface area of approximately 1,077 square miles. The Chicot Aquifer outcrop is the largest outcrop in the county and has an estimated area of about 798 square miles. The Evangeline Aquifer is located updip from the Chicot Aquifer outcrop and has an estimated area of about 223 square miles. The outcrop of the Jasper Aquifer can be found in the far northwestern part of Montgomery County and has an estimated area of approximately 24 square miles. The Burkeville Confining Unit is positioned between the outcrops of the Evangeline and Jasper aquifers and has an estimated area of about 32 square miles. The Catahoula Formation outcrop is further north and is not found in Montgomery County.

The geology of the Gulf Coast Aquifer System consists of a complex system of alternating layers of discontinuous sand, silt and clay. The similarities of sediments within each geologic unit can make it difficult to identify the individual geologic units that comprise the hydrogeologic units on geophysical logs. To put the complexity of the Gulf Coast Aquifer System into perspective, it should be noted that site-specific subsurface conditions must be evaluated for each water well that is constructed in the Gulf Coast Aquifer System in the greater Houston area.

Table 3 shows a correlation of the geologic and hydrogeologic units of the Gulf Coast Aquifer System within and near Montgomery County (Popkin, 1971; Young and Draper, 2020). The Chicot Aquifer is composed of the Beaumont, Lissie, and Willis formations. The Beaumont and Lissie formations are of Pleistocene age and the Willis Formation is of Pliocene age. The Goliad Sand and part of the Fleming Group (Upper Lagarto Formation) comprise the Evangeline Aquifer. The Burkeville Confining Unit is made up of the Middle Lagarto Formation and can extend into the upper and lower sections of the Lagarto Formation of the Fleming Group. The Jasper Aquifer also belongs to the Fleming Group and includes the Lower Lagarto and Oakville formations. There is some uncertainty

as to which geologic formation(s) would encompass the upper and lower sections of the Jasper Aquifer. The Catahoula Formation is of Oligocene age. The formations generally outcrop in bands that parallel the Gulf Coast and typically increase in depth and thickness to the south and southeast toward the coast.

The updip extent of the Chicot Aquifer generally aligns with the updip extent of the Willis Formation outcrop. The Lissie Formation can be found in the south and southeast parts of Montgomery County. The 2014 Bureau of Economic Geology Digital Geologic Atlas of Texas shows the Willis Formation (landward belt) and the Fleming Formation occurring at land surface in the northwest part of the county. The Evangeline Aquifer, Burkeville Confining Unit, and Jasper Aquifer are estimated to outcrop in the area where these formations outcrop. Note that the Willis Formation (landward belt) shown in the northwest part of Montgomery County on the Bureau of Economic Geology Digital Atlas of Texas is not included in Table 3.

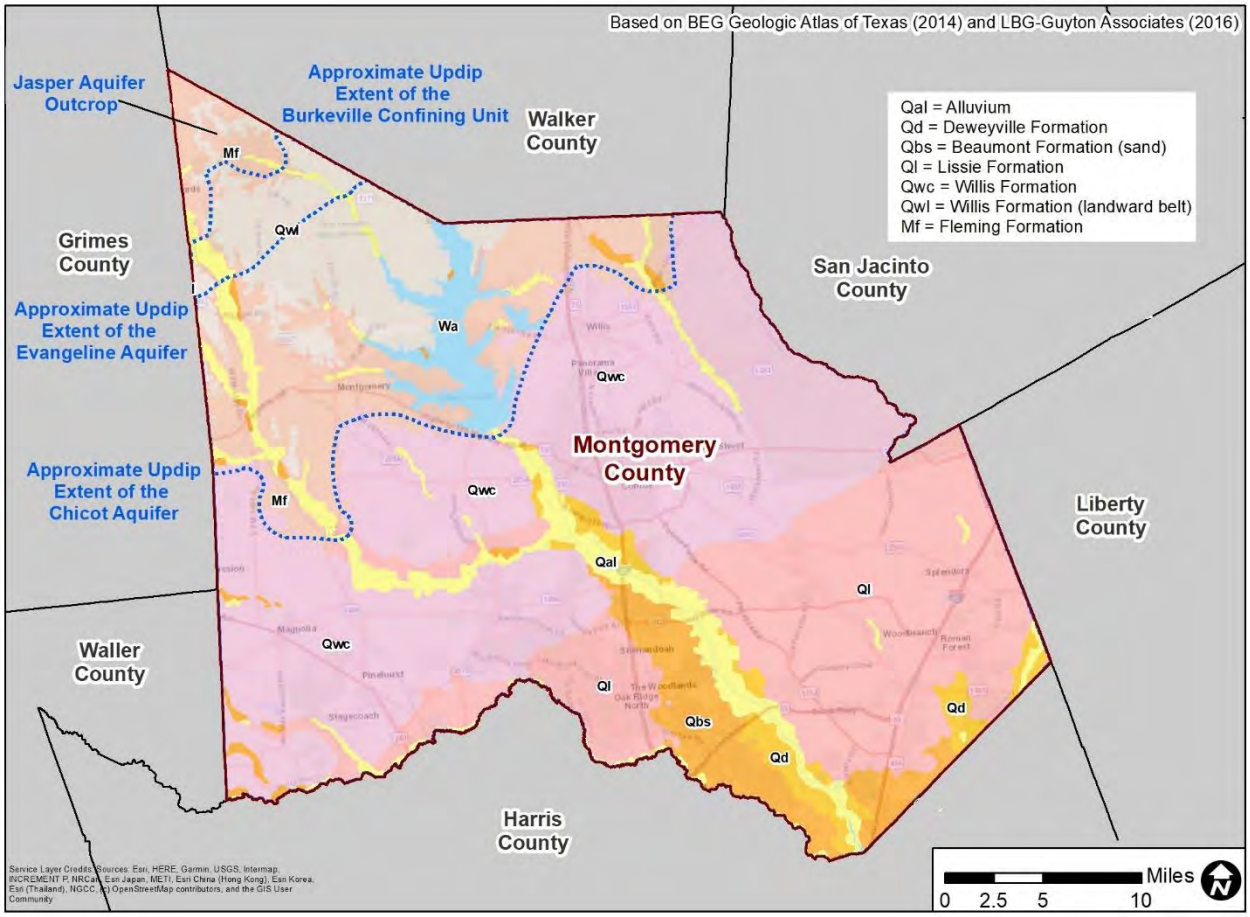


Figure 11. Montgomery County surface geology and approximate aquifer outcrop areas (Bureau of Economic Geology, 2014; LBG-Guyton Associates, 2016).

Table 3. Hydrogeologic and geologic units of the Gulf Coast Aquifer System within and near Montgomery County (Popkin, 1971; Young and Draper, 2020).

<table>
<tr><th>Epoch</th><th>Hydrogeologic Unit</th><th colspan="3">Geologic Unit</th></tr>
<tr><td>Holocene</td><td colspan="4">Alluvium</td></tr>
<tr><td rowspan="2">Pleistocene</td><td rowspan="3">Chicot Aquifer</td><td colspan="3">Beaumont Clay</td></tr>
<tr><td colspan="3">Lissie Formation</td></tr>
<tr><td>Pliocene</td><td colspan="3">Willis Formation</td></tr>
<tr><td rowspan="5">Miocene</td><td rowspan="2">Evangeline Aquifer</td><td colspan="2" rowspan="2">Goliad Sand</td><td>Upper</td></tr>
<tr><td>Lower</td></tr>
<tr><td rowspan="2">Burkeville Confining Unit</td><td rowspan="3">Fleming Formation</td><td rowspan="2">Lagarto</td><td>Upper</td></tr>
<tr><td>Middle</td></tr>
<tr><td>Upper Jasper Aquifer</td><td>Lower</td></tr>
<tr><td>Oligocene</td><td>Lower Jasper Aquifer
Catahoula</td><td>Oakville
Catahoula</td><td></td></tr>
</table>

The Chicot and Evangeline aquifers are considered a leaky artesian aquifer system consisting of unconsolidated and discontinuous layers of hydraulically connected sand and clay. The delineation of the Chicot and Evangeline aquifers can be difficult because an areally extensive confining unit does not exist between the two aquifers. Jorgensen (1975) discusses hydraulic conductivity as a basis for separating the Chicot Aquifer and Evangeline Aquifer in the Houston area. Differences in hydraulic conductivity are thought to cause, in part, differences in water level heads or elevations between the two aquifers. The differences in the static water level heads or elevations are noticeable and can be substantial in some areas, with the static water levels or heads in water wells completed in the Chicot Aquifer being shallower versus the static water levels in water wells completed in the Evangeline Aquifer. There also are differences in lithology, permeability and water quality in the Chicot Aquifer and Evangeline Aquifer. Geophysical logs of the test holes for water wells and oil and gas wells also have been used to estimate the resistivity of sand layers, the thicknesses of sand and clay units and help differentiate the contact of the Chicot and Evangeline aquifers in the greater Houston area.

Within the study area, the Burkeville Confining Unit is an aquitard or relatively impermeable layer that is positioned between the Evangeline and Jasper aquifers. The Burkeville Confining Unit can contain fresh to slightly saline water contained in individual sand layers but is considered a confining unit due to its large percentage of silt and clay compared to the Evangeline and Jasper aquifers (Baker,

Jr., 1979). The sand layers found in the Burkeville are typically thin and are not considered to be hydraulically connected.

While usually recognized as one hydrogeologic unit, the Jasper Aquifer can be divided into two sections, the Upper Jasper and Lower Jasper. Popkin (1971) had classified the Jasper Aquifer in Montgomery County into two units based on lithology, with the upper portion containing a massive sand layer and the lower part containing mostly interbedded sand and clay. The base of the Lower Jasper Aquifer as discussed by Popkin (1971) extends to a deeper elevation than what is considered the base of the Jasper Aquifer today. Baker, Jr. (1979) classified the Jasper Aquifer as a single hydrogeologic unit and interpreted the base of the Jasper Aquifer at a shallower elevation than Popkin's (1971) base of the Lower Jasper Aquifer. The base of the Jasper Aquifer corresponding to the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003) gained acceptance in Montgomery County through a LSGCD Groundwater Panel review during the early 2010's as the Catahoula Formation was being explored as an alternative water resource.

The Catahoula Formation is below the base of the Jasper Aquifer and provides a fresh groundwater supply in the north part of Montgomery County where the formation can contain water with a total dissolved solids concentration of less than 1,000 milligrams per liter. Exploration of the Catahoula Formation as a potential water supply has occurred in a several areas of Montgomery County. Many of these efforts resulted in the completion of large capacity water wells screening the Jasper Aquifer due to the presence of brackish groundwater in the deeper portions of the Catahoula in southern Montgomery County.

Subsurface geologic faults and large oil and gas field locations in the vicinity of Montgomery County are shown on Figure 12. Oil and gas drilling activities are often concentrated at or near subsurface geologic features. Figure 13 shows the locations of oil and gas well and/or test hole locations in and near Montgomery County based on datasets available from the Railroad Commission of Texas (RRC, 2021). It should be noted that this is not a comprehensive location map for all oil and gas wells and/or test holes in this area. The regional dip, subsurface geologic structure, formation thickness and/or groundwater quality may be influenced by geologic structures such as salt domes (TC&B, 2004).

The Conroe Oil Field is the largest oil and gas field in Montgomery County and is located to the southeast of the City of Conroe. Discovered in 1931, the Conroe Oil Field is located over a deep-seated salt dome that occurs at depths of greater than 5,000 feet (TC&B, 2004). Other salt domes in the vicinity of the study area include the Hockley Dome and Humble Dome in Harris County and the North Dayton Dome in Liberty County as shown on Figure 13.

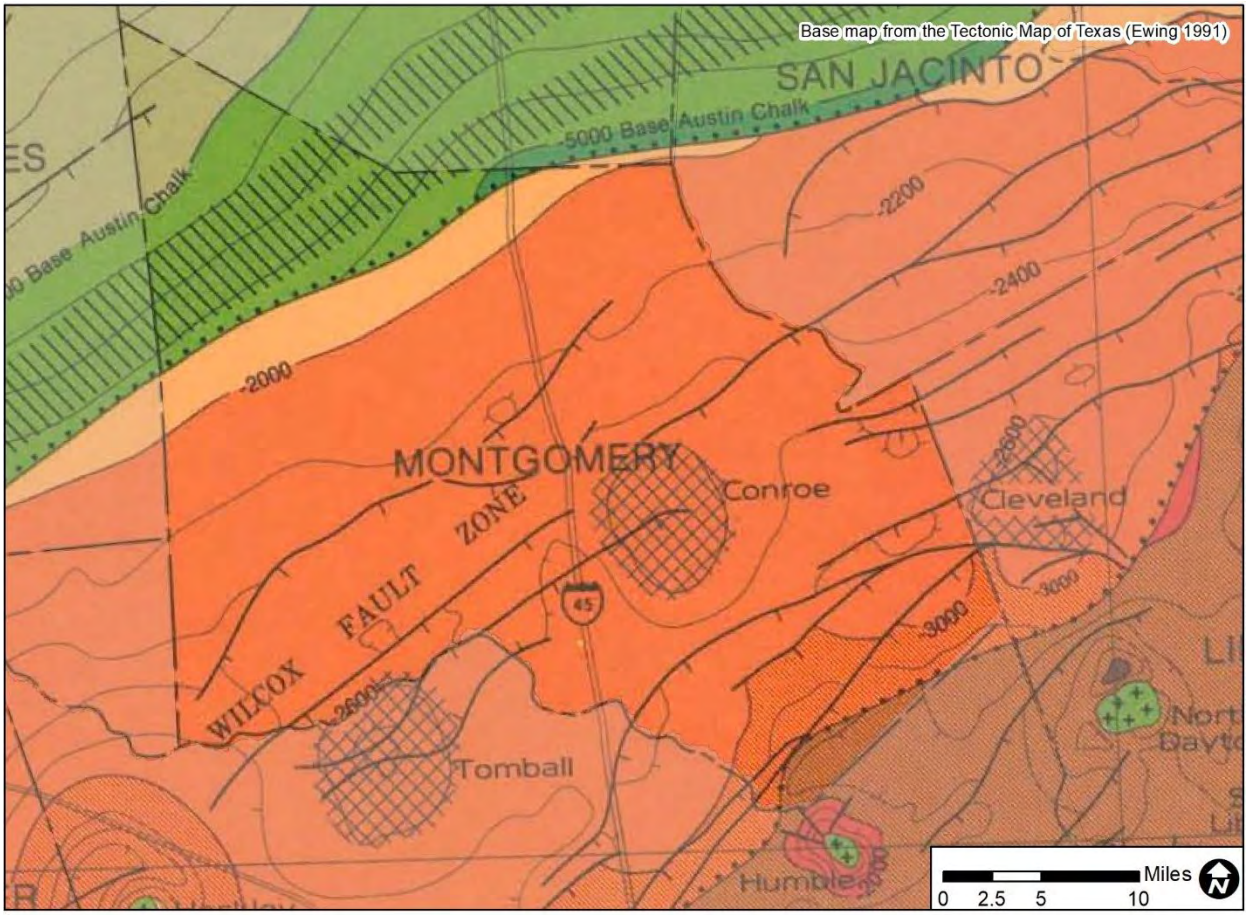


Figure 12. Subsurface faults and large oil and gas fields in the vicinity of Montgomery County (base map from the Tectonic Map of Texas, Ewing, 1991).

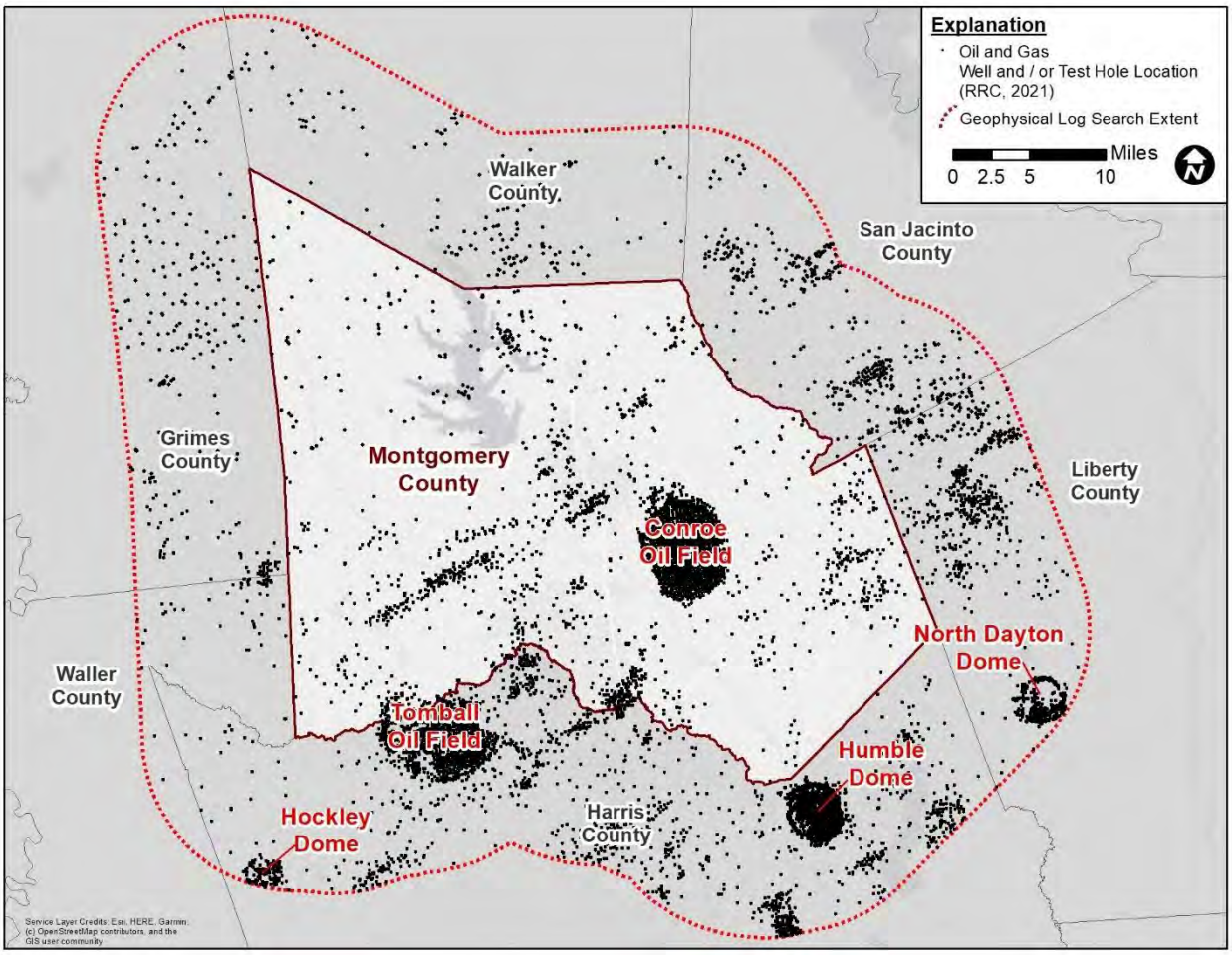


Figure 13. Locations of oil and gas wells or test holes (based on available data from the RRC, 2021).

Geophysical Log Evaluation

One of the goals of the LSGCD Phase 2 Subsidence Study is to improve the mapping and understanding of the subsurface hydrogeologic formations of Montgomery County. Geophysical logs are an important resource that can be utilized to estimate the depths, thicknesses, and composition of the subsurface hydrogeologic units that make up the Gulf Coast Aquifer System.

Geophysical or electric logs are evaluated using the resistivity curves that are shown to the right of the depth scale on the log along with other curves (such as, natural gamma, spontaneous potential, or porosity) when available. As the name implies, these resistivity curves measure the resistivity of the sands, clays, and fluids of the subsurface formations. Clean and coarse sands will have higher resistivity values than fine grained sand, sand intermixed with silt, silt, or clay (lowest resistivity values). Resistivity curves also can provide information on the general mineralization or gross quality of water within subsurface formations. Freshwater sands have higher resistivity values than sands that contain water with more mineralization and higher concentrations of total dissolved solids. The properties of resistivity and conductivity are inverses of each other, so higher resistivity equals lower conductivity. As a result, water that contains more dissolved minerals (that is, higher total dissolved

solids concentration) has a higher electrical conductivity and a lower electrical resistivity than water that has relatively low mineralization or total dissolved solids concentration.

Evaluation of spontaneous potential logs can be another way to assess the quality of the water contained within the subsurface formations. The spontaneous potential log is normally shown to the left of the depth scale on a geophysical log. The spontaneous potential curve will show little deflection as the logging tool passes through freshwater sands as freshwater is not highly conductive. The spontaneous potential curve will show more deflection as the logging tool passes through sands that contain water with higher total dissolved solids values.

For this study, the mapping of hydrogeologic units within Montgomery County focused on the Chicot, Evangeline, and Jasper aquifers and the Burkeville Confining Unit. The Jasper Aquifer has been divided into upper and lower units. The delineation of the base and total thickness of the Chicot, Evangeline, Burkeville, and Upper Jasper is based on geophysical log review. The base of the Lower Jasper Aquifer was established for this study using the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003).

LSGCD currently permits production from the Chicot and Evangeline aquifers as a single combined aquifer. However, it is important to understand the properties and structure of the individual aquifer units as these two aquifers are often represented as separate layers in groundwater flow models.

Geophysical Log Limitations

Evaluation of geophysical or electric logs to delineate the aquifers of the Gulf Coast Aquifer System is not an exact science. Selections of the top or bottom of a hydrostratigraphic unit is commonly based on experience and professional opinion. As illustrated later in our evaluation, the opinions regarding the top and bottom of hydrogeologic and geologic units can vary between professionals.

The geophysical log datum is a key component for standardizing the depth scale shown on a log. Often the depth shown on geophysical logs is converted to elevation relative to sea level in order to correct for variations in the land surface. The header of the geophysical log may contain the elevation of ground level, Kelly bushing, and drill floor, but often one or more pieces of this information is not available.

Acquiring geophysical logs that start shallow enough to include the base of the Chicot Aquifer was a priority consideration in our geophysical log assembly process. Locating logs that start shallow enough to include the base of Chicot Aquifer was challenging. Often the logs that have a top logged interval showing the base of Chicot Aquifer are relatively older (including from the 1940's) and can potentially be difficult to interpret due to the image quality of the log.

Geophysical Log Data

We evaluated a total of 146 geophysical logs obtained from public and private sources as part of this study. Most of the geophysical logs reviewed originate from oil and/or gas wells or test holes. The public sources for the geophysical logs include the TWDB Brackish Resources Aquifer Characterization System database (2021a) and the Texas Commission on Environmental Quality Water Well Report Viewer (2021). Geophysical logs also were purchased from a commercial log library in areas where geophysical log coverage was limited or not available from public sources. The

search radius for the geophysical logs extends up to 10-miles from Montgomery County in an effort to ensure adequate areal coverage. Figure 14 shows the locations of geophysical logs reviewed as part of this study.

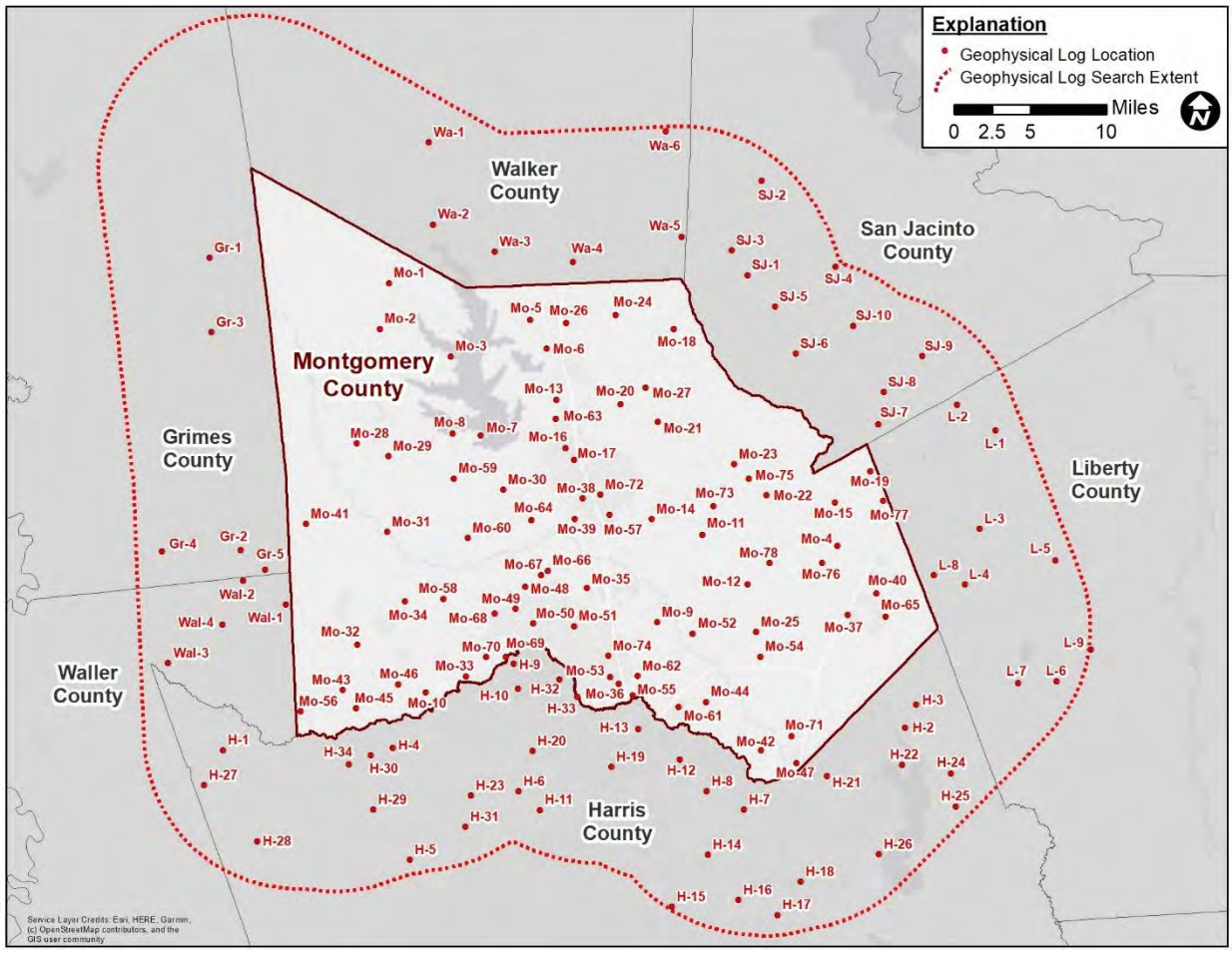


Figure 14. Locations of geophysical logs evaluated for this study.

The datum of the geophysical logs used in this study is based on the land surface elevation. The depth of the hydrogeologic unit selected from the geophysical log has been standardized to account for changes in the land surface elevation by converting the depth of the hydrogeologic unit to elevation relative to sea level. Appendix 1 includes a table that provides geophysical log data utilized in this study including the: Geophysical Log Number, API Number, State Well Number or "Q" Number, well or test hole operator and well ID, latitude and longitude, land surface elevation, and estimated hydrogeologic unit depth and elevation.

Typical Geophysical Logs

We identified 16 typical geophysical logs within Montgomery County and areas to the east and southeast of the county boundary to demonstrate the selection of the base of the hydrogeologic units in this study. Figure 15 shows the location of the geophysical type logs and reduced copies of the geophysical logs are included in Appendix 2. It should be noted that the estimated bases of the hydrogeologic units are shown in depth below land surface on the geophysical logs in Appendix 2.

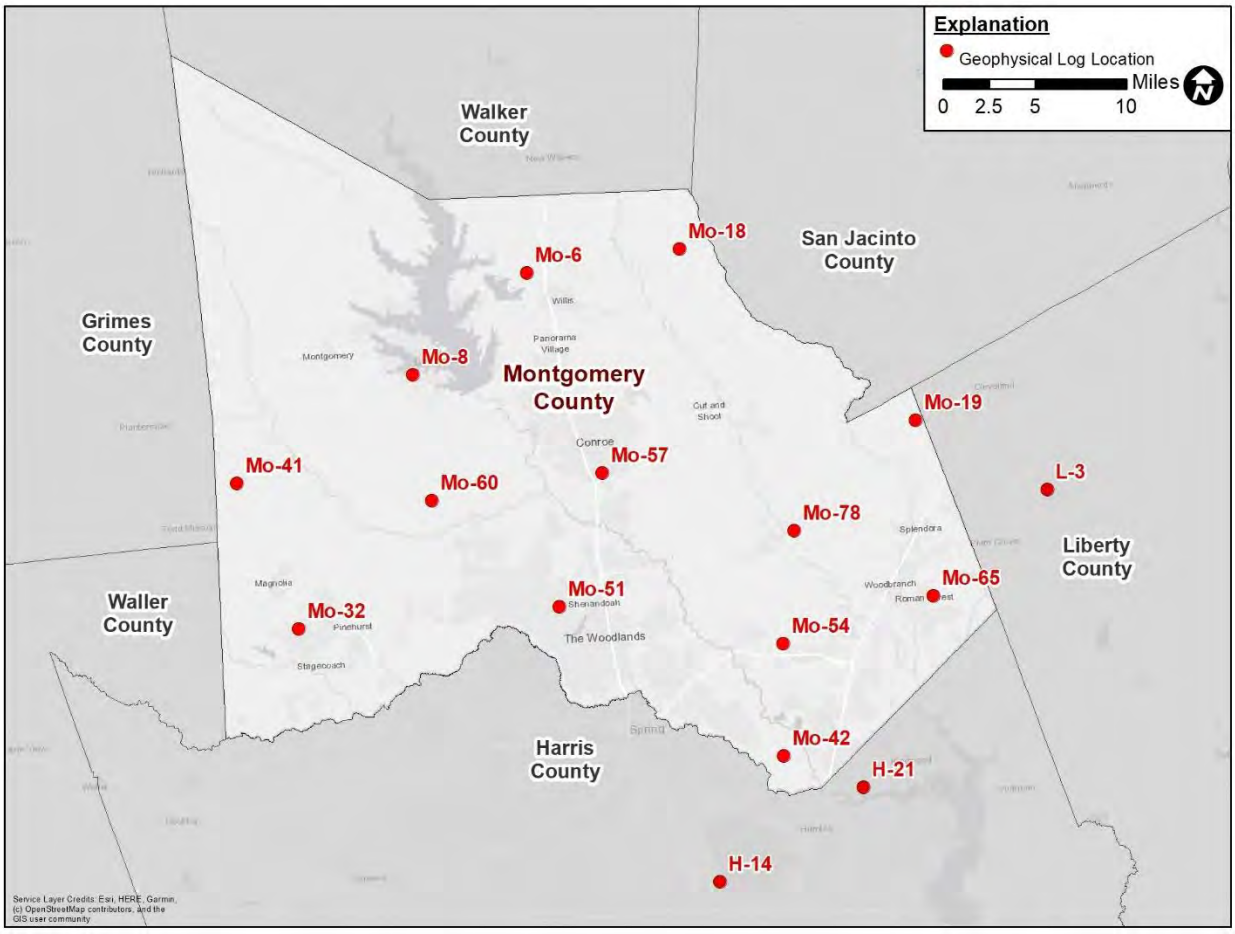


Figure 15. Locations of typical geophysical logs.

The geophysical logs in Appendix 2 show the estimated base of the Chicot, Evangeline, and Upper Jasper aquifers and Burkeville Confining Unit developed for this study, the base of the Jasper Aquifer according to the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003), and the base of the Lower Jasper Aquifer identified by Popkin (1971). We also identified the picks by Young and others (2012) and Young and Draper (2020), GULF-2023 dataset, on selected logs

In this study, the base of the Chicot Aquifer is generally estimated to occur at the base of shallow sands which have higher resistivity values and limited clay content. The higher resistivity values of the Chicot Aquifer often coincide with lower total dissolved solids concentrations in water collected and analyzed from water wells completed in the Chicot Aquifer relative to that of the water samples collected from wells completed in the Evangeline Aquifer.

Also, it should be noted that the base of the Lower Jasper as estimated by Popkin (1971) is significantly deeper than the United States Geological Survey Source Water Assessment Program base of Jasper estimate that gained acceptance in the early 2010's. In north Montgomery County, some of the sands that are screened in wells completed in the Catahoula Formation were considered to be part of the Lower Jasper according to the base of Lower Jasper Aquifer estimated by Popkin (1971).

Chicot Aquifer

The Chicot Aquifer is the shallowest hydrogeologic unit of the Gulf Coast Aquifer System occurring in Montgomery County and the aquifer outcrop is present at land surface over approximately 74 percent of the county. A lower amount of groundwater is pumped from the Chicot Aquifer relative to the Evangeline and Jasper aquifers in Montgomery County, with the primary use of the water being for domestic, irrigation (domestic and commercial), and some limited public supply.

Alternating layers of sand, silt, clay, and intermittent gravel comprise the Chicot Aquifer. The transition between the Chicot and Evangeline aquifers is not commonly clear and distinct. Historically, many United States Geological Survey and other scientists, geologists and engineers have used practical hydrogeology concepts, including noticeable differences in lithology, permeability, water levels, and water quality combined with geophysical log interpretation to identify the transition between the Chicot and Evangeline aquifers.

Figure 16 and Figure 17 show the estimated elevation of the base of the Chicot Aquifer and the estimated aquifer thickness, respectively. Evaluation of geophysical logs show that the aquifer is increasing in depth and thickness as the aquifer dips to the southeast towards the Gulf of Mexico. The Chicot Aquifer is estimated to dip at a rate of approximately 15 to 25 feet per mile to the southeast based on the geophysical logs used in this study. The base of the Chicot Aquifer is present at land surface in the outcrop area and is estimated to extend to an elevation of about -375 feet relative to sea level in the southeast part of Montgomery County. The thickness of the Chicot Aquifer increases with distance from the estimated updip extent of the aquifer outcrop to an estimated maximum thickness of approximately 470 feet in the southeast part of the county. The average thickness of the Chicot Aquifer in Montgomery County is estimated to be about 250 feet.

The estimated base of Chicot Aquifer elevation contour map developed for Montgomery County as part of this study is similar to the base of Chicot Aquifer maps shown in Espey, Huston & Associates (1979) and Carr and others (1985). The elevation of the base of the Chicot Aquifer is at or near sea level just to the north of the City of Conroe and the elevation of the base of the Chicot Aquifer is approaching about -400 feet relative to sea level near the Montgomery/Harris County line in the southeast part of Montgomery County in all three studies.

Evangeline Aquifer

The Evangeline Aquifer is positioned below the Chicot Aquifer and above the Burkeville Confining Unit. The aquifer outcrop is present at land surface over approximately 21 percent of Montgomery County. Groundwater pumped from the Evangeline Aquifer is utilized for public supply, commercial, irrigation and industrial uses.

The Evangeline Aquifer is made up of discontinuous layers of alternating sand and clay. Geophysical logs indicate that the Evangeline Aquifer dips at a rate of approximately 40 to 50 feet per mile to the southeast in Montgomery County. Figure 18 shows the estimated base of the Evangeline Aquifer occurring at a depth of about -800 feet relative to sea level in the southwest part of the county and about -1,400 feet relative to sea level in the southeast. Figure 19 shows the estimated thickness of the Evangeline Aquifer which increases with distance from the approximate updip extent in northwest Montgomery County to an estimated maximum thickness of more than 1,000 feet in the southeast part

of the county. The average thickness of the Evangeline Aquifer in Montgomery County is about 540 feet.

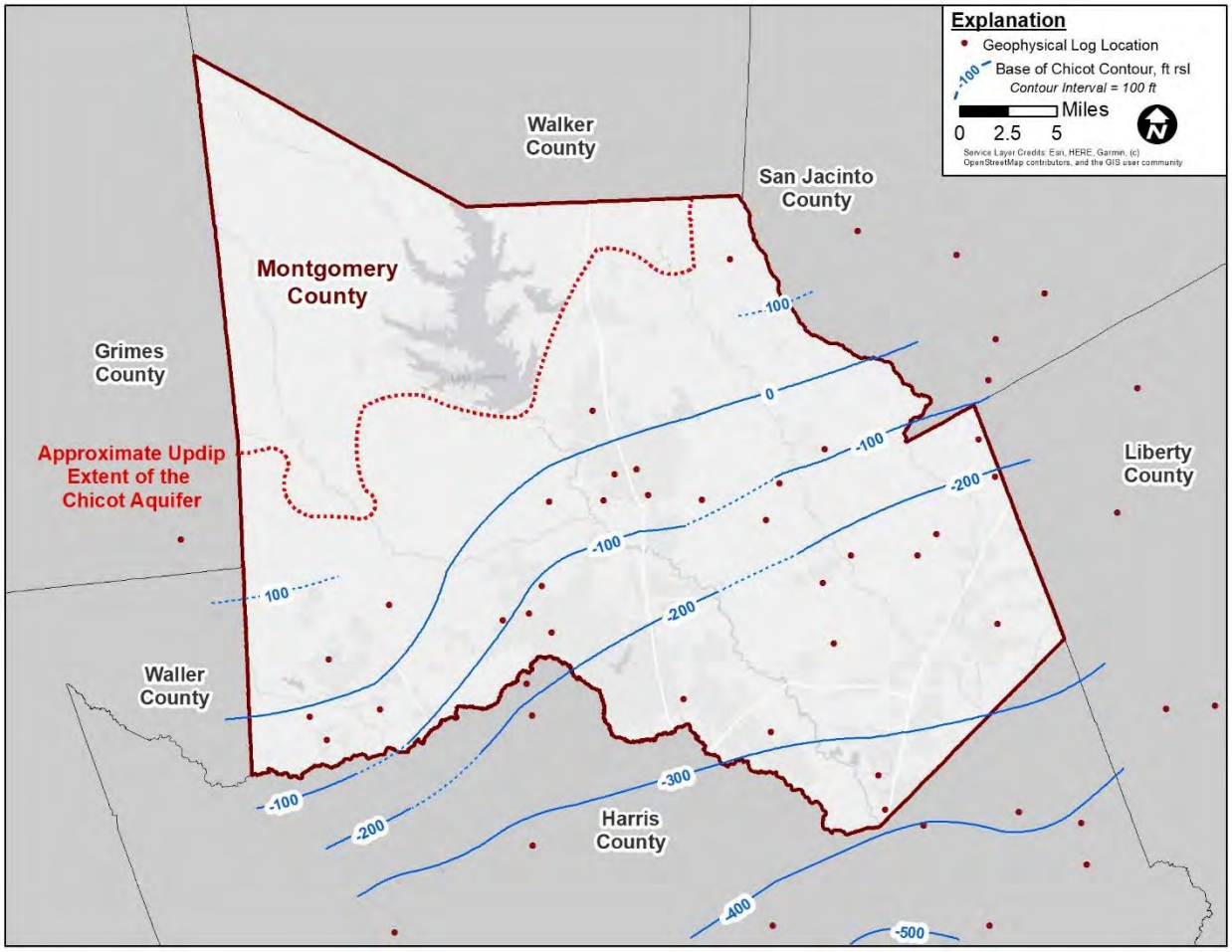


Figure 16. Estimated base of the Chicot Aquifer within Montgomery County.

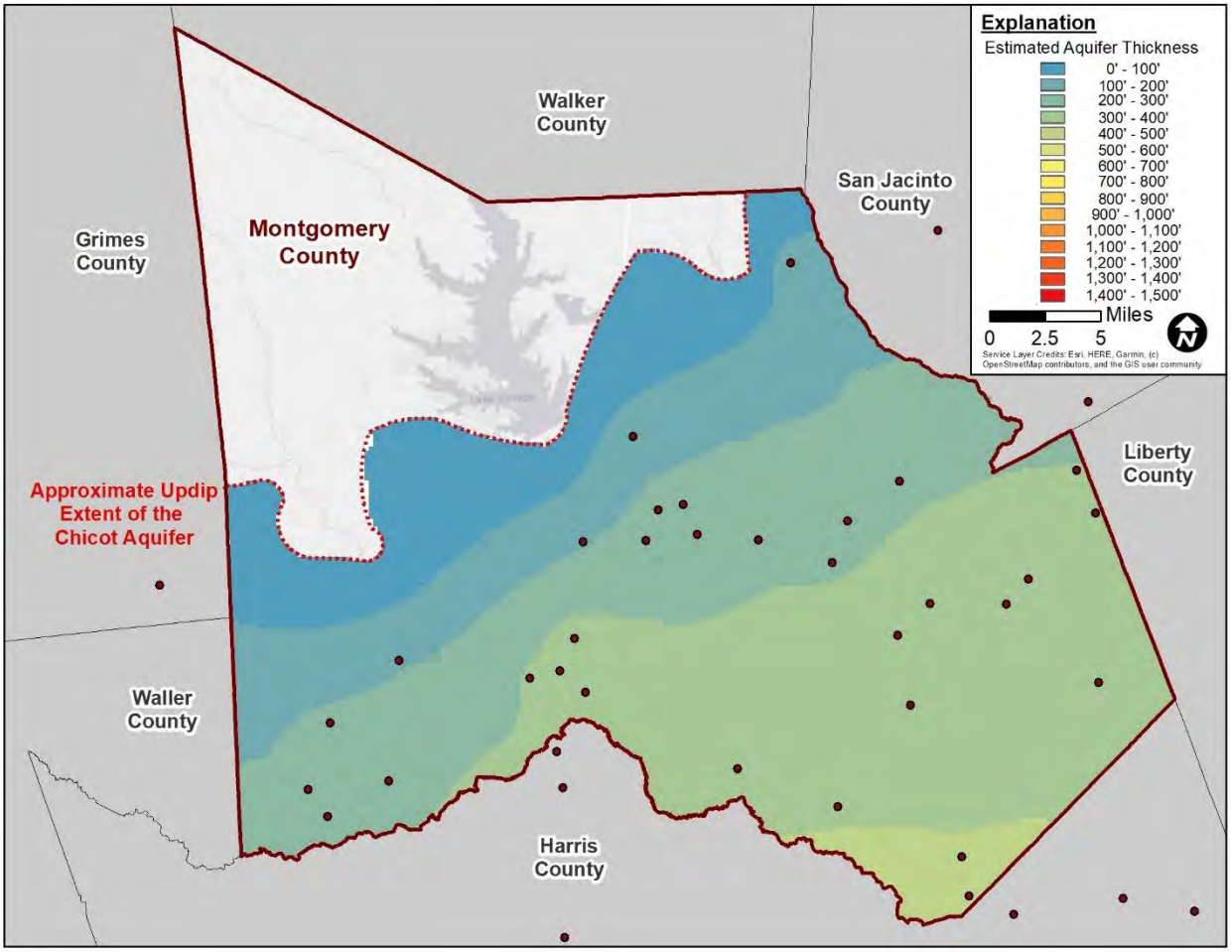


Figure 17. Estimated thickness of the Chicot Aquifer within Montgomery County.

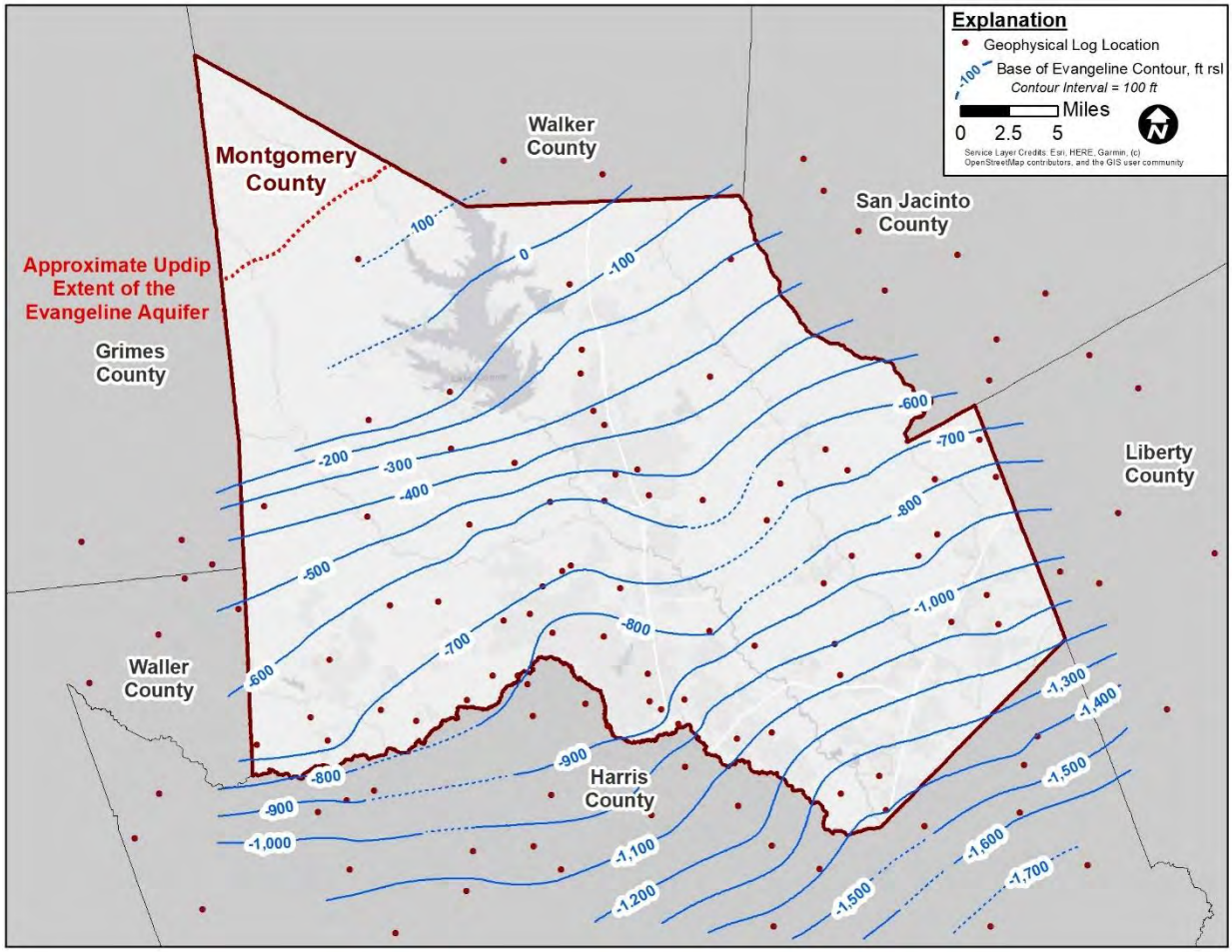


Figure 18. Estimated base of the Evangeline Aquifer within Montgomery County.

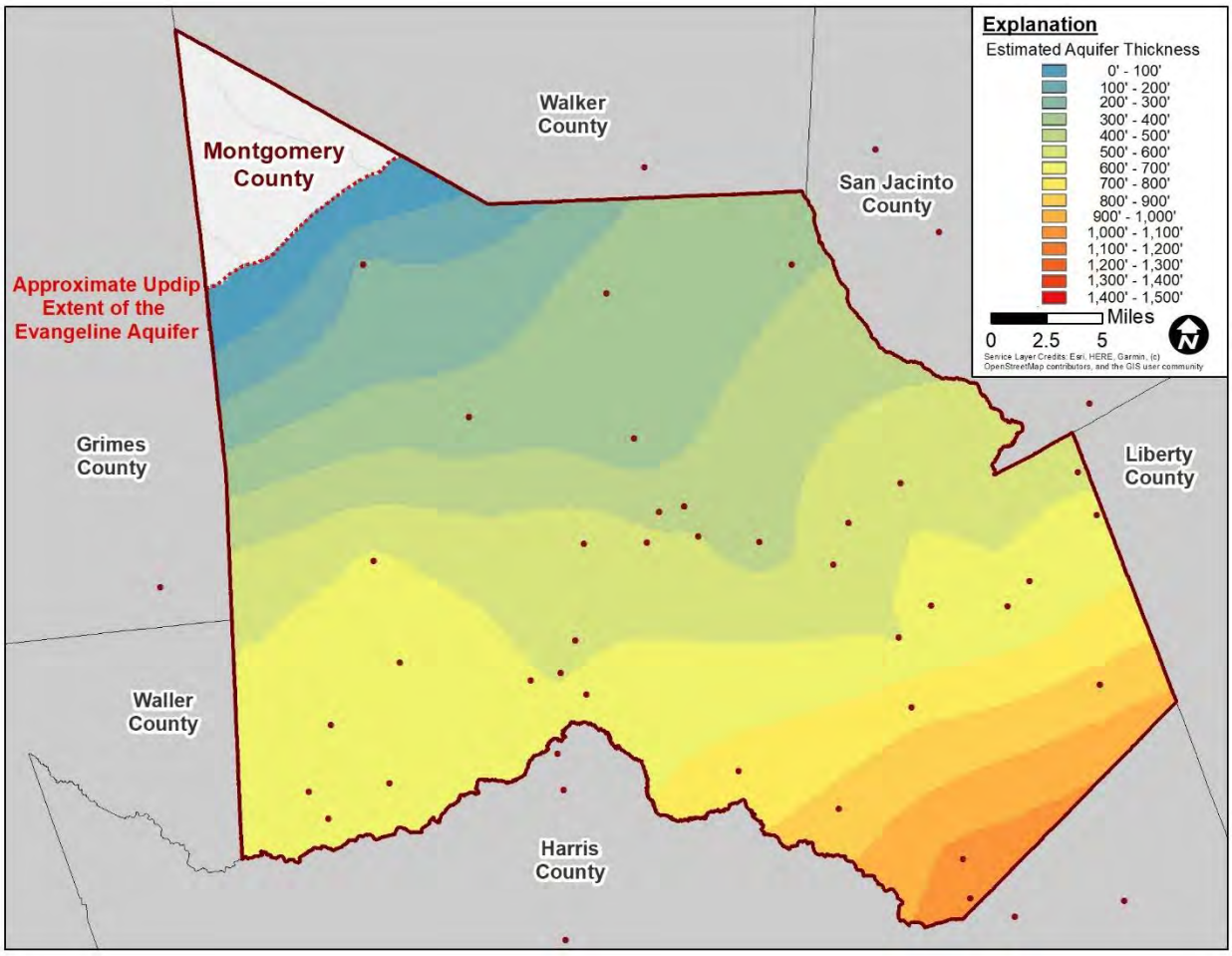


Figure 19. Estimated thickness of the Evangeline Aquifer within Montgomery County.

Burkeville Confining Unit

The Burkeville Confining Unit is vertically positioned between the Evangeline and Jasper aquifers, and the outcrop is estimated to be present at land surface over approximately three percent of Montgomery County. The high percentage of clay content in the Burkeville Confining Unit limits movement of groundwater between the Jasper and Evangeline aquifers. Limited sands occur in the Burkeville and are thought to not be hydraulically connected. In some areas completion of smaller volume domestic wells is possible in the Burkeville Confining Unit; however, the sands of the Burkeville Confining Unit might not be capable of fully supporting a moderate to large capacity water well. In some areas large capacity wells have been constructed with screen set opposite sands in the Burkeville, but the percentage of total well screen in the Burkeville is very small compared to the entire screen interval of the well, which probably is primarily in the shallower Evangeline Aquifer or the upper part of the Jasper Aquifer.

The estimated base of the Burkeville Confining is shown on Figure 20. The elevation of the base of the formation is estimated to occur at a depth of about -1,100 feet relative to sea level in the southwest part of the county and about -1,870 feet relative to sea level in the southeast part of the county. The estimated dip of the base of the Burkeville Confining Unit (equivalent to the top of the Jasper Aquifer) is generally to the southeast at a rate of approximately 40 to 50 feet per mile. The estimated thickness of the Burkeville Confining Unit is shown on Figure 21 and generally increases with distance from the approximate updip extent located in far northwest Montgomery County to an estimated maximum thickness of about 480 feet in the southeast part of the county. The Burkeville Confining Unit thickness is estimated to range from about 200 to 300 feet in a large part of Montgomery County, with an average thickness of the formation estimated to be approximately 240 feet.

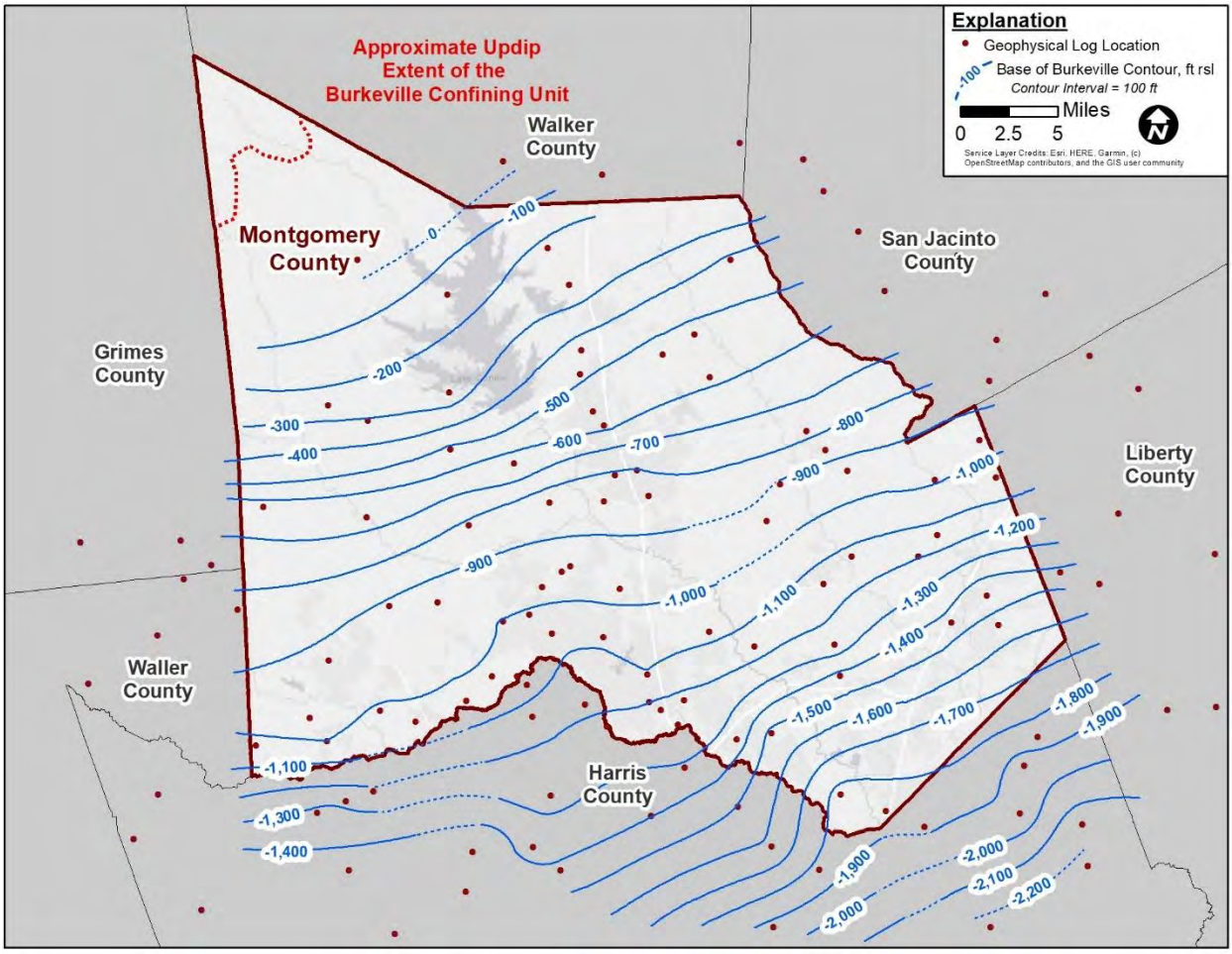


Figure 20. Estimated base of the Burkeville Confining Unit within Montgomery County.

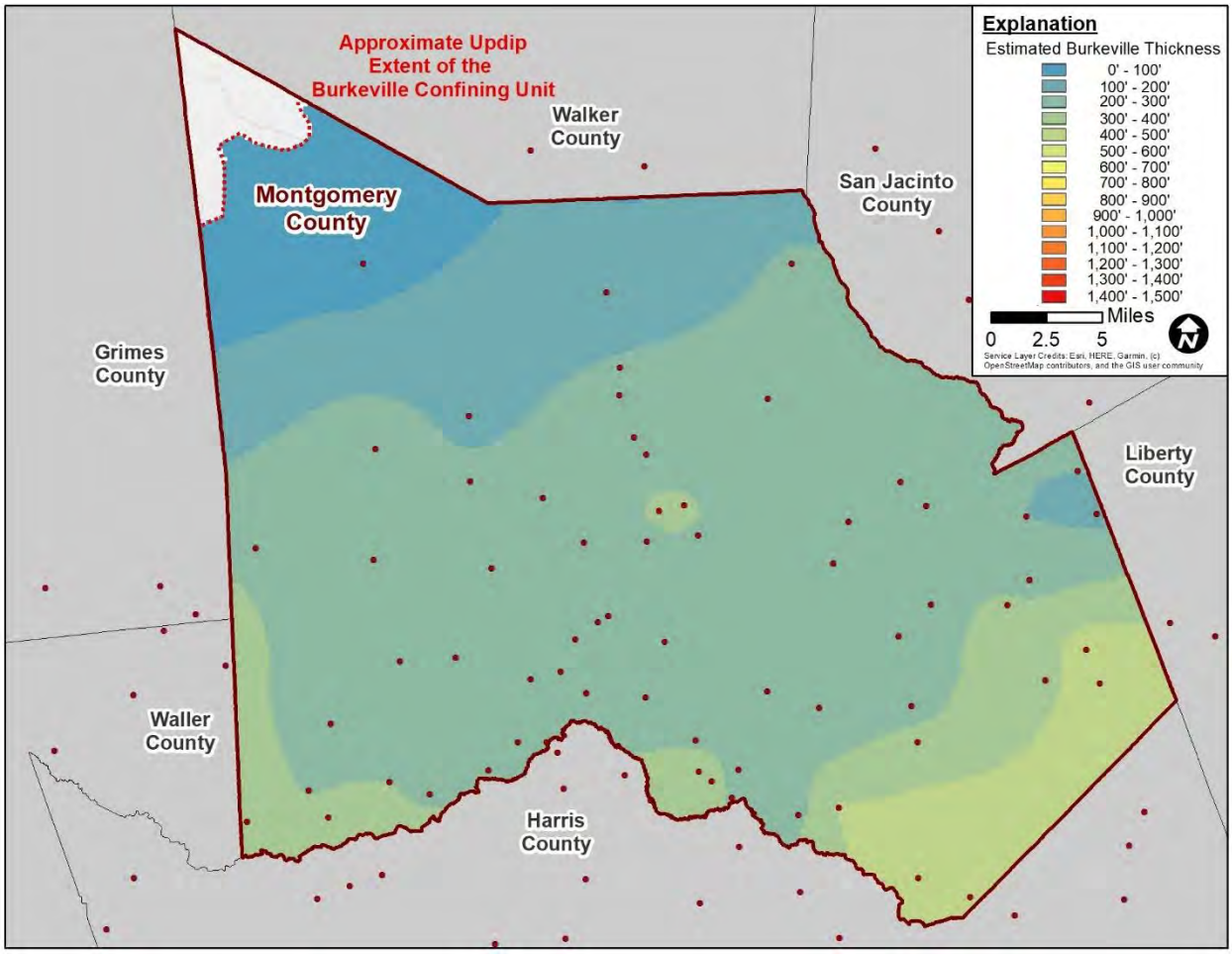


Figure 21. Estimated thickness of the Burkeville Confining Unit within Montgomery County.

Jasper Aquifer

The Jasper Aquifer is a significant source of groundwater production in Montgomery County. It is positioned between the overlying Burkeville Confining Unit and the underlying Catahoula Formation. Groundwater produced from the Jasper Aquifer is used for public, industrial, and other water supply, but also can be used for domestic purposes in the shallower, updip part of the formation. The Jasper Aquifer outcrop is present at land surface in approximately two percent of Montgomery County, the smallest of any hydrogeologic unit in the county.

As the focus of this study is on the principal hydrogeologic units from which groundwater is produced in Montgomery County, we separated the Jasper Aquifer into upper and lower units based on lithology. The Upper Jasper Aquifer contains more sand than the Lower Jasper and is the section of the aquifer screened in moderate to large capacity public supply and industrial wells throughout Montgomery County and in parts of north and northwest Harris County. The thicker sands that comprise the Upper Jasper Aquifer can contain brackish groundwater in downdip areas of the formation located in southeast Montgomery County. The Lower Jasper is made up of mostly interbedded sand and clay and the water contained within the sands can often be of brackish water quality. At the time of this study there has been no development of the brackish groundwater resources available from the Jasper Aquifer in Montgomery County. The United States Geological Survey Source Water Assessment Program dataset corresponding to the base of the Jasper Aquifer (Strom and others, 2003) was used as the base of the Lower Jasper in this study.

Upper Jasper Aquifer

The base of the Upper Jasper Aquifer is estimated to dip at a rate of approximately 50 to 60 feet per mile to the southeast. Figure 22 shows the estimated elevation of the base of the Upper Jasper Aquifer, with the elevation of the base of the Upper Jasper Aquifer occurring at a depth of about -1,500 feet relative to sea level in the southwest and about -2,350 feet relative to sea level in the southeast part of the county. Figure 23 illustrates the estimated thickness of the Upper Jasper Aquifer which increases with distance from the approximate updip extent in far northwest Montgomery County. The maximum estimated thickness is about 570 feet in the southeast part of the county. The average thickness of the Upper Jasper Aquifer is estimated to be about 390 feet in Montgomery County.

Lower Jasper Aquifer

The base of the Lower Jasper Aquifer was generated from the base of the Jasper Aquifer in the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003) and can be seen on Figure 24. Strom and others (2003) indicate that the Source Water Assessment Program base of the Jasper Aquifer was created using well data from cross sections included in Baker, Jr. (1979; 1986). The cross sections included in Baker, Jr. (1979; 1986) have limited geophysical log data within Montgomery County. The estimated dip of the base of the Lower Jasper Aquifer is approximately 50 to 60 feet per mile to the southeast. The elevation of the base of the Lower Jasper Aquifer is estimated to occur at a depth of about -2,000 feet relative to sea level in the southwest part of the county and about -2,900 feet relative to sea level in the southeast part.

Figure 25 shows the approximate thickness of the Lower Jasper Aquifer based on the estimated base of the Upper Jasper (as defined in this study) and the base of the Jasper Aquifer as defined by the

United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003). The estimated thickness of the Lower Jasper Aquifer in Montgomery County ranges from approximately 100 feet in the northwest part of the county to approximately 900 feet in the east part of the county, with an average thickness of about 500 feet.

Combined Jasper Aquifer

Figure 26 shows the estimated thickness of the Jasper Aquifer (combined upper and lower units) based on the difference between base of the Burkeville Confining Unit as delineated in this study and the base of the Jasper Aquifer depicted by the United States Geological Survey Source Water Assessment Program dataset. This thickness using the base of the Jasper Aquifer as defined by the United States Geological Survey Source Water Assessment Program dataset provides a general estimate of the total thickness of the Jasper Aquifer using the surface that was recognized as the base of the Jasper by LSGCD in the early 2010's. The total thickness of the Jasper Aquifer is estimated to range from about 150 feet in the outcrop area in the northwest part of Montgomery County to an estimated maximum thickness of approximately 1,280 feet in the east part of the county. The estimated average thickness of the Jasper Aquifer (combined upper and lower units) is approximately 890 feet.

The estimated thickness of the Jasper Aquifer (combined upper and lower units) based on Popkin (1971) is substantially greater than the estimated thickness using the United States Geological Survey Source Water Assessment Program dataset. An estimated thickness for the total Jasper Aquifer based on Popkin (1971) was developed using data assembled for the 2004 LSGCD Groundwater Resources Management Information Report for Montgomery County (TC&B, 2004). Estimated total Jasper Aquifer thicknesses based on the Popkin (1971) methodology range from approximately 1,490 feet to approximately 3,040 feet in Montgomery County, with an average thickness of about 2,100 feet.

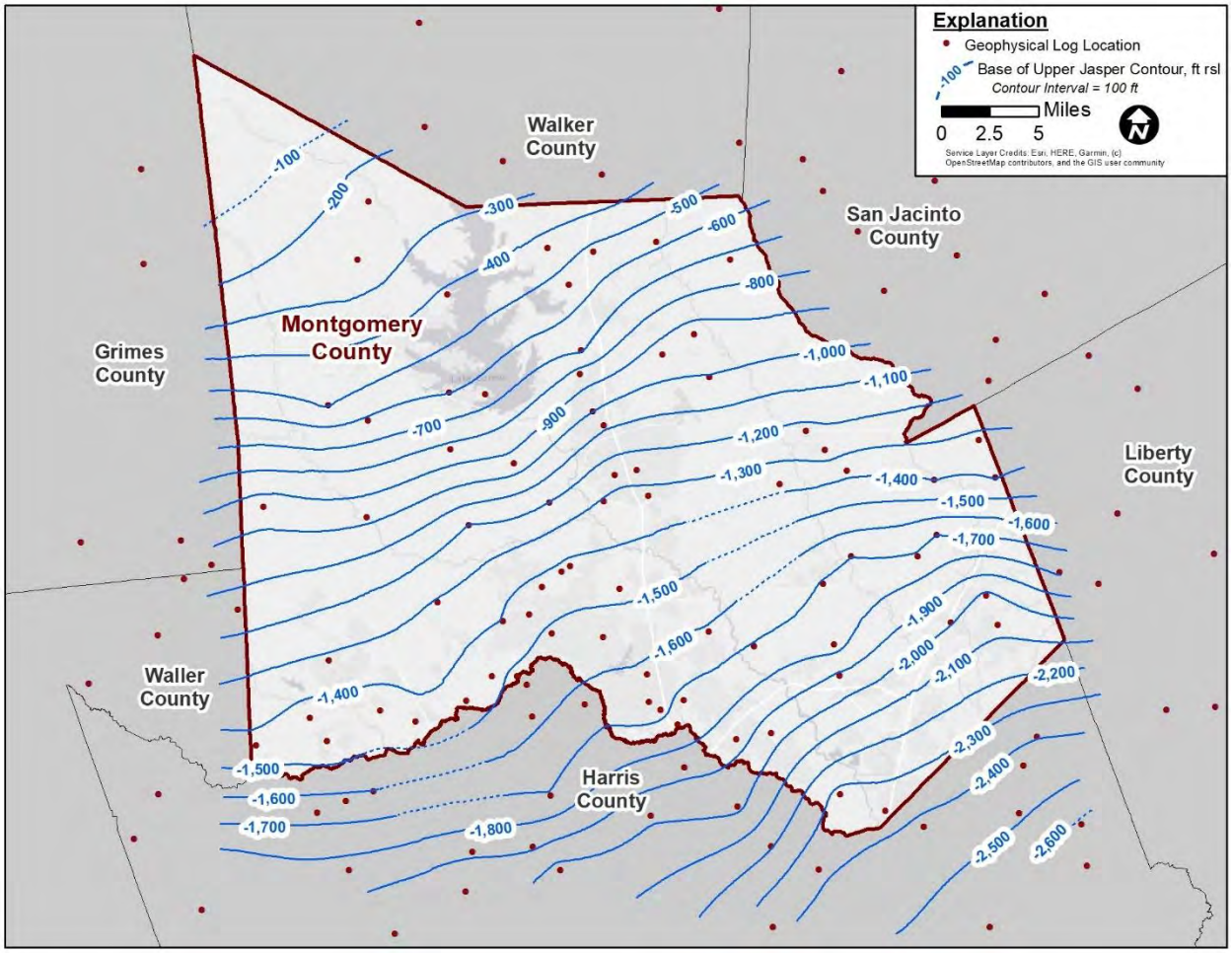


Figure 22. Estimated base of the Upper Jasper Aquifer within Montgomery County.

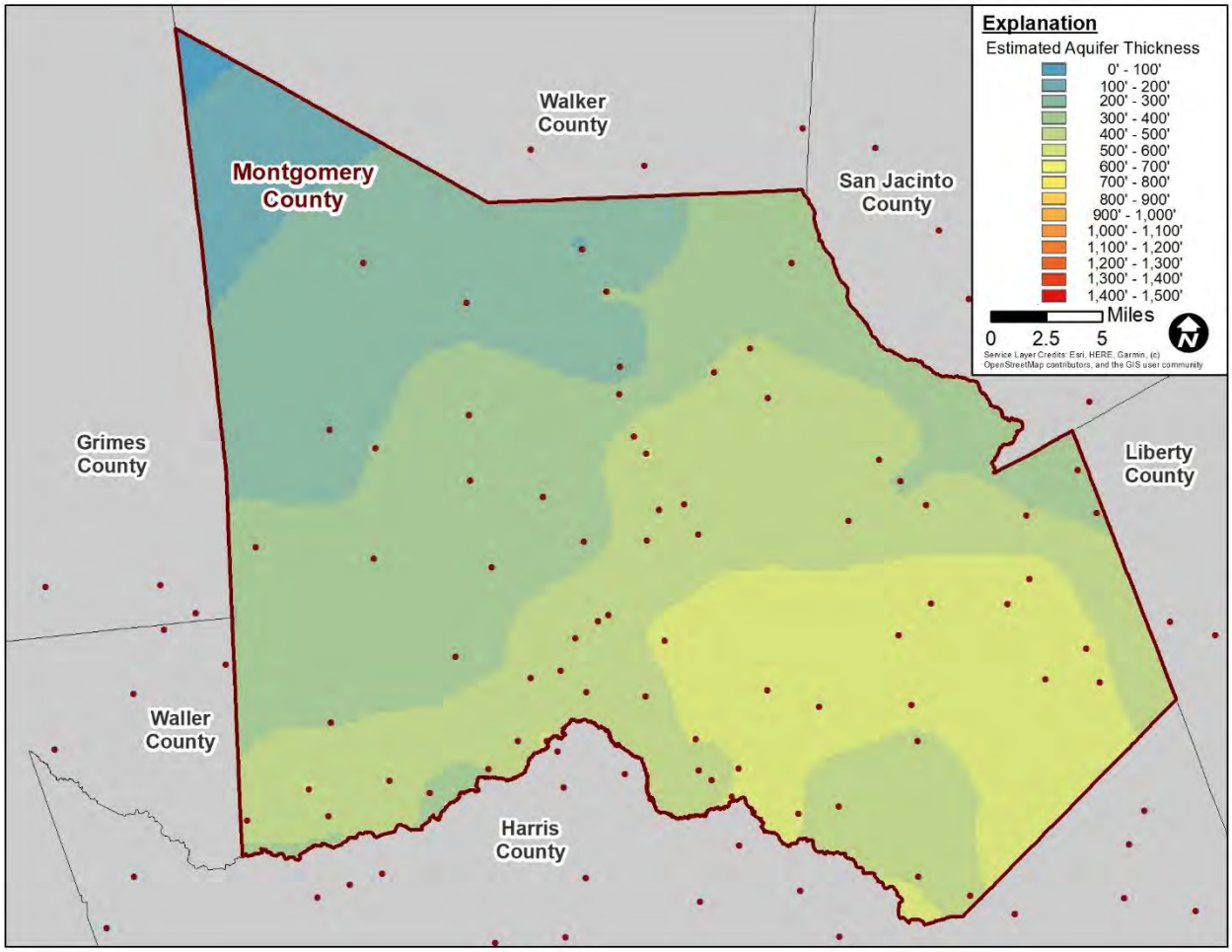


Figure 23. Estimated thickness of the Upper Jasper Aquifer within Montgomery County.

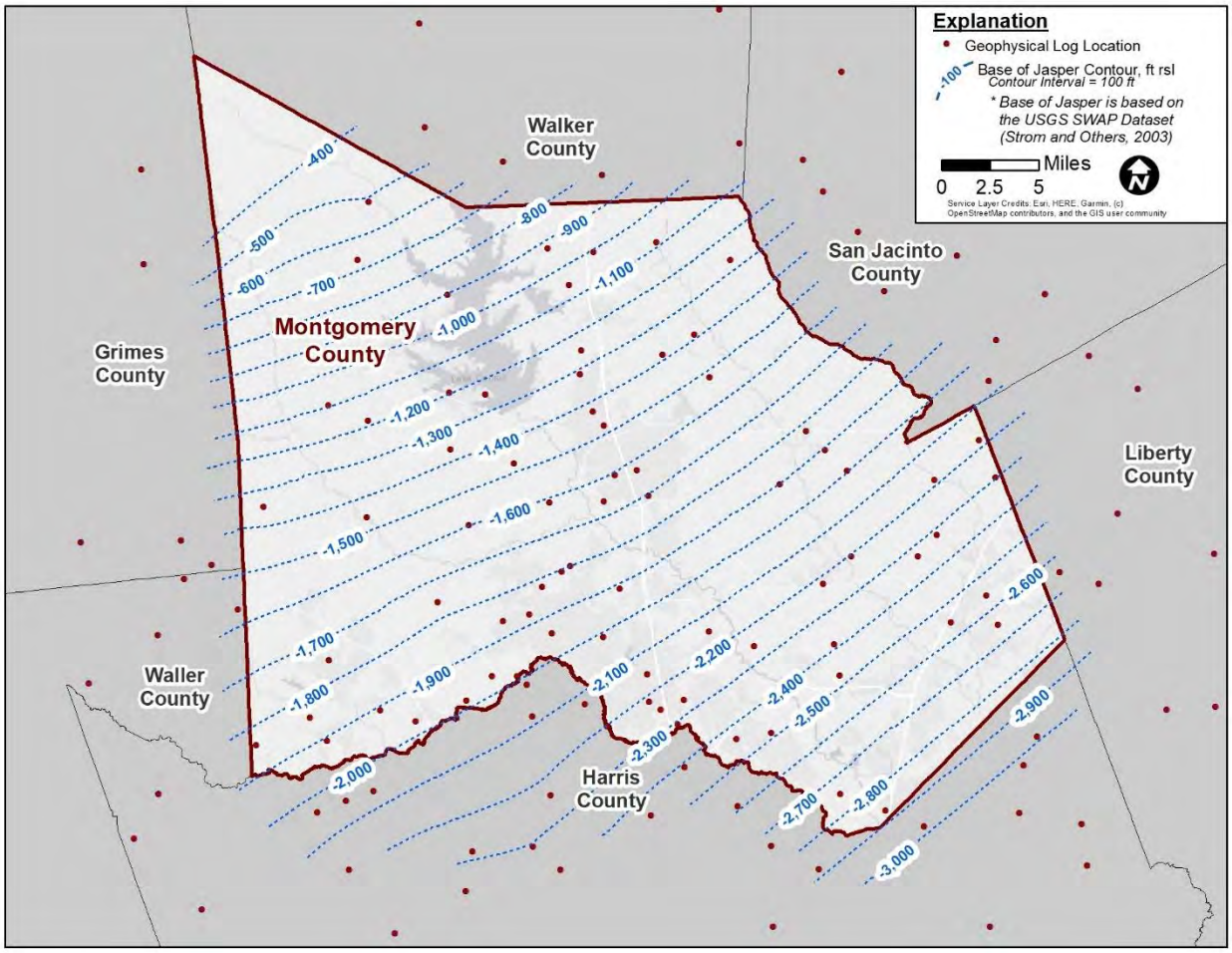


Figure 24. Estimated base of the Lower Jasper Aquifer within Montgomery County based on the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003).

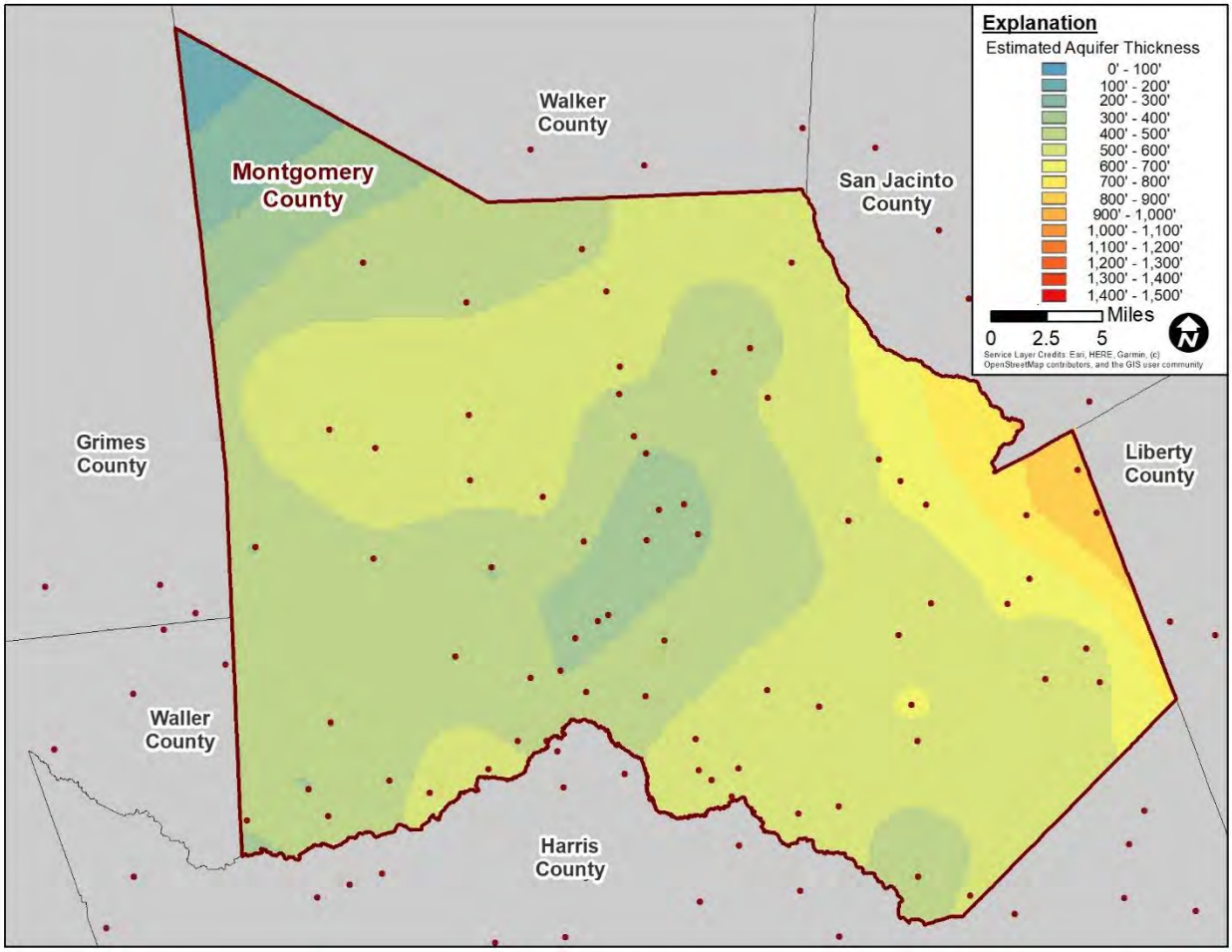


Figure 25. Estimated thickness of the Lower Jasper Aquifer within Montgomery County as the difference between the base of the Upper Jasper as defined as part of this study and the base of the Jasper Aquifer as defined by the United States Geological Survey Source Water Assessment Program dataset.

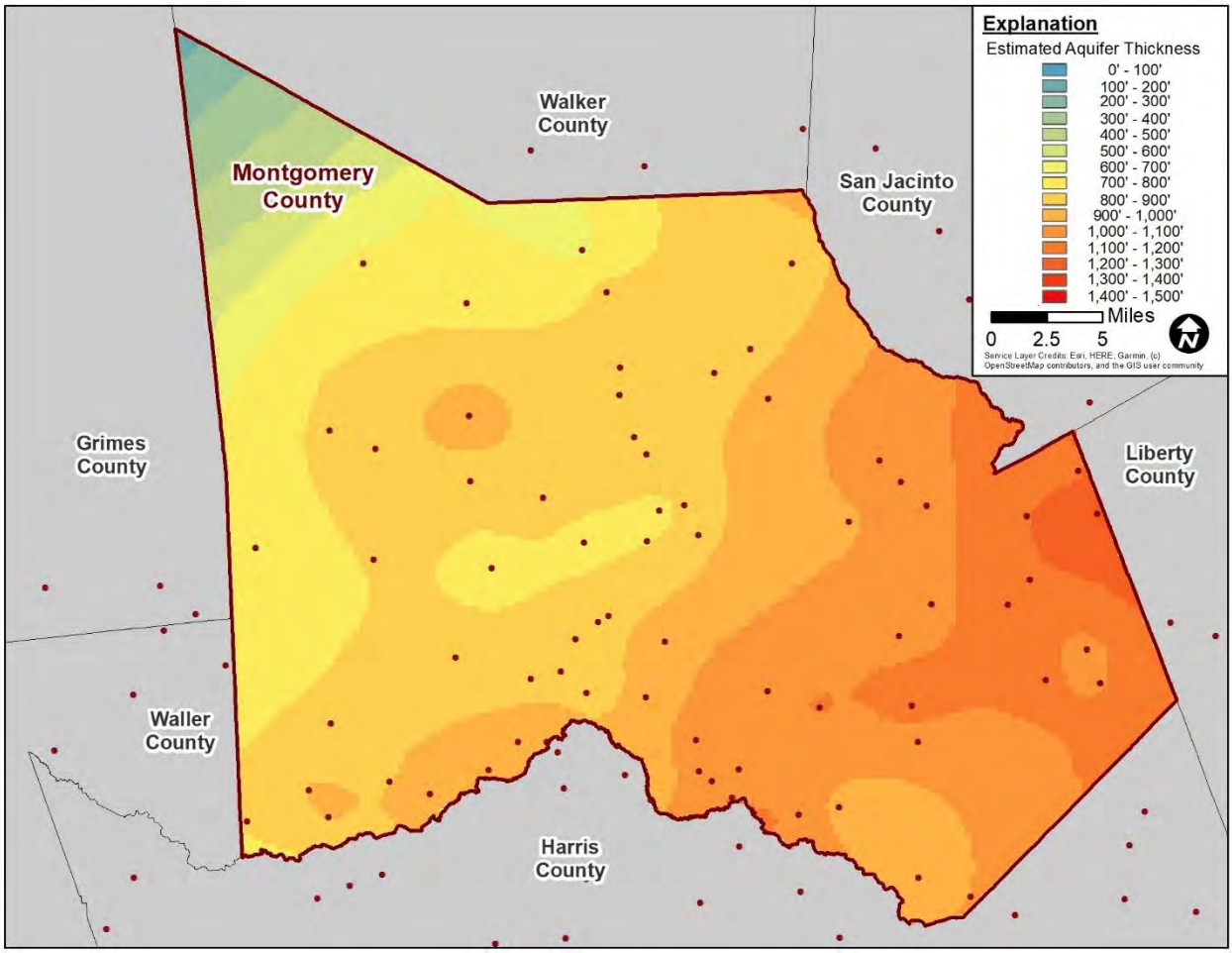


Figure 26. Estimated total thickness of the Jasper Aquifer within Montgomery County as the difference between the base of the Burkeville Confining Unit as defined in this study and the base of the Jasper Aquifer as defined by the United States Geological Survey Source Water Assessment Program dataset.

GULF-2023 Groundwater Flow Model

In an effort to improve future groundwater availability models of the Gulf Coast Aquifer System, additional stratigraphic and lithologic data beyond the existing Chicot, Evangeline, and Jasper aquifers and Burkeville Confining Unit data was developed by Young and others (2012). A lithostratigraphic approach, as defined by Young and others (2012), involves interpolating formation lithologies from geophysical logs and correlating the lithologies between additional geophysical logs (Young and other, 2012). To update the hydrostratigraphic framework of the Gulf Coast Aquifer System, Young and others (2012) utilized a chronostratigraphic approach and sequence stratigraphy to identify clay-dominated flooding surfaces of the same age and subsequently subdivide the Chicot, Evangeline, and Jasper aquifers and Burkeville Confining Unit into sub-aquifer layers.

As a result of the work performed, Young and others (2012) subdivided the Chicot, Evangeline, and Jasper aquifers and the Burkeville Confining Unit of the Gulf Coast Aquifer System into 10 subunits as follows:

- Chicot Aquifer: 1) Beaumont Clay; 2) Lissie Formation; 3) Willis Formation;
- Evangeline Aquifer: 4) Upper Goliad; 5) Lower Goliad; 6) Upper Lagarto;
- Burkeville Confining Unit: 7) Middle Lagarto;
- Jasper Aquifer: 8) Lower Lagarto; 9) Oakville Formation; and 10) Catahoula Formation

Young and Draper (2020) updated the extent of the Burkeville Confining Unit and the base of the Chicot Aquifer to support the development of the GULF-2023 groundwater model. The GULF-2023 groundwater model is a six-layer groundwater flow model that is currently being developed by the United States Geological Survey for the Harris-Galveston Subsidence District. The following layers are assigned to the GULF-2023 model: Layer 1 – Alluvium and Beaumont Clay; Layer 2 – Chicot Aquifer; Layer 3 – Evangeline Aquifer; Layer 4 – Burkeville Confining Unit; Layer 5 – Jasper Aquifer; and Layer 6 – Catahoula Formation.

Young and Draper (2020) updated the subdivided formations defined by Young and others (2012) by adjusting the base of the Chicot Aquifer (top of the Evangeline Aquifer), the top of the Burkeville Confining Unit (base of the Evangeline Aquifer), and the base of the Burkeville Confining Unit (top of Jasper Aquifer) to support the GULF-2023 model. Regarding the updated Burkeville Confining Unit utilized in the GULF-2023 model, Young and Draper (2020) state:

> "Because the Burkeville unit defined by Baker (1979) is a lithostratigraphic unit that is not bounded by isochronous boundaries and exists across the Upper, Middle and Lower Lagarto formations, it cannot be accurately represented by any single chronostratigraphic formation defined by Young and others (2010, 2012). To create a "lithostratigraphic-based" Burkeville Unit from the clays and sand sequences generated by Young and others (2010, 2012), we correlated the sand and clay sequences in the Upper, Middle and Lower Lagarto Formations based on a lithostratigraphic approach. This approach provides a practical integration of the lithostratigraphic and chronostratigraphic approaches to represent the conceptualization by Baker (1979) of the Burkeville Confining Unit."

Young and Draper (2020) indicated that the Willis Formation (base of Chicot Aquifer) was primarily updated to incorporate additional geophysical logs into the analysis, increasing the number of logs

used to estimate the base of the Willis Formation from 290 logs to 650 logs with stratigraphic picks. Young and Draper (2020) state:

> "At each geophysical log, the location of the base of the Willis was selected to represent a transition from the sand-rich basal Chicot Aquifer (Willis Formation) to the sand-poor top of the Evangeline. In most of the logs, the adjustment to the previous picks by Young and others (2010, 2012) was less than 100 feet."

GULF-2023 Hydrogeologic Surface Comparison

The base of the geologic units (with hydrogeologic equivalents) developed by Young and others (2012) and the updated picks of the hydrogeologic units based on Young and Draper (2020) are shown on the typical geophysical log examples included in Appendix 2, where available. Hydrogeologic picks approximated from Young and Draper (2020) are noted as the 'Gulf 2023 Dataset' and the geologic formation picks approximated from Young and others (2012) labeled 2012 and include the hydrogeologic unit where applicable.

The picks shown on the geophysical logs in Appendix 2 were based on common API numbers for geophysical logs used in this study and the referenced reports. The appendices included with Young and others (2012) and Young and Draper (2020) provide the geophysical log API number, datum, and the estimated elevation of the hydrogeologic/geologic unit. The geophysical log datum and hydrogeologic/geologic unit elevation were used to convert the elevation of the base of the hydrogeologic/geologic unit to depth below land surface for a cleaner presentation of the picks on the geophysical logs.

Based on a limited number of geophysical logs common between this study and Young and others (2012), the base of the hydrogeologic units selected by Young and others (2012) appears to be generally deeper in the subsurface in the southeast part of Montgomery County relative to this study. The Burkeville Confining Unit/Middle Lagarto as defined in Young and others (2012) include sand intervals that are considered to be part of the Upper Jasper Aquifer in this study. It should be noted that a number of high-capacity water wells in Montgomery County that screen sands of the Upper Jasper Aquifer would have been included as part of the Burkeville Confining Unit based on the chronostratigraphic formation picks of Young and others (2012).

Modifications to the Young and others (2012) dataset by Young and Draper (2020) to support the GULF-2023 model included adjustments to the top and bottom of the Burkeville Confining Unit and the base of the Chicot Aquifer. Young and Draper (2020) used a lithostratigraphic based approach to adjust the Burkeville Confining Unit elevations, which yielded formation picks that are generally similar to the picks defined in this study for most parts of Montgomery County.

A chronostratigraphic approach was utilized by Young and Draper (2020) to update the base of Chicot Aquifer in support of the GULF-2023 model. The base of the Chicot Aquifer as defined by Young and Draper (2020) is generally deeper than the base of Chicot Aquifer defined in this study and previous work by others and becomes increasingly deeper in the southeast part of Montgomery County. The depth of the estimated base of Chicot Aquifer (Young and Draper, 2020) exhibits larger increases in depth in parts of Liberty and Harris counties based on geophysical logs reviewed within the search area of this study.

The estimated depth of the base of the Chicot Aquifer as defined by Young and Draper (2020) can be significantly deeper in parts of northeast and east Harris County than defined in previous work. The estimated base of the Chicot Aquifer developed by Young and Draper (2020) can reach depths that are approximately twice as much as previous depth estimates in areas of Harris County.

GULF-2023 Observation Well Designations

The differences between the estimated aquifer elevations developed in support of the GULF-2023 model by Young and Draper (2020) and work performed by others can be illustrated by plotting the observation wells used in the development of the United States Geological Survey 2021 Water-Level Altitude Map Series and highlighting the observation wells that will receive new aquifer designations based on the GULF-2023 model.

In May 2021, LSGCD received provisional water level data in tabular form that was collected and provided by the United States Geological Survey (USGS, 2021b). The provisional table included a column that displayed the newly assigned aquifer designation based on the GULF-2023 model surfaces generated from the Young and Draper (2020) dataset. Original aquifer designations available from the United States Geological Survey National Water Information System Web Interface Groundwater Levels for Texas (2021a) were compared to the newly assigned aquifer designations.

Figure 27 shows the United States Geological Survey observation well locations that have an updated aquifer designation based on the GULF-2023 model surfaces that were developed using data from Young and Draper (2020). Based on the provisional data provided by the United States Geological Survey in May 2021, it is estimated that approximately 36 percent (165 out of 458) of the water wells included in the United States Geological Survey observation program experienced a change in aquifer designation in Montgomery and Harris counties.

Prior to the adoption of the new approach taken in the delineation of the hydrogeologic units for the GULF-2023 model, a large number of the wells in the United States Geological Survey observation program had been developed and evaluated over several decades by experienced local United States Geological Survey technical staff. In addition, previous United States Geological Survey aquifer data and designations have been reviewed and generally accepted by groundwater engineers, hydrogeologists, and consultants with decades of local experience in the greater Houston area, based on assessment of site-specific geophysical logs, well material setting sheets and construction data, and well pumping test data. Reassignment of the observation wells may affect conceptual understanding of groundwater flow in the Gulf Coast Aquifer System and ultimately how that flow is simulated in the GULF-2023 model.

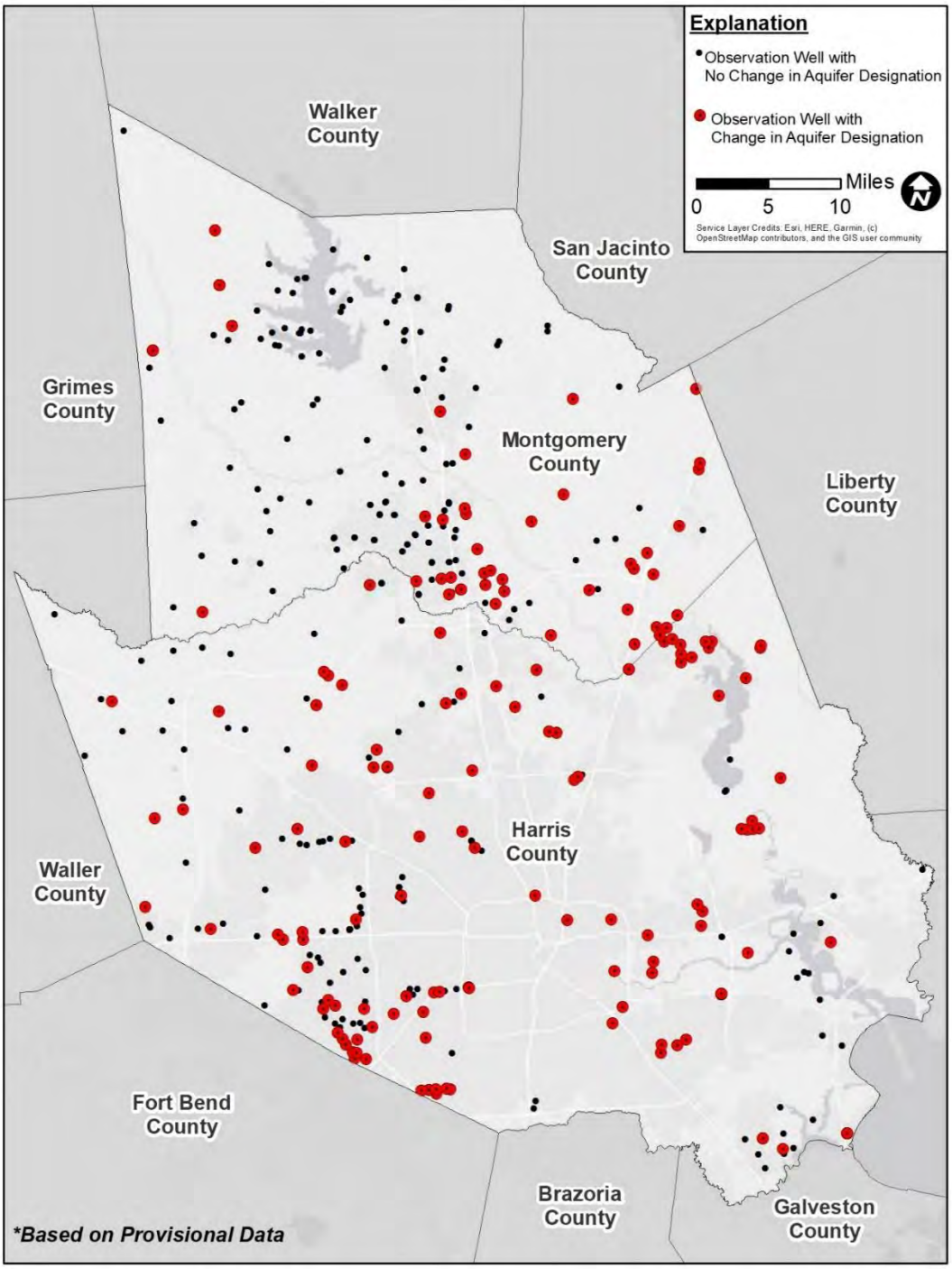


Figure 27. United States Geological Survey observation wells assigned a new aquifer designation based on the GULF-2023 groundwater flow model (based on provisional data provided by the United States Geological Survey in May 2021).

Summary of Clay Layer Thickness Based on Geophysical Log Analysis

It has long been understood that most compaction in sediments occurs in layers dominated by clay. Therefore, the thickness of clay layers within aquifers is one key in understanding the amount of subsidence that may occur in areas of groundwater withdrawal. The United States Geological Survey has produced maps showing cumulative clay thickness for the Chicot, Evangeline, and Jasper aquifers across the Houston Area including the entirety of Montgomery County (Kasmarek and Robinson, 2004). Similarly, LSGCD published maps showing the clay thickness for the geologic units that comprise the Chicot, Evangeline, and Jasper aquifers, and the Burkeville Confining Unit, all based on GIS operations utilizing datasets by Young and others (2012) (see Thornhill and Keester (2020)).

The United States Geological Survey conducted some of the definitive work relating to the depth of burial and the compressibility of clay layers in the Chicot and Evangeline aquifers in selected areas of southern Harris County and Galveston County, noting, "The time lag between loading and ultimate consolidation is dependent upon the thickness and permeability of the clay bed" (Gabrysch and Bonnet, 1976a). Similarly, Kelley and others (2018) noted the relationship between the fluid-pressure reductions in groundwater producing zones (that is, sands), the thickness of individual clay beds (sometimes called interbeds), the vertical hydraulic conductivity of the clay layers, and the time it takes for compaction to occur. Figure 28, reproduced from Kelley and others (2018) illustrates the relationship of the positioning and thickness of clay interbeds and the compaction of a clay layer between aquifer sand zones.

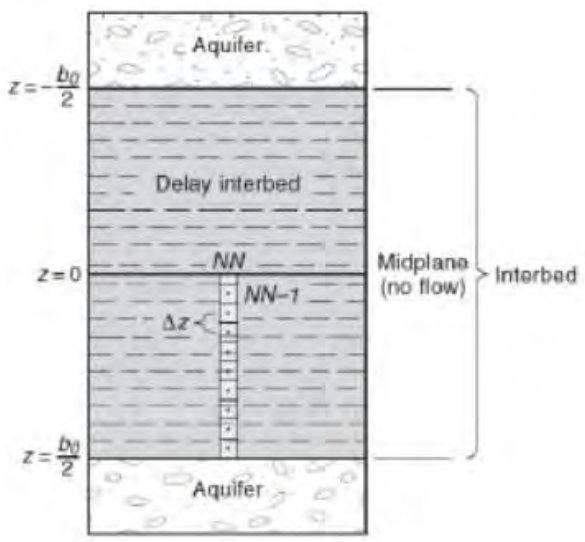


Figure 28. Illustration of the relationship between the aquifer sands and clay interbeds (reproduced from Kelley and others, 2018).

Kelley and others (2018) provided a summary of individual clay-bed thicknesses for selected logs across much of the Houston area including the southern part of Montgomery County from about Lake Conroe to the southern county border. For this study, we focused on log analysis to determine clay-bed thicknesses and distributions relative to producing intervals (that is, sands) across all of Montgomery County. While total clay thickness is important, understanding the vertical and horizontal distributions of clay layers relative to sand zones that are typically screened in water wells within Montgomery County and the region also affects the understanding of potential compaction. The relationships between the thicknesses of clay layers and the positioning with respect to well-screen intervals can impact the total amount and rate of compaction. Therefore, the work included:

- Analyzing the geophysical logs and making picks categorized as sand, silty or clayey sand, silty or sandy clay and clay. For this evaluation, the zones were simplified as either being "clay" or "sand" based on the predominant geophysical signature;
- Evaluating the clay layers for the Chicot, Evangeline, and Jasper aquifers, as well as for the Burkeville Confining Unit, with respect to total clay thickness, and average clay-layer thickness; and,
- Selecting potential high production sand intervals and evaluating the clay layers within the interval that would likely be screened in a well, and determining the number of clay interbeds, the total clay thickness, the minimum and maximum clay-bed thicknesses, and average interbed thickness.

Due to the age of the logs available, the clay picks were primarily based on induction (that is, resistivity) log signatures, although spontaneous potential curves were also assessed. Because of the log resolution, some thicker sequences of clays are likely comprised of multiple layers of thinner beds which cannot be distinguished based on log interpretation alone.

Figure 29 is a histogram illustrating the clay-bed thickness distribution by hydrologic unit in Montgomery County. The histogram shows that most clay layers are less than 50 feet thick. 58 percent of the clay beds within the Chicot Aquifer are less than 30 feet thick with 89 percent being less than 50 feet thick. For the Evangeline, the percentage of clay beds less than 30 feet thick reduces to 55 percent with 73 percent of the clay beds being less than 50 feet thick. There is an even greater percentage of the clay beds in the Burkeville being greater than 50 feet thick with only 42 percent being less than the 50-foot thickness. In the Upper Jasper, the clay bed thicknesses are similar to the Chicot with about 59 percent being less than 30 feet and 77 percent being less than 50 feet in thickness.

Figure 30 is a violin plot illustrating the distribution of clay thicknesses in the hydrostratigraphic units of the Gulf Coast Aquifer System. The width of the violin plot indicates the relative number of clay beds with a particular thickness and the dots represent the actual clay thickness value. Like the histogram suggests, the width of the violin plots in Figure 30 for the Chicot, Evangeline, and Upper Jasper indicates most of the clay beds are less than 20 feet thick in these aquifers. There are fewer clay bed thickness values for the Chicot and Burkeville than for the Evangeline and Upper Jasper. For Chicot, the fewer clay beds is due to fewer logs of the Chicot interval while for the Burkeville the fewer clay beds is due to the beds generally being thicker.

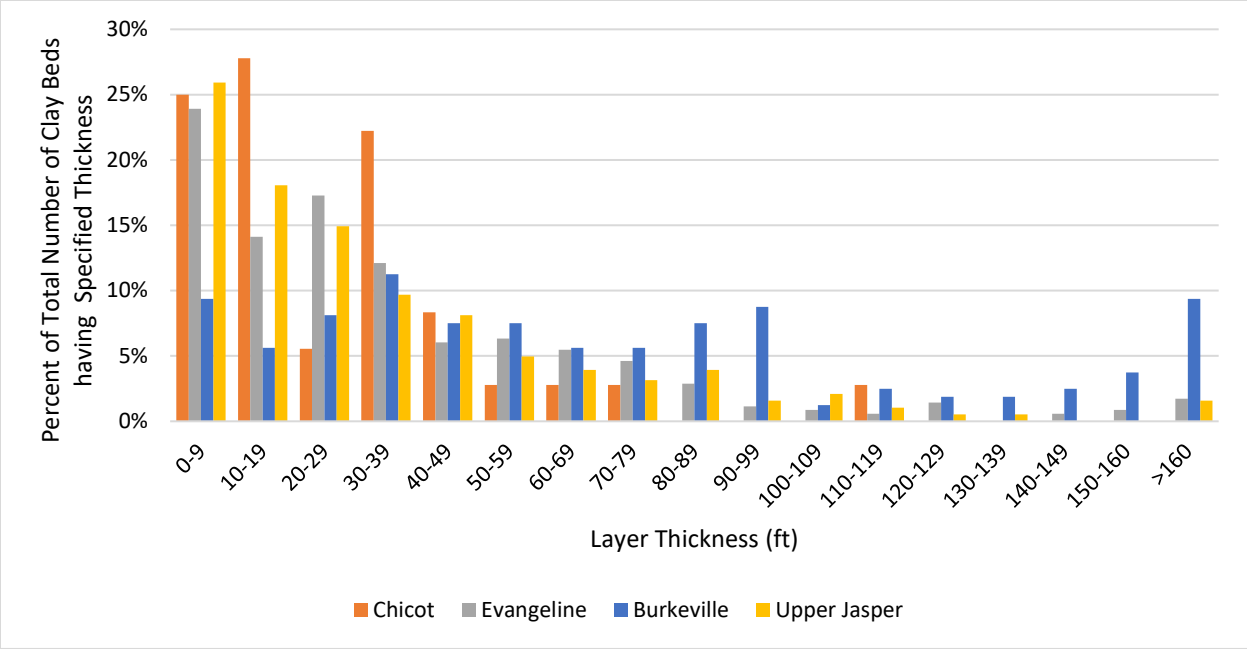


Figure 29. Histogram illustrating the percentage of clay bed thicknesses by hydrogeologic unit in Montgomery County.

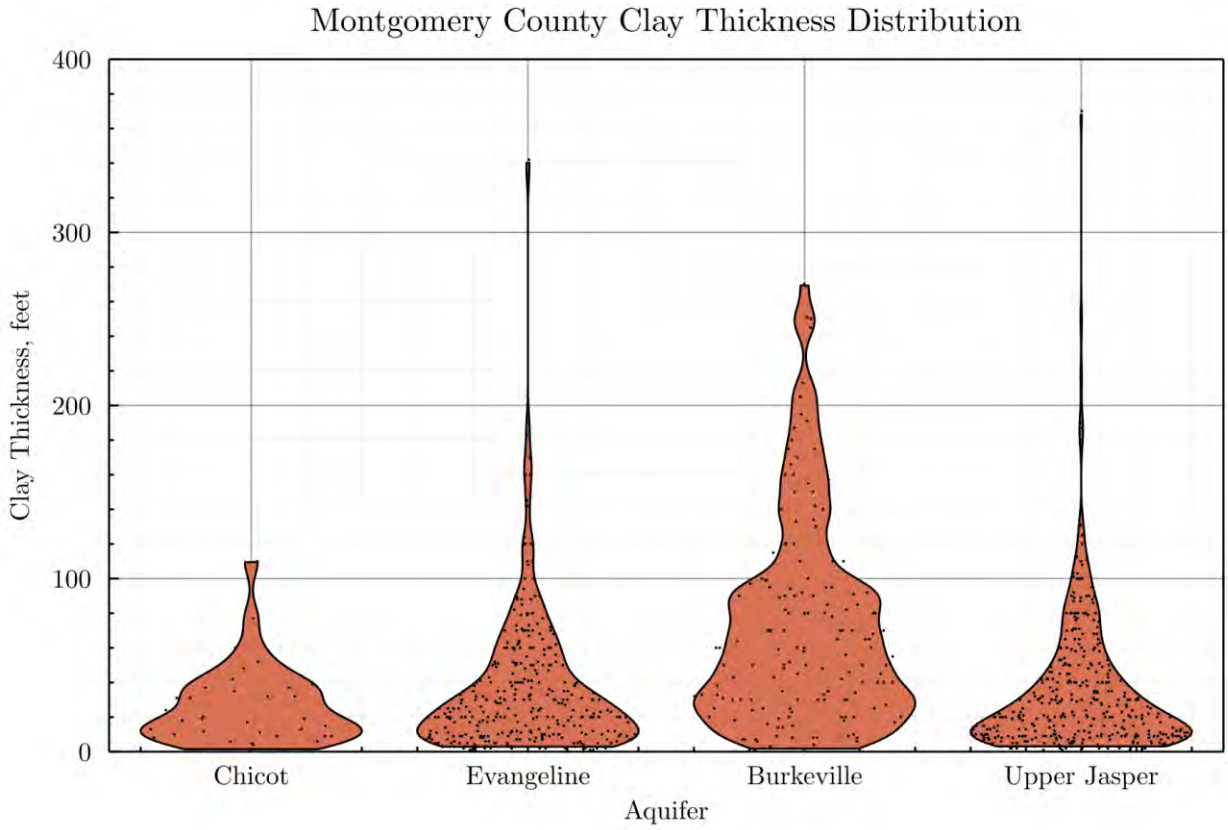


Figure 30. Violin plot illustrating the distribution of clay bed thickness by hydrogeologic unit in Montgomery County.

Appendix 3 provides summary tables characterizing sand and clay layers for 60 log sites in Montgomery County. For the identified sites, we used the hydrostratigraphic picks with our sand and clay determinations to calculate the net sand and net clay percentages. Using our professional judgement and experience, we also identified the likely producing interval (that is, where a well is more likely to be screened) within each hydrostratigraphic unit to determine the percentage of sand and clay associated with the producing interval. Appendix 4 provides maps illustrating the percent clay calculations at each evaluated site.

Visual comparison of our calculations with cumulative clay thicknesses presented by Kasmarek and Robinson (2004) suggest the total clay thickness for the Chicot and Evangeline aquifers are similar. However, since Jasper production within Montgomery and northern Harris counties is almost exclusively limited to the Upper Jasper Aquifer, the total clay thickness likely affected by depressurization is thinner than the reported clay thickness of the entire Jasper. Comparing original GAM cumulative clay thickness for the Jasper Aquifer as presented by Kasmarek and Robinson (2004) with Upper Jasper clay-interbed thicknesses suggests that the GAM Jasper clay thicknesses are 2.3 to 4.9 times thicker than the clay interbeds within likely targeted fresh and brackish groundwater zones in the Upper Jasper.

The distribution and thickness of clay layers is critical to understanding the hydraulics, mechanics, magnitude, and timing of compaction and resulting subsidence. Understanding these distributions as related to zones targeted for large-capacity pumping should also be a consideration for future studies and modeling efforts. The information compiled from the log analyses identifying clay and sand layers will be critical in planning subsequent work including planning drilling, logging, and coring efforts.

PHASE 3 DRILLING AND TESTING PLAN

Much of the work by Kelley and others (2018) was based on data collected approximately 50 years ago. Since the work by Gabrysch and Bonnet (1974; 1976a; 1976b), drilling and testing specifically for subsidence investigations has not occurred. As a next step in the District's subsidence investigations, we have developed a drilling and testing plan designed specifically to obtain site-specific data related to the potential compaction of the subsurface geologic units.

Proposed Test Drilling Locations

A first step for the test drilling program is to secure site for conducting the operations. For possible locations we considered several factors, including:

- Areas of observed or projected water level decline in the aquifers
- Areas with anticipated growth or increase in groundwater demand
- Locations with potential collaborators or interested parties
- Locations near existing GPS monitoring sites
- Locations that are accessible for drilling equipment
- Locations with limited geophysical data

Considering these factors, we identified six locations for conducting drilling and testing. These proposed locations are spread across the county and will provide site-specific data that does not place a greater weight on any particular area. Figure 31 illustrates the locations of the proposed drilling locations across the county. Appendix 5 includes a map for each proposed location with notes regarding the proposed site. Our recommended priority of drilling and testing is:

1. Lone Star Groundwater Conservation District
2. Woodlands Area
3. Magnolia Area
4. Southeast Area
5. Splendora Area
6. Montgomery Area

As one may expect, clay bed thicknesses within the hydrostratigraphic units are not uniform across the county. For each of the proposed drilling and testing sites, we associated geophysical log locations to the site based on proximity to the site; that is, if a log location was closer to the LSGCD location than to any other, then it was assigned to the LSGCD location. We then prepared a violin plot for the subset of clay thicknesses associated with the proposed drilling and testing location. These plots are included with the proposed test drilling location maps in Appendix 5.

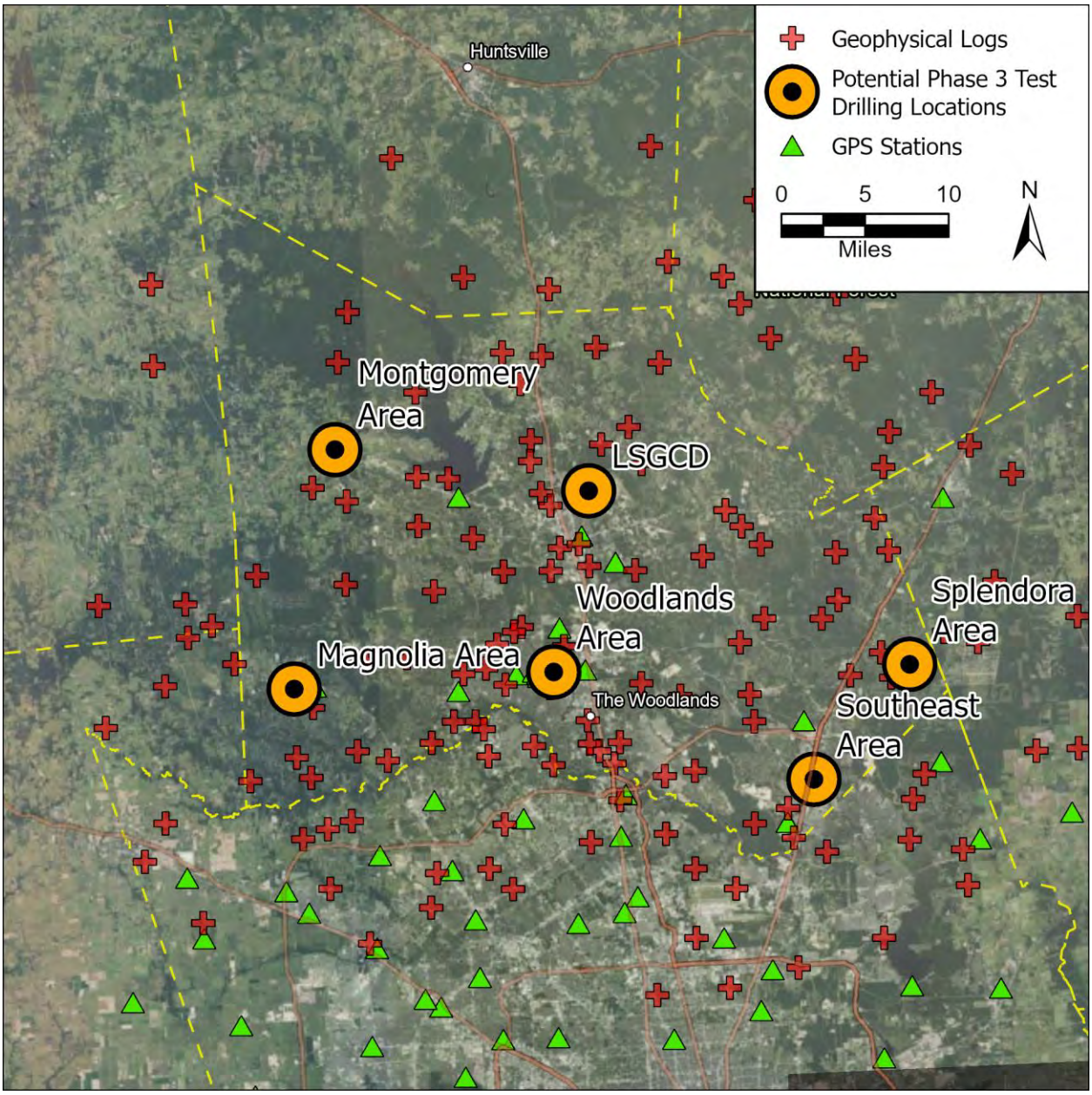


Figure 31. Proposed drilling and testing locations.

Proposed Data Collection

Proposed test drilling operations will involve drilling a test hole followed by coring selected intervals of the subsurface materials. During drilling of the test hole, a geoscientist will analyze and describe drill cuttings of the subsurface formations collected by the drilling contractor. Following completion of the test hole, a geophysical logging contractor will obtain a geophysical log of the open hole. Following are the geophysical logs we recommend obtaining for the initial test hole:

- Triple Combo (Resistivity, Natural Gamma, and Neutron/Density porosity)
    - Lithology
    - Water quality
    - Porosity
- Micro-normal/micro-inverse resistivity
    - Relative permeability (qualitative)
    - Water quality
- Spectral Gamma
    - Lithology
    - Clay mineral composition
- Magnetic Resonance
    - Permeability (quantitative)
    - Porosity
    - Movable water

The triple combo geophysical log is standard in the industry for obtaining site-specific depths of the subsurface lithologic materials. The addition micro resistivity provides additional information for the investigator to infer the relative permeability of the subsurface materials and for estimating the dissolved solids concentration of the formation water. With these logs alone we are able to delineate the general subsurface lithology, determine the aquifer intervals, and calculate the net sand and clay as we have done in this Phase 2 Subsidence Investigation. However, there are additional geophysical logs that will provide meaningful insight into the subsurface characteristics.

The spectral gamma log provides an in-situ analysis of the type of clays in the subsurface through measurements of the thorium, uranium, and potassium content. Data from the spectral gamma log will provide insight into the clay composition. Figure 32 illustrates how the type of clay may be determined based on the ratio of thorium and potassium in the mineral. As discussed previously, Kelley and others (2018) note that clays composed of montmorillonite have the highest compressibility (see Other Considerations section). Obtaining the spectral gamma log will improve our understanding of the subsurface clay mineralogy and where compaction may more likely occur due to that mineralogy.

The magnetic resonance logging tool creates a magnetic field that changes the orientation of water molecules within the pore space of the subsurface lithology. The tool then measures the magnetic resonance as the molecules then reorient to their original positions. Processing of the collected measurements then provides information on the porosity and permeability of the formation on a continuous basis. Subsequently, we can estimate the transmissivity of specific subsurface intervals using the thickness of the interval. Figure 33 illustrates the permeability and volumetric water content that can be derived from the magnetic resonance logging data.

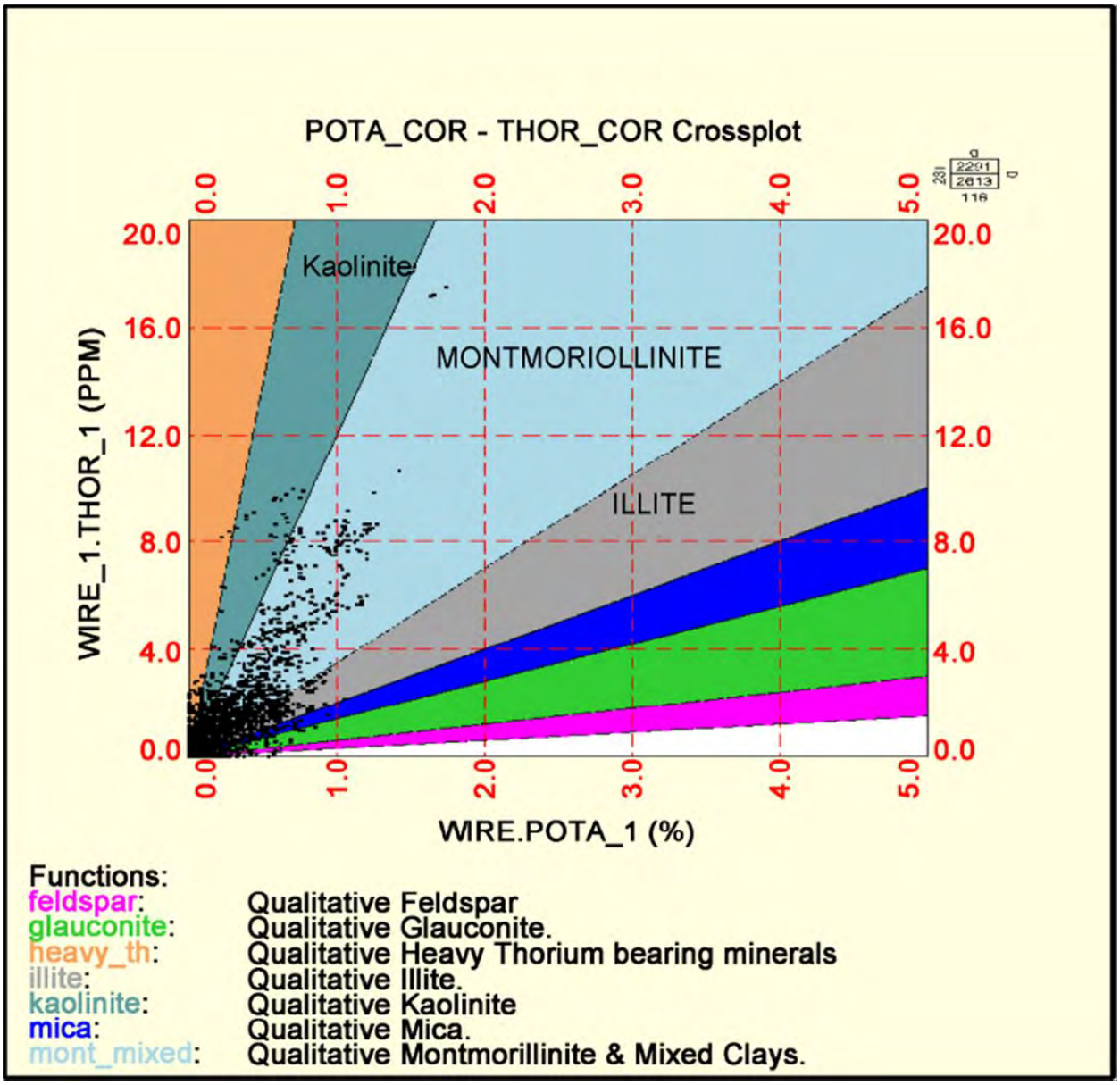


Figure 32. Cross plot illustrating clay type determination from spectral gamma ray tool measurements (Arbab and others, 2017).

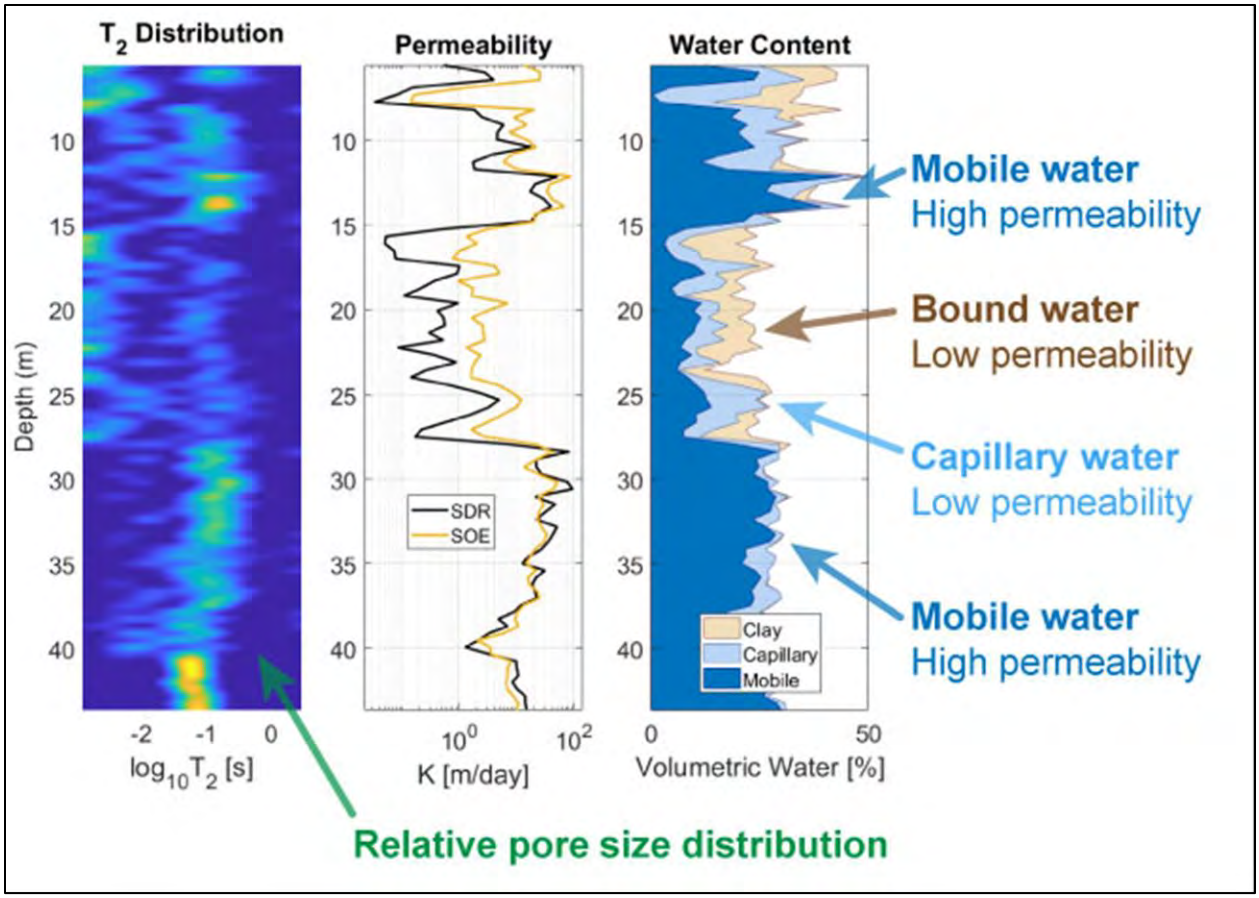


Figure 33. Illustration of measurements and results from a magnetic resonance log (Vista Clara, Inc., 2022).

In addition to the geophysical logs, we recommend collection of percussion sidewall cores for analysis of depth-specific porosity and mineralogy (Figure 34 illustrates clay mineral identification of a core sample using x-ray diffraction). Sampling depths for these cores will be selected by the onsite professional geoscientist based on the geophysical logging. Following collection, the cores will be submitted to lab for analysis and the results can be used to inform or calibrate the magnetic resonance logging data. In addition, the porosity data collected will aid in our understanding of the specific storage values of the subsurface materials (see the section on Specific Storage for a discussion of the calculation of specific storage values from porosity).

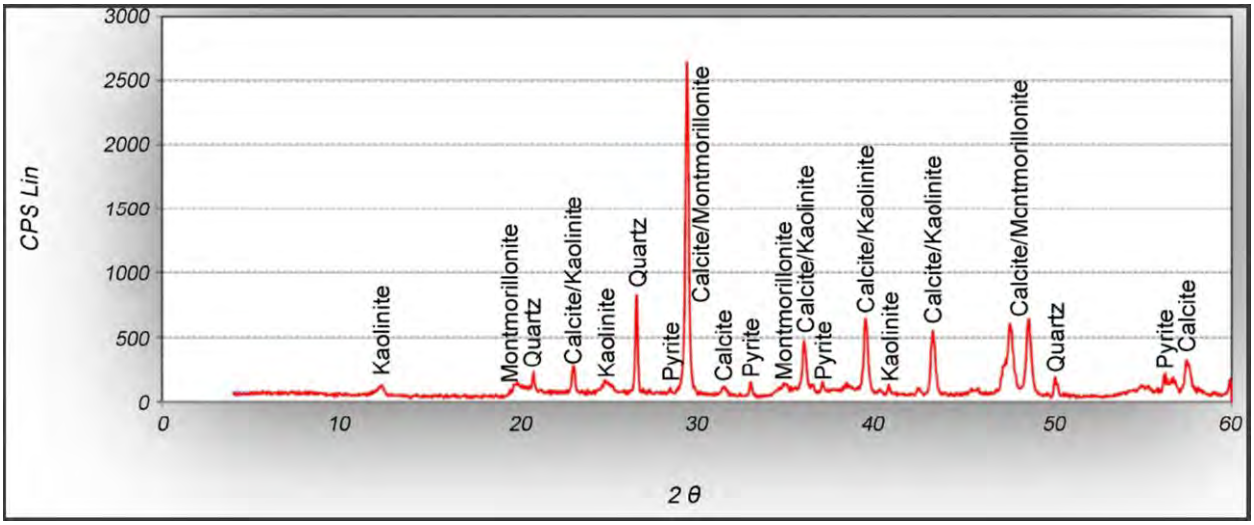


Figure 34. Illustration of clay mineral identification using x-ray diffraction (Arbab and others, 2017).

Once the geophysical logs and samples are collected, we recommend completion of a dedicated water-level monitoring well at the location. The completion interval for the dedicated monitoring well could be determined based on the site-specific conditions, stakeholder interest, and input from the property owner. Once the monitoring well is complete, the drilling contractor would move the rig a short distance (30 to 50 feet) from the test hole to collect cores of selected subsurface clay intervals. Following collection of the core samples, a second dedicated water-level monitoring well could be installed to monitor a different sub-surface interval than that of the well completed at the test hole site.

We anticipate coring of up to ten subsurface intervals to collect samples for laboratory analysis. Similar to the sidewall cores, the laboratory would analyze the porosity and mineralogy of the core sample. In addition, the lab would perform oedometer testing to measure the change in void ratio with pressure which would provide a direct comparison to the data reported by Gabrysch and Bonnet (1974; 1976a; 1976b). Finally, the lab will analyze the core for permeability in the vertical direction.

As discussed in the section reviewing the brackish Jasper Aquifer conceptual model, the porosity of the sediments relates to the specific storage (inelastic and elastic) and the amount of compaction that can occur. The vertical permeability (and related hydraulic conductivity) affects the rate of the compaction. While the lab analyses will provide data for only a specific site at specific depths, much like the work of Gabrysch and Bonnet (1974; 1976a; 1976b), the results will inform our understanding of the Gulf Coast Aquifer System characteristics throughout Montgomery County and nearby areas.

Researchers, consultants, regulatory entities, and others have referred to the work by Gabrysch and Bonnet (1974; 1976a; 1976b) for nearly 50 years when discussing the factors affecting compaction and subsidence in the Gulf Coast Aquifer System. Their work has been interpreted and applied to inform the understanding of compaction throughout the Gulf Coast Region despite being limited to a relatively small area. Adding to the body of knowledge by developing physical data related to clay compaction in an updip area of the Gulf Coast Aquifer System, and particularly in the Jasper Aquifer, will provide benefit to the scientific community for years to come and will enhance the data-driven management of groundwater resources by Lone Star Groundwater Conservation District.

SUMMARY AND CONCLUSIONS

Our work during the Phase 2 subsidence investigations focused primarily on two of the most applicable questions from the Phase 1 work. We focused on these questions as they were identified as providing the highest level of support to the data-driven management of groundwater resources by Lone Star Groundwater Conservation District. In addition, the work conducted during this Phase 2 forms a basis for the potential Phase 3 drilling and testing program.

Brackish Jasper Aquifer Conceptual Model

One of the questions under investigation related to the brackish Jasper Aquifer conceptual model develop by Kelley and others (2018). During Harris-Galveston Subsidence District Regulatory Plan Update meetings, United States Geological Survey staff appeared to suggest that they would use this conceptual model as the basis for simulating compaction of the Jasper Aquifer in the GULF-2023 model. Since the conceptual model dictates or guides the subsequent development of a numerical model, it follows that any issues or potential flaws with the conceptual model are also issues or potential flaws with the numerical model. Our review of Kelley and others (2018) revealed questions with their conceptualization of compaction in the Jasper Aquifer.

- Our calculated estimates of inelastic and elastic specific storage of clay samples from Gabrysch and Bonnet (1974; 1976a; 1976b) are similar to those of Kelley and others (2018).
    - Data reported by Gabrysch and Bonnet (1974; 1976a; 1976b) are used to calculate the coefficients needed to determine the inelastic and elastic specific storage of the clay samples. These coefficients (namely, porosity and compressibility) are not reported by Gabrysch and Bonnet (1974; 1976a; 1976b) as stated by Kelley and others (2018).
    - Our evaluation of the porosity and compressibility values results in trend (that is, model) that differs increasing for depths below about 500 feet.
    - Kelley and others (2018) trend through porosity values calculated from the Gabrysch and Bonnet (1974; 1976a; 1976b) data results in unrealistic porosity values for shallow depths.
    - The constant geostatic stress gradient used by Kelley and others (2018) to determine effective burial depth from applied pressure may be too high for the Gulf Coast Region.
- Gabrysch and Bonnet (1974) report laboratory measured hydraulic conductivity for four clay samples, but they do not indicate if it is horizontal or vertical hydraulic conductivity.
    - Kelley and others (2018) state the hydraulic conductivity data from Gabrysch and Bonnet (1974) is a measure of the vertical component.
    - The hydraulic conductivity values from Gabrysch and Bonnet (1974) are consistent with representative values of the horizontal hydraulic conductivity of clays.
    - The minimum hydraulic conductivity values from Gabrysch and Bonnet (1974) are about four times greater than the maximum representative value of the vertical hydraulic conductivity of clays.
    - High values for the vertical hydraulic conductivity of the clay result in a shorter time constant for compaction. That is, compaction occurs at a faster rate.

- Kelley and others (2018) conceptualization of drawdown at preconsolidation stress does not appear to be consistent with observed changes in water level and compaction.
    - Observations by Gabrysch (1982) indicated that water-level declines in the deep Evangeline Aquifer did not result in appreciable compaction.
    - Observations at the Lake Houston extensometer site indicate there is no discernable compaction of units below the Evangeline Aquifer despite about 150 feet of water level decline in the Jasper Aquifer.
    - Preconsolidation head may be below observed water-level declines in the Jasper or the drawdown at preconsolidation stress is greater than conceptualized by Kelley and others (2018).
- Along with burial depth, the age and mineralogy of the sediments may affect the compressibility of the clay layers.
    - It is suspected that younger and shallower materials will compact more easily (Gabrysch, 1982).
    - Kelley and others (2018) note that clays composed of montmorillonite have the highest compressibility
    - Chemical reactions within older sediments may allow for increased cementation of the grains.
    - Burial depth increases the effective stress on the sediment grains which increases compaction of the units.

With regard to the application of the work by Kelley and others (2018) to the Jasper Aquifer in Montgomery County it is important to remember that the data they used are from more than 20 miles away and are not from the Jasper Aquifer. The data used by Kelley and others (2018) are from younger sediments of the Chicot and Evangeline aquifers. Regarding their analyses, Kelley and others (2018) state that "properties controlling compaction of the brackish Jasper Aquifer should be considered uncertain."

We recommend users of the Kelley and others (2018) conceptual model of compaction in the Jasper Aquifer carefully consider the conclusions listed above. Revisions to the conceptual model based on our observations may result in less predicted compaction in Jasper Aquifer or a slower rate of compaction. While the sediments that make up the formations of the Jasper Aquifer may compact with declining water levels, it is important to appropriately conceptualize the compaction based on the observed data. While the compaction results from a numerical model will remain uncertain, we may reduce the uncertainty through consideration of the available observations.

Hydrostratigraphy

For decades a common approach was taken by groundwater professionals towards the delineation of water bearing units of the Gulf Coast Aquifer System in Montgomery and surrounding counties. This common approach was practical and reflected the consensus and understanding of the aquifers and groundwater flow through the system. Recently, other approaches to delineating the hydrostratigraphic units have been applied; however, practical application of the results from the approach within the GULF-2023 model were unsuccessful and required revision to allow implementation within the numerical model. For our evaluation of the local hydrostratigraphy, we applied the common approach and practical understanding of the hydrostratigraphic units of the Gulf Coast Aquifer System to develop the structural and clay thickness dataset for Montgomery County. The following provides a summary of our evaluations focused on the subsurface conditions beneath Montgomery County.

- The geology of the Gulf Coast Aquifer System is made up of a complex system of alternating layers of discontinuous sand, silt, and clay that increase with depth and thickness toward the Gulf of Mexico.
    - It can be difficult to identify the individual geologic units on geophysical logs due to the similarities of sediments within each geologic unit.
    - Historically, the sub-aquifers of the Gulf Coast Aquifer System in Montgomery County and the greater Houston area have been classified by hydrogeologic units and include from shallowest (younger) to deepest (older) the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit, Jasper Aquifer and the Catahoula Formation.
    - Our evaluation focused on the Chicot, Evangeline, and Jasper aquifers which are the principal aquifers for groundwater production in Montgomery County. The Catahoula was not discussed at length in this report.
- In this study the Jasper Aquifer was divided into two units based on lithology, the Upper Jasper and the Lower Jasper.
    - The upper part of the Jasper Aquifer can have relatively thick sand beds that typically contain freshwater and are capable of supporting moderate to large capacity water wells in most parts of Montgomery County.
    - The lower part of the Jasper Aquifer contains mostly interbedded sand and clay and the sands contain water with likely brackish quality.
    - At the time of this study, no wells have been completed in the brackish portion of the Jasper Aquifer.
    - It is our understanding that all registered and permitted wells with the LSGCD that are designated as the Jasper Aquifer are completed in the sands that comprise the upper part of the aquifer.
- We evaluated geophysical logs to improve the understanding of the depth, thickness, and composition of the principal aquifers within Montgomery County.
    - Elevation estimates relative to sea level were developed and mapped for the base of the Chicot, Evangeline and Upper Jasper aquifers and the Burkeville Confining Unit.
    - We applied the United States Geological Survey Source Water Assessment Program dataset (Strom and others, 2003) as the base of the Lower Jasper.

  - The base of aquifer and confining unit surfaces developed as part of this study provide a reference for the approximation of the tops and bottoms of the hydrogeologic units in Montgomery County. Site specific conditions may vary from the surfaces developed using the evaluated geophysical logs.
- Young and Draper (2020) used an approach combining the chronostratigraphic and lithostratigraphic methodology to update the hydrogeologic units in support of the development of the GULF-2023 groundwater flow model.
  - The approach resulted in a generally deeper base of the Chicot Aquifer in Montgomery and surrounding counties compared to the base of Chicot Aquifer as defined in this study and previous work (Popkin, 1971; Gabrysch and Bonnet, 1974; 1976a; 1976b; Baker, Jr., 1979; Espey, Huston & Associates, Inc., 1979; Carr and others, 1985; Kasmarek and Robinson, 2004; Kasmarek, 2013).
  - The lithostratigraphic based approach to adjust the Burkeville Confining Unit elevations yielded formation picks that are generally similar to the picks defined in this study for most parts of Montgomery County.
  - While the GULF-2023 model will have hydrogeologic surfaces that are delineated differently, the hydrogeologic and subsidence parameters assigned to each model layer will likely influence the performance of the model and its ability to simulate observed aquifer conditions as much or more than the hydrogeologic surfaces developed for the model.
- Jasper production within Montgomery and northern Harris counties is almost exclusively limited to the Upper Jasper Aquifer
  - The clay layers likely affected by depressurization and potential compaction are likely much thinner than the cumulative clay thickness of the entire Jasper.
  - Comparing cumulative thickness for the Jasper Aquifer as presented by Kasmarek and Robinson (2004) with clay-interbed thicknesses from our evaluations indicates that the cumulative clay thicknesses for the Jasper are up to five times thicker than the clay interbeds within likely targeted production zones in the Upper Jasper.
- The distribution and thickness of clay layers is critical to understanding the hydraulics, mechanics, magnitude, and timing of compaction and resulting subsidence. Understanding these distributions as related to zones targeted for large-capacity pumping should be a consideration for all future studies and model parameterization. The information compiled from the log analyses and identifying clay and sand layers will be critical in planning subsequent work including planning of drilling, logging, and coring efforts.

Phase 3 Drilling and Testing

Researchers, consultants, regulatory entities, and others have referred to the work by Gabrysch and Bonnet (1974; 1976a; 1976b) for nearly 50 years when discussing the factors affecting compaction and subsidence in the Gulf Coast Aquifer System. Their work has been interpreted and applied to inform the understanding of compaction throughout the Gulf Coast Region despite being limited to a relatively small area. Adding to the body of knowledge by developing physical data related to clay compaction in an updip area of the Gulf Coast Aquifer System, and particularly in the Jasper Aquifer, will provide benefit to the scientific community for years to come and will enhance the data-driven management of groundwater resources by Lone Star Groundwater Conservation District.

To obtain this data, we recommend conducting a drilling and testing program designed to collect data that are directly applicable to understanding the subsurface compaction characteristics. We anticipate the program would involve:

1. Drilling a test hole to obtain lithologic samples and geophysical logs then completing a water-level monitoring well
2. Adjacent to the test hole, drilling to collect core samples of selected clay layers then completing a second water-level monitoring well

One immediate benefit of the program would be dedicated water-level monitoring wells (screened at different intervals) for potential collection of continuous data. Lab analysis of core samples collected from each hole would provide mineralogical, compressibility, porosity, and permeability data. These collected data would then inform the conceptual understanding of potential compaction within the groundwater production intervals and guide management of the resources by the District.

To begin collection of the data, we recommend drilling and testing at six locations spread across Montgomery County. We recommend the first location be at the Lone Star Groundwater Conservation District property if space is available. This location could provide the District with the demonstration of on-site data collection and could be used for long-term educational opportunities. For all six of the proposed locations, our recommended priority for drilling and testing locations is:

1. Lone Star Groundwater Conservation District
2. Woodlands Area
3. Magnolia Area
4. Southeast Area
5. Splendora Area
6. Montgomery Area

REFERENCES

American Geological Institute, 1976, Dictionary of Geological Terms: Revised Edition: Garden City, New York, Anchor Press/Doubleday, 472 p.

Arbab, B., Jahani, D., and Movahed, B., 2017, Reservoir Characterization and Pore Type Systems of Carbonate Low Resistivity Pay in Persian Gulf: Open Journal of Geology, v. 7, p. 859-870.

Baker, Jr., E.T., 1979, Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas: Texas Department of Water Resources Report 236, 43 p.

Baker, Jr., E.T., 1986, Hydrology of the Jasper Aquifer in the Southeast Texas Coastal Plain: Texas Water Development Board Report 295, 65 p.

Bear, J., 1979, Hydraulics of Groundwater: Mineola, New York, Dover Publications, Inc., 569 p.

Bureau of Economic Geology, 2014, Geologic Atlas of Texas: Digital map,

Carr, J.E., Meyer, W.R., Sandeen, W.M., and McLane, I.R., 1985, Digital models for simulation of ground-water hydrology of the Chicot and Evangeline aquifers along the Gulf Coast of Texas: Texas Department of Water Resources Report 289, 101 p.

Espey, Huston & Associates, Inc., 1979, Houston-Galveston Coastal Subsidence District Water Resource Management Program Phase I: Prepared for the Harris-Galveston Coastal Subsidence District, unk. p.

Fetter, C.W., 1994, Applied Hydrogeology: (Third Edition) Upper Saddle River, New Jersey, Prentice Hall, 691 p.

Gabrysch, R.K., 1982, Ground-water withdrawals and land-surface subsidence in the Houston-Galveston Region, Texas, 1906-80: U. S. Geological Survey Open-File Report 82-571, 68 p.

Gabrysch, R.K. and Bonnet, C.W., 1974, Land-Surface Subsidence in the Area of Burnett, Scott, and Crystal Bays Near Baytown, Texas: U.S. Geological Survey Water-Resources Investigations Report 74-21, 48 p.

Gabrysch, R.K. and Bonnet, C.W., 1976a, Land-surface subsidence at Seabrook, Texas: U.S. Geological Survey Water Resources Investigation, 53 p.

Gabrysch, R.K. and Bonnet, C.W., 1976b, Land-surface subsidence in the area of Moses Lake near Texas City, Texas: U.S. Geological Survey Water-Resources Investigation 76-32, 42 p.

Hoffman, J., Leake, S.A., Galloway, D.L., and Wilson, A.M., 2003, MODFLOW-2000 Ground-Water Model—User Guide to the Subsidence and Aquifer-System Compaction (SUB) Package: U.S. Geological Survey, Open-File Report 03—233, 46 p.

Jorgensen, D.G., 1975, Analog-Model Studies of Ground-Water Hydrogeology in the Houston District, Texas: Texas Water Development Board Report 190, 84 p.

Kasmarek, M.C., 2013, Hydrogeology and Simulation of Groundwater Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas, 1891-2009: U.S. Geological Survey Scientific Investigations Report 2012-5154, 55 p.

Kasmarek, M.C. and Robinson, J.L., 2004, Hydrogeology and Simulation of Ground-Water Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5102, 111 p.

Keester, M., Thornhill, M., Beach, J., and Drabek, C., 2021, Evaluation of the Correlation between Land-Surface Movement, Water-Level Change, and Groundwater Production in Montgomery County: Report prepared for the Lone Star Groundwater Conservation District, 42 p.

Kell, G.S., 1975, Density, Thermal Expansivity, and Compressibility of Liquid Water from 0° to 150°C: Correlations and Tables for Atmospheric Pressure and Saturation Reviewed and Expressed on 1968 Temperature Scale: Journal of Chemical and Engineering Data, v. 20, no. 1, p. 97-105.

Kelley, V., Deeds, N., Young, S.C., Pinkard, J., Sheng, Z., Seifert, J., and Marr, S., 2018, Subsidence Risk Assessment and Regulatory Considerations for the Brackish Jasper Aquifer - Harris-Galveston and Fort Bend Subsidence Districts: Report prepared for Harris-Galveston Subsidence District and Fort Bend Subsidence District, 69 p.

LBG-Guyton Associates, 2016, Technical Memorandum Regarding Total Estimated Recoverable Storage and Implications for Groundwater Management: Prepared for Task 2 of the Lone Star Groundwater Conservation District Strategic Water Resources Planning Study, 31 p.

Leake, S.A. and Galloway, D.L., 2007, MODFLOW Ground-Water Model—User Guide to the Subsidence and Aquifer-System Compaction Package (SUB-WT) for Water-Table Aquifers: U.S. Geological Survey, Techniques and Methods 6–A23, 42 p.

Leake, S.A. and Prudic, D.E., 1991, Documentation of a Computer Program to Simulate Aquifer-System Compaction Using the Modular Finite-Difference Ground-Water Flow Model: U.S. Geological Survey, Techniques of Water-Resources Investigations 06-A2, 68 p.

Long, C., 2020, Texas State Historical Association Handbook of Texas, https://www.tshaonline.org/handbook/entries/montgomery-county, accessed November 2021.

Meade, R.H., 1964, Removal of water and rearrangement of particles during the compaction of the clayey sediments: U.S. Geological Survey Professional Paper 497-B, 23 p.

Popkin, B.P., 1971, Ground-Water Resources of Montgomery County, Texas: TWDB Report No. 136, 143 p.

Prozorovich, E.A., 1964, Factors determining compaction in sedimentary rocks: International Geology Review, v. 6, no. 3, p. 405-419.

Puttiwongrak, A., Nufus, S., Bunprasert, C., Giao, P.H., Vann, S., Suteerasak, T., and Sasaki, N., 2021, mpaction Model for Shale in Differences of Geological Ages Using A 3D Empirical Relationship in Northeastern Thailand: Preprints, no. 2021040589, p. 1-10.

Railroad Commission of Texas, 2021, Data Sets Available for Download, https://www.rrc.state.tx.us/resource-center/research/data-sets-available-for-download/, accessed September 2021.

Ramage, J.K. and Shah, S.D., 2019, Cumulative Compaction of Subsurface Sediments in the Chicot and Evangeline Aquifers in the Houston-Galveston Region, Texas (ver. 2.0, June 2020), https://www.sciencebase.gov/catalog/item/5cd30a76e4b09b8c0b7a5cb3, accessed March 2020.

Strom, E.W., Houston, N.A., and A., G.C., 2003, August Selected Hydrogeologic Datasets for the Jasper aquifer, Texas: Open-File Report 03-299.

Terzaghi, K., 1925, Erdbaumechanik auf bodenphysikalisher Grundlage: Vienna, Austria, Deuticke, 399 p.

Texas Commission on Environmental Quality, 2021, Water Well Report Viewer, https://www.tceq.texas.gov/gis/waterwellview.html, accessed November 2021.

Texas Water Development Board, 2021a, Groundwater Data Viewer: BRACS Database, https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundWaterDataViewer, accessed November 2021.

Texas Water Development Board, 2021b, Groundwater Database Reports, http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp, accessed July 2021.

Thornhill, M.R. and Keester, M.R., 2020, Subsidence Investigations — Phase 1 - Assessment of Past and Current Investigations: Report prepared for the Lone Star Groundwater Conservation District, 35 p.

Tiab, D. and Donaldson, E.C., 2016, Effect of Stress on Reservoir Rock Properties (Chapter 9) in Petrophysics - Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties: (4th) New York, Elsevier, 483-582 p.

Turner Collie & Braden, Inc., 2004, Groundwater Resources Management Information Report: Prepared for the Lone Star Groundwater Conservation District, 61 p.

United States Geological Survey, 2021a, National Water information System Web Interface Groundwater Levels for Texas, https://nwis.waterdata.usgs.gov/tx/nwis/gwlevels/, accessed November 2021.

United States Geological Survey, 2021b, Provisionsal 2021 Water Level Altitude Data for Montgomery and Harris Counties: Provisional data provided to LSGCD,

Vista Clara, Inc., 2022, Magnetic Resonance Borehole Logging Tools, https://www.vista-clara.com/borehole-logging-solutions/, accessed April 2022.

Walton, C.W., 1987, Groundwater Pumping Tests – Design & Analysis: Boca Raton, CRC Press, 216 p.

Wilson, J.A., 1962, Tertiary Formations between Austin and Houston with Special Emphasis on the Miocene and Pliocene: Field Excursions No. 10 - The University of Texas at Austin, 12 p.

Young, S.C. and Draper, C., 2020, The Delineation of the Burkeville Confining Unit and the Base of the Chicot Aquifer to Support the Development of the Gulf 2023 Groundwater Model: Prepared for Harris-Galveston Subsidence District and Fort Bend Subsidence District, 27 p.

Young, S.C., Ewing, T., Hamlin, S., Baker, E., and Lupton, D., 2012, Final Report - Updating the Hydrogeologic Framework for the Northern Portion of the Gulf Coast Aquifer: Contract report for the Texas Water Development Board, 285 p.

Young, S.C., Jigmond, M., Deeds, N., Blainey, J., Ewing, T.E., Banerj, D., Piemonti, D., Jones, T., Griffith, C., Lupton, D., et al., 2016, FINAL REPORT: Identification of Potential Brackish

Groundwater Production Areas – Gulf Coast Aquifer System: Contract report to the Texas Water Development Board, 636 p.

Young, S.C., Kelley, V., Deeds, N., Knox, P., Budge, T., Baker, E., Galloway, B., and Dutton, A., 2006, A Site Conceptual Model to Support the Development of a Detailed Groundwater Model for Colorado, Wharton, and Matagorda Counties: Prepared for LCRA, 304 p.

Yuen, S.T.S., n.d., Compressibility and Settlement, https://people.eng.unimelb.edu.au/stsy/geomechanics_text/Ch9_Settlement.pdf, accessed Novemeber 2021.

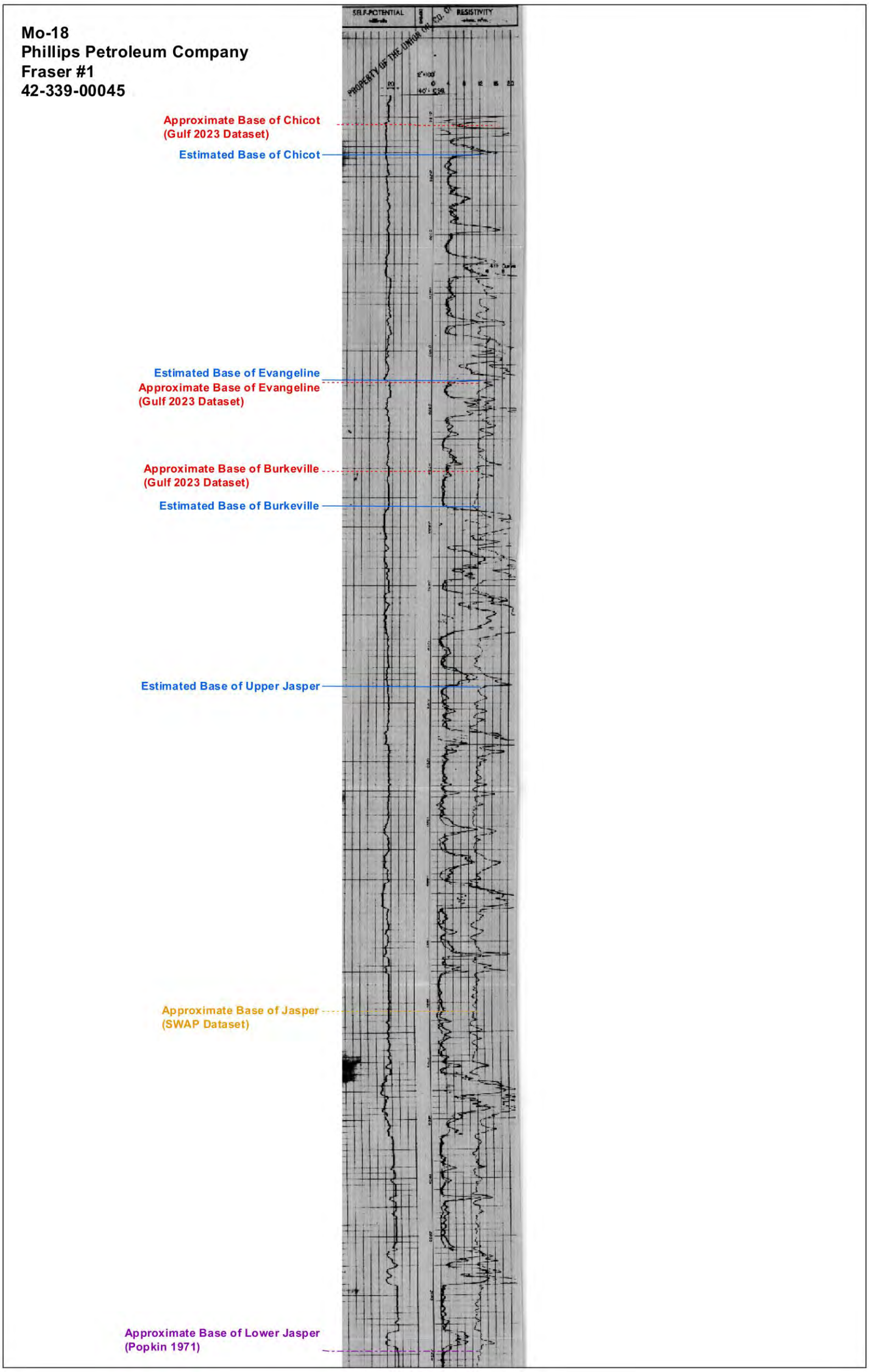
APPENDIX 1 – GEOPHYSICAL LOG DATA

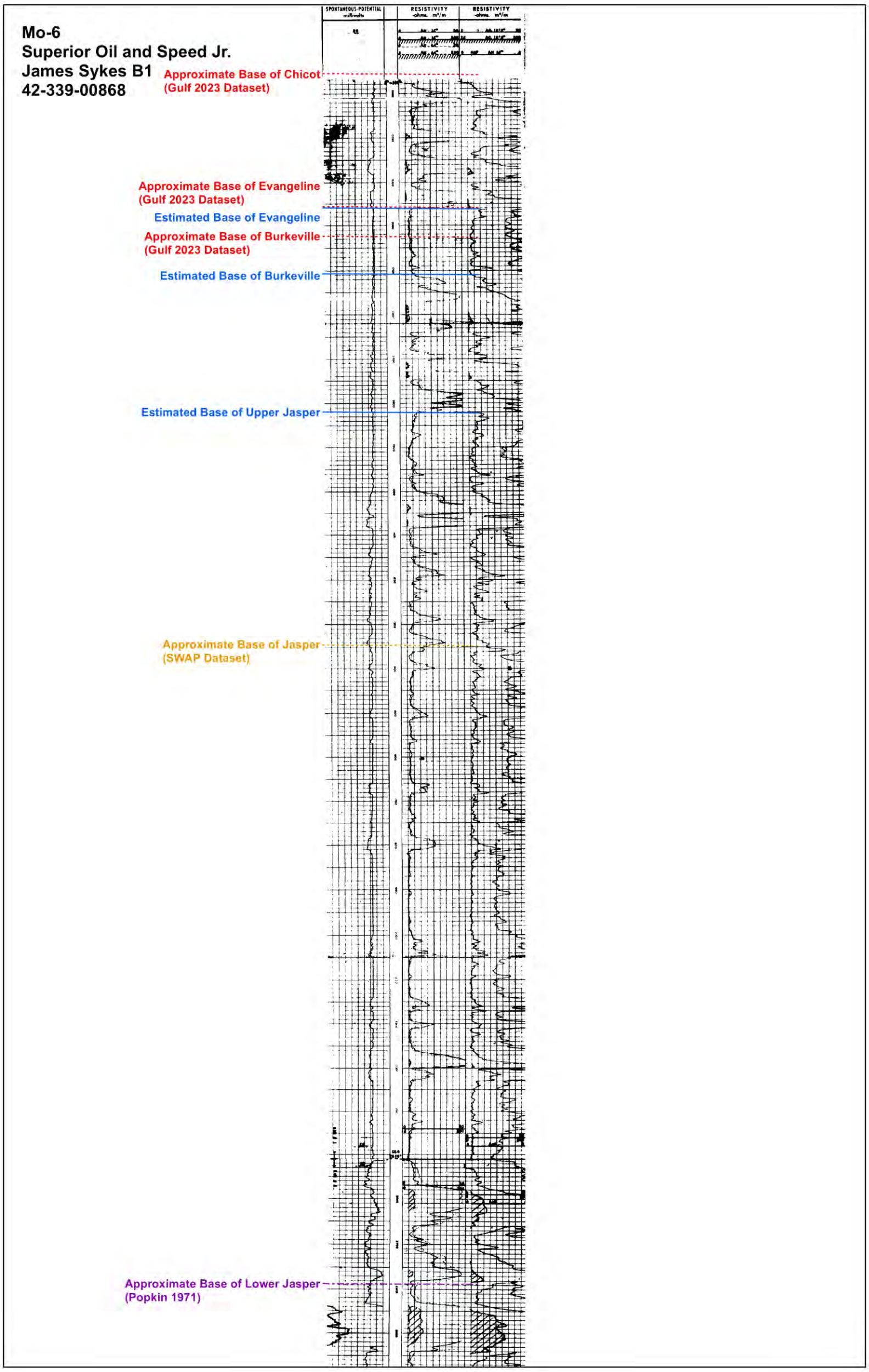
Geophysical Log Number	API Number, State Well Number and / or Q Number	Company	Well	Latitude	Longitude	Land Surface Elevation (feet)	Base of Chicot Depth (feet, bls)	Base of Evangeline Depth (feet, bls)	Base of Burkeville Depth (feet, bls)	Base of Upper Jasper Depth (feet, bls)	Base of Chicot Elevation (feet, rsl)	Base of Evangeline Elevation (feet, rsl)	Base of Burkeville Elevation (feet, rsl)	Base of Upper Jasper Elevation (feet, rsl)	SWAP Base of Jasper Elevation (feet, rsl)
Mo-1	4233901886	THE PURE OIL CO. & W.T. MORAN CORP.	CENTRAL COAL & COKE 3	30.5159	-95.6830	191	--	--	--	445	--	--	--	-254	-507
Mo-2	4233900966	RED BANK OIL CO.	CENTRAL COAL & COKE	30.4727	-95.6947	334	--	220	280	550	--	114	54	-216	-665
Mo-3	Q-41 / 6036403	STRUM & WOMACK	FOSTER #2	30.4441	-95.6180	191	--	--	335	610	--	66	-144	-419	-905
Mo-4	4233901799	E.L. KURTH TRUSTEE	SOUTHLAND PAPER MILLS 4	30.2492	-95.2027	123	390	1,005	1,260	1,825	-267	-882	-1,137	-1,702	-2,320
Mo-5	Q-197 / 6036304	C.W. CHICK HANSLIP	CRAWFORD #1	30.4756	-95.5294	290	--	--	538	730	--	--	-248	-440	-927
Mo-6	4233900868	SUPERIOR OIL CO AND CARLTON L. SPEED JR.	JAMES SYKES B 1	30.4477	-95.5122	284	--	360	510	820	--	-76	-226	-536	-1,059
Mo-7	4233900980 / 6044101	T. J. WOOD	FULTZ #1	30.3682	-95.5885	210	--	--	--	860	--	--	--	-650	-1,249
Mo-8	4233900979 / 6043304	F. A. CALLERY	WEISINGER 1	30.3707	-95.6197	264	--	330	500	860	--	-66	-236	-596	-1,197
Mo-9	4233930630	CYPRESS ENERGY DEV.	HARPER B. / 1	30.1842	-95.4035	117	--	910	1,190	1,730	--	-793	-1,073	-1,613	-2,149
Mo-10	4233901142	STABLE OIL CO.	JOLKE #1	30.1260	-95.6601	167	--	900	1,190	1,580	--	-733	-1,023	-1,413	-1,970
Mo-11	4233930951	WHITING PETROLEUM CORPORATION	RHODES, W.S. 1801A	30.2653	-95.3500	159	280	810	1,090	--	-121	-651	-931	--	-1,969
Mo-12	4233901930	HUMBLE OIL AND REFINING CO	KATHRYN M. HINES 1	30.2161	-95.3030	124	400	995	1,280	1,835	-276	-871	-1,156	-1,711	-2,224
Mo-13	4233900901	SUNRAY - MIDCONTINENNT OIL CO.	MARGARET SYKES #1	30.3985	-95.5042	339	--	580	790	1,025	126	-241	-451	-686	-1,253
Mo-14	Q-152	HUMBLE OIL REFINING CO.	SO TEX DEV CO 80-A	30.2822	-95.4048	210	290	745	--	--	-80	-535	--	--	-1,810
Mo-15	4233900032	J. A. GRAY	FOSTER LBR. CO. #1	30.2905	-95.2032	123	--	910	1,110	1,520	-135	-787	-987	-1,397	-2,185
Mo-16	4233900097	OHIO OIL CO.	ANDERSON #1	30.3525	-95.4961	203	180	510	780	1,200	23	-307	-577	-997	-1,428
Mo-17	4233900101	COX & CAL-MON OIL CO.	FOSTER #2	30.3413	-95.4872	235	--	600	810	1,320	-5	-365	-575	-1,085	-1,478
Mo-18	4233900045	PHILLIPS PETR. CO.	FRASER #1	30.4613	-95.3718	345	165	550	765	1,070	180	-205	-420	-725	-1,269
Mo-19	4233900013	AMERADA PETR. CO.	FOSTER LUMBER CO. #1	30.3187	-95.1627	155	305	950	1,150	1,480	-150	-795	-995	-1,325	-2,180
Mo-20	4233900082 / 6037803	MORRIS K. WOMACK	HUNT #1	30.3925	-95.4337	265	--	--	815	1,220	87	--	-550	-955	-1,386
Mo-21	4233900079	MORRIS K. WOMACK ETAL	HUTCHINGS SEALY NBT #1	30.3742	-95.3940	253	--	585	825	1,250	--	-332	-572	-997	-1,520
Mo-22	4233900504	CURTIS HANKAMER	FORMAN #1	30.3001	-95.2780	165	--	830	1,100	1,540	-110	-665	-935	-1,375	-1,997
Mo-23	4233900502	W. F. NEWTON	MARSH - RICE UNIVERSITY #1	30.3310	-95.3120	208	--	--	962	1,440	-64	-652	-754	-1,232	-1,826
Mo-24	4233900056	MCCRAY G. / 1	COPANO TRANS	30.4768	-95.4349	272	--	--	--	850	--	--	--	-578	-1,087
Mo-25	4233901713	STANDARD OIL OF TEXAS	DOROTHY ANDERSON 1	30.1707	-95.2957	120	350	1,120	1,360	1,880	-230	-1,000	-1,240	-1,760	-2,388
Mo-26	4233900059	SPILLER J.B. / 1	KINSALA & NEWTON	30.4715	-95.4897	330	--	--	--	860	--	--	--	-530	-1,009
Mo-27	4233900066	ROSE K.G. / 1	THE MORAN CORP.	30.4067	-95.4056	244	--	--	780	1,200	--	--	-536	-956	-1,388
Mo-28	Q-44 / 6043101	O. C. GARVEY AND TODD	MARTIN #1	30.3649	-95.7250	261	--	--	535	760	--	--	-274	-499	-1,094
Mo-29	4233900993	F. A. CALLERY	MARY LENA CASTLE #1	30.3519	-95.6911	393	--	425	700	1,010	--	-32	-307	-617	-1,185
Mo-30	Q-362	FISH OIL AND GAS CO.	BERKLEY & HOGG #1	30.3158	-95.5663	231	--	600	850	1,170	--	-369	-619	-939	-1,476
Mo-31	4233930484	SOUTHLAND ROYALTY COMPANY	GEORGE MITCHELL #1	30.2799	-95.6954	183	--	620	840	1,160	--	-437	-657	-977	-1,463
Mo-32	4233901881	HUMBLE OIL & REFINING CO.	J. W. LEWIS ET AL #1	30.1743	-95.7328	261	220	920	1,190	1,580	41	-659	-929	-1,319	-1,753
Mo-33	4233901102	MITCHELL & MITCHELL	NEIDRAL #1	30.1399	-95.6155	149	--	900	1,180	1,580	--	-751	-1,031	-1,431	-1,982
Mo-34	4233901046	THE GRAY WOLFE CO	PAN-AM 3	30.2131	-95.6788	249	190	885	1,180	--	59	-636	-931	--	-1,712
Mo-35	Q-222 / 6053105	BASSETT S. WINMILL	F.M. YOST ETAL	30.2190	-95.4792	185	--	890	1,140	1,650	--	-705	-955	-1,465	-1,916
Mo-36	4233901420	COFFEE C W	LATZER-LAYTON UNIT 1	30.1271	-95.4482	134	--	1,020	1,370	1,820	--	-886	-1,236	-1,686	-2,251
Mo-37	4233901846	F. S. CROCKETT	BUCK WILLIAMS #1	30.1834	-95.1941	107	--	1,180	1,538	2,100	-333	-1,073	-1,431	-1,993	-2,553
Mo-38	4233900162	HUMBLE OIL AND REFINING CO	O. C. COX 1	30.3043	-95.4794	179	220	690	1,025	1,450	-41	-511	-846	-1,271	-1,607
Mo-39	4233900199	HUMBLE OIL AND RRG. CO	B. D. GRIFFIN B-1	30.2848	-95.4895	160	240	760	1,020	1,470	-80	-600	-860	-1,310	-1,655
Mo-40	4233930558	INDEPENDENT EXPL.	MCCLAIN / 1	30.2021	-95.1622	105	--	1,140	1,600	2,130	--	-1,035	-1,495	-2,025	-2,559
Mo-41	4233930072	GLENN H. MCCARTHY	SAUNDERS GREGG ET AL 1	30.2906	-95.7842	318	--	670	940	1,275	--	-352	-622	-957	-1,352
Mo-42	4233901732	W. O. HEINZE	BENDER #1	30.0586	-95.2960	78	--	1,450	1,920	2,415	-372	-1,372	-1,842	-2,337	-2,748
Mo-43	4233901014	STANOLIND OIL AND GAS CO	H. C. NICHOLS 1	30.1317	-95.7511	229	240	880	1,170	1,680	-11	-651	-941	-1,451	-1,846
Mo-44	4233901739	MOBIL OIL COMPANY	BENDER ESTATE FARM 1	30.1065	-95.3535	100	390	1,220	1,630	2,060	-290	-1,120	-1,530	-1,960	-2,486
Mo-45	4233930521	ALLIED PRODUCTION CORP.	JOHN BIRCH	30.1137	-95.7374	219	230	880	1,220	1,640	-11	-661	-1,001	-1,421	-1,909
Mo-46	4233901079	COAST CO	PITTS AND LYLES 1	30.1351	-95.6901	216	240	930	1,230	1,685	-24	-714	-1,014	-1,469	-1,910
Mo-47	4233901728	D B OIL COMPANY	CLEVELAND W D / 1	30.0448	-95.2575	104	460	1,500	1,970	2,450	-356	-1,396	-1,866	-2,346	-2,868
Mo-48	4233901109	MOBIL OIL CORPORATION	INA ARCENAUX 1	30.2228	-95.5462	194	340	900	1,170	1,630	-146	-706	-976	-1,436	-1,824
Mo-49	4233930003	THE MORAN CORPATION COLUMBIA DRILLING CO.	M AND M MINERALS 1	30.2024	-95.5583	187	320	895	1,190	1,670	-133	-708	-1,003	-1,483	-1,876
Mo-50	4233901954	CYPRUS OIL COMPANY	CHASE MANHATTAN 4	30.1877	-95.5394	173	325	1,015	1,260	1,680	-152	-842	-1,087	-1,507	-1,943
Mo-51	4233901879	ASSOCIATED OIL AND GAS COMPANY	BLANCHE FOLEY EST 1	30.1835	-95.4949	165	--	1,035	1,250	1,730	-145	-870	-1,085	-1,565	-2,012
Mo-52	4233901721	WHIFFEN ESTATES INC.	C. A. WHITE #1	30.1719	-95.3650	100	--	1,035	1,250	1,810	--	-935	-1,150	-1,710	-2,256
Mo-53	4233901779	WILEY CORP.	WILEY #1	30.1337	-95.4575	121	--	930	1,320	1,750	--	-809	-1,199	-1,629	-2,216
Mo-54	4233901718	HUMBLE OIL & REFINING CO.	W. M. WICKIZER	30.1471	-95.2921	120	--	1,200	1,550	2,040	-311	-1,080	-1,430	-1,920	-2,474
Mo-55	4233901743	CORLEY & GEISELMAN	HARVEY P. / 1	30.1156	-95.4337	105	--	1,020	1,310	1,820	--	-915	-1,205	-1,715	-2,309
Mo-56	4.2339E+13	FLEMMING #1	DAVID B. MACDANIEL	30.1128	-95.7983	243	--	890	1,265	1,670	--	-647	-1,022	-1,427	-1,841
Mo-57	4233900202	HUMBLE OIL AND REFINING	GRAND LAKE GAS UNIT 2 WELL 1	30.2875	-95.4508	169	220	720	1,010	1,495	-51	-551	-841	-1,326	-1,706

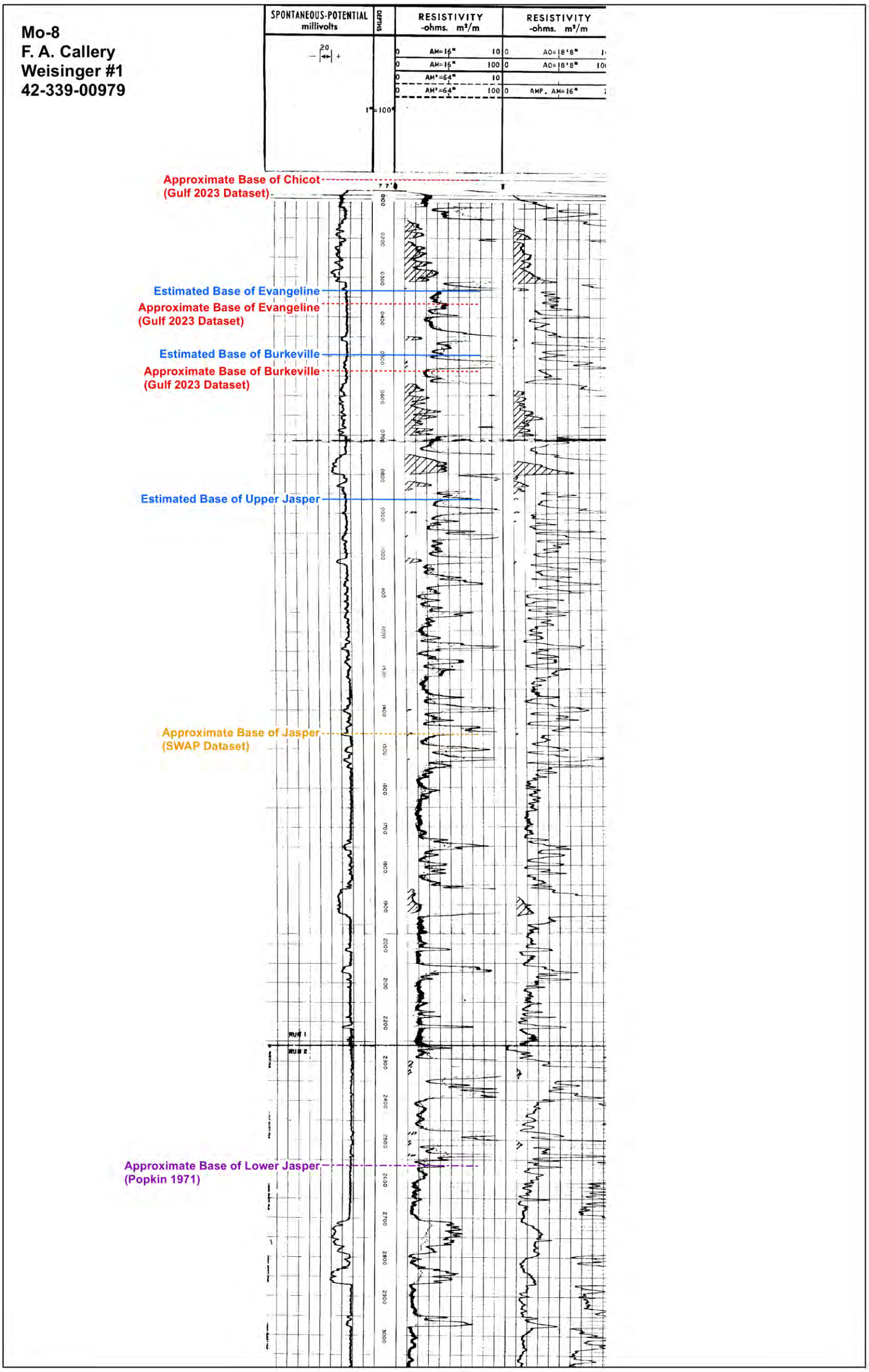
Geophysical Log Number	API Number, State Well Number and / or Q Number	Company	Well	Latitude	Longitude	Land Surface Elevation (feet)	Base of Chicot Depth (feet, bls)	Base of Evangeline Depth (feet, bls)	Base of Burkeville Depth (feet, bls)	Base of Upper Jasper Depth (feet, bls)	Base of Chicot Elevation (feet, rsl)	Base of Evangeline Elevation (feet, rsl)	Base of Burkeville Elevation (feet, rsl)	Base of Upper Jasper Elevation (feet, rsl)	SWAP Base of Jasper Elevation (feet, rsl)
Mo-58	4233901039	ACCO-ROBERTS & MURPHY COMPANY	M ROBERTS ESTATE / 1	30.2143	-95.6370	220	--	840	1,140	1,530	--	-620	-920	-1,310	-1,764
Mo-59	4233901887	SOCONY MOBIL OIL COMPANY	SEALY-SMITH FOUNDATION / 1	30.3282	-95.6204	227	--	530	750	1,060	--	-303	-523	-833	-1,365
Mo-60	4233930199	LADD PET. CORP.	SEALY & SMITH FDTN. / 2	30.2711	-95.6073	195	--	780	1,030	1,400	--	-585	-835	-1,205	-1,600
Mo-61	4233901734	JACK W. FRAZIER	BENDER #1	30.1029	-95.3838	104	--	1,180	1,450	1,960	-282	-1,076	-1,346	-1,856	-2,439
Mo-62	4233930730	FIRST MATAGORDA CORP	BENDER ESTATES A-2	30.1339	-95.4274	112	360	1,095	1,340	1,850	-248	-983	-1,228	-1,738	-2,267
Mo-63	4233900902	B. B. BURKE	FERGERSON #1	30.3805	-95.5057	307	--	550	790	1,150	100	-243	-483	-843	-1,315
Mo-64	4233900934	HUMBLE O&R CO.	HUMBLE O&R CO.	30.2857	-95.5367	167	190	775	1,010	1,370	-23	-608	-843	-1,203	-1,613
Mo-65	4233901849	ATLANTIC REFINING COMPANY	FOSTER LBR. CO 1	30.1799	-95.1533	105	340	1,180	1,660	2,180	-235	-1,075	-1,555	-2,075	-2,650
Mo-66	4233901113	DAVID L. GORDON	MCMAHAN H.M. / 1	30.2372	-95.5209	182	--	880	1,120	1,610	--	-698	-938	-1,428	-1,802
Mo-67	4233901105	D.L. GORDON TRUST	D.L. GORDON TRUST	30.2334	-95.5288	190	--	880	1,130	1,610	--	-690	-940	-1,420	-1,808
Mo-68	4233930494	AIKMAN PETROLEUM INC	AIKMAN PETROLEUM INC	30.1983	-95.5812	216	310	930	1,220	1,620	-94	-714	-1,004	-1,404	-1,864
Mo-69	4233930097	BINTLIFF DAVID C	BINTLIFF DAVID C	30.1569	-95.5709	160	--	915	1,160	1,680	--	-755	-1,000	-1,520	-1,991
Mo-70	4233901101	SIMONTON & TALLEY	SIMONTON & TALLEY	30.1575	-95.5924	162	--	910	1,180	1,640	--	-748	-1,018	-1,478	-1,963
Mo-71	6062604	LAYNE TEXAS COMPANY	KINGWOOD PLACE #1	30.0706	-95.2620	85	410	1,450	--	--	-325	-1,365	--	--	-2,779
Mo-72	4233900154	HUMBLE OIL AND REFINING COMPANY	CONROE TOWNSITE OIL UNIT 97 1	30.3070	-95.4602	209	218	695	1,010	1,470	-9	-486	-801	-1,261	-1,629
Mo-73	4233900742 / 6046504	HUMBLE OIL & REFINING CO.	MARY A. EMORY #5	30.2921	-95.3369	164	275	855	1,080	1,540	-111	-691	-916	-1,376	-1,903
Mo-74	4233901423	C.W. COFFEY ETAL	BALDWIN BROS #1	30.1540	-95.4586	145	--	980	1,250	1,760	-250	-835	-1,105	-1,615	-2,156
Mo-75	4233901872	TEXACO INCOROATED	B.D. GRIFFIN 1	30.3165	-95.2964	194	280	870	1,070	1,440	-86	-676	-876	-1,246	-1,907
Mo-76	4233901801	E. L. KURTH AND S. W. HENDERSON JR.	SOUTHLAND PAPER MILLS 8	30.2336	-95.2202	119	390	990	1,315	1,830	-271	-871	-1,196	-1,711	-2,333
Mo-77	4233900019	AMERADA PETROLEUM CORPORATION	H. A. GODEJOHN 1	30.2901	-95.1502	155	360	995	1,170	1,550	-205	-840	-1,015	-1,395	-2,297
Mo-78	4233901604 / 6054302	ATLANTIC REFG. CO	SO. TEX. DEVELOPMENT 1	30.2358	-95.2777	130	340	990	1,260	1,830	-210	-860	-1,130	-1,700	-2,207
Wa-1	Q-50	M. H. MARR AND THE MORAN CORRPORATION	KATIE WARD NO 1	30.6477	-95.6329	345	--	--	--	190	--	--	--	155	-122
Wa-2	4247130016	MORAN CORPORATION, THE	CENTRAL COAL AND COKE 9	30.5698	-95.6318	211	--	--	--	390	--	--	--	-179	-394
Wa-3	4247130010	THE MORAN CORP.	CENTRAL COAL & COKE A-2	30.5419	-95.5653	352	--	220	322	564	--	132	30	-212	-617
Wa-4	4247100046	R.W. RAMEY AND TEXMO OIL CO.	TOMY KMEICIK 1	30.5287	-95.4799	349	--	300	370	630	--	49	-21	-281	-818
Wa-5	4247130232 / Q-91	GETTY OIL CO	T.W. KEELAND 1	30.5484	-95.3592	353	--	--	325	770	--	--	28	-417	-990
Wa-6	4247130011	PLACID OIL COMPANY	GIBBS BROS. #2	30.6492	-95.3718	340	--	--	--	240	--	--	--	100	-623
Gr-1	4218530369	ARCO EXPLORATION	CHARLIE ASHORN 1	30.5465	-95.8792	359	--	--	--	190	--	--	--	169	8
Gr-2	4218530009	LONE STAR PRODUCING CO	GOFORTH 1	30.2681	-95.8569	317	120	700	975	1,260	197	-383	-658	-943	-1,392
Gr-3	4218530028	VICTORY PETROLEUM CO.	WILLIAM BLEVINS #1	30.4756	-95.8801	375	--	--	--	370	--	--	-999	5	-317
Gr-4	4218500117	ATLANTIC REFINING CO	E. R. SANDERS 1	30.2695	-95.9437	324	--	610	860	1,040	--	-286	-536	-716	-1,162
Gr-5	4218530056	CHARLES B. MARINO	COWAN-ZOLLMAN 1-6	30.2488	-95.8310	306	--	730	1,090	1,350	--	-424	-784	-1,044	-1,467
SJ-1	4240700031	MIDLAND PRODUCTION CORP AND WOLF'S HEAD	HILL ESTATE 1	30.5096	-95.2884	376	--	535	750	1,010	--	-159	-374	-634	-1,283
SJ-2	4240730059	GLEN ROSE CORP	CENTRAL COAL AND COKE C-1	30.5985	-95.2685	312	--	--	--	830	--	--	--	-518	-1,010
SJ-3	4240730086	HOUSTON PETROLEUM CO	BROWDER-SCOTT UNIT 1	30.5338	-95.3049	273	--	350	455	820	--	-77	-182	-547	-1,160
SJ-4	4240730453	HOUSTON PETROLEUM COMPANY	U.S.A. 1	30.5140	-95.1913	254	--	--	--	865	--	--	--	-611	-1,483
SJ-5	4240730017	CONTINENTAL OIL CO	GIBBS BROTHERS AND COMPANY 1	30.4784	-95.2597	266	95	545	715	995	171	-279	-449	-729	-1,461
SJ-6	4240730018	CONTINENTAL OIL COMPANY	DRUCILLA MAYS, ET AL #1	30.4331	-95.2394	235	--	600	800	1,090	--	-365	-565	-855	-1,665
SJ-7	4240700271	ATLANTIC REFINING CO	R. L. WHITE 1	30.3626	-95.1519	180	255	750	1,010	1,370	-75	-570	-830	-1,190	-2,066
SJ-8	4240700214	AMERADA PETR. CORP AND MID-STATES OIL CORP.	CENTRAL COAL COKE CORP 1	30.3930	-95.1444	151	175	670	900	1,180	-24	-519	-749	-1,029	-1,988
SJ-9	4240700246 / Q-8	MAGNOLIA PETROLEUM COMPANY	HINCHLIFF-SIMS #1	30.4257	-95.1002	187	200	630	900	1,160	-13	-443	-713	-973	-1,962
SJ-10	4240700156 / Q-130	AMERADA PET. CO	FOSTER LBR. CO A-1	30.4572	-95.1749	253	210	560	770	1,012	43	-307	-517	-759	-1,780
L-1	42229105456	WILSON - BROACH CO.	C. M. HIGHTOWER #1	30.3517	-95.0232	156	315	840	1,185	1,460	-159	-684	-1,029	-1,304	-2,349
L-2	4229100008	MILES PRODUCTION CO	HINCHLIFF MRS M P / 1	30.3780	-95.0643	214	--	810	1,030	1,360	--	-596	-816	-1,146	-2,183
L-3	4229105018	HUMBLE OIL AND REFINING COMPANY	B. E. QUINN B-1	30.2592	-95.0455	123	370	1,040	1,310	1,680	-247	-917	-1,187	-1,557	-2,622
L-4	4229131549	GUARDIAN OIL COMPANY	FRIENDSWOOD 1	30.2073	-95.0648	130	--	1,200	1,650	1,970	--	-1,070	-1,520	-1,840	-2,754
L-5	4229102431	ACORN OIL CO.	C.C. BERRY 1	30.2259	-94.9641	115	--	1,260	1,710	2,025	0	-1,145	-1,595	-1,910	-2,909
L-6	4229102483	THE TEXAS CO.	R.B. BALDWIN C-4	30.1114	-94.9689	82	450	--	2,040	2,490	-368	--	-1,958	-2,408	-3,279
L-7	4229132387	ANSCHUTZ EXPLORATION CORPORATION	STORSSER FARMS INC. #1	30.1110	-95.0113	80	420	1,640	2,065	2,510	-340	-1,560	-1,985	-2,430	-3,185
L-8	4229130349	ANDERSON T G	BALDWIN EST / 1	30.2175	-95.0983	89	--	1,120	1,510	1,875	--	-1,031	-1,421	-1,786	-2,647
L-9	4229105450	CENTAUR PETR CORP	M R SCOTT ETAL 1 / 1	30.1399	-94.9297	97	--	1,755	2,400	2,590	--	-1,658	-2,303	-2,493	-3,284
Wal-1	4247330066	STARR OIL & GAS CO.	WILLIAM M. RICE INSTITUTE	30.2147	-95.8099	280	--	790	1,110	1,420	--	-510	-830	-1,140	-1,569
Wal-2	4247330379	HIGH CHAPPARAL OIL COMPANY	COWAN-ZOLLMAN-HIGH CHAPPAR	30.2390	-95.8554	290	--	740	1,080	1,330	--	-450	-790	-1,040	-1,473
Wal-3	4247300029	C. W. WEAVER	STEGER #1	30.1635	-95.9410	300	--	910	1,100	1,480	--	-610	-800	-1,180	-1,522
Wal-4	4247300037	STARR OIL & GAS COMPANY	WILLIAM M. RICE INSTITUTE / 1	30.1977	-95.8802	283	--	785	1,140	1,460	--	-502	-857	-1,177	-1,523
H-1	4220107892	AL A. BROWN	W. P. THOMPSON #1	30.0789	-95.8848	245	--	1,010	1,360	1,800	9	-765	-1,115	-1,555	-1,816
H-2	4220101024	J. M. FLAITZ & R. B. MITCHELL	HAMILTON ESTATE / 1	30.0740	-95.1367	59	--	1,480	2,020	2,510	--	-1,421	-1,961	-2,451	-3,027

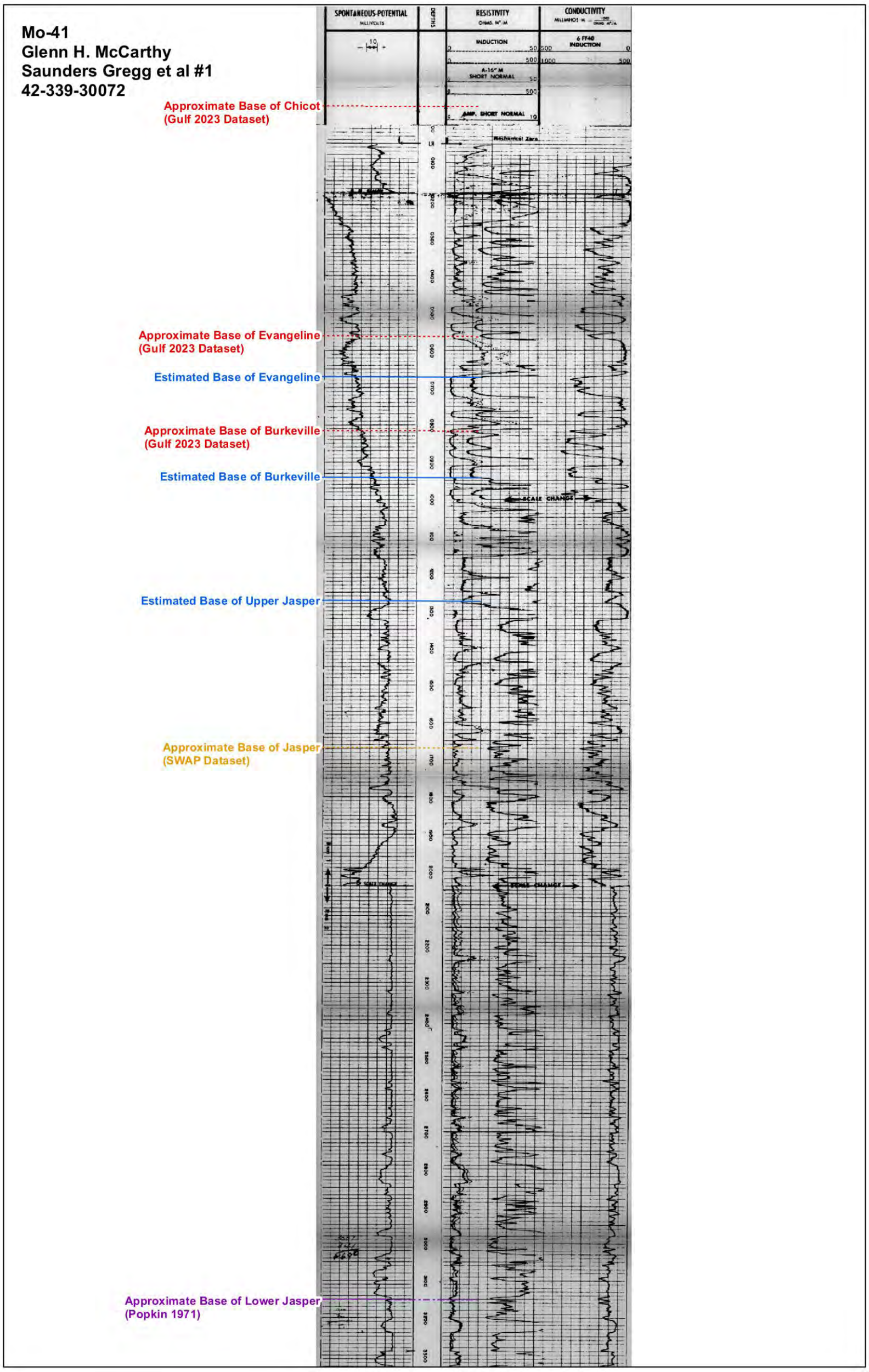
Geophysical Log Number	API Number, State Well Number and / or Q Number	Company	Well	Latitude	Longitude	Land Surface Elevation (feet)	Base of Chicot Depth (feet, bls)	Base of Evangeline Depth (feet, bls)	Base of Burkeville Depth (feet, bls)	Base of Upper Jasper Depth (feet, bls)	Base of Chicot Elevation (feet, rsl)	Base of Evangeline Elevation (feet, rsl)	Base of Burkeville Elevation (feet, rsl)	Base of Upper Jasper Elevation (feet, rsl)	SWAP Base of Jasper Elevation (feet, rsl)
H-3	4220101022	S. & H. OIL & ROYALITY	W. M. ALLAUN	30.0953	-95.1241	105	--	1,510	1,950	2,500	-391	-1,405	-1,845	-2,395	-2,988
H-4	Q-222 / 6059503	THE TEXAS COMPANY	J.E. WILSON #1	30.0749	-95.6986	206	--	1,090	1,420	1,810	--	-884	-1,214	-1,604	-2,061
H-5	4220132375	CARNEGIE FINANCIAL CORP	J A KITZMANN 1A	29.9681	-95.6851	147	550	1,360	1,760	2,150	-403	-1,213	-1,613	-2,003	-2,375
H-6	4220100858	SLICK OIL CORPORATION	PAUL H. JACKSON 1	30.0288	-95.5628	143	480	1,190	1,485	2,030	-337	-1,047	-1,342	-1,887	-2,306
H-7	4220101017	STARR OIL & GAS COMPANY	LEANDER WALKER / 1	30.0030	-95.3174	91	--	1,480	1,920	2,470	--	-1,389	-1,829	-2,379	-2,878
H-8	4220101014	ALLDAY & TAYLOR	#1 DULANEY	30.0217	-95.3572	74	--	1,310	1,690	2,270	-426	-1,236	-1,616	-2,196	-2,740
H-9	4220100717	SOUTHERN UNION GAS COMPANY	WM. HOLDREITH 1	30.1500	-95.5629	135	310	990	1,190	1,645	-175	-855	-1,055	-1,510	-2,018
H-10	4220100794	R.W. RAMEY	W.T. JONES #2	30.1263	-95.5593	166	390	992	1,315	1,740	-224	-826	-1,149	-1,574	-2,083
H-11	4220100882	R. D. SIMONTON	HIEDAN 1	30.0104	-95.5402	130	--	1,212	1,565	2,170	-510	-1,082	-1,435	-2,040	-2,413
H-12	4220100964	FALCON SEABOARD DRILLING COMPANY	HUGO LEMM / 1	30.0529	-95.3851	104	--	1,230	1,608	2,080	--	-1,126	-1,504	-1,976	-2,589
H-13	4220131542	HAMMAN OIL & REFINING COMPANY	R. D. SMITH / 1	30.0836	-95.4293	117	--	1,200	1,430	1,990	--	-1,083	-1,313	-1,873	-2,412
H-14	4220102972	UNION PRODUCING COMPANY	DEUTSER 1	29.9615	-95.3589	70	500	1,510	2,000	2,450	-430	-1,440	-1,930	-2,380	-2,918
H-15	4220102680	TEXAS STATE DRILLING COMPANY	FLEMING 1	29.9134	-95.4005	57	510	1,690	2,150	2,340	-453	-1,633	-2,093	-2,283	-2,973
H-16	4220103001	J. BRIAN EBY	CLAUD B. HAMILL 1	29.9171	-95.3277	66	570	1,680	2,190	2,510	-504	-1,614	-2,124	-2,444	-3,116
H-17	4220132052	MARSHALL, A.B.	MARSHALL, A.B. FEE 25	29.9015	-95.2854	70	600	1,760	2,290	2,575	-530	-1,690	-2,220	-2,505	-3,254
H-18	4220102983	MCDANNALD OIL CO.	MCDANNALD FEE 1	29.9321	-95.2583	70	610	1,740	2,260	2,585	-540	-1,670	-2,190	-2,515	-3,216
H-19	4220100991	SOHIO PETROLEUM COMPANY	H. KOTHMAN / 1	30.0484	-95.4604	110	--	1,145	1,510	2,095	--	-1,035	-1,400	-1,985	-2,453
H-20	4220132489	DAN A. HUGHES COMPANY	WRIGHTSTONE UNIT / 1	30.0668	-95.5458	149	--	1,090	1,415	1,855	--	-941	-1,266	-1,706	-2,234
H-21	4220107603	HUMBLE OIL AND REFINING COMPANY	FOSTER LUMBER CO 2	30.0315	-95.2249	70	475	1,540	1,950	2,500	-405	-1,470	-1,880	-2,430	-2,978
H-22	4220101032	HUMBLE OIL AND REFINING COMPANY	FOSTER LUMBER COMPANY 1	30.0388	-95.1419	52	410	1,645	1,965	2,535	-358	-1,593	-1,913	-2,483	-3,127
H-23	4220100709	GORDON STREET INC	FINGER / 1	30.0269	-95.6154	148	--	1,200	1,690	2,030	--	-1,052	-1,542	-1,882	-2,281
H-24	4220101065	PLACID OIL COMPANY	MRS. D.F. SMITH 1	30.0284	-95.0890	80	500	--	2,260	2,700	-420	--	-2,180	-2,620	-3,269
H-25	4220132265	ARKLA EXPLORATION CO	THARP ESTATE 2	29.9972	-95.0856	67	500	1,800	2,310	2,715	-433	-1,733	-2,243	-2,648	-3,368
H-26	4220102720	CHARLES B. WRIGHTSMAN	HARRIS COUNTY LAND AND IMPRO	29.9548	-95.1717	59	550	1,855	2,310	2,620	-491	-1,796	-2,251	-2,561	-3,321
H-27	4220131572	DURANGO EXPLORATION	RAINES 1	30.0463	-95.9069	247	--	1,260	1,530	1,950	--	-1,013	-1,283	-1,703	-1,861
H-28	4220104295	J. F. CORLEY	WARREN RANCH / 1	29.9914	-95.8508	201	--	1,450	1,865	2,275	--	-1,249	-1,664	-2,074	-2,076
H-29	4220100476	CARNES W. WEAVER	KITZMANN / 1	30.0169	-95.7225	169	--	1,210	1,600	2,010	--	-1,041	-1,431	-1,841	-2,186
H-30	4220100090	M. E. ANDREWS & KIRBY SOUTHWORTH DRILLING	A. A. FROENAIEN #1	30.0686	-95.7228	211	--	1,100	1,490	1,840	-89	-889	-1,279	-1,629	-2,048
H-31	4220103517	M. P. S. PRODUCTION COMPANY	JOYCE BURG / 1	29.9972	-95.6226	143	--	1,270	1,765	2,140	-308	-1,127	-1,622	-1,997	-2,368
H-32	4220100809	RAMEY & MOSBACHER	PEDEN ET AL #1	30.1336	-95.5133	128	--	982	1,310	1,770	-252	-854	-1,182	-1,642	-2,128
H-33	422010078	HARRELL OIL COMPANY	HILDERBRANDT G. / 1	30.1164	-95.4948	112	--	990	1,340	1,815	--	-878	-1,228	-1,703	-2,203
H-34	4220130640	MCCORMICK OIL & GAS CORP.	GERALD O. NICHOLS ET AL / 1	30.0608	-95.7479	216	--	1,200	1,550	1,880	--	-984	-1,334	-1,664	-2,036

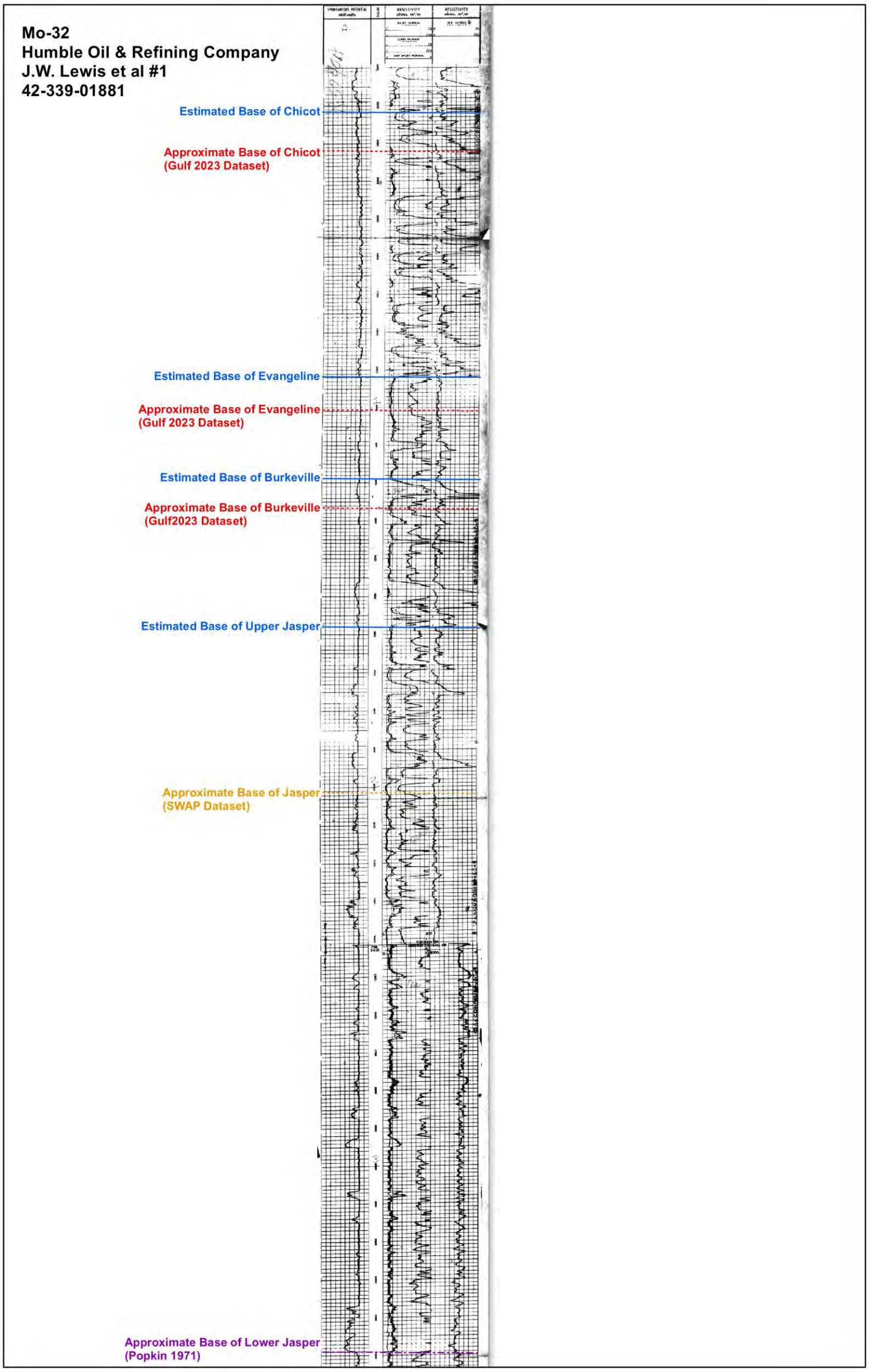
APPENDIX 2 – TYPICAL GEOPHYSICAL LOGS

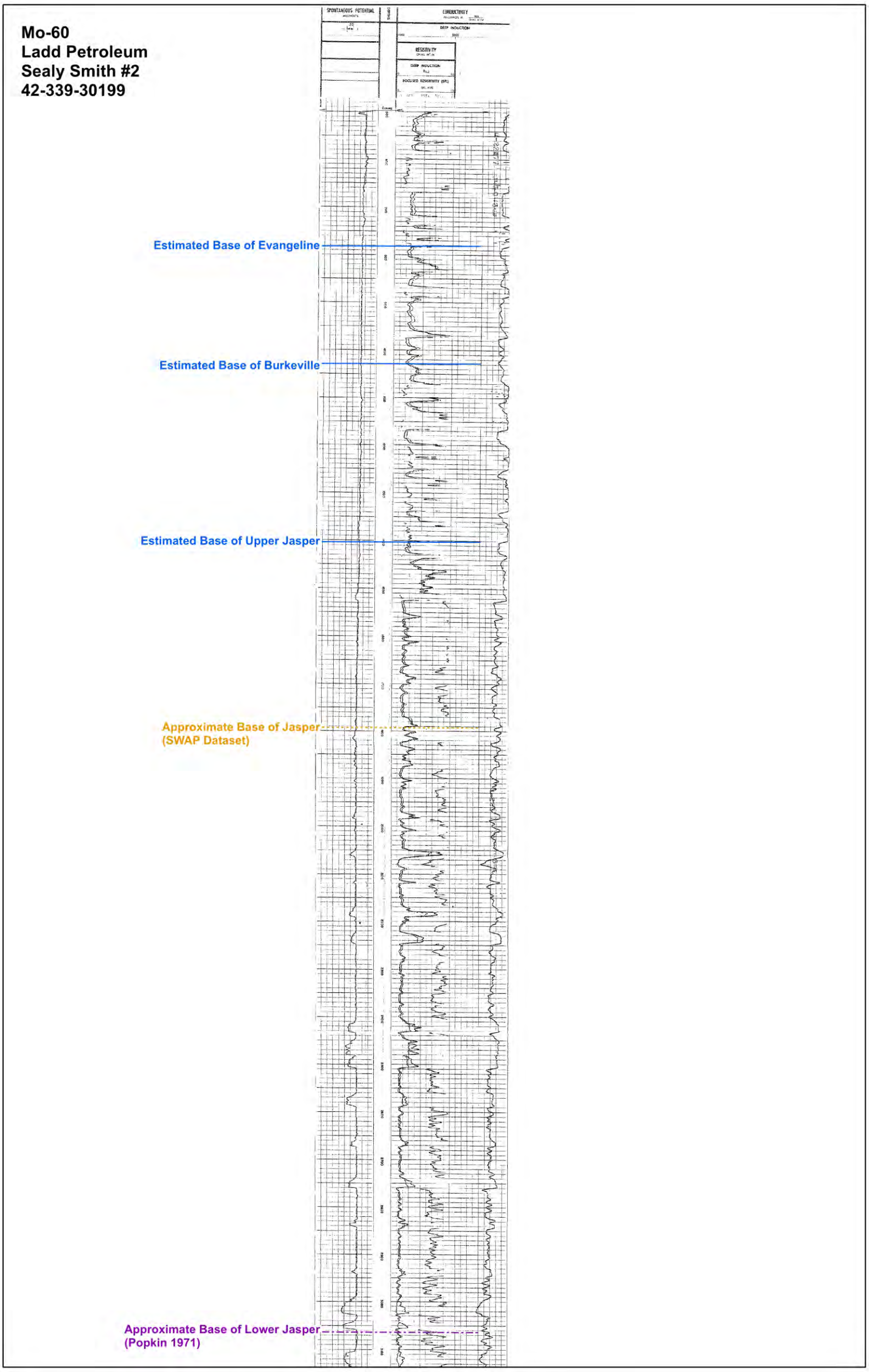

Mo-18
Phillips Petroleum Company
Fraser #1
42-339-00045
SELF-POTENTIAL
RESISTIVITY
Approximate Base of Chicot
(Gulf 2023 Dataset)
Estimated Base of Chicot
Estimated Base of Evangeline
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)

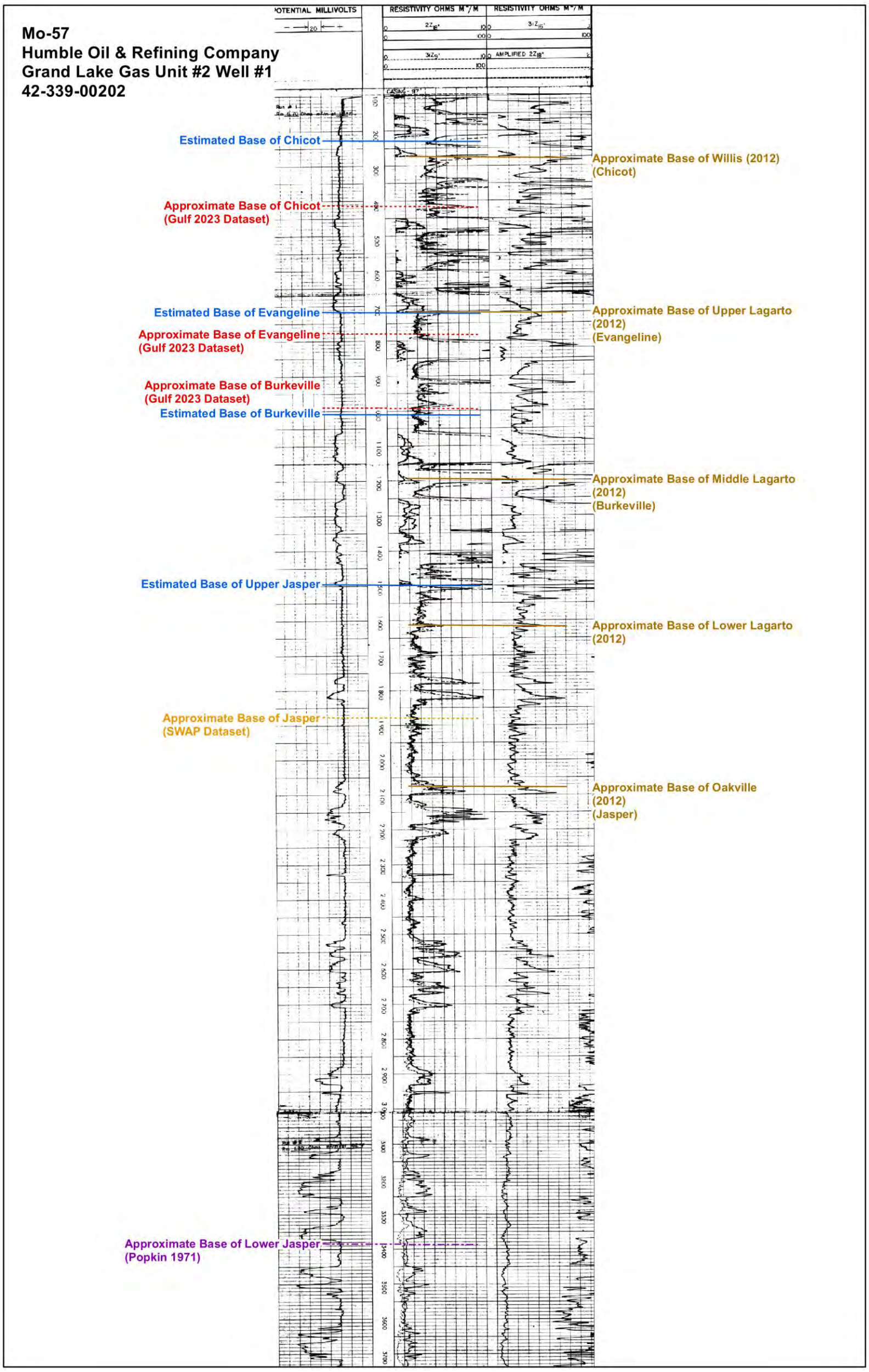

Mo-6
Superior Oil and Speed Jr.
James Sykes B1
42-339-00868
SPONTANEOUS-POTENTIAL millivolts
RESISTIVITY -ohms. m²/m
RESISTIVITY -ohms. m²/m
Approximate Base of Chicot (Gulf 2023 Dataset)
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lower Jasper (Popkin 1971)

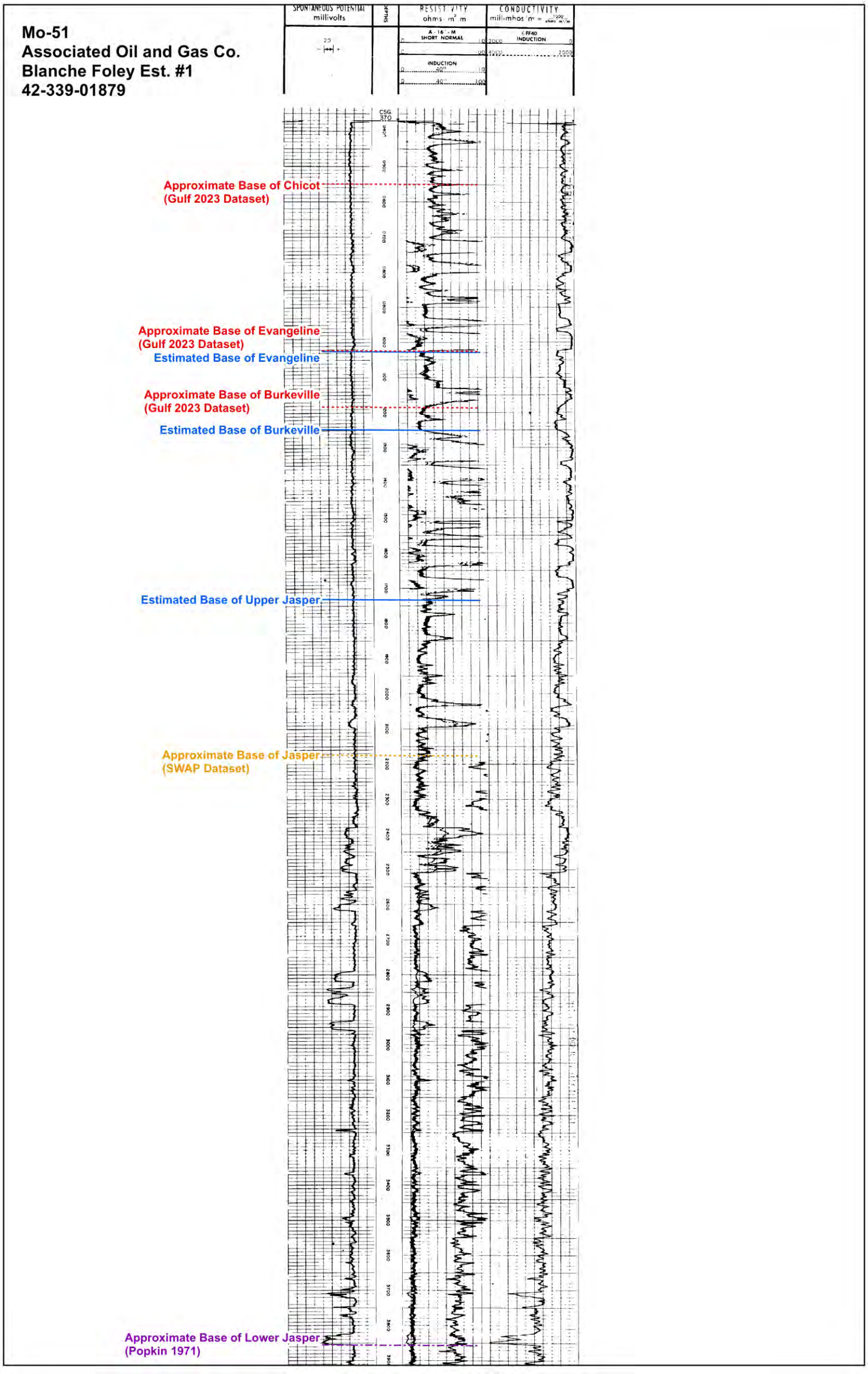

Mo-8
F. A. Callery
Weisinger #1
42-339-00979
SPONTANEOUS-POTENTIAL millivolts
DEPTHS
RESISTIVITY -ohms. m²/m
RESISTIVITY -ohms. m²/m
Approximate Base of Chicot (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Burkeville
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lower Jasper (Popkin 1971)

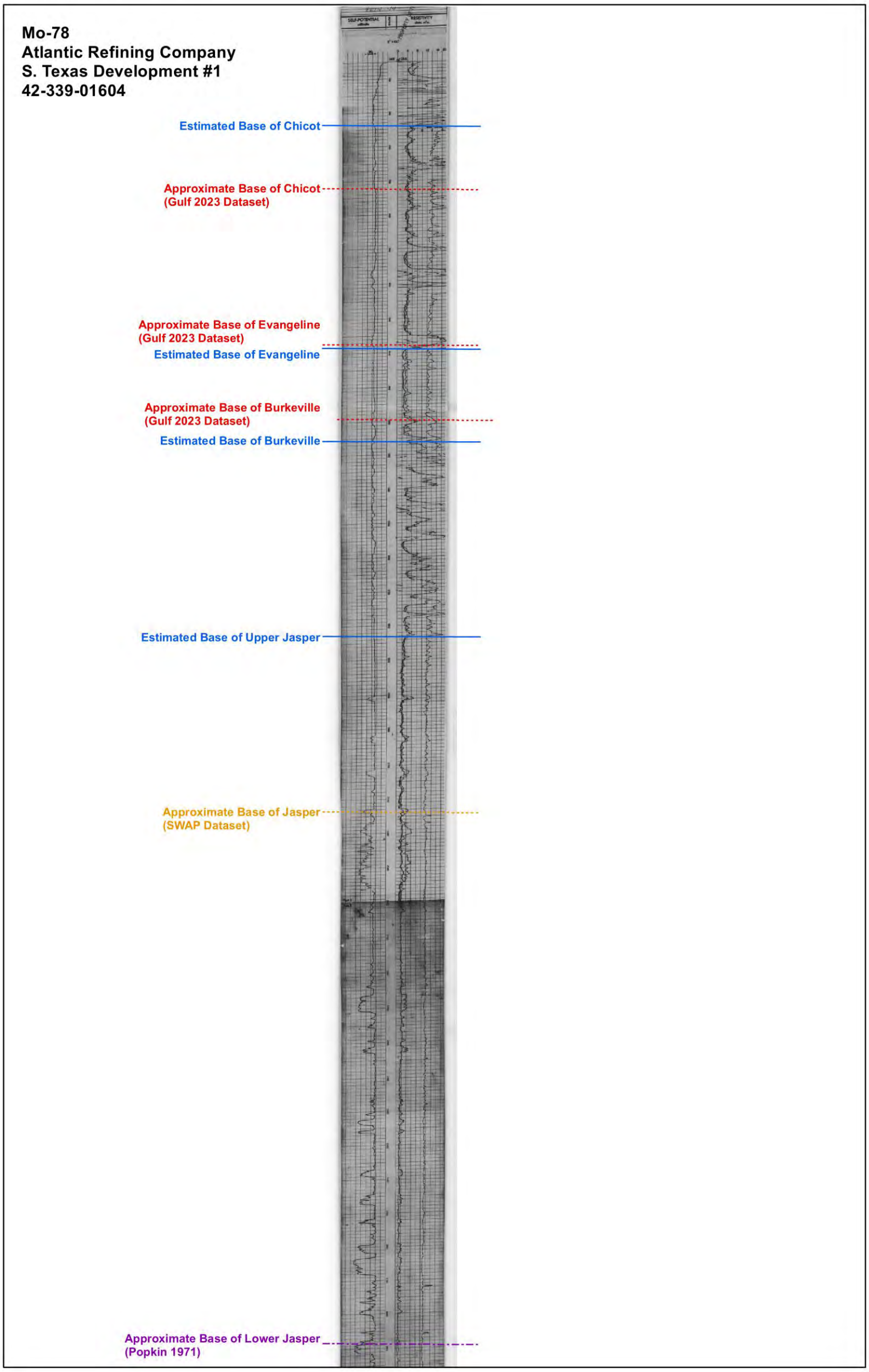

Mo-41
Glenn H. McCarthy
Saunders Gregg et al #1
42-339-30072
SPONTANEOUS-POTENTIAL
RESISTIVITY
CONDUCTIVITY
INDUCTION
6 FF40 INDUCTION
A-16" M SHORT NORMAL
AMP. SHORT NORMAL
Approximate Base of Chicot (Gulf 2023 Dataset)
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lower Jasper (Popkin 1971)


Mo-32
Humble Oil & Refining Company
J.W. Lewis et al #1
42-339-01881
Estimated Base of Chicot
Approximate Base of Chicot
(Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Approximate Base of Burkeville
(Gulf2023 Dataset)
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)

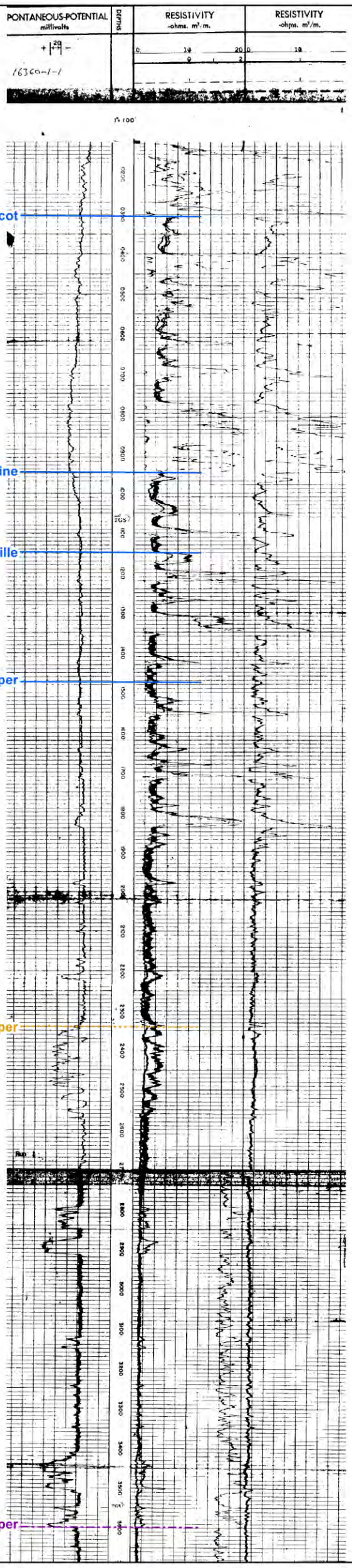

Mo-60
Ladd Petroleum
Sealy Smith #2
42-339-30199
SPONTANEOUS POTENTIAL
CONDUCTIVITY
DEEP INDUCTION
RESISTIVITY
DEEP INDUCTION
FOCUSED RESISTIVITY (SFL)
Estimated Base of Evangeline
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)

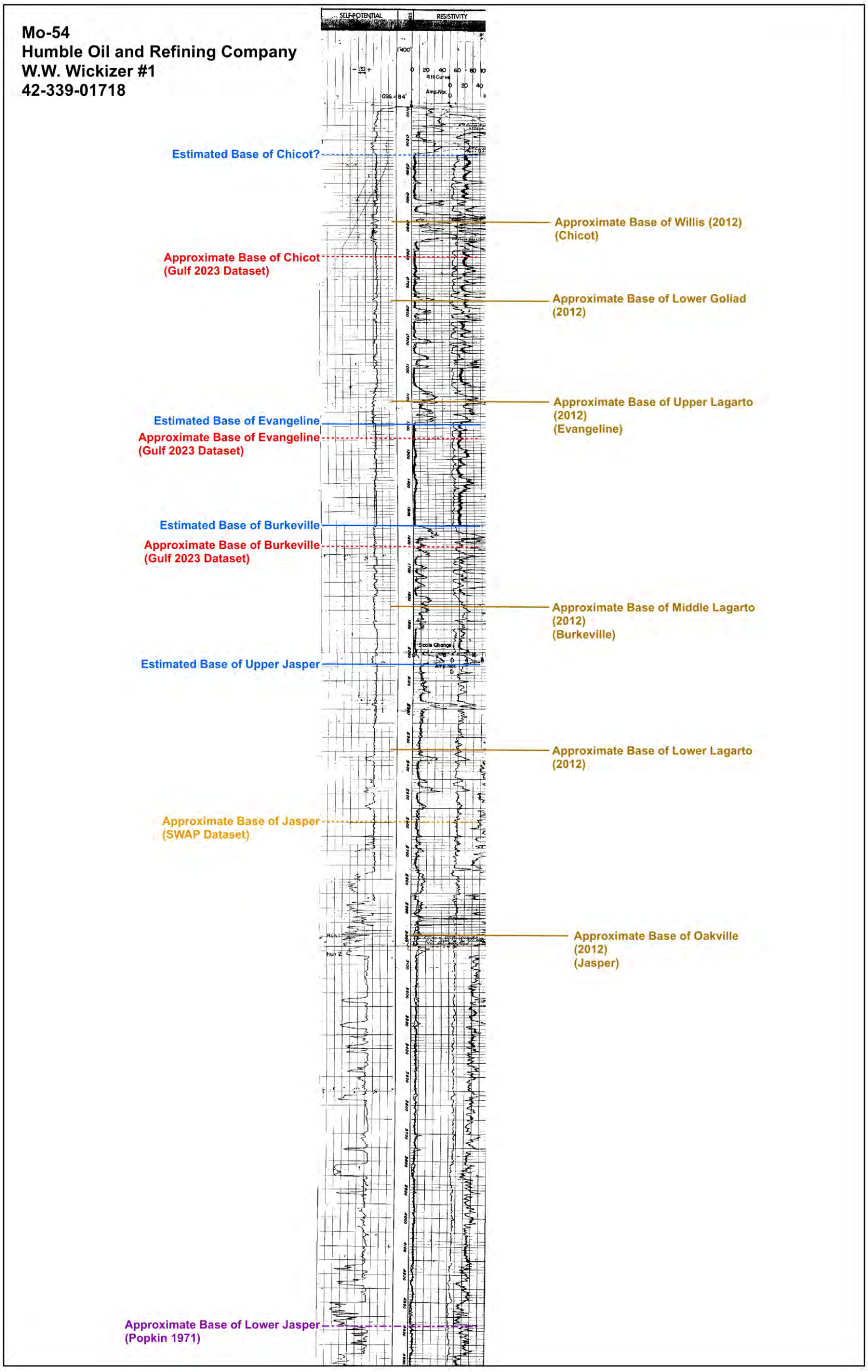

Mo-57
Humble Oil & Refining Company
Grand Lake Gas Unit #2 Well #1
42-339-00202
POTENTIAL MILLIVOLTS
RESISTIVITY OHMS M²/M
RESISTIVITY OHMS M²/M
AMPLIFIED 2Z18'
CASING - 97'
Estimated Base of Chicot
Approximate Base of Chicot
(Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)
Approximate Base of Willis (2012)
(Chicot)
Approximate Base of Upper Lagarto
(2012)
(Evangeline)
Approximate Base of Middle Lagarto
(2012)
(Burkeville)
Approximate Base of Lower Lagarto
(2012)
Approximate Base of Oakville
(2012)
(Jasper)

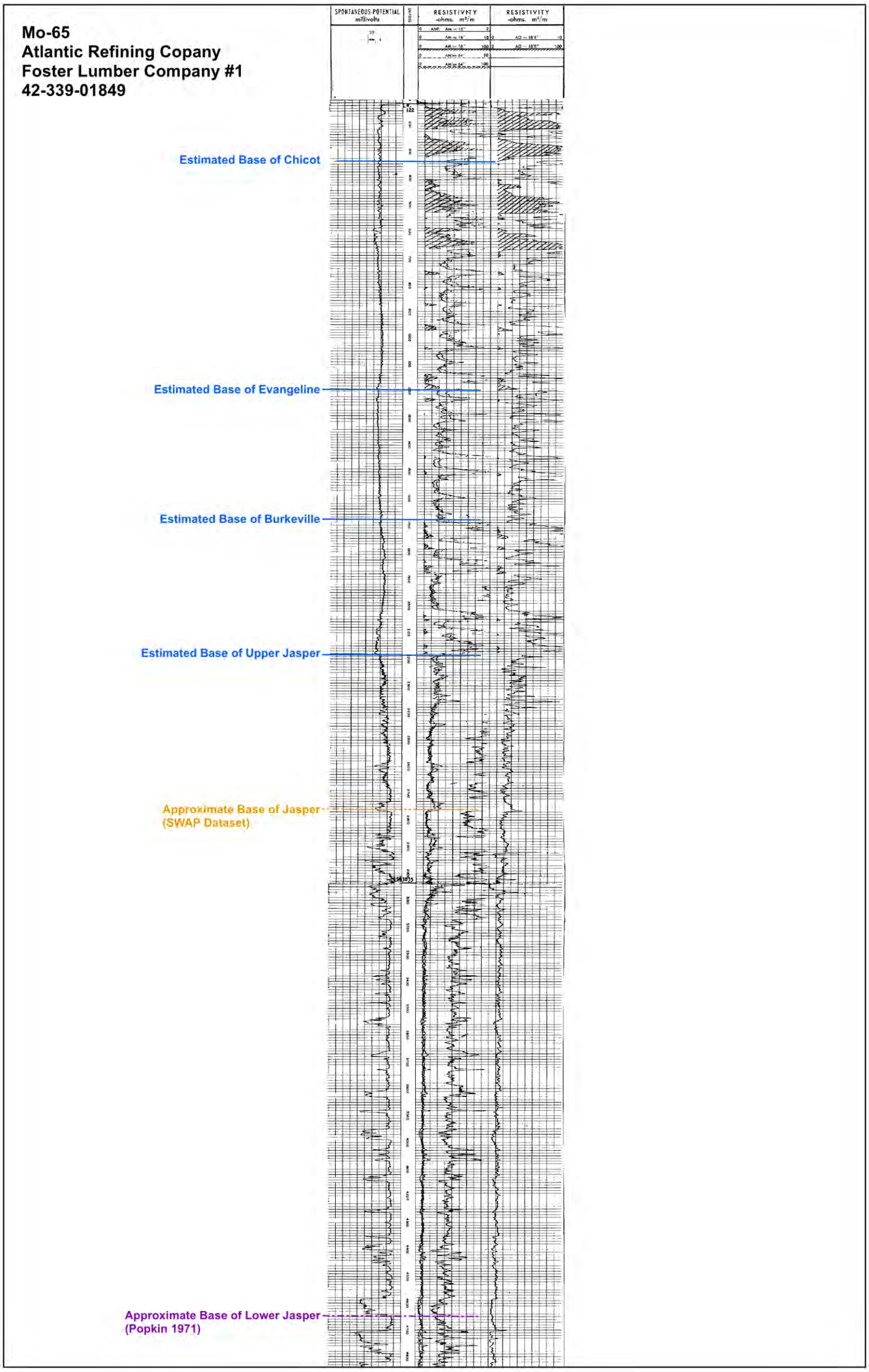

Mo-51
Associated Oil and Gas Co.
Blanche Foley Est. #1
42-339-01879
SPONTANEOUS POTENTIAL millivolts
DEPTHS
RESISTIVITY ohms-m²/m
A-16"-M SHORT NORMAL
INDUCTION 40"
40"
CONDUCTIVITY millimhos/m
CFF40 INDUCTION
CSG. 370
Approximate Base of Chicot (Gulf 2023 Dataset)
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lower Jasper (Popkin 1971)

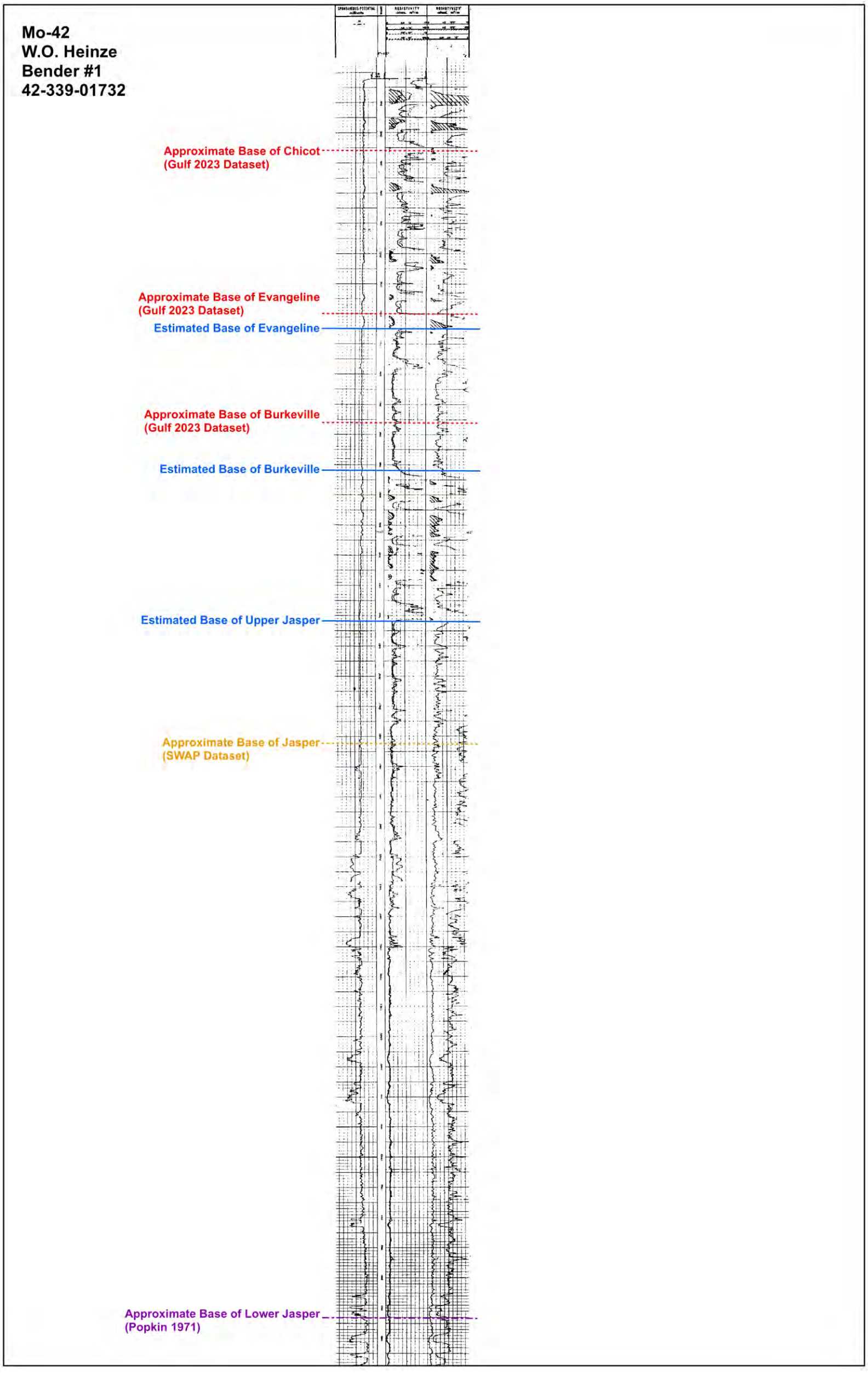

Mo-78
Atlantic Refining Company
S. Texas Development #1
42-339-01604
Estimated Base of Chicot
Approximate Base of Chicot
(Gulf 2023 Dataset)
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)

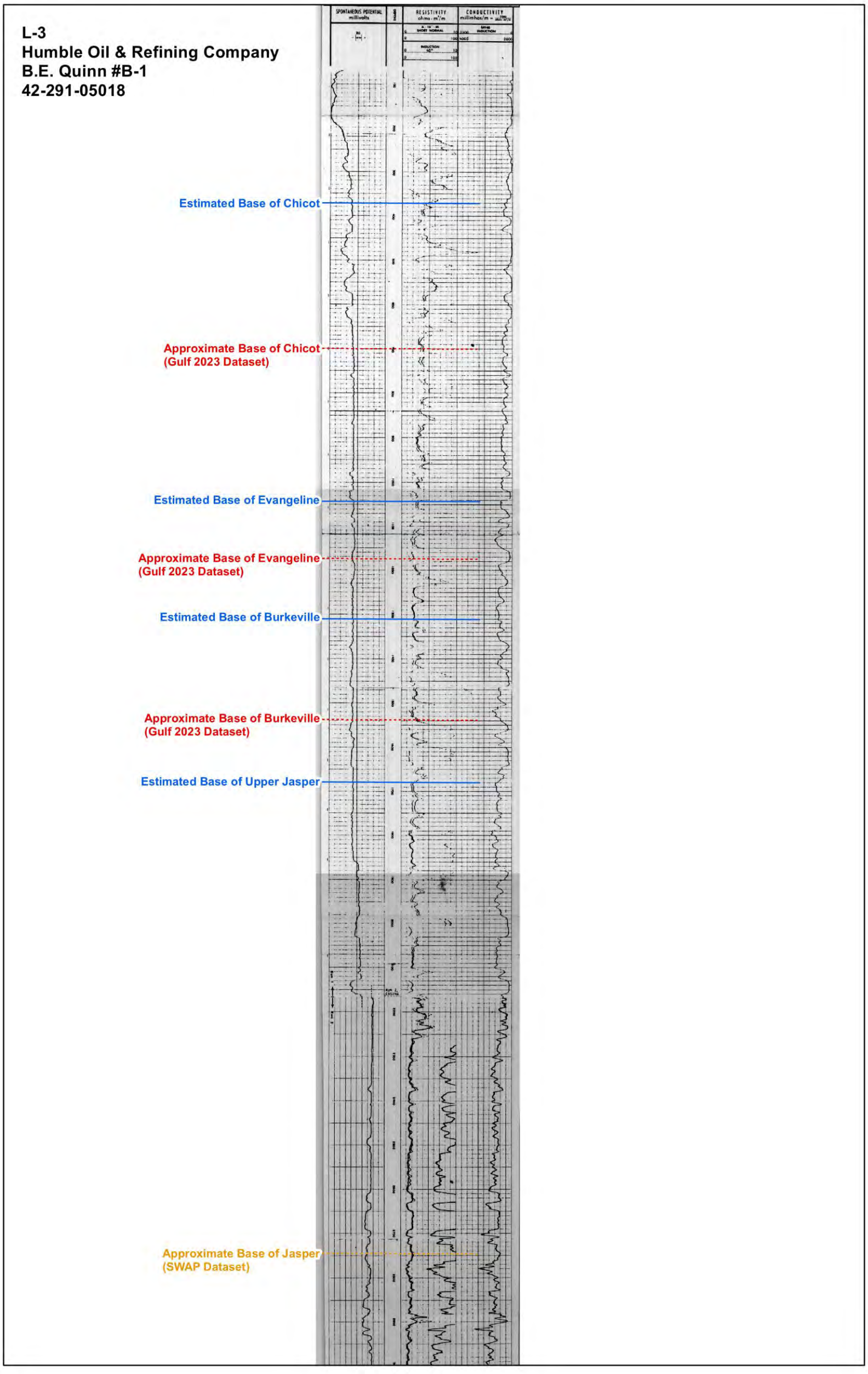
Mo-19
Amerada Petroleum Company
Foster Lumber Company #1
42-339-00013

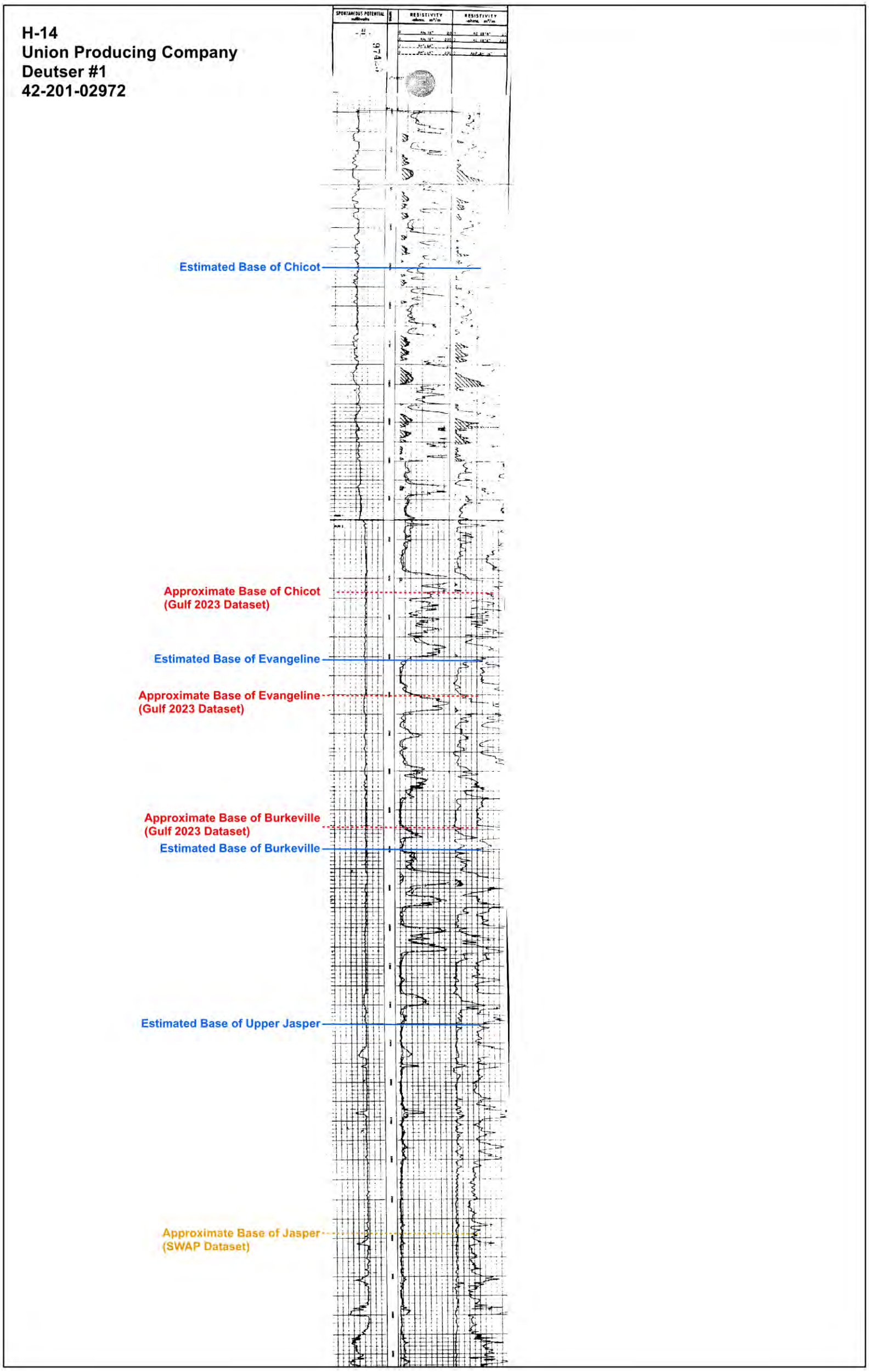


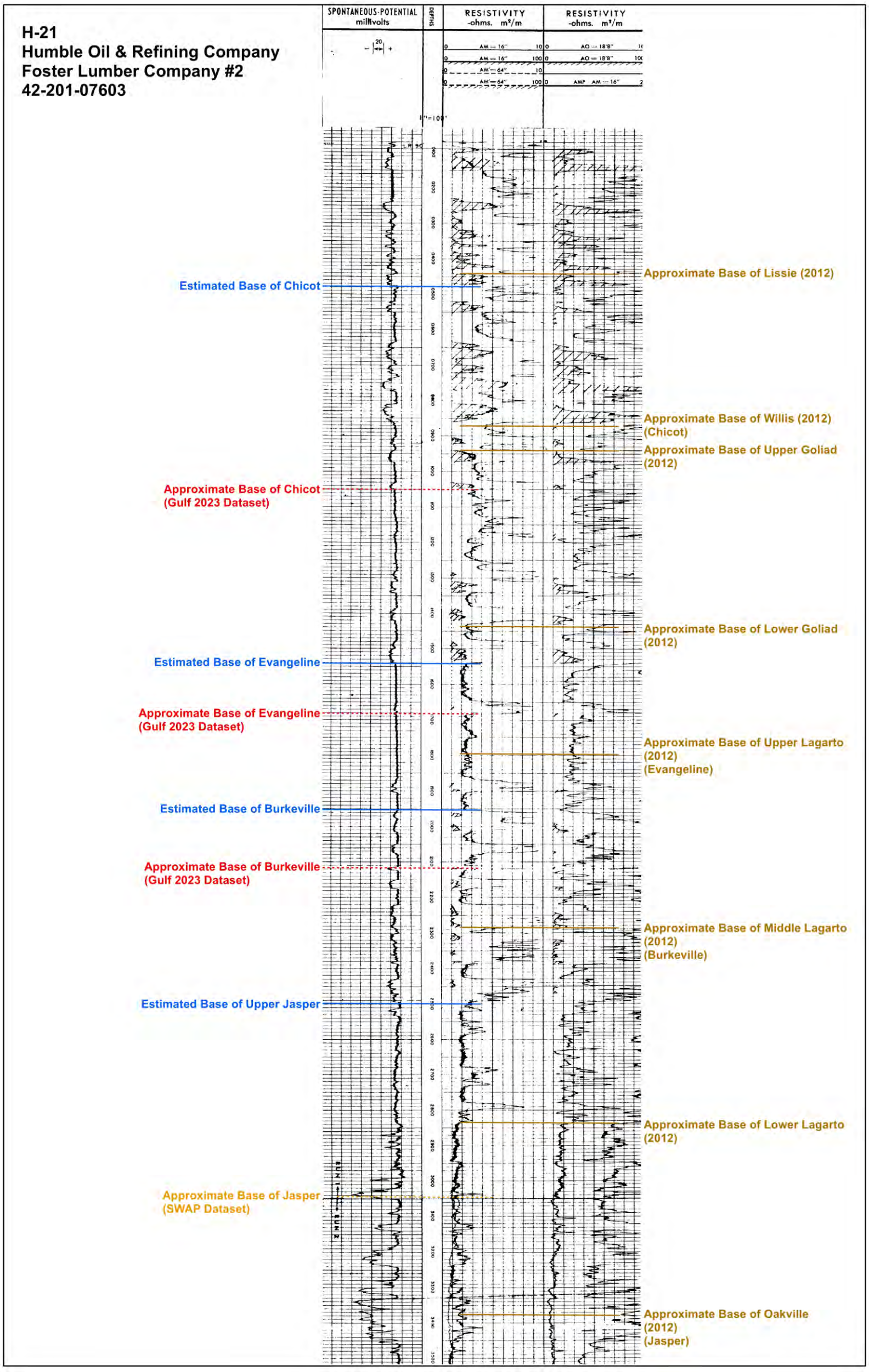

Mo-54
Humble Oil and Refining Company
W.W. Wickizer #1
42-339-01718
SELF-POTENTIAL
RESISTIVITY
Estimated Base of Chicot?
Approximate Base of Chicot
(Gulf 2023 Dataset)
Approximate Base of Willis (2012)
(Chicot)
Approximate Base of Lower Goliad
(2012)
Approximate Base of Upper Lagarto
(2012)
(Evangeline)
Estimated Base of Evangeline
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Approximate Base of Middle Lagarto
(2012)
(Burkeville)
Estimated Base of Upper Jasper
Approximate Base of Lower Lagarto
(2012)
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Oakville
(2012)
(Jasper)
Approximate Base of Lower Jasper
(Popkin 1971)


Mo-65
Atlantic Refining Copany
Foster Lumber Company #1
42-339-01849
SPONTANEOUS-POTENTIAL millivolts
RESISTIVITY -ohms. m²/m
RESISTIVITY -ohms. m²/m
Estimated Base of Chicot
Estimated Base of Evangeline
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lower Jasper (Popkin 1971)


Mo-42
W.O. Heinze
Bender #1
42-339-01732
Approximate Base of Chicot
(Gulf 2023 Dataset)
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)
Approximate Base of Lower Jasper
(Popkin 1971)


L-3
Humble Oil & Refining Company
B.E. Quinn #B-1
42-291-05018
SPONTANEOUS POTENTIAL millivolts
RESISTIVITY ohms - m²/m
CONDUCTIVITY millimhos/m
Estimated Base of Chicot
Approximate Base of Chicot (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Burkeville
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)


H-14
Union Producing Company
Deutser #1
42-201-02972
Estimated Base of Chicot
Approximate Base of Chicot
(Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline
(Gulf 2023 Dataset)
Approximate Base of Burkeville
(Gulf 2023 Dataset)
Estimated Base of Burkeville
Estimated Base of Upper Jasper
Approximate Base of Jasper
(SWAP Dataset)


H-21
Humble Oil & Refining Company
Foster Lumber Company #2
42-201-07603
SPONTANEOUS-POTENTIAL millivolts
DEPTHS
RESISTIVITY -ohms. m²/m
RESISTIVITY -ohms. m²/m
1"=100'
Estimated Base of Chicot
Approximate Base of Chicot (Gulf 2023 Dataset)
Estimated Base of Evangeline
Approximate Base of Evangeline (Gulf 2023 Dataset)
Estimated Base of Burkeville
Approximate Base of Burkeville (Gulf 2023 Dataset)
Estimated Base of Upper Jasper
Approximate Base of Jasper (SWAP Dataset)
Approximate Base of Lissie (2012)
Approximate Base of Willis (2012) (Chicot)
Approximate Base of Upper Goliad (2012)
Approximate Base of Lower Goliad (2012)
Approximate Base of Upper Lagarto (2012) (Evangeline)
Approximate Base of Middle Lagarto (2012) (Burkeville)
Approximate Base of Lower Lagarto (2012)
Approximate Base of Oakville (2012) (Jasper)

APPENDIX 3 – CLAY LAYERS SUMMARY

Appendix Clay Layers Summary Geophysical Log: Mo-4				
	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	390	1005	1260	1826
Total Clay Thickness (ft)	50	379	235	339
Total Sand Thickness (ft)	340	626	1025	1487
Percent Clay	13%	38%	19%	19%
Percent Sand	87%	62%	81%	81%
	Potential High Producing Interval			
Number of Producing	1	1	N/A	1
Producing Interval Thickness	390	1005	N/A	1801
Net Clay Thickness (ft)	50	379	N/A	214
Net Sand Thickness (ft)	340	626	N/A	200
Percent Clay	13%	38%	N/A	12%
Percent Sand	87%	62%	N/A	11%
	Clay Interbed Characteristics			
Number of Clay Intereds	1	6	N/A	6
Minimum Thickness (ft)	19	3	N/A	4
Maximum Thickness (ft)	33	90	N/A	50
Average Thickness (ft)	25	32	N/A	21

Appendix
Clay Layers Summary
Geophysical Log: Mo-5

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	UTD	192
Total Clay Thickness (ft)	UTD	UTD	UTD	74
Total Sand Thickness (ft)	UTD	UTD	UTD	118
Percent Clay	UTD	UTD	UTD	39%
Percent Sand	UTD	UTD	UTD	61%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	UTD	1
Producing Interval Thickness (	UTD	UTD	UTD	152
Net Clay Thickness (ft)	UTD	UTD	UTD	34
Net Sand Thickness (ft)	UTD	UTD	UTD	118
Percent Clay	UTD	UTD	UTD	22%
Percent Sand	UTD	UTD	UTD	78%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	UTD	4
Minimum Thickness (ft)	UTD	UTD	UTD	2
Maximum Thickness (ft)	UTD	UTD	UTD	14
Average Thickness (ft)	UTD	UTD	UTD	9

Appendix
Clay Layers Summary
Geophysical Log: Mo-6

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	150	310
Total Clay Thickness (ft)	UTD	UTD	150	92
Total Sand Thickness (ft)	UTD	UTD	0	218
Percent Clay	UTD	UTD	100%	30%
Percent Sand	UTD	UTD	0%	70%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	305
Net Clay Thickness (ft)	UTD	UTD	N/A	87
Net Sand Thickness (ft)	UTD	UTD	N/A	218
Percent Clay	UTD	UTD	N/A	29%
Percent Sand	UTD	UTD	N/A	71%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	3
Minimum Thickness (ft)	UTD	UTD	N/A	10
Maximum Thickness (ft)	UTD	UTD	N/A	50
Average Thickness (ft)	UTD	UTD	N/A	29

Appendix
Clay Layers Summary
Geophysical Log: Mo-8

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	170	360
Total Clay Thickness (ft)	UTD	UTD	160	130
Total Sand Thickness (ft)	UTD	UTD	10	230
Percent Clay	UTD	UTD	94%	36%
Percent Sand	UTD	UTD	6%	64%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	335
Net Clay Thickness (ft)	UTD	UTD	N/A	125
Net Sand Thickness (ft)	UTD	UTD	N/A	210
Percent Clay	UTD	UTD	N/A	37%
Percent Sand	UTD	UTD	N/A	63%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	3
Minimum Thickness (ft)	UTD	UTD	N/A	20
Maximum Thickness (ft)	UTD	UTD	N/A	55
Average Thickness (ft)	UTD	UTD	N/A	42

Appendix
Clay Layers Summary
Geophysical Log: Mo-9

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	270	279	535
Total Clay Thickness (ft)	UTD	139	179	281
Total Sand Thickness (ft)	UTD	131	100	254
Percent Clay	UTD	51%	64%	53%
Percent Sand	UTD	49%	36%	47%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	1	1
Producing Interval Thickness	UTD	270	120	535
Net Clay Thickness (ft)	UTD	139	60	281
Net Sand Thickness (ft)	UTD	131	60	254
Percent Clay	UTD	51%	50%	53%
Percent Sand	UTD	49%	50%	47%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	3	12
Minimum Thickness (ft)	UTD	8	9	3
Maximum Thickness (ft)	UTD	41	90	100
Average Thickness (ft)	UTD	28	45	20

Appendix
Clay Layers Summary
Geophysical Log: Mo-10

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	332	287	390
Total Clay Thickness (ft)	UTD	95	195	298
Total Sand Thickness (ft)	UTD	237	92	92
Percent Clay	UTD	29%	68%	76%
Percent Sand	UTD	71%	32%	24%
	Potential High Producing Interval			
Number of Producing Intervals	UTD	1	1	1
Producing Interval Thickness	UTD	332	247	338
Net Clay Thickness (ft)	UTD	95	155	168
Net Sand Thickness (ft)	UTD	237	92	170
Percent Clay	UTD	29%	63%	50%
Percent Sand	UTD	71%	37%	50%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	4	6	7
Minimum Thickness (ft)	UTD	18	7	7
Maximum Thickness (ft)	UTD	30	70	70
Average Thickness (ft)	UTD	24	28	33

Appendix
Clay Layers Summary
Geophysical Log: Mo-12

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	160	715	285	555
Total Clay Thickness (ft)	70	420	245	350
Total Sand Thickness (ft)	90	295	40	205
Percent Clay	44%	59%	86%	63%
Percent Sand	56%	41%	14%	37%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	N/A	1
Producing Interval Thickness	160	715	N/A	253
Net Clay Thickness (ft)	70	420	N/A	53
Net Sand Thickness (ft)	90	295	N/A	200
Percent Clay	44%	59%	N/A	21%
Percent Sand	56%	41%	N/A	79%
	Clay Interbed Characteristics			
Number of Clay Intereds	4	11	5	9
Minimum Thickness (ft)	9	4	20	8
Maximum Thickness (ft)	41	60	65	100
Average Thickness (ft)	23	35	35	31

Appendix
Clay Layers Summary
Geophysical Log: Mo-13

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	210	235
Total Clay Thickness (ft)	UTD	UTD	210	77
Total Sand Thickness (ft)	UTD	UTD	0	158
Percent Clay	UTD	UTD	100%	33%
Percent Sand	UTD	UTD	0%	67%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	227
Net Clay Thickness (ft)	UTD	UTD	N/A	69
Net Sand Thickness (ft)	UTD	UTD	N/A	158
Percent Clay	UTD	UTD	N/A	30%
Percent Sand	UTD	UTD	N/A	70%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	6
Minimum Thickness (ft)	UTD	UTD	N/A	5
Maximum Thickness (ft)	UTD	UTD	N/A	20
Average Thickness (ft)	UTD	UTD	N/A	12

Appendix
Clay Layers Summary
Geophysical Log: Mo-16

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	330	270	420
Total Clay Thickness (ft)	UTD	240	208	308
Total Sand Thickness (ft)	UTD	90	62	112
Percent Clay	UTD	73%	77%	73%
Percent Sand	UTD	27%	23%	27%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	108	N/A	168
Net Clay Thickness (ft)	UTD	29	N/A	83
Net Sand Thickness (ft)	UTD	79	N/A	85
Percent Clay	UTD	27%	N/A	49%
Percent Sand	UTD	73%	N/A	51%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	N/A	3
Minimum Thickness (ft)	UTD	2	N/A	10
Maximum Thickness (ft)	UTD	14	N/A	55
Average Thickness (ft)	UTD	7	N/A	28

Appendix
Clay Layers Summary
Geophysical Log: Mo-17

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	210	510
Total Clay Thickness (ft)	UTD	UTD	189	184
Total Sand Thickness (ft)	UTD	UTD	21	326
Percent Clay	UTD	UTD	90%	36%
Percent Sand	UTD	UTD	10%	64%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	492
Net Clay Thickness (ft)	UTD	UTD	N/A	166
Net Sand Thickness (ft)	UTD	UTD	N/A	326
Percent Clay	UTD	UTD	N/A	34%
Percent Sand	UTD	UTD	N/A	66%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	5
Minimum Thickness (ft)	UTD	UTD	N/A	10
Maximum Thickness (ft)	UTD	UTD	N/A	52
Average Thickness (ft)	UTD	UTD	N/A	33

Appendix
Clay Layers Summary
Geophysical Log: Mo-18

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	385	215	305
Total Clay Thickness (ft)	UTD	300	185	163
Total Sand Thickness (ft)	UTD	85	30	142
Percent Clay	UTD	78%	86%	53%
Percent Sand	UTD	22%	14%	47%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	265	N/A	213
Net Clay Thickness (ft)	UTD	180	N/A	71
Net Sand Thickness (ft)	UTD	85	N/A	142
Percent Clay	UTD	68%	N/A	33%
Percent Sand	UTD	32%	N/A	67%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	8	N/A	4
Minimum Thickness (ft)	UTD	3	N/A	8
Maximum Thickness (ft)	UTD	70	N/A	42
Average Thickness (ft)	UTD	23	N/A	18

Appendix
Clay Layers Summary
Geophysical Log: Mo-19

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	146	614	270	329
Total Clay Thickness (ft)	43	360	188	175
Total Sand Thickness (ft)	103	254	82	154
Percent Clay	29%	59%	70%	53%
Percent Sand	71%	41%	30%	47%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	N/A	1
Producing Interval Thickness	146	514	N/A	201
Net Clay Thickness (ft)	43	260	N/A	47
Net Sand Thickness (ft)	103	254	N/A	154
Percent Clay	29%	51%	N/A	23%
Percent Sand	71%	49%	N/A	77%
	Clay Interbed Characteristics			
Number of Clay Intereds	2	8	N/A	7
Minimum Thickness (ft)	19	3	N/A	5
Maximum Thickness (ft)	24	68	N/A	50
Average Thickness (ft)	23	35	N/A	25

Appendix
Clay Layers Summary
Geophysical Log: Mo-20

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	UTD	405
Total Clay Thickness (ft)	UTD	UTD	UTD	90
Total Sand Thickness (ft)	UTD	UTD	UTD	315
Percent Clay	UTD	UTD	UTD	22%
Percent Sand	UTD	UTD	UTD	78%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	UTD	1
Producing Interval Thickness (	UTD	UTD	UTD	400
Net Clay Thickness (ft)	UTD	UTD	UTD	87
Net Sand Thickness (ft)	UTD	UTD	UTD	313
Percent Clay	UTD	UTD	UTD	22%
Percent Sand	UTD	UTD	UTD	78%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	UTD	2
Minimum Thickness (ft)	UTD	UTD	UTD	34
Maximum Thickness (ft)	UTD	UTD	UTD	53
Average Thickness (ft)	UTD	UTD	UTD	44

Appendix
Clay Layers Summary
Geophysical Log: Mo-21

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	240	425
Total Clay Thickness (ft)	UTD	UTD	222	217
Total Sand Thickness (ft)	UTD	UTD	18	208
Percent Clay	UTD	UTD	93%	51%
Percent Sand	UTD	UTD	7%	49%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	420
Net Clay Thickness (ft)	UTD	UTD	N/A	212
Net Sand Thickness (ft)	UTD	UTD	N/A	208
Percent Clay	UTD	UTD	N/A	50%
Percent Sand	UTD	UTD	N/A	50%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	7
Minimum Thickness (ft)	UTD	UTD	N/A	5
Maximum Thickness (ft)	UTD	UTD	N/A	71
Average Thickness (ft)	UTD	UTD	N/A	31

Appendix
Clay Layers Summary
Geophysical Log: Mo-22

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	258	272	440
Total Clay Thickness (ft)	UTD	169	230	284
Total Sand Thickness (ft)	UTD	89	42	156
Percent Clay	UTD	66%	85%	65%
Percent Sand	UTD	34%	15%	35%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	1	1
Producing Interval Thickness	UTD	258	192	440
Net Clay Thickness (ft)	UTD	169	150	284
Net Sand Thickness (ft)	UTD	89	42	156
Percent Clay	UTD	66%	78%	65%
Percent Sand	UTD	34%	22%	35%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	4	6
Minimum Thickness (ft)	UTD	9	10	20
Maximum Thickness (ft)	UTD	100	82	54
Average Thickness (ft)	UTD	56	38	36

Appendix
Clay Layers Summary
Geophysical Log: Mo-23

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	110	478
Total Clay Thickness (ft)	UTD	UTD	110	202
Total Sand Thickness (ft)	UTD	UTD	0	276
Percent Clay	UTD	UTD	100%	42%
Percent Sand	UTD	UTD	0%	58%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	204	N/A	458
Net Clay Thickness (ft)	UTD	59	N/A	182
Net Sand Thickness (ft)	UTD	145	N/A	276
Percent Clay	UTD	29%	N/A	40%
Percent Sand	UTD	71%	N/A	60%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	3	N/A	6
Minimum Thickness (ft)	UTD	9	N/A	6
Maximum Thickness (ft)	UTD	38	N/A	63
Average Thickness (ft)	UTD	20	N/A	30

Appendix
Clay Layers Summary
Geophysical Log: Mo-25

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	230	713	240	542
Total Clay Thickness (ft)	29	443	200	319
Total Sand Thickness (ft)	201	270	40	223
Percent Clay	13%	62%	83%	59%
Percent Sand	87%	38%	17%	41%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	1	1
Producing Interval Thickness	230	713	112	542
Net Clay Thickness (ft)	29	443	83	319
Net Sand Thickness (ft)	201	270	29	223
Percent Clay	13%	62%	74%	59%
Percent Sand	87%	38%	26%	41%
	Clay Interbed Characteristics			
Number of Clay Intereds	4	16	5	14
Minimum Thickness (ft)	5	3	10	1
Maximum Thickness (ft)	9	40	80	70
Average Thickness (ft)	7	20	25	28

Appendix
Clay Layers Summary
Geophysical Log: Mo-29

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	275	310
Total Clay Thickness (ft)	UTD	UTD	246	121
Total Sand Thickness (ft)	UTD	UTD	29	189
Percent Clay	UTD	UTD	89%	39%
Percent Sand	UTD	UTD	11%	61%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	260
Net Clay Thickness (ft)	UTD	UTD	N/A	71
Net Sand Thickness (ft)	UTD	UTD	N/A	189
Percent Clay	UTD	UTD	N/A	27%
Percent Sand	UTD	UTD	N/A	73%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	4
Minimum Thickness (ft)	UTD	UTD	N/A	15
Maximum Thickness (ft)	UTD	UTD	N/A	21
Average Thickness (ft)	UTD	UTD	N/A	18

Appendix
Clay Layers Summary
Geophysical Log: Mo-30

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	250	320
Total Clay Thickness (ft)	UTD	UTD	250	153
Total Sand Thickness (ft)	UTD	UTD	0	167
Percent Clay	UTD	UTD	100%	48%
Percent Sand	UTD	UTD	0%	52%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	300
Net Clay Thickness (ft)	UTD	UTD	N/A	133
Net Sand Thickness (ft)	UTD	UTD	N/A	167
Percent Clay	UTD	UTD	N/A	44%
Percent Sand	UTD	UTD	N/A	56%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	4
Minimum Thickness (ft)	UTD	UTD	N/A	7
Maximum Thickness (ft)	UTD	UTD	N/A	68
Average Thickness (ft)	UTD	UTD	N/A	33

Appendix
Clay Layers Summary
Geophysical Log: Mo-32

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	700	270	390
Total Clay Thickness (ft)	UTD	366	250	276
Total Sand Thickness (ft)	UTD	334	20	114
Percent Clay	UTD	52%	93%	71%
Percent Sand	UTD	48%	7%	29%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	608	N/A	373
Net Clay Thickness (ft)	UTD	302	N/A	259
Net Sand Thickness (ft)	UTD	306	N/A	114
Percent Clay	UTD	50%	N/A	69%
Percent Sand	UTD	50%	N/A	31%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	10	N/A	5
Minimum Thickness (ft)	UTD	8	N/A	7
Maximum Thickness (ft)	UTD	90	N/A	120
Average Thickness (ft)	UTD	30	N/A	52

Appendix
Clay Layers Summary
Geophysical Log: Mo-33

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	280	400
Total Clay Thickness (ft)	UTD	UTD	210	276
Total Sand Thickness (ft)	UTD	UTD	70	124
Percent Clay	UTD	UTD	75%	69%
Percent Sand	UTD	UTD	25%	31%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	1	1
Producing Interval Thickness (	UTD	380	115	340
Net Clay Thickness (ft)	UTD	163	45	216
Net Sand Thickness (ft)	UTD	217	70	124
Percent Clay	UTD	43%	39%	64%
Percent Sand	UTD	57%	61%	36%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	2	2
Minimum Thickness (ft)	UTD	14	10	60
Maximum Thickness (ft)	UTD	52	35	216
Average Thickness (ft)	UTD	33	23	138

Appendix
Clay Layers Summary
Geophysical Log: Mo-35

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	250	510
Total Clay Thickness (ft)	UTD	UTD	235	207
Total Sand Thickness (ft)	UTD	UTD	15	303
Percent Clay	UTD	UTD	94%	41%
Percent Sand	UTD	UTD	6%	59%
	Potential High Producing Interval			
Number of Producing Interval	UTD	UTD	N/A	1
Producing Interval Thickness (	UTD	UTD	N/A	482
Net Clay Thickness (ft)	UTD	UTD	N/A	179
Net Sand Thickness (ft)	UTD	UTD	N/A	303
Percent Clay	UTD	UTD	N/A	37%
Percent Sand	UTD	UTD	N/A	63%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	UTD	N/A	8
Minimum Thickness (ft)	UTD	UTD	N/A	5
Maximum Thickness (ft)	UTD	UTD	N/A	46
Average Thickness (ft)	UTD	UTD	N/A	23

Appendix
Clay Layers Summary
Geophysical Log: Mo-36

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	350	450
Total Clay Thickness (ft)	UTD	UTD	321	331
Total Sand Thickness (ft)	UTD	UTD	29	119
Percent Clay	UTD	UTD	92%	74%
Percent Sand	UTD	UTD	8%	26%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	290	N/A	350
Net Clay Thickness (ft)	UTD	118	N/A	231
Net Sand Thickness (ft)	UTD	172	N/A	119
Percent Clay	UTD	41%	N/A	66%
Percent Sand	UTD	59%	N/A	34%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	3	N/A	6
Minimum Thickness (ft)	UTD	20	N/A	10
Maximum Thickness (ft)	UTD	60	N/A	68
Average Thickness (ft)	UTD	39	N/A	39

Appendix
Clay Layers Summary
Geophysical Log: Mo-37

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	457	358	562
Total Clay Thickness (ft)	UTD	16	179	220
Total Sand Thickness (ft)	UTD	441	179	342
Percent Clay	UTD	4%	50%	39%
Percent Sand	UTD	96%	50%	61%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	2	1	2
Producing Interval Thickness	UTD	377	70	150
Net Clay Thickness (ft)	UTD	14	0	4
Net Sand Thickness (ft)	UTD	363	70	146
Percent Clay	UTD	4%	0%	3%
Percent Sand	UTD	96%	100%	97%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	3	4	6
Minimum Thickness (ft)	UTD	2	17	2
Maximum Thickness (ft)	UTD	12	99	87
Average Thickness (ft)	UTD	5	45	37

Appendix
Clay Layers Summary
Geophysical Log: Mo-38

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	470	335	425
Total Clay Thickness (ft)	UTD	317	313	193
Total Sand Thickness (ft)	UTD	153	22	232
Percent Clay	UTD	67%	93%	45%
Percent Sand	UTD	33%	7%	55%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	215	N/A	410
Net Clay Thickness (ft)	UTD	99	N/A	178
Net Sand Thickness (ft)	UTD	116	N/A	232
Percent Clay	UTD	46%	N/A	43%
Percent Sand	UTD	54%	N/A	57%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	N/A	7
Minimum Thickness (ft)	UTD	8	N/A	11
Maximum Thickness (ft)	UTD	45	N/A	45
Average Thickness (ft)	UTD	25	N/A	25

Appendix
Clay Layers Summary
Geophysical Log: Mo-39

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	520	260	450
Total Clay Thickness (ft)	UTD	295	248	246
Total Sand Thickness (ft)	UTD	225	12	204
Percent Clay	UTD	57%	95%	55%
Percent Sand	UTD	43%	5%	45%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	278	N/A	300
Net Clay Thickness (ft)	UTD	72	N/A	125
Net Sand Thickness (ft)	UTD	206	N/A	175
Percent Clay	UTD	26%	N/A	42%
Percent Sand	UTD	74%	N/A	58%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	6	N/A	6
Minimum Thickness (ft)	UTD	5	N/A	5
Maximum Thickness (ft)	UTD	24	N/A	60
Average Thickness (ft)	UTD	12	N/A	20

Appendix
Clay Layers Summary
Geophysical Log: Mo-40

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	610	460	530
Total Clay Thickness (ft)	UTD	195	248	132
Total Sand Thickness (ft)	UTD	415	212	398
Percent Clay	UTD	32%	54%	25%
Percent Sand	UTD	68%	46%	75%
	Potential High Producing Interval			
Number of Producing Intervals	UTD	2	1	2
Producing Interval Thickness	UTD	350	320	280
Net Clay Thickness (ft)	UTD	70	220	88
Net Sand Thickness (ft)	UTD	280	100	192
Percent Clay	UTD	20%	69%	31%
Percent Sand	UTD	80%	31%	69%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	7	7	5
Minimum Thickness (ft)	UTD	5	8	2
Maximum Thickness (ft)	UTD	50	80	48
Average Thickness (ft)	UTD	28	35	22

Appendix
Clay Layers Summary
Geophysical Log: Mo-42

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	828	470	495
Total Clay Thickness (ft)	UTD	204	289	68
Total Sand Thickness (ft)	UTD	624	181	427
Percent Clay	UTD	25%	61%	14%
Percent Sand	UTD	75%	39%	86%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	1	1
Producing Interval Thickness	UTD	828	50	495
Net Clay Thickness (ft)	UTD	204	0	68
Net Sand Thickness (ft)	UTD	624	50	427
Percent Clay	UTD	25%	0%	14%
Percent Sand	UTD	75%	100%	86%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	9	6	3
Minimum Thickness (ft)	UTD	12	4	13
Maximum Thickness (ft)	UTD	35	95	42
Average Thickness (ft)	UTD	23	48	23

Appendix
Clay Layers Summary
Geophysical Log: Mo-43

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	650	290	510
Total Clay Thickness (ft)	UTD	317	179	338
Total Sand Thickness (ft)	UTD	333	111	172
Percent Clay	UTD	49%	62%	66%
Percent Sand	UTD	51%	38%	34%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	1	1
Producing Interval Thickness (	UTD	580	182	480
Net Clay Thickness (ft)	UTD	247	74	308
Net Sand Thickness (ft)	UTD	333	108	172
Percent Clay	UTD	43%	41%	64%
Percent Sand	UTD	57%	59%	36%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	3	8
Minimum Thickness (ft)	UTD	35	14	10
Maximum Thickness (ft)	UTD	71	40	80
Average Thickness (ft)	UTD	49	25	39

Appendix
Clay Layers Summary
Geophysical Log: Mo-44

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	290	830	410	430
Total Clay Thickness (ft)	18	133	191	176
Total Sand Thickness (ft)	272	697	219	254
Percent Clay	6%	16%	47%	41%
Percent Sand	94%	84%	53%	59%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	N/A	1
Producing Interval Thickness	290	830	N/A	300
Net Clay Thickness (ft)	18	133	N/A	66
Net Sand Thickness (ft)	272	697	N/A	234
Percent Clay	6%	16%	N/A	22%
Percent Sand	94%	84%	N/A	78%
	Clay Interbed Characteristics			
Number of Clay Intereds	3	6	5	2
Minimum Thickness (ft)	1	2	2	4
Maximum Thickness (ft)	9	39	50	110
Average Thickness (ft)	6	11	32	44

Appendix
Clay Layers Summary
Geophysical Log: Mo-45

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	650	340	420
Total Clay Thickness (ft)	UTD	420	192	225
Total Sand Thickness (ft)	UTD	230	148	195
Percent Clay	UTD	65%	56%	54%
Percent Sand	UTD	35%	44%	46%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	1	1
Producing Interval Thickness (	UTD	275	248	420
Net Clay Thickness (ft)	UTD	135	100	225
Net Sand Thickness (ft)	UTD	140	148	195
Percent Clay	UTD	49%	40%	54%
Percent Sand	UTD	51%	60%	46%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	4	6
Minimum Thickness (ft)	UTD	20	18	12
Maximum Thickness (ft)	UTD	145	35	90
Average Thickness (ft)	UTD	71	25	38

Appendix
Clay Layers Summary
Geophysical Log: Mo-46

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	690	300	455
Total Clay Thickness (ft)	UTD	418	233	374
Total Sand Thickness (ft)	UTD	272	67	81
Percent Clay	UTD	61%	78%	82%
Percent Sand	UTD	39%	22%	18%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	390	N/A	392
Net Clay Thickness (ft)	UTD	191	N/A	311
Net Sand Thickness (ft)	UTD	199	N/A	81
Percent Clay	UTD	49%	N/A	79%
Percent Sand	UTD	51%	N/A	21%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	6	N/A	5
Minimum Thickness (ft)	UTD	10	N/A	8
Maximum Thickness (ft)	UTD	67	N/A	190
Average Thickness (ft)	UTD	32	N/A	62

Appendix
Clay Layers Summary
Geophysical Log: Mo-47

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	1040	470	480
Total Clay Thickness (ft)	UTD	650	56	162
Total Sand Thickness (ft)	UTD	390	414	318
Percent Clay	UTD	63%	12%	34%
Percent Sand	UTD	38%	88%	66%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	400	N/A	480
Net Clay Thickness (ft)	UTD	180	N/A	162
Net Sand Thickness (ft)	UTD	220	N/A	318
Percent Clay	UTD	45%	N/A	34%
Percent Sand	UTD	55%	N/A	66%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	8	N/A	8
Minimum Thickness (ft)	UTD	5	N/A	5
Maximum Thickness (ft)	UTD	110	N/A	55
Average Thickness (ft)	UTD	23	N/A	20

Appendix
Clay Layers Summary
Geophysical Log: Mo-48

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	560	270	460
Total Clay Thickness (ft)	UTD	325	197	331
Total Sand Thickness (ft)	UTD	235	73	129
Percent Clay	UTD	58%	73%	72%
Percent Sand	UTD	42%	27%	28%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	500	N/A	362
Net Clay Thickness (ft)	UTD	265	N/A	233
Net Sand Thickness (ft)	UTD	235	N/A	129
Percent Clay	UTD	53%	N/A	64%
Percent Sand	UTD	47%	N/A	36%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	8	N/A	7
Minimum Thickness (ft)	UTD	20	N/A	10
Maximum Thickness (ft)	UTD	62	N/A	45
Average Thickness (ft)	UTD	33	N/A	33

Appendix
Clay Layers Summary
Geophysical Log: Mo-49

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	230	575	293	480
Total Clay Thickness (ft)	70	447	259	349
Total Sand Thickness (ft)	160	128	34	131
Percent Clay	30%	78%	88%	73%
Percent Sand	70%	22%	12%	27%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	1	1
Producing Interval Thickness	230	575	98	480
Net Clay Thickness (ft)	70	447	27	349
Net Sand Thickness (ft)	160	128	71	131
Percent Clay	30%	78%	28%	73%
Percent Sand	70%	22%	72%	27%
	Clay Interbed Characteristics			
Number of Clay Intereds	2	12	8	11
Minimum Thickness (ft)	8	5	6	3
Maximum Thickness (ft)	52	80	31	30
Average Thickness (ft)	35	25	19	17

Appendix
Clay Layers Summary
Geophysical Log: Mo-50

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	690	245	420
Total Clay Thickness (ft)	UTD	438	162	231
Total Sand Thickness (ft)	UTD	252	83	189
Percent Clay	UTD	63%	66%	55%
Percent Sand	UTD	37%	34%	45%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	367	N/A	320
Net Clay Thickness (ft)	UTD	135	N/A	131
Net Sand Thickness (ft)	UTD	232	N/A	189
Percent Clay	UTD	37%	N/A	41%
Percent Sand	UTD	63%	N/A	59%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	8	N/A	5
Minimum Thickness (ft)	UTD	8	N/A	10
Maximum Thickness (ft)	UTD	223	N/A	68
Average Thickness (ft)	UTD	55	N/A	26

Appendix
Clay Layers Summary
Geophysical Log: Mo-51

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	233	475
Total Clay Thickness (ft)	UTD	UTD	185	128
Total Sand Thickness (ft)	UTD	UTD	48	347
Percent Clay	UTD	UTD	79%	27%
Percent Sand	UTD	UTD	21%	73%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	312	N/A	475
Net Clay Thickness (ft)	UTD	143	N/A	128
Net Sand Thickness (ft)	UTD	169	N/A	347
Percent Clay	UTD	46%	N/A	27%
Percent Sand	UTD	54%	N/A	73%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	N/A	9
Minimum Thickness (ft)	UTD	10	N/A	3
Maximum Thickness (ft)	UTD	68	N/A	30
Average Thickness (ft)	UTD	36	N/A	14

Appendix
Clay Layers Summary
Geophysical Log: Mo-52

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	545	215	560
Total Clay Thickness (ft)	UTD	334	165	311
Total Sand Thickness (ft)	UTD	211	50	249
Percent Clay	UTD	61%	77%	56%
Percent Sand	UTD	39%	23%	44%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	1	6
Producing Interval Thickness	UTD	545	230	456
Net Clay Thickness (ft)	UTD	334	36	207
Net Sand Thickness (ft)	UTD	211	194	249
Percent Clay	UTD	61%	16%	45%
Percent Sand	UTD	39%	84%	55%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	3	7
Minimum Thickness (ft)	UTD	13	30	10
Maximum Thickness (ft)	UTD	142	85	175
Average Thickness (ft)	UTD	67	55	50

Appendix
Clay Layers Summary
Geophysical Log: Mo-53

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	390	430
Total Clay Thickness (ft)	UTD	UTD	369	254
Total Sand Thickness (ft)	UTD	UTD	21	176
Percent Clay	UTD	UTD	95%	59%
Percent Sand	UTD	UTD	5%	41%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	150	N/A	307
Net Clay Thickness (ft)	UTD	38	N/A	141
Net Sand Thickness (ft)	UTD	112	N/A	166
Percent Clay	UTD	25%	N/A	46%
Percent Sand	UTD	75%	N/A	54%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	2	N/A	3
Minimum Thickness (ft)	UTD	18	N/A	45
Maximum Thickness (ft)	UTD	20	N/A	52
Average Thickness (ft)	UTD	19	N/A	48

Appendix
Clay Layers Summary
Geophysical Log: Mo-55

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	590	290	510
Total Clay Thickness (ft)	UTD	330	210	389
Total Sand Thickness (ft)	UTD	260	80	121
Percent Clay	UTD	56%	72%	76%
Percent Sand	UTD	44%	28%	24%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	1	2
Producing Interval Thickness	UTD	590	100	280
Net Clay Thickness (ft)	UTD	330	28	88
Net Sand Thickness (ft)	UTD	260	72	192
Percent Clay	UTD	56%	28%	31%
Percent Sand	UTD	44%	72%	69%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	7	3	8
Minimum Thickness (ft)	UTD	10	30	9
Maximum Thickness (ft)	UTD	90	70	160
Average Thickness (ft)	UTD	47	42	39

Appendix
Clay Layers Summary
Geophysical Log: Mo-56

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	375	405
Total Clay Thickness (ft)	UTD			
Total Sand Thickness (ft)	UTD			
Percent Clay	UTD			
Percent Sand	UTD			
		Potential High Producing Interval		
Number of Producing Interv	UTD	1		1
Producing Interval Thicknes	UTD	70		252
Net Clay Thickness (ft)	UTD	18		169
Net Sand Thickness (ft)	UTD	52		83
Percent Clay	UTD	26%		67%
Percent Sand	UTD	74%		33%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	1		2
Minimum Thickness (ft)	UTD	18		46
Maximum Thickness (ft)	UTD	18		123
Average Thickness (ft)	UTD	18		85

Appendix
Clay Layers Summary
Geophysical Log: Mo-57

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	117	500	290	860
Total Clay Thickness (ft)	71	284	210	545
Total Sand Thickness (ft)	46	216	80	315
Percent Clay	61%	57%	72%	63%
Percent Sand	39%	43%	28%	37%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	1	1
Producing Interval Thickness	117	500	200	860
Net Clay Thickness (ft)	71	284	54	545
Net Sand Thickness (ft)	46	216	146	315
Percent Clay	61%	57%	27%	63%
Percent Sand	39%	43%	73%	37%
	Clay Interbed Characteristics			
Number of Clay Intereds	5	10	4	11
Minimum Thickness (ft)	19	3	20	3
Maximum Thickness (ft)	30	50	50	110
Average Thickness (ft)	24	24	30	36

Appendix
Clay Layers Summary
Geophysical Log: Mo-60

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	UTD	250	370
Total Clay Thickness (ft)	UTD	UTD	240	153
Total Sand Thickness (ft)	UTD	UTD	10	217
Percent Clay	UTD	UTD	96%	41%
Percent Sand	UTD	UTD	4%	59%
	Potential High Producing Interval			
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	198	N/A	330
Net Clay Thickness (ft)	UTD	64	N/A	108
Net Sand Thickness (ft)	UTD	134	N/A	212
Percent Clay	UTD	32%	N/A	33%
Percent Sand	UTD	68%	N/A	64%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	3	N/A	8
Minimum Thickness (ft)	UTD	8	N/A	2
Maximum Thickness (ft)	UTD	48	N/A	30
Average Thickness (ft)	UTD	21	N/A	14

Appendix
Clay Layers Summary
Geophysical Log: Mo-61

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	270	510
Total Clay Thickness (ft)	UTD	UTD	270	326
Total Sand Thickness (ft)	UTD	UTD	0	184
Percent Clay	UTD	UTD	100%	64%
Percent Sand	UTD	UTD	0%	36%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	448	N/A	440
Net Clay Thickness (ft)	UTD	265	N/A	256
Net Sand Thickness (ft)	UTD	183	N/A	184
Percent Clay	UTD	59%	N/A	58%
Percent Sand	UTD	41%	N/A	42%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	3	N/A	3
Minimum Thickness (ft)	UTD	30	N/A	25
Maximum Thickness (ft)	UTD	200	N/A	175
Average Thickness (ft)	UTD	88	N/A	85

Appendix
Clay Layers Summary
Geophysical Log: Mo-62

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	256	753	245	510
Total Clay Thickness (ft)	173	390	205	310
Total Sand Thickness (ft)	83	363	40	200
Percent Clay	68%	52%	84%	61%
Percent Sand	32%	48%	16%	39%
	Potential High Producing Interval			
Number of Producing Intervals	2	1	N/A	1
Producing Interval Thickness	156	753	N/A	510
Net Clay Thickness (ft)	55	390	N/A	310
Net Sand Thickness (ft)	101	363	N/A	200
Percent Clay	35%	52%	N/A	61%
Percent Sand	65%	48%	N/A	39%
	Clay Interbed Characteristics			
Number of Clay Intereds	5	18	6	10
Minimum Thickness (ft)	10	2	10	7
Maximum Thickness (ft)	32	35	65	50
Average Thickness (ft)	22	20	21	24

Appendix
Clay Layers Summary
Geophysical Log: Mo-63

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	50	240	360
Total Clay Thickness (ft)	UTD	8	187	192
Total Sand Thickness (ft)	UTD	42	53	168
Percent Clay	UTD	16%	78%	53%
Percent Sand	UTD	84%	22%	47%
	Potential High Producing Interval			
Number of Producing Intervals	UTD	1	1	2
Producing Interval Thickness	UTD	50	88	360
Net Clay Thickness (ft)	UTD	8	23	192
Net Sand Thickness (ft)	UTD	42	65	168
Percent Clay	UTD	16%	26%	53%
Percent Sand	UTD	84%	74%	47%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	3	7	7
Minimum Thickness (ft)	UTD	8	7	7
Maximum Thickness (ft)	UTD	8	70	42
Average Thickness (ft)	UTD	8	37	24

Appendix
Clay Layers Summary
Geophysical Log: Mo-64

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	90	585	235	320
Total Clay Thickness (ft)	15	274	228	86
Total Sand Thickness (ft)	75	311	7	234
Percent Clay	17%	47%	97%	27%
Percent Sand	83%	53%	3%	73%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	N/A	1
Producing Interval Thickness	90	585	N/A	320
Net Clay Thickness (ft)	15	274	N/A	86
Net Sand Thickness (ft)	75	311	N/A	234
Percent Clay	17%	47%	N/A	27%
Percent Sand	83%	53%	N/A	73%
	Clay Interbed Characteristics			
Number of Clay Intereds	2	11	3	10
Minimum Thickness (ft)	15	1	34	2
Maximum Thickness (ft)	15	100	60	41
Average Thickness (ft)	15	25	45	17

Appendix
Clay Layers Summary
Geophysical Log: Mo-65

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	210	840	480	520
Total Clay Thickness (ft)	20	490	420	291
Total Sand Thickness (ft)	190	350	60	229
Percent Clay	10%	58%	88%	56%
Percent Sand	90%	42%	13%	44%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	N/A	2
Producing Interval Thickness	210	840	N/A	378
Net Clay Thickness (ft)	20	490	N/A	149
Net Sand Thickness (ft)	190	350	N/A	200
Percent Clay	10%	58%	N/A	39%
Percent Sand	90%	42%	N/A	53%
	Clay Interbed Characteristics			
Number of Clay Intereds	1	9	6	9
Minimum Thickness (ft)	20	30	20	2
Maximum Thickness (ft)	20	80	90	130
Average Thickness (ft)	20	49	47	32

Appendix
Clay Layers Summary
Geophysical Log: Mo-66

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	270	240	487
Total Clay Thickness (ft)	UTD	91	210	246
Total Sand Thickness (ft)	UTD	179	30	241
Percent Clay	UTD	34%	88%	51%
Percent Sand	UTD	66%	13%	49%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	N/A	1
Producing Interval Thickness	UTD	270	N/A	487
Net Clay Thickness (ft)	UTD	91	N/A	246
Net Sand Thickness (ft)	UTD	179	N/A	241
Percent Clay	UTD	34%	N/A	51%
Percent Sand	UTD	66%	N/A	49%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	N/A	13
Minimum Thickness (ft)	UTD	2	N/A	2
Maximum Thickness (ft)	UTD	40	N/A	30
Average Thickness (ft)	UTD	18	N/A	15

Appendix
Clay Layers Summary
Geophysical Log: Mo-67

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	250	250	480
Total Clay Thickness (ft)	UTD	74	210	267
Total Sand Thickness (ft)	UTD	176	40	213
Percent Clay	UTD	30%	84%	56%
Percent Sand	UTD	70%	16%	44%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	N/A	1
Producing Interval Thickness	UTD	250	N/A	480
Net Clay Thickness (ft)	UTD	74	N/A	267
Net Sand Thickness (ft)	UTD	176	N/A	213
Percent Clay	UTD	30%	N/A	56%
Percent Sand	UTD	70%	N/A	44%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	N/A	12
Minimum Thickness (ft)	UTD	1	N/A	1
Maximum Thickness (ft)	UTD	40	N/A	40
Average Thickness (ft)	UTD	25	N/A	18

Appendix
Clay Layers Summary
Geophysical Log: Mo-68

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	180	620	290	400
Total Clay Thickness (ft)	10	338	260	241
Total Sand Thickness (ft)	170	282	30	159
Percent Clay	6%	55%	90%	60%
Percent Sand	94%	45%	10%	40%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	1	1
Producing Interval Thickness	180	620	26	400
Net Clay Thickness (ft)	10	338	26	241
Net Sand Thickness (ft)	170	282	0	159
Percent Clay	6%	55%	N/A	60%
Percent Sand	94%	45%	N/A	40%
	Clay Interbed Characteristics			
Number of Clay Intereds	3	16	7	8
Minimum Thickness (ft)	4	1	7	6
Maximum Thickness (ft)	6	60	40	70
Average Thickness (ft)	5	17	22	27

Appendix
Clay Layers Summary
Geophysical Log: Mo-69

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	285	245	520
Total Clay Thickness (ft)	UTD	57	245	221
Total Sand Thickness (ft)	UTD	228	0	299
Percent Clay	UTD	20%	100%	43%
Percent Sand	UTD	80%	0%	58%
		Potential High Producing Interval		
Number of Producing Intervals	UTD	1	N/A	1
Producing Interval Thickness	UTD	285	N/A	520
Net Clay Thickness (ft)	UTD	57	N/A	221
Net Sand Thickness (ft)	UTD	228	N/A	299
Percent Clay	UTD	20%	N/A	43%
Percent Sand	UTD	80%	N/A	58%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	N/A	12
Minimum Thickness (ft)	UTD	8	N/A	5
Maximum Thickness (ft)	UTD	20	N/A	50
Average Thickness (ft)	UTD	14	N/A	22

Appendix
Clay Layers Summary
Geophysical Log: Mo-70

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	UTD	450	270	459
Total Clay Thickness (ft)	UTD	210	230	207
Total Sand Thickness (ft)	UTD	240	40	252
Percent Clay	UTD	47%	85%	45%
Percent Sand	UTD	53%	15%	55%
	Potential High Producing Interval			
Number of Producing Intervals	UTD	1	1	1
Producing Interval Thickness	UTD	450	270	459
Net Clay Thickness (ft)	UTD	210	230	207
Net Sand Thickness (ft)	UTD	240	40	252
Percent Clay	UTD	47%	85%	45%
Percent Sand	UTD	53%	15%	55%
	Clay Interbed Characteristics			
Number of Clay Intereds	UTD	6	4	8
Minimum Thickness (ft)	UTD	4	20	5
Maximum Thickness (ft)	UTD	110	70	50
Average Thickness (ft)	UTD	35	46	23

Appendix
Clay Layers Summary
Geophysical Log: Mo-72

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	477	315	460
Total Clay Thickness (ft)	UTD	277	236	155
Total Sand Thickness (ft)	UTD	200	79	305
Percent Clay	UTD	58%	75%	34%
Percent Sand	UTD	42%	25%	66%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	115	N/A	350
Net Clay Thickness (ft)	UTD	16	N/A	90
Net Sand Thickness (ft)	UTD	99	N/A	260
Percent Clay	UTD	14%	N/A	26%
Percent Sand	UTD	86%	N/A	74%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	4	N/A	5
Minimum Thickness (ft)	UTD	2	N/A	3
Maximum Thickness (ft)	UTD	8	N/A	40
Average Thickness (ft)	UTD	4	N/A	18

Appendix
Clay Layers Summary
Geophysical Log: Mo-73

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	175	580	227	218
Total Clay Thickness (ft)	0	436	113	100
Total Sand Thickness (ft)	175	144	114	118
Percent Clay	0%	75%	50%	46%
Percent Sand	100%	25%	50%	54%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	1	2
Producing Interval Thickness	175	230	139	62
Net Clay Thickness (ft)	0	86	25	18
Net Sand Thickness (ft)	175	144	114	44
Percent Clay	0%	37%	18%	29%
Percent Sand	100%	63%	82%	71%
	Clay Interbed Characteristics			
Number of Clay Intereds	0	8	4	11
Minimum Thickness (ft)	0	8	1	2
Maximum Thickness (ft)	0	96	50	65
Average Thickness (ft)	0	36	28	16

Appendix
Clay Layers Summary
Geophysical Log: Mo-74

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	UTD	270	510
Total Clay Thickness (ft)	UTD	UTD	241	218
Total Sand Thickness (ft)	UTD	UTD	29	292
Percent Clay	UTD	UTD	89%	43%
Percent Sand	UTD	UTD	11%	57%
		Potential High Producing Interval		
Number of Producing Interval	UTD	1	N/A	1
Producing Interval Thickness (	UTD	356	N/A	505
Net Clay Thickness (ft)	UTD	121	N/A	213
Net Sand Thickness (ft)	UTD	235	N/A	292
Percent Clay	UTD	34%	N/A	42%
Percent Sand	UTD	66%	N/A	58%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5	N/A	7
Minimum Thickness (ft)	UTD	7	N/A	8
Maximum Thickness (ft)	UTD	58	N/A	73
Average Thickness (ft)	UTD	26	N/A	22

Appendix
Clay Layers Summary
Geophysical Log: Mo-75

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	590	200	370
Total Clay Thickness (ft)	UTD			
Total Sand Thickness (ft)	UTD			
Percent Clay	UTD			
Percent Sand	UTD			
		Potential High Producing Interval		
Number of Producing Interv	UTD	1		1
Producing Interval Thicknes	UTD	390		340
Net Clay Thickness (ft)	UTD	106		75
Net Sand Thickness (ft)	UTD	284		265
Percent Clay	UTD	27%		22%
Percent Sand	UTD	73%		78%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	5		3
Minimum Thickness (ft)	UTD	13		10
Maximum Thickness (ft)	UTD	32		40
Average Thickness (ft)	UTD	21		25

Appendix
Clay Layers Summary
Geophysical Log: Mo-76

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	290	600	325	515
Total Clay Thickness (ft)	35	292	258	325
Total Sand Thickness (ft)	255	308	67	190
Percent Clay	12%	49%	79%	63%
Percent Sand	88%	51%	21%	37%
	Potential High Producing Interval			
Number of Producing Intervals	1	1	2	1
Producing Interval Thickness	290	600	152	515
Net Clay Thickness (ft)	35	292	85	325
Net Sand Thickness (ft)	255	308	67	190
Percent Clay	12%	49%	56%	63%
Percent Sand	88%	51%	44%	37%
	Clay Interbed Characteristics			
Number of Clay Intereds	1	7	8	11
Minimum Thickness (ft)	35	6	6	1
Maximum Thickness (ft)	35	83	50	30
Average Thickness (ft)	35	37	18	14

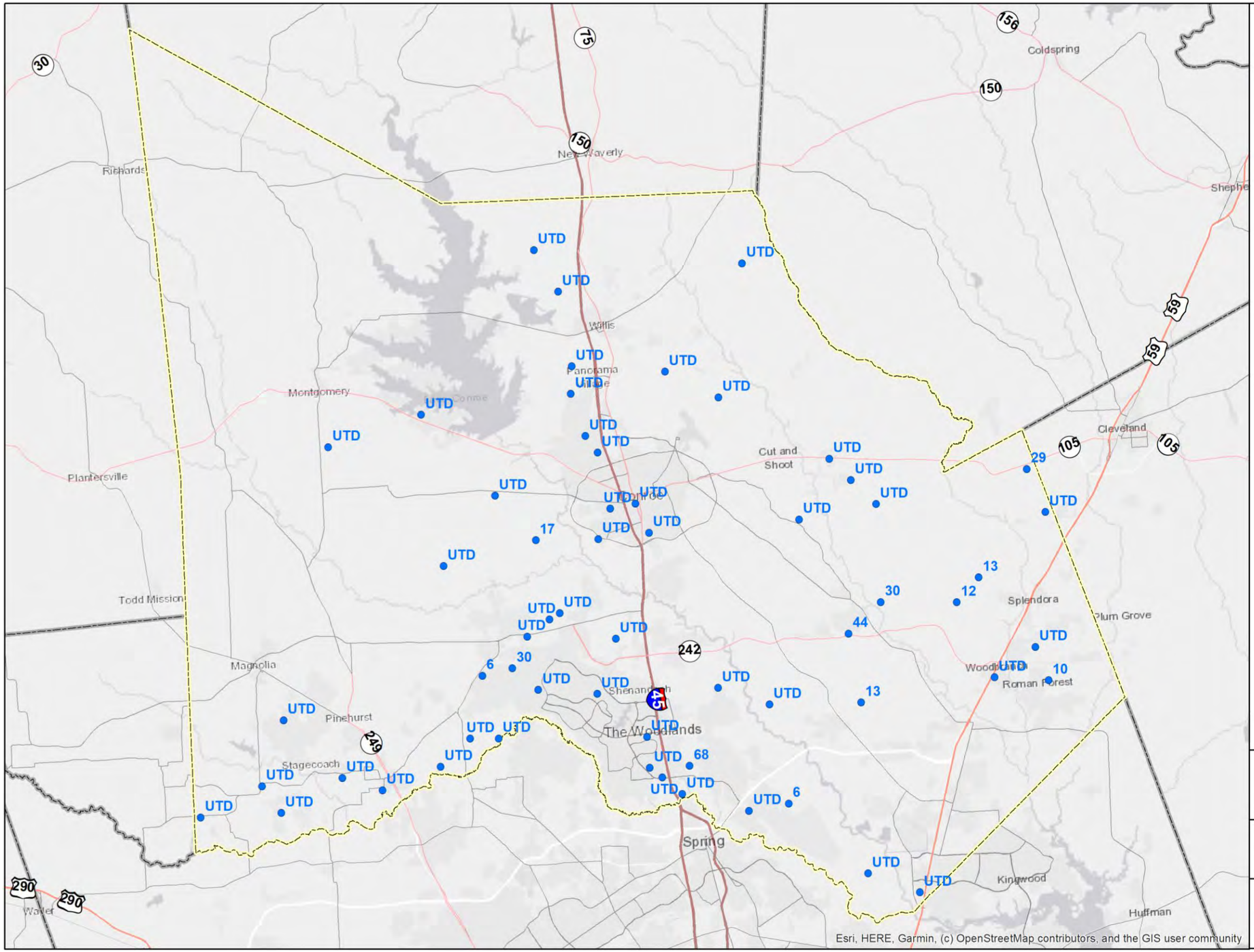
Appendix
Clay Layers Summary
Geophysical Log: Mo-77

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
		Total Aquifer Interval		
Total Interval Thickness (ft)	UTD	635	175	380
Total Clay Thickness (ft)	UTD			
Total Sand Thickness (ft)	UTD			
Percent Clay	UTD			
Percent Sand	UTD			
		Potential High Producing Interval		
Number of Producing	UTD	1		1
Producing Interval Thickness	UTD	310		228
Net Clay Thickness (ft)	UTD	177		130
Net Sand Thickness (ft)	UTD	133		100
Percent Clay	UTD	57%		57%
Percent Sand	UTD	43%		44%
		Clay Interbed Characteristics		
Number of Clay Intereds	UTD	6		4
Minimum Thickness (ft)	UTD	8		15
Maximum Thickness (ft)	UTD	67		70
Average Thickness (ft)	UTD	30		33

Appendix
Clay Layers Summary
Geophysical Log: Mo-78

	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Layer	Upper Jasper Aquifer
	Total Aquifer Interval			
Total Interval Thickness (ft)	142	730	240	570
Total Clay Thickness (ft)	42	171	126	318
Total Sand Thickness (ft)	100	559	114	252
Percent Clay	30%	23%	53%	56%
Percent Sand	70%	77%	47%	44%
	Potential High Producing Interval			
Number of Producing	1	1	N/A	1
Producing Interval Thickness	96	190	N/A	500
Net Clay Thickness (ft)	0	71	N/A	170
Net Sand Thickness (ft)	96	119	N/A	330
Percent Clay	0%	37%	N/A	34%
Percent Sand	100%	63%	N/A	66%
	Clay Interbed Characteristics			
Number of Clay Intereds	1	10	N/A	10
Minimum Thickness (ft)	42	1	N/A	1
Maximum Thickness (ft)	42	63	N/A	35
Average Thickness (ft)	42	17	N/A	12

APPENDIX 4 – PERCENT CLAY MAPS



Explanation

- Wells
- Montgomery County
- County Boundary

N

0 2.25 4.5 9

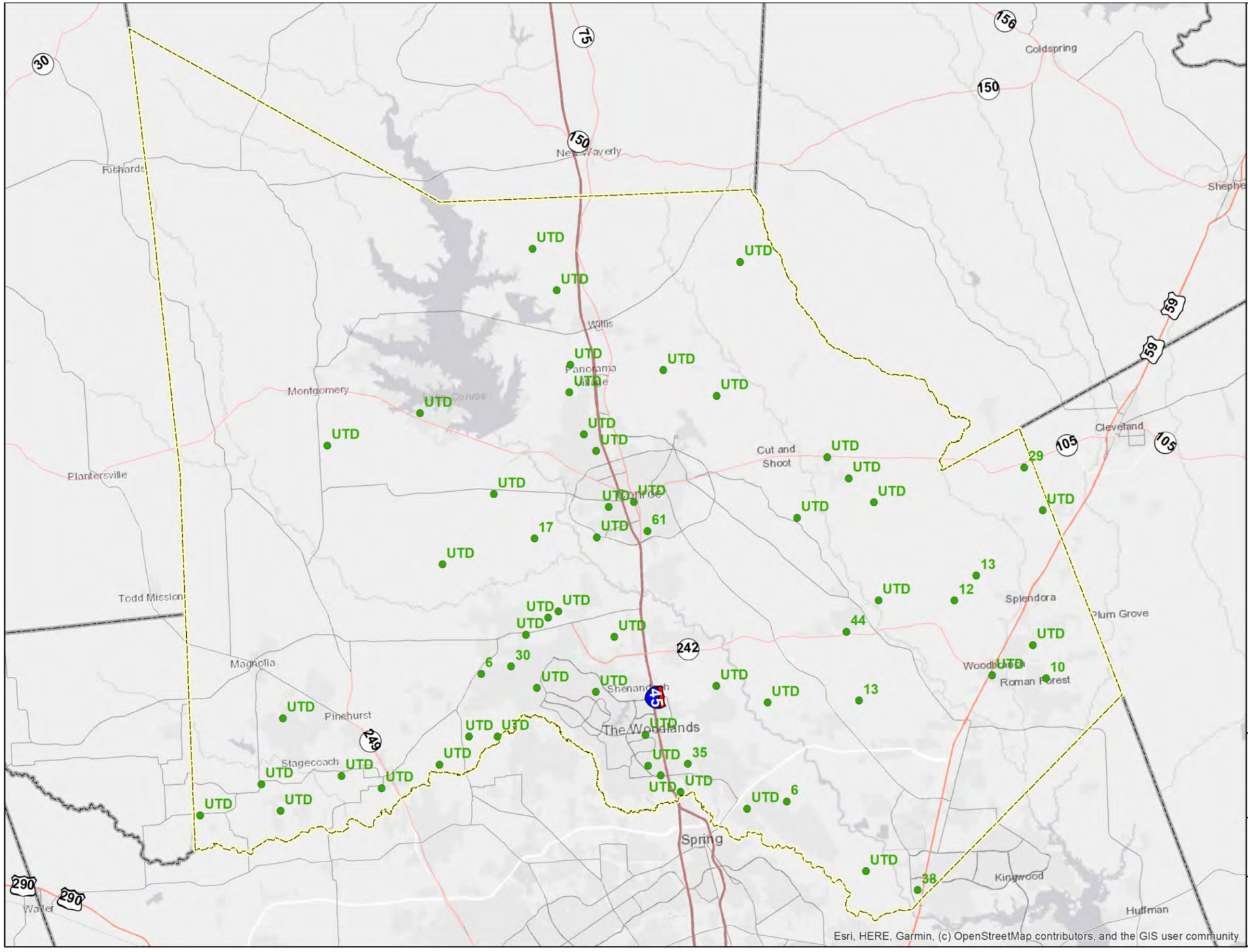
Miles

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Percent Clay - Chicot Aquifer

Lone Star Groundwater Conservation District

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists



Explanation

- Wells
- Montgomery County
- County Boundary

N

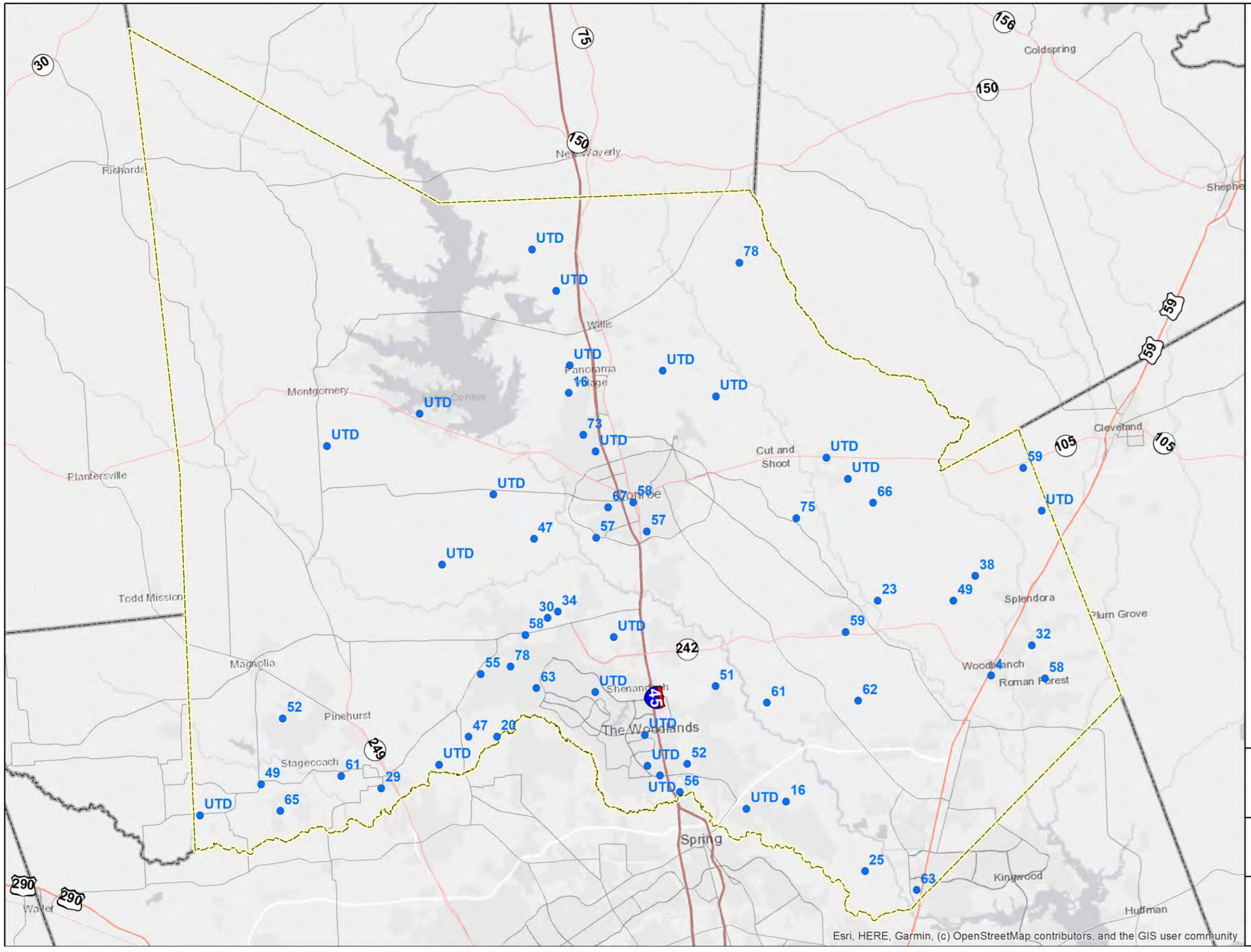
0 2.25 4.5 9

Miles

Percent Clay - Potential Producing Zone in Chicot Aquifer

Lone Star Groundwater Conservation District

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists



Explanation

- Wells
- Montgomery County
- County Boundary

N

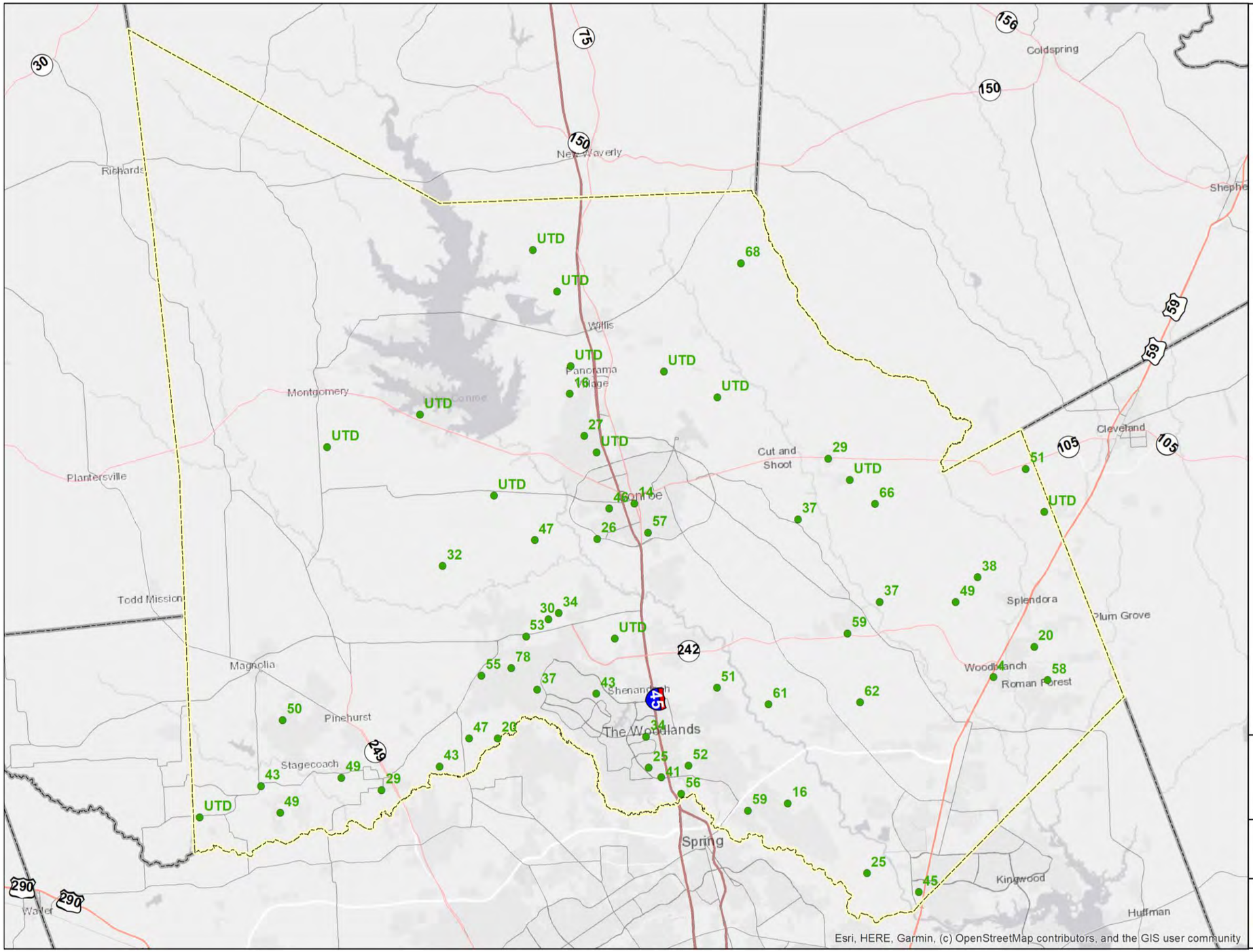
0 2.25 4.5 9

Miles

Percent Clay - Evangeline Aquifer

Lone Star Groundwater Conservation District

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists



Explanation

- Wells
- Montgomery County
- County Boundary

N

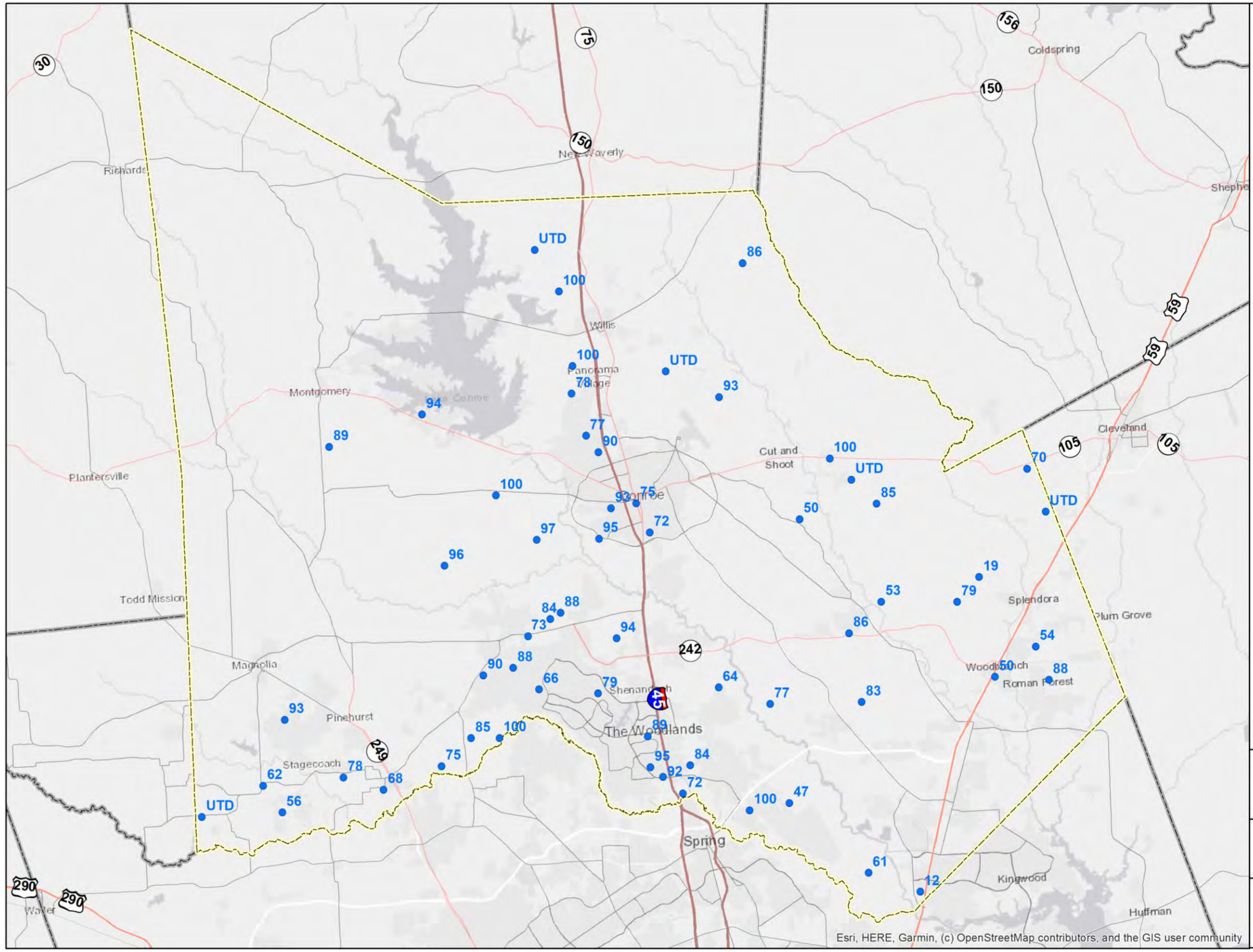
0 2.25 4.5 9

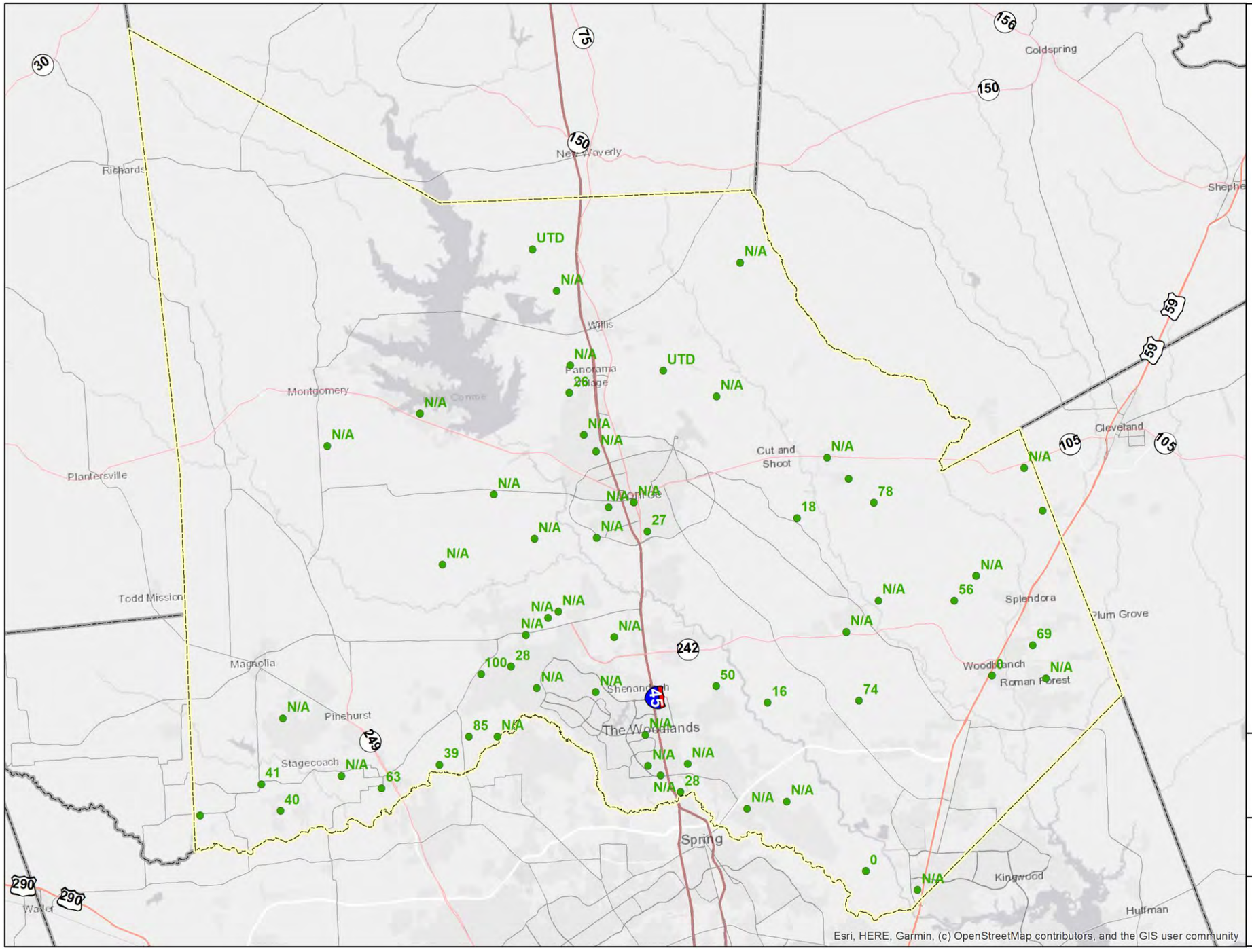
Miles

Percent Clay - Potential Producing Zone in Evangeline Aquifer

Lone Star Groundwater Conservation District

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Explanation
Wells
Montgomery County
County Boundary
N
0 2.25 4.5 9
Miles
Percent Clay -
Burkeville Confining Unit
Lone Star Groundwater Conservation District
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Coldspring
New Waverly
Richards
Willis
Montgomery
Plantersville
Todd Mission
Magnolia
Pinehurst
Stagecoach
Panorama Village
Cut and Shoot
Splendora
Plum Grove
Roman Forest
Shenandoah
The Woodlands
Spring
Cleveland
Kingwood
Huffman
Waller
UTD
100
86
78
93
94
89
77
90
75
97
95
72
96
84
88
73
94
90
66
79
64
77
83
53
79
19
86
54
50
88
85
62
56
68
92
47
61
12
70
85
50



Explanation

- Wells
- Montgomery County
- County Boundary

N

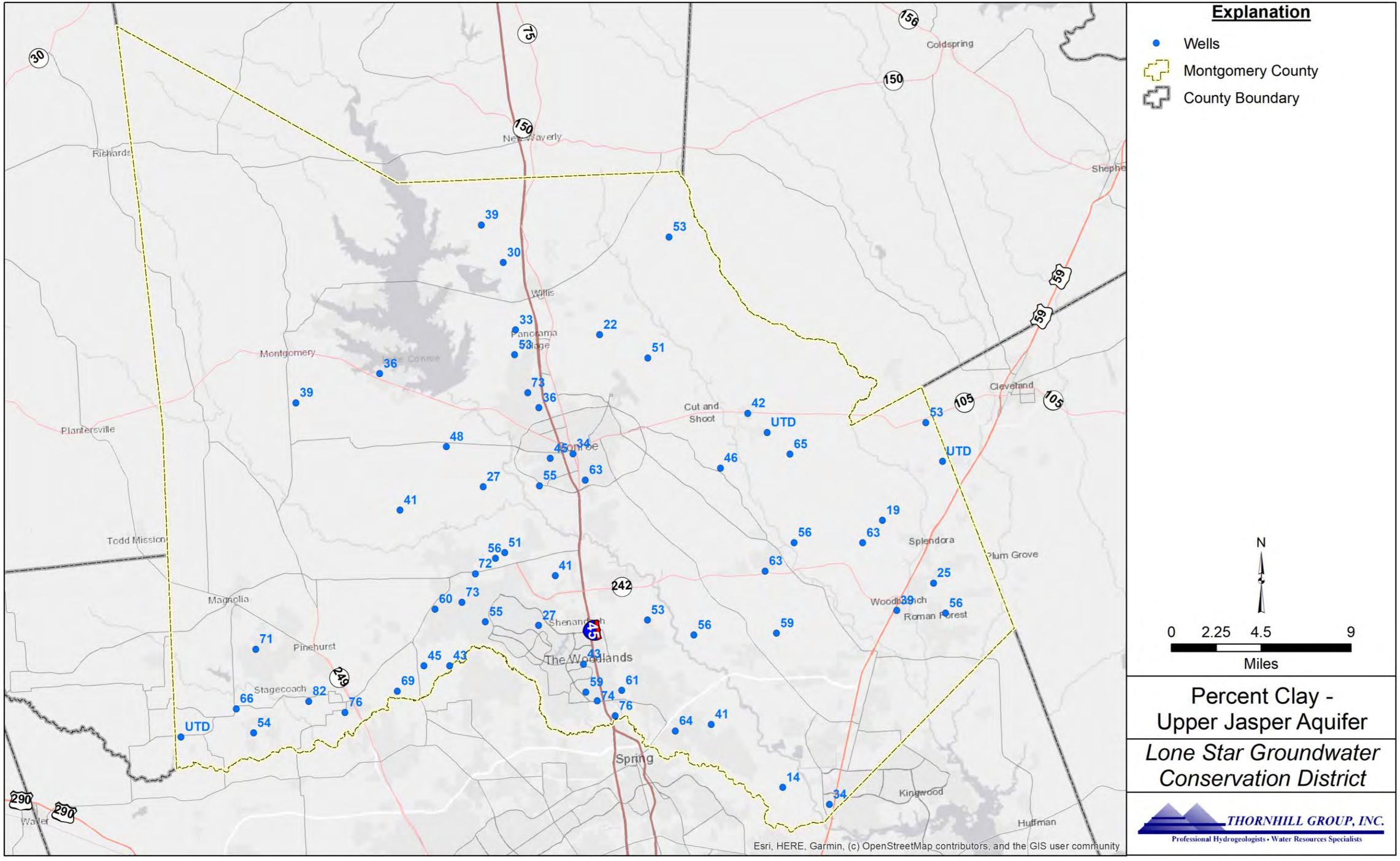
0 2.25 4.5 9

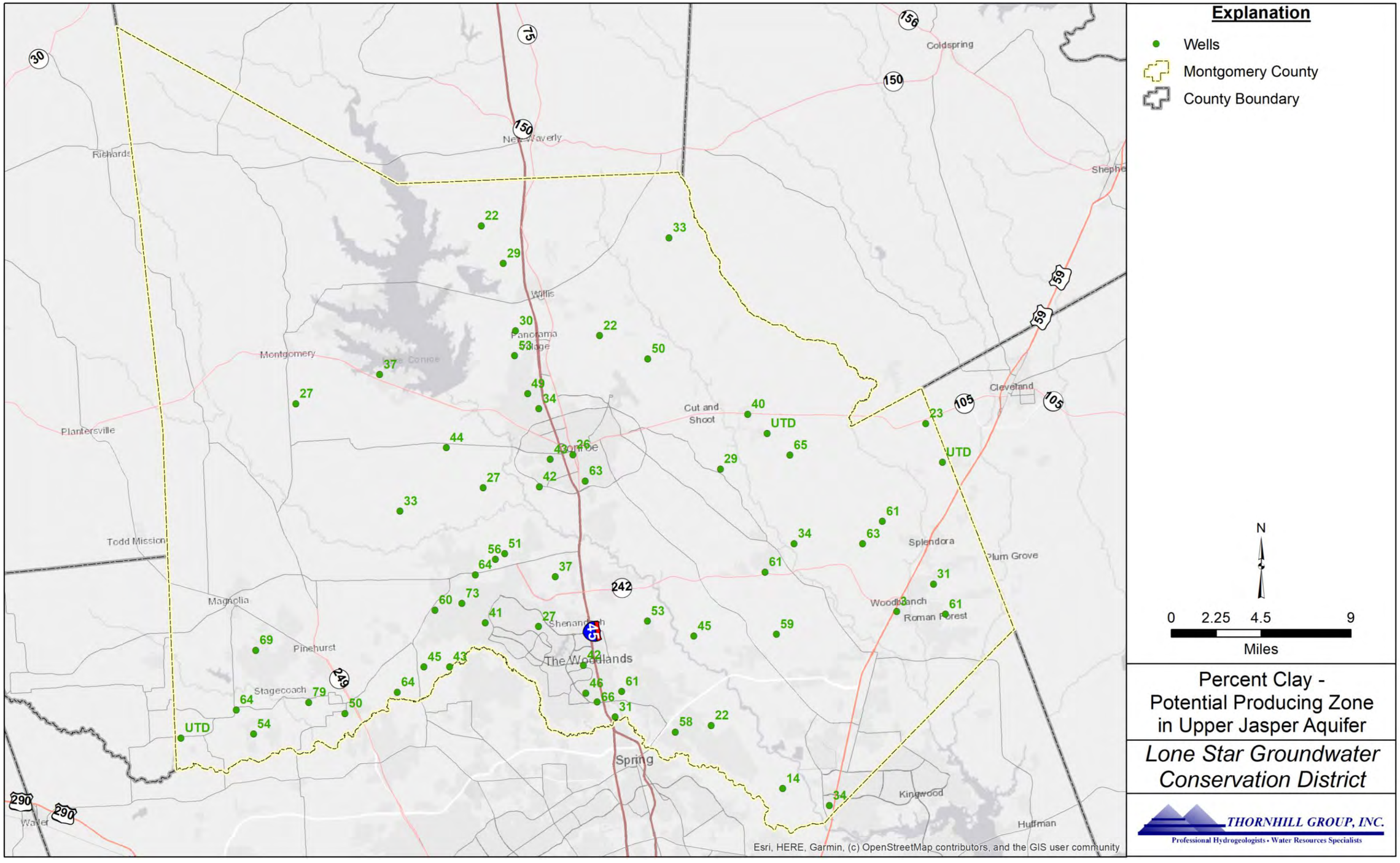
Miles

Percent Clay - Potential Producing Zone in Burkeville Confining Unit

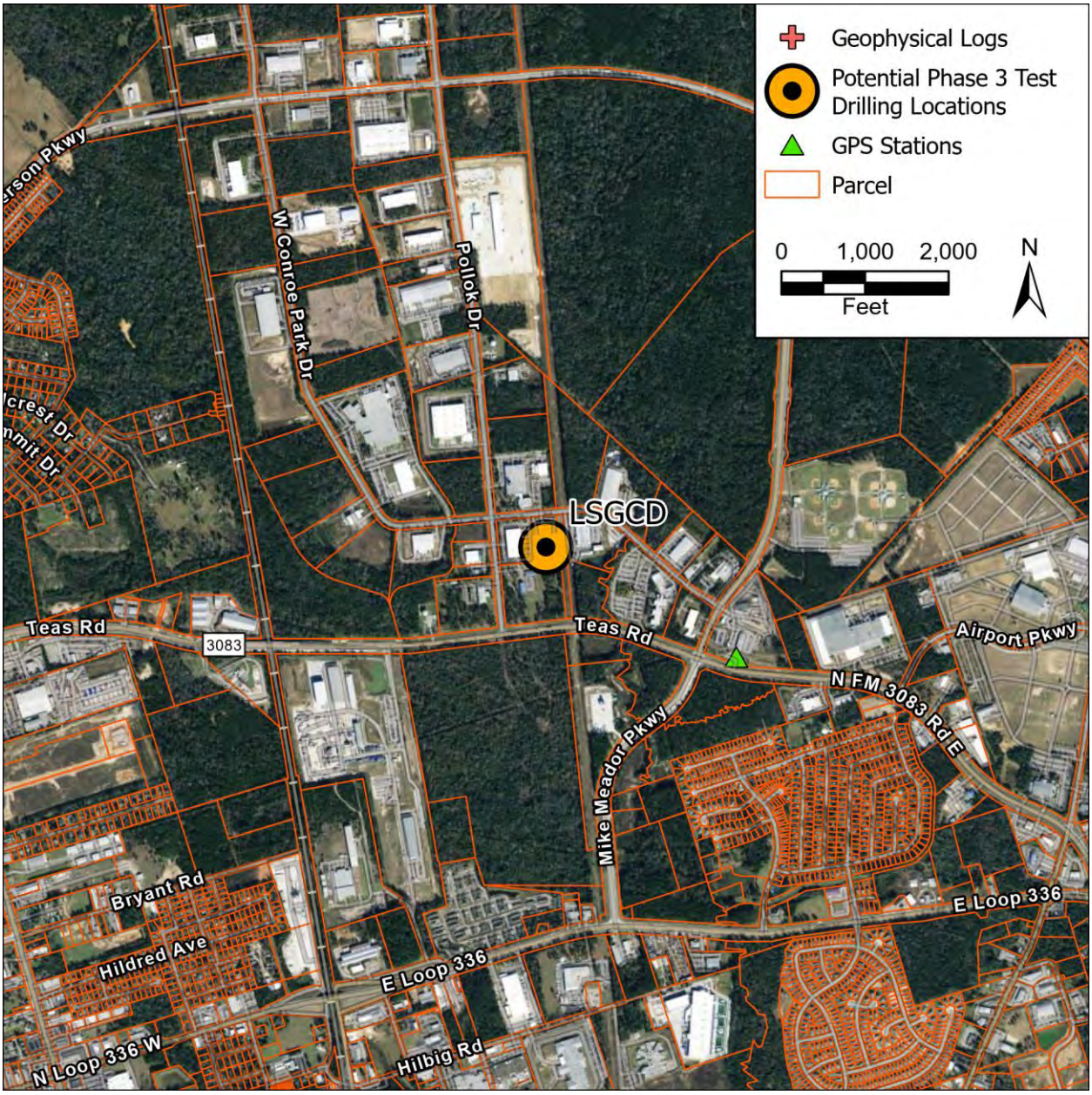
Lone Star Groundwater Conservation District

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

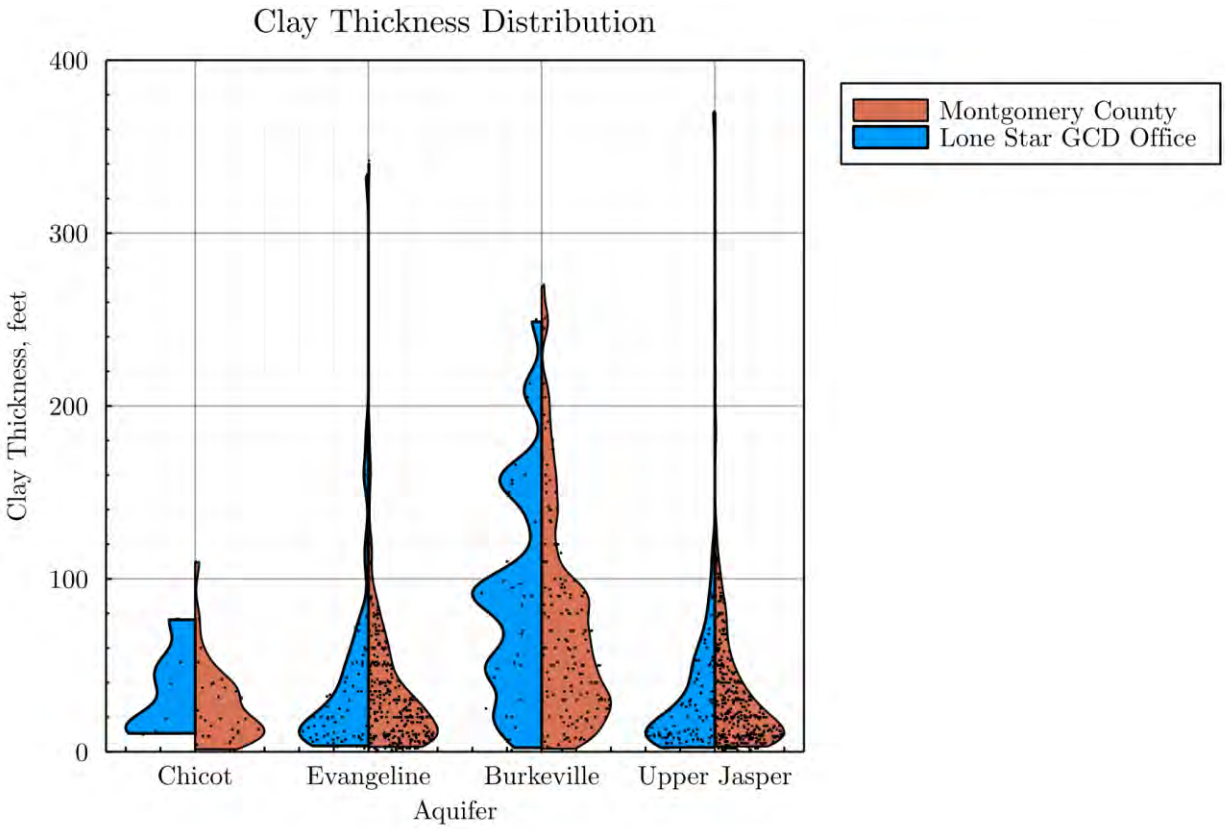

Explanation
Wells
Montgomery County
County Boundary
N
0 2.25 4.5 9
Miles
Percent Clay -
Upper Jasper Aquifer
Lone Star Groundwater Conservation District
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
New Waverly
Richards
Coldspring
Willis
Montgomery
Cut and Shoot
Cleveland
Plantersville
Todd Mission
Magnolia
Pinehurst
Stagecoach
The Woodlands
Spring
Splendora
Plum Grove
Roman Forest
Kingwood
Huffman
Waller
39
30
53
33
22
53
51
36
39
73
36
42
UTD
53
48
34
65
46
45
27
55
63
41
19
56
63
56
51
72
41
63
25
60
73
55
27
53
56
59
71
45
43
69
66
82
76
59
61
74
76
64
41
UTD
54
14
34

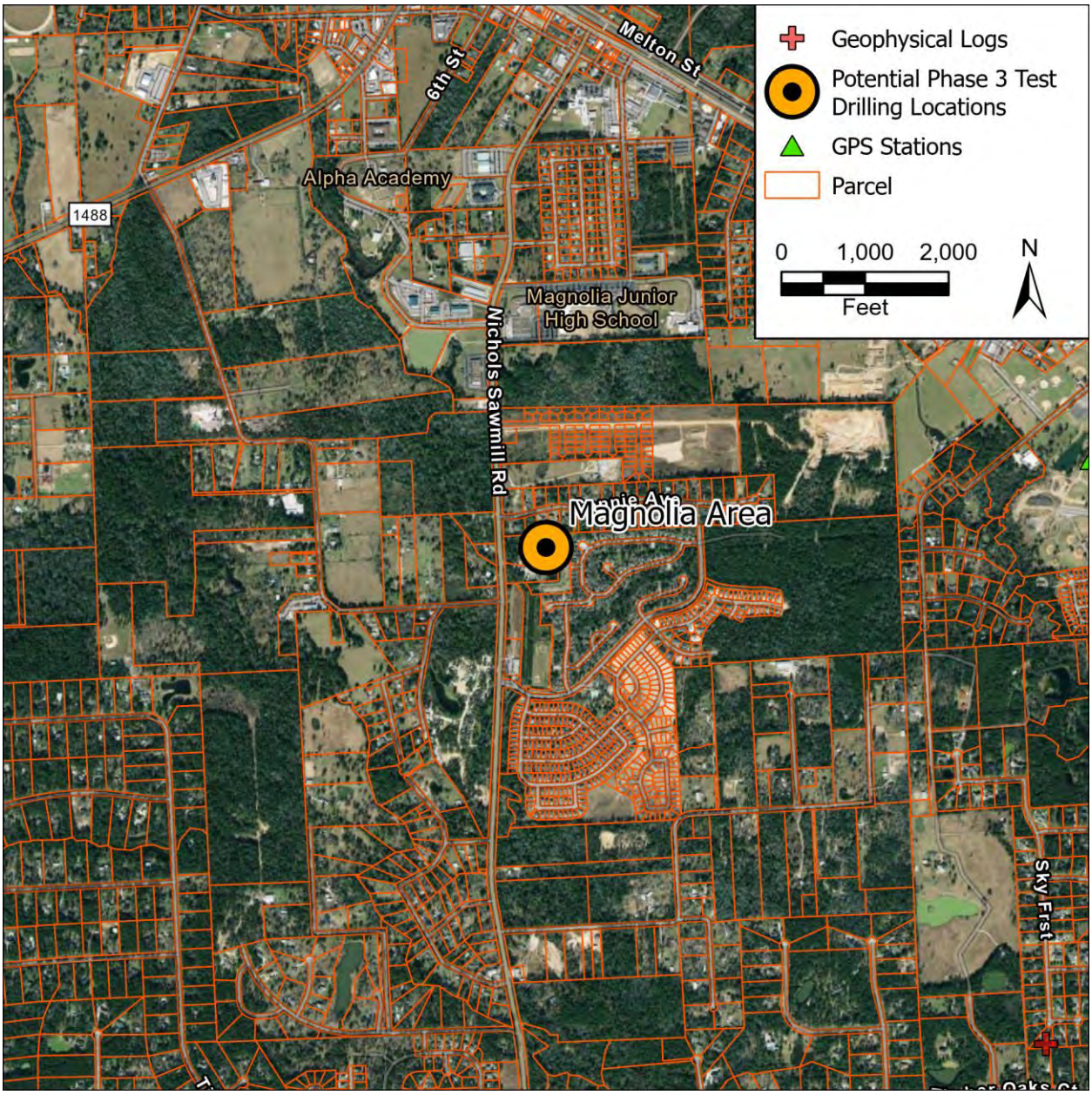

Explanation
Wells
Montgomery County
County Boundary
N
0 2.25 4.5 9
Miles
Percent Clay -
Potential Producing Zone
in Upper Jasper Aquifer
Lone Star Groundwater
Conservation District
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
New Waverly
Coldspring
Willis
Montgomery
Conroe
Cut and
Shoot
Cleveland
Plantersville
Todd Mission
Magnolia
Splendora
Plum Grove
Pinehurst
Stagecoach
Shenandoah
The Woodlands
Spring
Kingwood
Huffman
Roman Forest
Panorama
Village
22
29
33
30
53
22
50
37
27
49
34
40
UTD
23
44
43
26
65
29
UTD
27
42
63
33
61
34
63
56
51
64
37
61
31
60
73
41
27
53
45
59
61
69
45
43
42
64
46
61
64
79
50
66
31
UTD
54
58
22
14
34

APPENDIX 5 – PROPOSED TEST DRILLING LOCATIONS

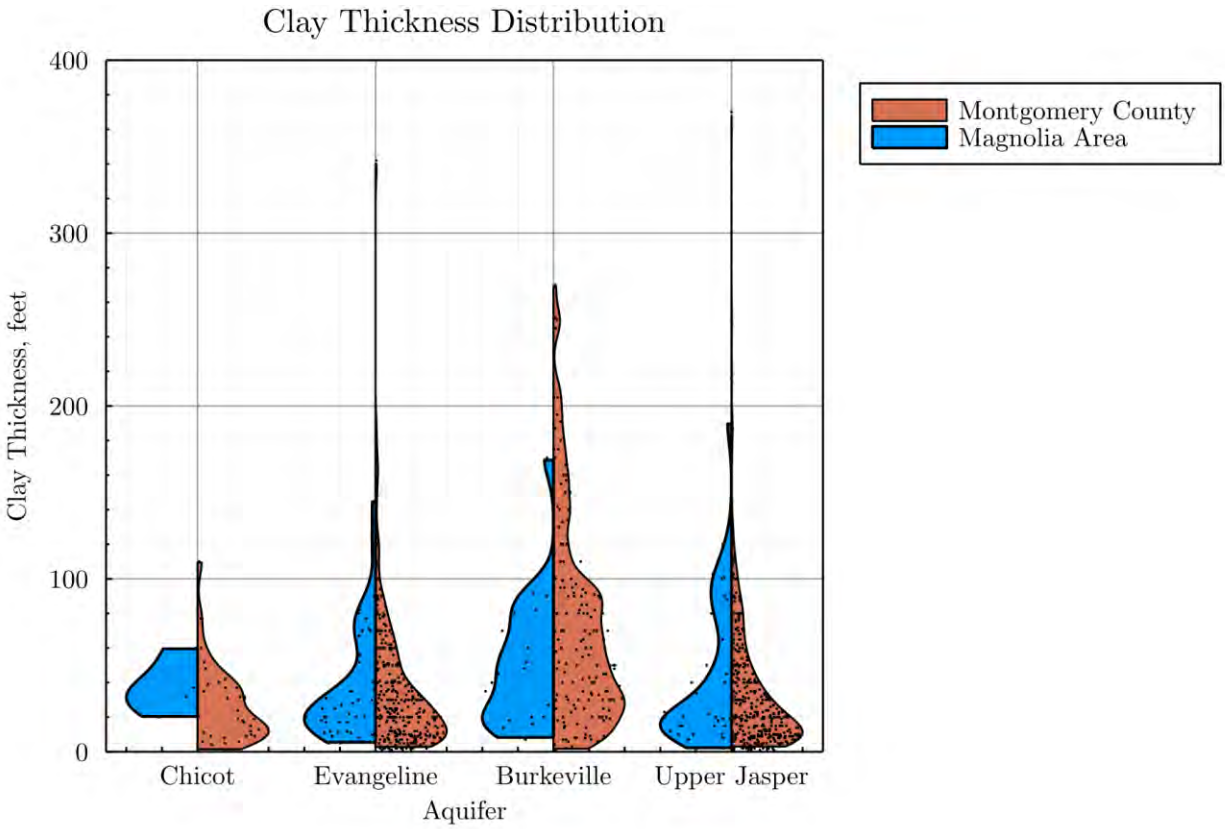


- Site Info:
  - Property ID: 373396
  - Owner: Lone Star Groundwater
- At District office
- Educational tool
- Central part of the District
- Near existing GPS site (TXCN)

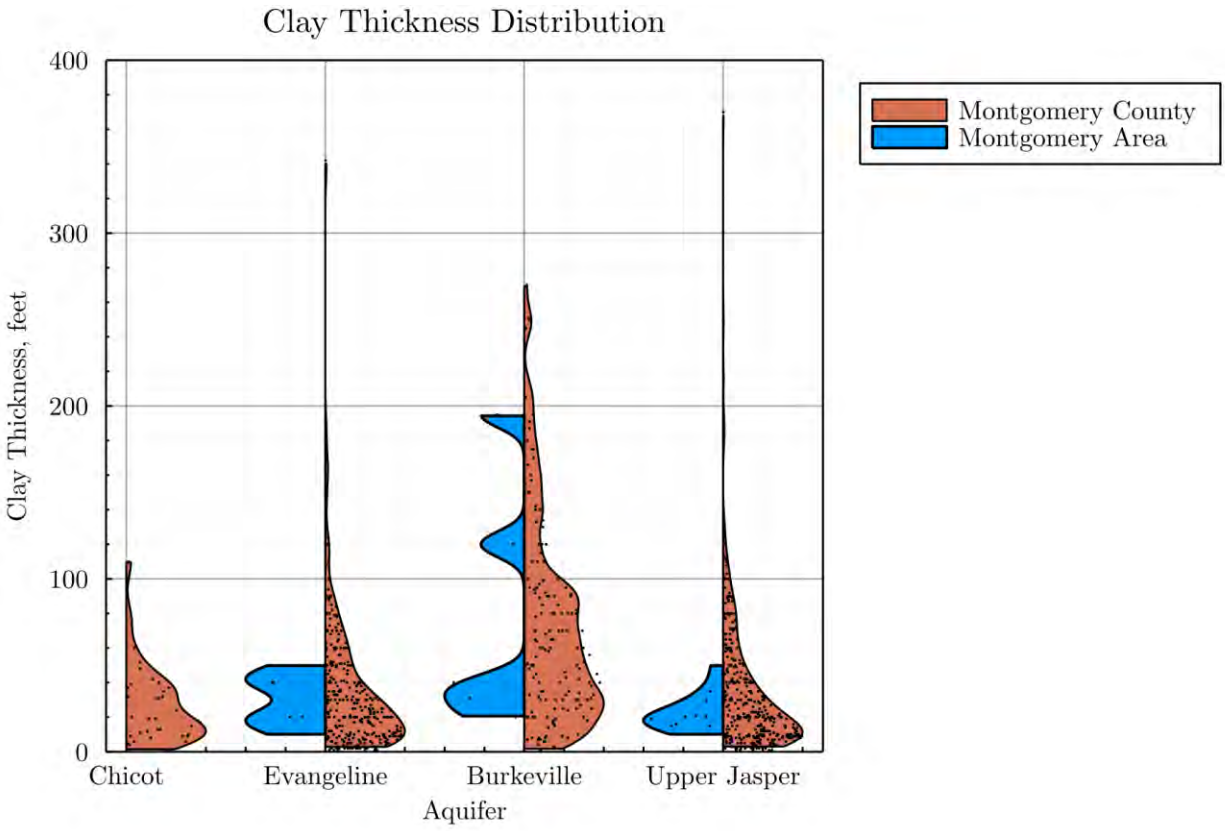

Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Lone Star GCD Office

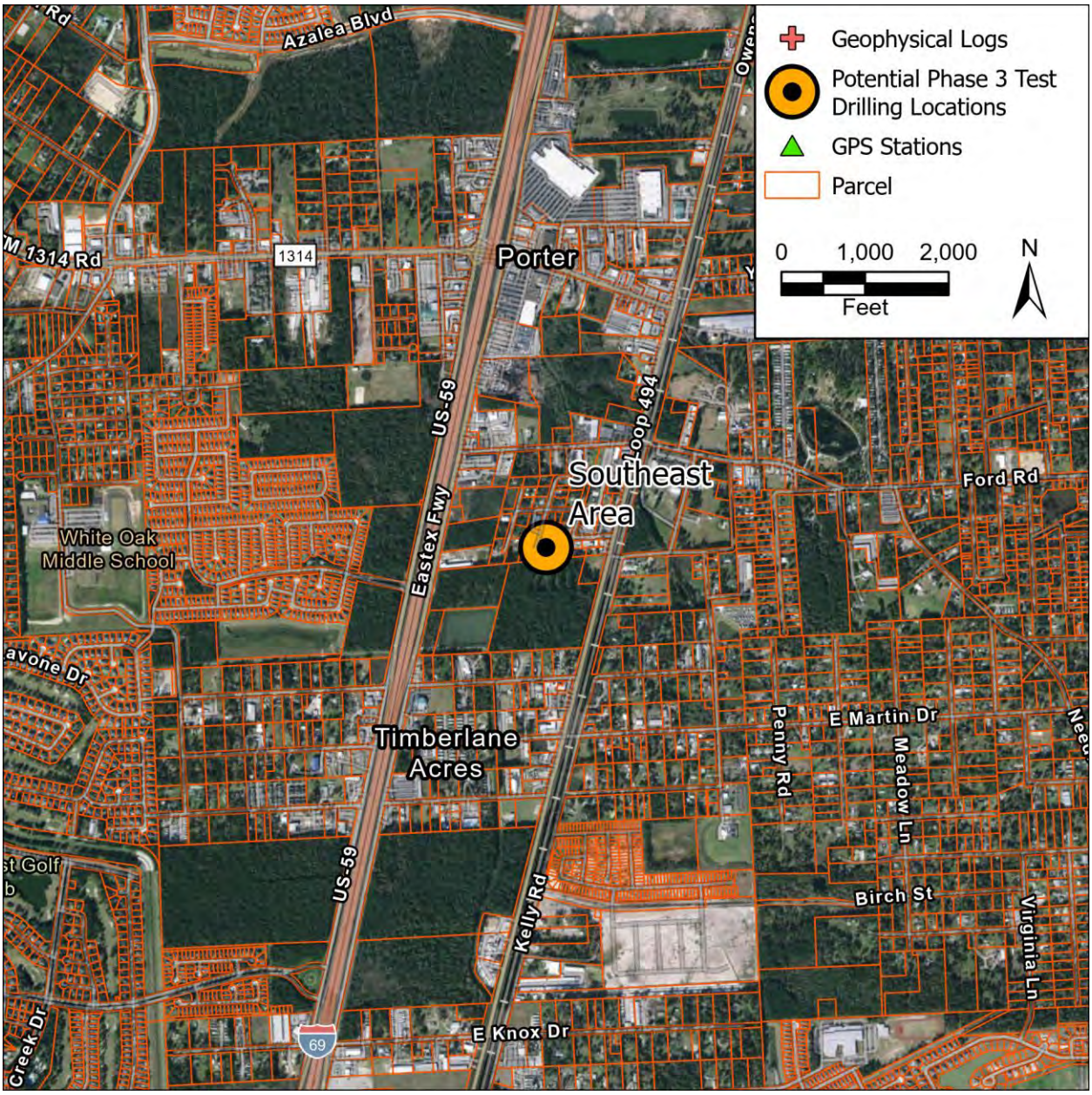


- Site Info:
  - Property ID: 283366
  - Owner: City of Magnolia
- Southwest corner of the District
- Near areas of projected growth or increase in GW demand
- Relatively sparse geophysical data

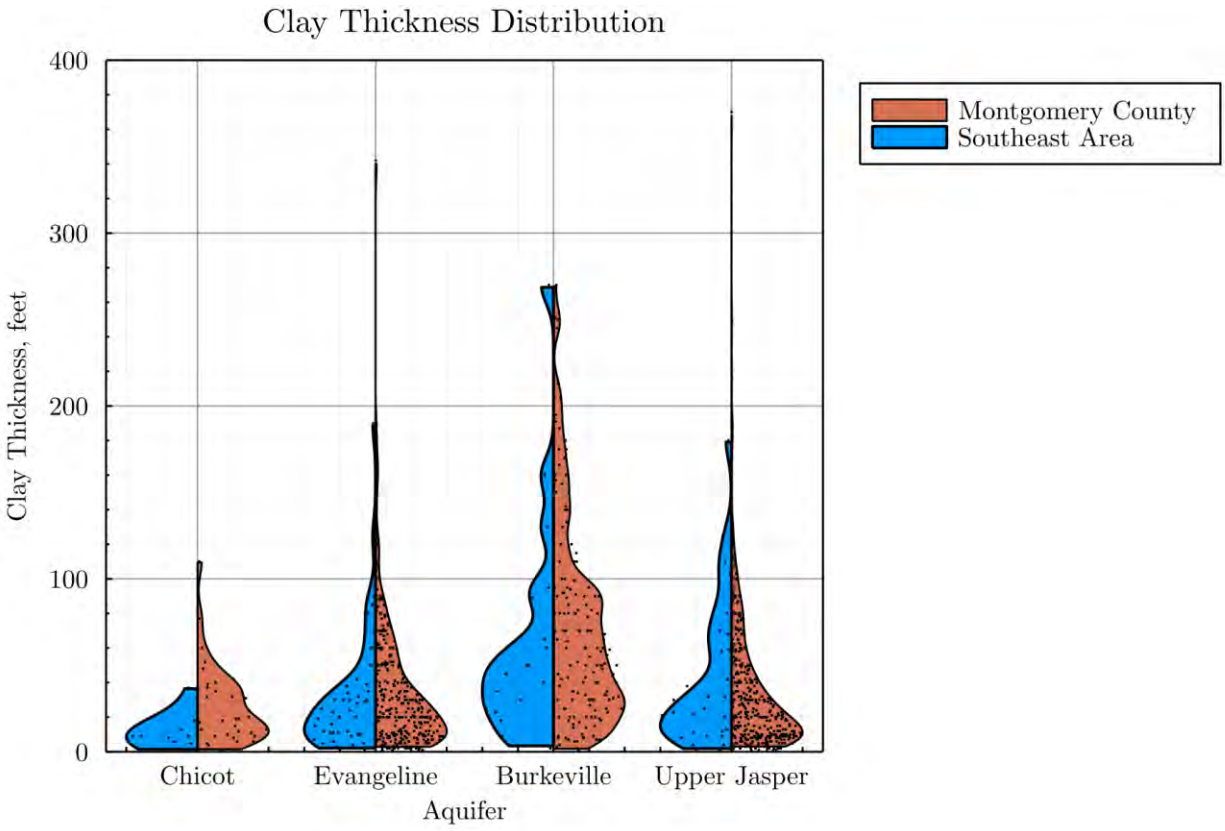

Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Magnolia Area

- Site Info:
  - Property ID: 124049
  - Owner: City of Montgomery
- Relatively sparse geophysical data
- Northwest area monitoring
- Possible growth area
- Shallowest Jasper of the six possible locations

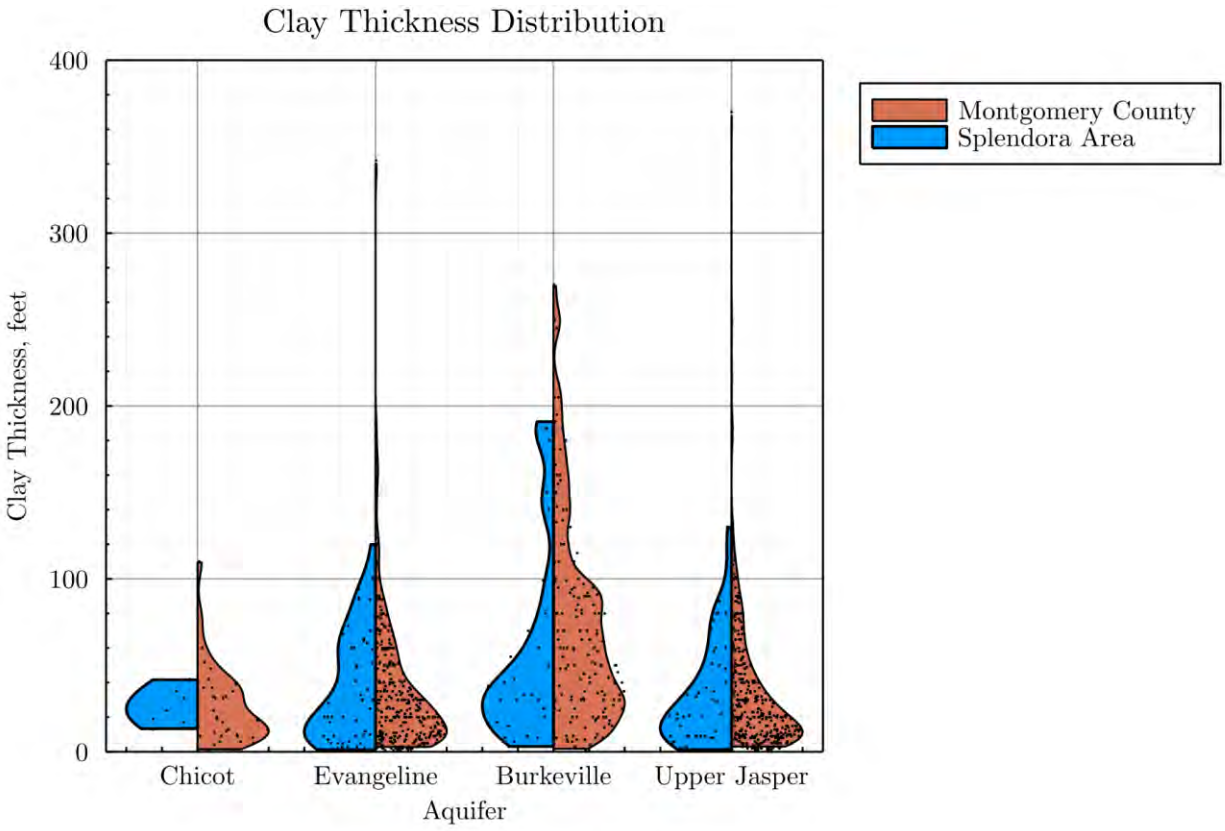

Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Montgomery Area



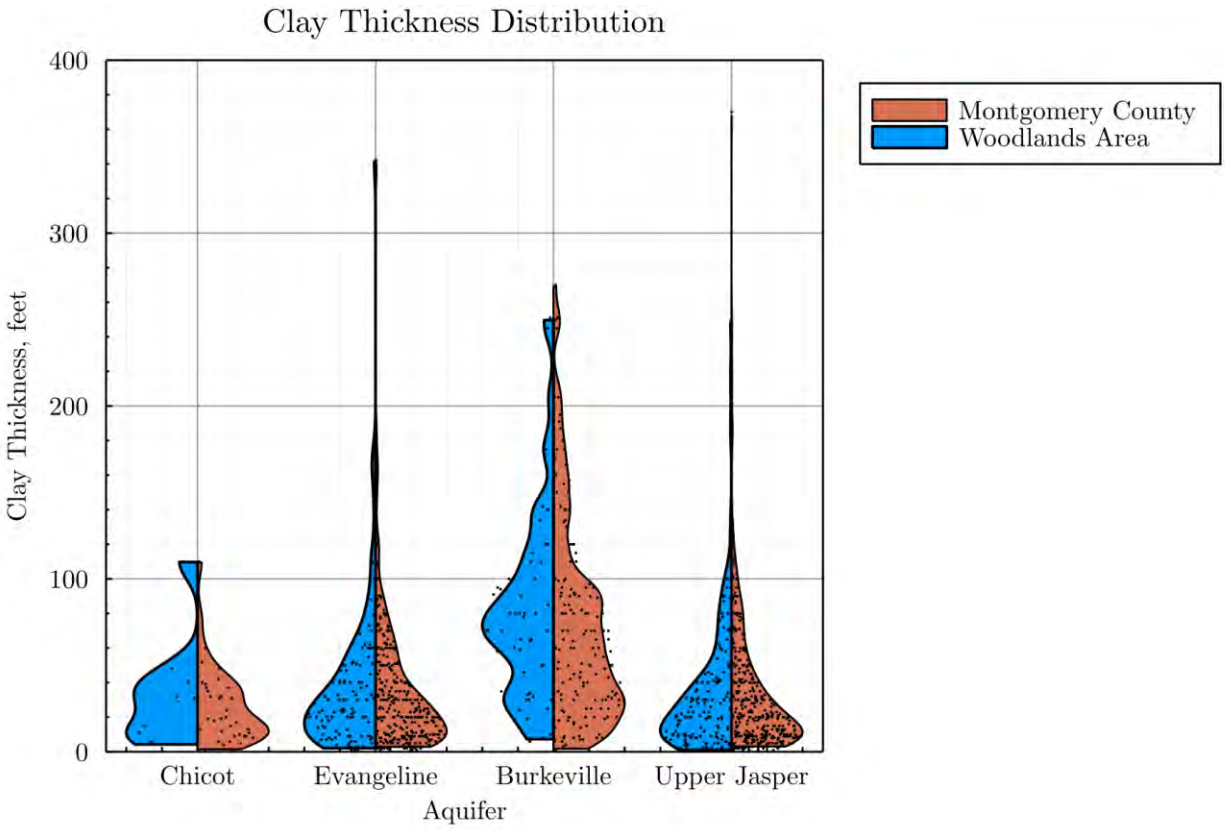
- Site Info:
  - Property ID: 49361
  - Owner: Porter Special Utility District
- Identified water level declines in special project
- Near growth areas
- Relatively close to the Lake Houston Site
- Deepest Jasper of the six possible locations


Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Southeast Area

- Site Info:
  - Property ID: 152063
  - Owner: Southern Oaks Water System, Inc.
- Possible area of future growth
- Sporadic historical water level data, but generally slower declines than central and southern MoCo
- Near log Mo-4; New site won't add much more info regarding structure


Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Splendora Area

- Site Info:
  - Property ID: 210035
  - Owner: San Jac River Authority
  - Same property as PA13
- Area of high interest
- Along growth corridor
- Near SJRA well field


Clay Thickness Distribution
Clay Thickness, feet
400
300
200
100
0
Chicot
Evangeline
Burkeville
Upper Jasper
Aquifer
Montgomery County
Woodlands Area