City of Waco Landfill
McLennan and Limestone Counties
TCEQ Permit No. MSW-2400
Parts III and IV, Volume 2 of 4

Administratively Complete

Prepared for

City of Waco

501 Schroeder Drive
Waco, Texas 76710

Prepared by:

SCS ENGINEERS

SCS Project No. 16216088.00 | Revision 0 – May 2020 and June 2020

1901 Central Drive, Suite 550
Bedford, Texas 76021
817.571.2288

City of Waco Landfill
McLennan and Limestone Counties
TCEQ Permit No. MSW -2400

MSW Landfill Permit Application, Parts III and IV
Table of Contents

SCS Engineers
TBPE Reg. # F-3407

TCEQ Core Data Form

TCEQ Use Only

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (If other is checked please describe in space provided.)

☐ New Permit, Registration or Authorization (Core Data Form should be submitted with the program application.)

☐ Renewal (Core Data Form should be submitted with the renewal form) ☒ Other Update to Sections II and III Information

2. Customer Reference Number (if issued)	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number (if issued)
CN 600131940		RN 110471307

SECTION II: Customer Information

4. General Customer Information | 5. Effective Date for Customer Information Updates (mm/dd/yyyy)

☐ New Customer ☒ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name (If an individual, print last name first: e.g.: Doe, John) | If new Customer, enter previous Customer below:

7. TX SOS/CPA Filing Number	8. TX State Tax ID (11 digits)	9. Federal Tax ID (9 digits)	10. DUNS Number (if applicable)

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☐ Limited

Government: ☒ City ☐ County ☐ Federal ☐ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees
☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated?
☐ Yes ☐ No

14. Customer Role (Proposed or Actual) - as it relates to the Regulated Entity listed on this form. Please check one of the following:

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other:

15. Mailing Address:

City | State | ZIP | ZIP + 4

16. Country Mailing Information (if outside USA)

17. E-Mail Address (if applicable)
charlesd@wacotx.gov

18. Telephone Number	19. Extension or Code	20. Fax Number (if applicable)
( ) -		( ) -

SECTION III: Regulated Entity Information

21. General Regulated Entity Information (If `New Regulated Entity" is selected below this form should be accompanied by a permit application)

☐ New Regulated Entity ☒ Update to Regulated Entity Name ☐ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name (Enter name of the site where the regulated action is taking place.)

23. Street Address of the Regulated Entity: (No PO Boxes)							
	City		State		ZIP		ZIP + 4
24. County							

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:		
26. Nearest City	State	Nearest ZIP Code

27. Latitude (N) In Decimal:			28. Longitude (W) In Decimal:		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

29. Primary SIC Code (4 digits)	30. Secondary SIC Code (4 digits)	31. Primary NAICS Code (5 or 6 digits)	32. Secondary NAICS Code (5 or 6 digits)
33. What is the Primary Business of this entity? (Do not repeat the SIC or NAICS description.)			

34. Mailing Address:	301 Schroeder Drive						
	City	Waco	State	TX	ZIP	76710	ZIP + 4
35. E-Mail Address:	charlesd@wacotx.gov						

36. Telephone Number	37. Extension or Code	38. Fax Number (if applicable)
( ) -		( ) -

39. **TCEQ Programs and ID Numbers** Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☒ Districts	☐ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☒ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
To Be Assigned				
☐ Sludge	☒ Storm Water	☒ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name: Ryan R. Kuntz, P.E.			41. Title: Vice President
42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address
(817) 358 - 6117		(817) 571 - 2188	RKuntz@scsengineers.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	City of Waco	Job Title:	City Manager
Name(*In Print*):	Wiley Stem III	Phone:	(254) 750 - 5645
Signature:	Wiley Stem	Date:	05/21/20

Facility Name: City of Waco Landfill
Permittee/Registrant Name: City of Waco
MSW Authorization #:2400
Initial Submittal Date: 8/7/2018
Revision Date: 6/15/2020

TCEQ

Texas Commission on Environmental Quality

Part I Form for New Permit/Registration and Amendment Applications for an MSW Facility

1. Reason for Submittal

☐ Initial Submittal ☒ Notice of Deficiency (NOD) Response

2. Authorization Type

☒ Permit ☐ Registration

3. Application Type

☒ New ☐ Major Amendment
☐ Major Amendment (Limited Scope)

4. Application Fees

☐ Pay by Check ☒ Online Payment

If paid online, e-Pay Confirmation Number: **582EA000311862**

5. Application URL

Is the application submitted for Type I Arid Exempt (AE) and/or Type IV AE facility?

☐ Yes ☒ No

If the answer is "No", provide the URL address of a publicly accessible internet web site where the application and all revisions to that application will be posted.
http://**http://www.waco-texas.com/landfill-application-process.asp**

6. Application Publishing

Party Responsible for Publishing Notice:

☐ Applicant ☐ Agent in Service ☒ Consultant

Contact Name: **Ryan R. Kuntz, P.E.** Title: **Vice President /Project Director**

7. Alternative Language Notice

Is an alternative language notice required for this application? (For determination refer to Alternative Language Checklist on the Public Notice Verification Form TCEQ-20244-Waste)

☐ Yes ☒ No

8. Public Place Location of Application

Name of the Public Place: **Waco-McLennan County Central Library**

Physical Address: **1717 Austin Avenue**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76701**

(Area code) Telephone Number: **254.750.5941**

9. Consolidated Permit Processing

Is this submittal part of a consolidated permit processing request, in accordance with 30 TAC Chapter 33?

☐ Yes ☒ No ☐ Not Applicable

If "Yes", state the other TCEQ program authorizations requested:

10. Confidential Documents

Does the application contain confidential documents?

☐ Yes ☒ No

If "Yes", cross-reference the confidential documents throughout the application and submit as a separate attachment in a binder clearly marked "CONFIDENTIAL."

11. Permits and Construction Approvals

Permit or Approval	Received	Pending	Not Applicable
Hazardous Waste Management Program under the Texas Solid Waste Disposal Act	☐	☐	☒
Underground Injection Control Program under the Texas Injection Well Act	☐	☐	☒
National Pollutant Discharge Elimination System Program under the Clean Water Act and Waste Discharge Program under Texas Water Code, Chapter 26	☐	☒	☐
Prevention of Significant Deterioration Program under the Federal Clean Air Act (FCAA). Nonattainment Program under the FCAA	☐	☐	☒
National Emission Standards for Hazardous Air Pollutants Preconstruction Approval under the FCAA	☐	☐	☒
Ocean Dumping Permits under the Marine Protection Research and Sanctuaries Act	☐	☐	☒

Permit or Approval	Received	Pending	Not Applicable
Dredge or Fill Permits under the CWA	☐	☐	☒
Licenses under the Texas Radiation Control Act	☐	☐	☒
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐

12. General Facility Information

Facility Name: **City of Waco Landfill**

Contact Name: **Charles Dowdell** Title: **Director of Solid Waste**

MSW Authorization No. (if available): **2400**

Regulated Entity Reference No. (if issued)*: RN**110471307**

Physical or Street Address (if available): **4730 T K Parkway**

City: **Axtell** County: **McLennan & Limestone** State: **TX** Zip Code: **76624**

(Area Code) Telephone Number: **(254) 750-1601**

Latitude (Degrees, Minutes Seconds): **N 31° 42' 05.31"**

Longitude (Degrees, Minutes Seconds): **W 96° 55' 52.07"**

Benchmark Elevation (above mean sea level): ft.

Provide a description of the location of the facility with respect to known or easily identifiable landmarks: **approximately 0.4 mile south of the intersection of TK Parkway and State Highway 31 in McLennan County**

Detail access routes from the nearest United States or state highway to the facility: **approximately 0.4 mile south of the intersection of TK Parkway and State Highway 31 in McLennan County**

*If this number has not been issued for the facility, complete a TCEQ Core Data Form (TCEQ-10400) and submit it with this application. List the Facility as the Regulated Entity.

13. Facility Type(s)

☒ Type I ☐ Type IV ☐ Type V

☐ Type I AE ☐ Type IV AE ☐ Type VI

14. Activities Conducted at the Facility

☐ Storage ☐ Processing ☒ Disposal

15. Facility Waste Management Unit(s)

- ☒ Landfill Unit(s)
- ☐ Class 1 Landfill Unit(s)
- ☐ Process Tank(s)
- ☐ Storage Tank(s)
- ☐ Tipping Floor
- ☐ Storage Area
- ☐ Container(s)
- ☐ Roll-off Boxes
- ☐ Surface Impoundment
- ☐ Incinerator(s)
- ☐ Autoclave(s)
- ☐ Refrigeration Unit(s)
- ☐ Mobile Processing Unit(s)
- ☐ Type VI Demonstration Unit
- ☐ Compost Pile(s) and/or Vessel(s)
- ☐ Other (Specify)
- ☐ Other (Specify)
- ☐ Other (Specify)

16. Description of Proposed Facility or Changes to Existing Facility

Provide a brief description of the proposed activities if application is for a new facility, or the proposed changes to an existing facility or permit conditions if the application is for an amendment.

Proposed Type I Municipal Solid Waste Landfill located on 502.5 acres of land in McLennan and Limestone Counties, designed in accordance with Title 30, Texas Administrative Code, Chapter 330. The primary purpose of this landfill is to serve as a replacement for the current City of Waco landfill (MSW Permit No. 948A). The landfill will provide disposal capacity for residences, businesses, and industries primarily in the communities of McLennan and Limestone Counties and other nearby counties. The landfill will provide disposal of household waste, yard waste, commercial waste, Class 2/3 non-hazardous industrial wastes, C/D waste, and special wastes authroized by TCEQ. Includes submittal of Parts III and IV of the permit application.

17. Facility Contact Information

Site Operator (Permittee/Registrant) Name: City of Waco

Customer Reference No. (if issued)*: CN**600131940**

Contact Name: **Charles Dowdell** Title: **Director of Solid Waste**

Mailing Address: **501 Schroeder Drive**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76710**

(Area Code) Telephone Number: **(254) 750-1601**

Email Address: **charlesd@wacotx.gov**

TX Secretary of State (SOS) Filing Number:

*If the Site Operator (Permittee/Registrant) does not have this number, complete a TCEQ Core Data Form (TCEQ-10400) and submit it with this application. List the Site Operator (Permittee/Registrant) as the Customer.

Operator Name[1]: same as Permittee

Customer Reference No. (if issued)*:

Contact Name: Title:

Mailing Address:

City: County: State: Zip Code:

(Area Code) Telephone Number:

Email Address:

TX SOS Filing Number:

[1]If the Operator is the same as Site Operator/Permittee type "Same as "Site Operator (Permittee/Registrant)".
*If the Operator does not have this number, complete a TCEQ Core Data Form (TCEQ-10400) and submit it with this application. List the Operator as the customer.

Consultant Name (if applicable): SCS Engineers, TBPE Registration No. F-3407

Texas Board of Professional Engineers Firm Registration Number:

Contact Name: **Ryan R. Kuntz, P.E.** Title: **Vice Pres., Pr. Director**

Mailing Address: **1901 Central Drive, Suite 550**

City: **Bedford** County: **Tarrant** State: **TX** Zip Code: **76021**

(Area Code) Telephone Number: **817.358.6117**

E-Mail Address: **rkuntz@scsengineers.com**

Agent in Service Name (required only for out-of-state):

Mailing Address:

City: County: State: Zip Code:

(Area Code) Telephone Number:

E-Mail Address:

18. Facility Supervisor's License

Select the Type of License that the Solid Waste Facility Supervisor, as defined in 30 TAC Chapter 30, Occupational Licenses and Registrations, will obtain prior to commencing facility operations.

☒ Class A ☐ Class B

19. Ownership Status of the Facility

☐ Corporation	☐ Limited Partnership	☐ Federal Government
☐ Individual	☒ City Government	☐ Other Government
☐ Sole Proprietorship	☐ County Government	☐ Military
☐ General Partnership	☐ State Government	☐ Other (Specify):

Does the Site Operator (Permittee/Registrant) own all the facility units and all the facility property?

☒ Yes ☐ No

If "No", provide the information requested below for any additional ownership.

Owner Name:

Street or P.O. Box:

City: County: State: Zip Code:

(Area Code) Telephone Number:

Email Address (optional):

20. Other Governmental Entities Information

Texas Department of Transportation District: Waco

District Engineer's Name: **Stanley Swiatek, P.E.**

Street Address or P.O. Box: **100 S. Loop Drive**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76704-2858**

(Area Code) Telephone Number: **(254) 867-2700**

E-Mail Address (optional):

The Local Governmental Authority Responsible for Road Maintenance (if applicable): N.A.

Contact Person's Name:

Street Address or P.O. Box:

City: County: State: Zip Code:

(Area Code) Telephone Number:

E-Mail Address (optional):

City Mayor Information

City Mayor's Name: **Kyle Deaver**

Office Address: **300 Austin Ave**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76702**

(Area Code) Telephone Number: **(254) 750-5750**

E-Mail Address (optional): **kyle.deaver@wcotx.gov**

City Health Authority: Waco-McLennan County Public Health District

Contact Person's Name: **Dr. Brenda Gray, Director**

Street Address or P.O. Box: **225 W. Waco Drive**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76707**

(Area Code) Telephone Number: **(254) 750-5450**

E-Mail Address (optional):

County Judge Information

County Judge's Name: **Scott M. Felton**

Street Address or P.O. Box: **501 Washington Ave, Room 214**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76701**

(Area Code) Telephone Number: **(254) 757-5049**

E-Mail Address (optional):

County Health Authority: Waco-McLennan County Public Health District

Contact Person's Name: **E. Farley Verner, M.D.**

Street Address or P.O. Box: **7030 New Sanger Road, Suite 202**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76712**

(Area Code) Telephone Number: **(254) 855-9790**

E-Mail Address (optional): **farleyverner@gmail.com**

State Representative Information

District Number: **12**

State Representative's Name: **Kyle Kacal**

District Office Address: **3000 Briarcrest Dr., Ste 203**

City: **Bryan** County: **Brazos** State: **TX** Zip Code: **77802**

(Area Code) Telephone Number: **979-774-7276**

E-Mail Address (optional):

State Senator Information

District Number: **22**

State Senator's Name: **The Honorable Brian Birdwell**

District Office Address: **900 Austin Ave, Suite 500**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76701**

(Area Code) Telephone Number: **(254) 772-6225**

E-Mail Address (optional):

Council of Government (COG) Name: Heart of Texas

COG Representative's Name: **Falen Bohannon**

COG Representative's Title: **Solid Waste Program Manager**

Street Address or P.O. Box: **1514 S. New Road**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76711**

(Area Code) Telephone Number: **(254)292-1800**

E-Mail Address (optional): **Falen.Bohannon@hot.cog.tx.us**

County Judge Information

County Judge's Name: **Limestone County Judge: Honorable Richard Duncan**

Street Address or P.O. Box: **200 W. State ST., Ste 101**

City: **Groesbeck** County: **Limestone** State: **TX** Zip Code: **76642**

(Area Code) Telephone Number: **254-729-3810**

E-Mail Address (optional):

County Health Authority: Limestone Medical Center

Contact Person's Name: **Dr. Jeffrey Rettig**

Street Address or P.O. Box: **204 W. Trinity Street**

City: **Groesbeck** County: **Limestone** State: **TX** Zip Code: **76642**

(Area Code) Telephone Number: **254-729-3740**

E-Mail Address (optional):

State Representative Information

District Number: **12**

State Representative's Name: **Kyle Kacal**

District Office Address: **3000 Briarcrest Dr., Ste 203**

City: **Bryan** County: **Brazos** State: **TX** Zip Code: **77802**

(Area Code) Telephone Number: **979-774-7276**

E-Mail Address (optional):

State Senator Information

District Number: **5**

State Senator's Name: **Charles Schwertner**

District Office Address: **3000 Briarcrest Drive, Suite 202**

City: **Bryan** County: **Brazos** State: **TX** Zip Code: **77802**

(Area Code) Telephone Number: **979-776-0222**

E-Mail Address (optional):

Council of Government (COG) Name: Heart of Texas

COG Representative's Name: **Falen Bohannon**

COG Representative's Title: **Solid Waste Program Manager**

Street Address or P.O. Box: **1514 S. New Road**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76711**

(Area Code) Telephone Number: **(254)292-1800**

E-Mail Address (optional): **Falen.Bohannon@hot.cog.tx.us**

River Basin Authority Name: Brazos River Authority

Contact Person's Name: **Phil Ford**

Watershed Sub-Basin Name:

Street Address or P.O. Box: **4600 Cobbs Drive**

City: **Waco** County: **McLennan** State: **TX** Zip Code: **76710**

(Area Code) Telephone Number: **(888) 922-6272**

E-Mail Address (optional):

Coastal Management Program

Is the facility within the Coastal Management Program boundary?

☐ Yes ☒ No

U.S. Army Corps of Engineers

The facility is located in the following District of the U.S. Army Corps of Engineers:

☐ Albuquerque, NM ☐ Galveston, TX

☒ Ft. Worth, TX ☐ Tulsa, OK

Local Government Jurisdiction

Within City Limits of:

Within Extraterritorial Jurisdiction of:

Is the facility located in an area in which the governing body of the municipality or county has prohibited the storage, processing or disposal of municipal or industrial solid waste?

☐ Yes ☒ No

(If "Yes", provide a copy of the ordinance or order as an attachment):

Signature Page

I, Wiley Stem III, City Manager,
(Site Operator (Permittee/Registrant)'s Authorized Signatory) (Title)

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: ______________ Date: 6-16-20

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, ____________________, hereby designate ____________________
(Print or Type Operator Name) (Print or Type Representative Name)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

____
Printed or Typed Name of Operator or Principal Executive Officer

____
Signature

SUBSCRIBED AND SWORN to before me by the said Wiley Stem III

On this 16th day of June, 2020

My commission expires on the 31st day of March, 2022

____
Notary Public in and for

McLennan County, Texas

(Note: Application Must Bear Signature & Seal of Notary Public)

NOTARY PUBLIC STATE OF TEXAS
NITA H MAYS
Notary Public, State of Texas
Comm. Expires 03-31-2022
Notary ID 1117522-0

Part I Attachments

(See Instructions for P.E. seal requirements.)

Required Attachments	Attachment No.
Supplementary Technical Report	X
Property Legal Description	X
Property Metes and Bounds Description	X
Facility Legal Description	X
Facility Metes and Bounds Description	X
Metes and Bounds Drawings	X
On-Site Easements Drawing	X
Land Ownership Map	X
Land Ownership List	X
Electronic List or Mailing Labels	X
Texas Department of Transportation (TxDOT) County Map	X
General Location Map	X
General Topographic Map	X
Verification of Legal Status	X
Property Owner Affidavit	X
Evidence of Competency	X
Additional Attachments as Applicable- Select all those apply and add as necessary	
☒ TCEQ Core Data Form(s)	X
☒ Signatory Authority Delegation	X
☒ Fee Payment Receipt	X
☐ Confidential Documents	
☐ Waste Storage, Processing and Disposal Ordinances	
☐ Final Plat Record of Property	
☐ Certificate of Fact (Certificate of Incorporation)	
☐ Assumed Name Certificate	

CHECKLIST FOR MSW PERMITS, REGISTRATIONS, AND AMENDMENTS

(PARTS III/IV ONLY)

Administrative and Technical Review Checklist for Municpipal Solid Waste (MSW) Permits, Registrations and Amendments

This checklist is designed to provide guidance for the Municipal Solid Waste (MSW) rules found in Title 30 Texas Administrative Code (30 TAC) Chapter 330, for Type I, IV and V registration, permit, and permit amendment applications. Areas of the checklist that are shaded in gray are for information purposes only.

Please fill out application information before selecting and filling out a checklist.

Applicant Information

First name:	Charles	Last name	Dowdell
Applicant Title:	Director of Solid Waste	Prefix:	
Company:	City of Waco		
Street Address:	501 Schroeder Drive		
City:	Waco	State:	Texas
Zipcode:	76701		

Consultant Information

First name:	Ryan	Last name:	Kuntz
Consultant Title:	Vice President	Prefix:	
Consultant Firm:	SCS Engineers		
Consultant Address:	1901 Central Drive, Suite 550		
City:	Bedford	State:	Texas
Zipcode:	76021		

Application Information

Facility Name:	City of Waco Landfill		
Application Date	May 13 2020		
CN:	600131940	MSW ID:	2400
RN:	110471307	Authorization Type:	Permit
County:	McLennan	Application Type:	New Permit

Disclaimer: This checklist is intended for use as a reference in the application process and will not be considered a substitute for required application materials. Rules referenced have been paraphrased or reworded to facilitate this process. Any conflict or questions regarding rule interpretation should be directed to TCEQ for determination, and disputes will be resolved in favor of the exact language of rules, statutes or federal requirements. Should any dispute occur in an administrative proceeding, the applicant will bear the burden of proof of compliance with any and all applicable TCEQ and federal statutes, rules, or policies and procedures. This checklist is subject to discovery in administrative and civil legal proceedings and should not be considered confidential from the public.

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
266	Part III	Describe facility access control features	Required	330.63(b)(1)	Yes	Drawings 1.1 and 1.5		General Facility Design
267	Part III	Submit a process design for the facility [that includes items 330.63(b)(2)(A) through 330.63(b)(2)(I)]	Required	330.63(b)(2)	Yes	Drawings 1.1 and 1.5		General Facility Design
268	Part III	Submit a flow diagram(s) to describe the storage, processing, and disposal sequences for each type of waste and/or feedstock/recyclable	Required	330.63(b)(2)(A)	No		Not Applicable	General Facility Design
269	Part III	Submit a schematic view drawing(s) showing phases for collection, separation and processing/disposal of each type of waste and/or feedstock/recyclable material	Required	330.63(b)(2)(B)	Yes	Drawing 1.2		General Facility Design
270	Part III	Provide ventilation & odor control measures for each unit	Required	330.63(b)(2)(C)	No		Not Applicable	General Facility Design
271	Part III	Provide construction details of storage, processing units & components, dimensions, capacity, materials used, etc.	Required	330.63(b)(2)(D)	No		Not Applicable	General Facility Design
272	Part III	Provide performance data for all storage and processing units and ancillary equipment	Required	330.63(b)(2)(D)	No		Not Applicable	General Facility Design
281	Part III	Provide adequate floor drains and/or sumps	Required	330.63(b)(3)(D)	No		Not Applicable	General Facility Design
282	Part III	Describe proper disposal of liquids resulting from waste processing, cleaning, and washing and provide for the treatment of waste water	Required	330.63(b)(4)	No		Not Applicable	General Facility Design
283	Part III	Describe how facility will be designed to protect endangered species	Required	330.63(b)(5)	Yes	Part I/II, Section 12, Paragraph 2, and see coordination letters to TPWD and USFWS in Appendix I/IIA.		General Facility Design
284	Part III	Acknowledge that the facility design complies with the requirements of 30 TAC 330.303(a) - (b)	Acknowledgement	330.63(c)	Yes	Attachment 6A, Section 1		Surface Water Drainage Report
285	Part III	Submit a surface water and drainage report that is in accordance with 30 TAC, Chapter 330, Subchapter G	Required	330.63(c)	Yes	Attachment 6A		Surface Water Drainage Report
286	Part III	Demonstrate that existing or permitted drainage patterns will not be adversely altered	Required	330.305(a)	Yes	Attachment 6A, Section 5.4		Surface Water Drainage Report
287	Part III	Provide a design of the run-on control system to prevent 25 yr. storm run-on to active face	Required	330.305(b)	Yes	Attachment 12, Section 2.3, Paragraph 1; Appendix 12C and Drawing 12C.1		Surface Water Drainage Report
288	Part III	Provide a design for run-off management system to, at a minimum, collect & control run-off at the active face from a 24 hr. 25 yr. storm event	Required	330.305(c)	Yes	Attachment 12, Section 4 and Drawing 6A.2		Surface Water Drainage Report
289	Part III	Provide erosion control of top dome & external embankment side slope surfaces during life and post-closure care of facility	Required	330.305(d)	Yes	Attachment 6A, Section 6		Surface Water Drainage Report
290	Part III	Demonstrate estimated peak velocities for top surfaces and external embankment slopes to be less than the permissible non-erodible velocities under similar conditions	Required	330.305(d)(1)	Yes	Attachment 6A, Section 6.4 and 6.5, Appendix 6A.E		Surface Water Drainage Report
291	Part III	Provide a design for top surfaces and external embankment slopes to minimize erosion and not exceed the permissible soil loss	Required	330.305(d)(2)	Yes	Drawings 6A.3, 6A-E1, 6A-E2, 6A-E3, 6A-E4, and 6A-E5		Surface Water Drainage Report

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
292	Part III	Provide a design for drainage features, sizing and grading to prevent erosion, long term, low maintenance geotechnical stability to the final cover	Required	330.305(e)	Yes	Attachment 6A, Section 2.2.2, and Drawings 6A-12 and 6A-13		Surface Water Drainage Report
293	Part III	Describe maintenance and repair procedures of the collection, drainage, and/or storage units	Required	330.305(e)(1)	Yes	Attachment 6A, Section 6.7		Surface Water Drainage Report
294	Part III	Provide interim erosion controls for phased development	Required	330.305(e)(2)	Yes	Attachment 6A, Section 6.1		Surface Water Drainage Report
295	Part III	Provide drainage calculations using Rational Method for areas 200 acres or less	Required	330.305(f)(1)	Yes	Attachment 6A, Section 2.2.2.1, Appendix 6A-E		Surface Water Drainage Report
296	Part III	Provide drainage calculations using w/ HEC Modeling Systems or equivalent for areas > 200 acres	Required	330.305(f)(2)	Yes	Attachment 6A, Section 2.1, Appendix 6A-A		Surface Water Drainage Report
297	Part III	Acknowledge that handling, storage, treatment, & disposal of contaminated surface or groundwater should be per 330.207	Acknowledgement	330.305(g)	Yes	Attachment 6A, Section 6.2.3, last bullet; Attachment 15, Sections 4 & 5		Surface Water Drainage Report
298	Part III	Provide designs for contaminated water storage units	Required	330.305(g)	Yes	Attachment 6A, Section 6.2.3, last bullet; Attachment 12, Sections 4		Surface Water Drainage Report
299	Part III	Provide drainage area drawing(s) & calculations	Required	330.63(c)(1)(A)	Yes	Drawings 6A.1A, 6A.1B, and 6A.2		Surface Water Drainage Report
300	Part III	Submit drainage area designs to include cross-sections for drainage facilities within the facility area	Required	330.63(c)(1)(B)	Yes	Drawings 6A.3, 6A.4, 6A.5, 6A.6, 6A.7, and 6A.8		Surface Water Drainage Report
301	Part III	Submit drainage area designs to include ditch grades	Required	330.63(c)(1)(B)	Yes	Drawings 6A.4, 6A.5, 6A.6, 6A.7, and 6A.8		Surface Water Drainage Report
302	Part III	Submit drainage area designs to include water flow rates, elevations, velocities, and flow line elevations	Required	330.63(c)(1)(B)	Yes	Appendix 6A-E		Surface Water Drainage Report
303	Part III	Submit calculations verifying drainage patterns will not be adversely altered	Required	330.63(c)(1)(C)	Yes	Attachment 6A, Section 5.4, and Appendix 6A-D		Surface Water Drainage Report
304	Part III	Submit and identify hydrologic method & calculations used to estimate peak flow rates and run-off volumes	Required	330.63(c)(1)(D)	Yes	Attachment 6A, Section 2.1		Surface Water Drainage Report
305	Part III	Submit and identify the 25-year rainfall intensity used for facility design including the source of the data	Required	330.63(c)(1)(D)(i)	Yes	Attachment 6A, Section 2.1.1.3, Appendix 6A-A		Surface Water Drainage Report
306	Part III	Submit and identify the 25-year rainfall intensity used for facility design including all other data used in conjunction with the selected hydrologic method. Their sources should be documented and described	Required	330.63(c)(1)(D)(i)	Yes	Appendix 6A-A		Surface Water Drainage Report
307	Part III	Submit and identify hydraulic calculations and designs for sizing the necessary collection, drainage, and/or detention facilities	Required	330.63(c)(1)(D)(ii)	Yes	Appendix 6A-A (basins) Appendix 6A-E (swales, downchutes,channels)		Surface Water Drainage Report
308	Part III	Submit a discussion and analyses to demonstrate that existing drainage patterns will not be adversely altered as a result of the proposed landfill development	Required	330.63(c)(1)(D)(iii)	Yes	Attachment 6A, Section 5, Appendix 6A-D		Surface Water Drainage Report
309	Part III	Submit structural designs of the collection, drainage, and/or storage facilities	Required	330.63(c)(1)(D)(iv)	Yes	Attachment 6A, Section 6.2.2 & 6.2.3, Drawings 6A.9, 6A.10, 6A.11, 6A.12, 6A.13, 6A.14		Surface Water Drainage Report

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
310	Part III	Provide the location for the facility to identify whether the site is located within a 100-year floodplain. Indicate the 100-year floodplain on the drawing listed in paragraph 330.63(c)(1)(A) of this subsection	Required	330.63(c)(2)(A)	Yes	Attachment 6B and Drawing 6B.1		Surface Water Drainage Report
311	Part III	Provide the source of all data for flood plain determination. The boundaries of the proposed landfill facility should be shown on the floodplain map	Required	330.63(c)(2)(B)	Yes	Attachment 6B, Section 2		Surface Water Drainage Report
312	Part III	Provide (if the site is located within the 100-year floodplain) information detailing the specific flooding levels. If the Preliminary Plan approval is not required under Chapter 301 of this title and Section 16.236 of Texas Water Code you may indicate that the checklist items relevant to Chapter 301 are not applicable.	Required	330.63(c)(2)(C)	No		Not Applicable	Surface Water Drainage Report
313	Part III	The facility shall be protected from flooding by suitable levees constructed to provide protection from a 100-year frequency flood and in accordance with the rules of the commission relating to levee improvement districts and approval of plans for reclamation projects or the rules of the county or city having jurisdiction under Texas Water Code, §16.236, as implemented by Chapter 301, Subchapter C of this title (relating to Approval of Levees and Other Improvements)	Informational	330.307(a)				Surface Water Drainage Report
314	Part III	Provide maps, plats, drawings, computations and narratives of landfill levees; the applicant should submit a detailed map	Required if Requested	301.33(a)(1)	No		Not Applicable	Surface Water Drainage Report
315	Part III	Provide the name and course of the river, stream, or other watercourse, which is associated with or would be affected by the proposed project	Required if Requested	301.33(a)(2)	No		Not Applicable	Surface Water Drainage Report
316	Part III	Provide the location & ownership of existing levees, channels, dams, etc. that may be affected	Required if Requested	301.33(a)(3)	No		Not Applicable	Surface Water Drainage Report
317	Part III	Provide the location and ownership, including current mailing address of owners, and location, shown by map, of all properties lying within any proposed protected area	Required if Requested	301.33(a)(4)(A)	No		Not Applicable	Surface Water Drainage Report
318	Part III	Provide a list of potentially affected property owners for notice adjacent to the proposed works or which may be affected by the project's alteration of the flood flows of the stream	Required if Requested	301.33(a)(4)(B)	No		Not Applicable	Surface Water Drainage Report
319	Part III	Provide a project design based on a statistical 100-year flood as a minimum. Flood level data available from state or federal agencies or other sources shall be provided for consideration in the selection of design flood frequency and elevation	Required if Requested	301.33(b)(1)	No		Not Applicable	Surface Water Drainage Report

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
320	Part III	Provide plans to demonstrate the effects the proposed project will impose on existing flood conditions. This shall be illustrated by floodwater surface-elevation profiles and design-flood delineations of the floodplain with and without the project in place	Required if Requested	301.33(b)(2)	No		Not Applicable	Surface Water Drainage Report
321	Part III	Provide additional flood water surface-elevation profiles and design-flood delineations of the floodplain with the project in place and with a comparable levee or landfill on the opposite site of the stream if such do not exist	Required if Requested	301.33(b)(3)	No		Not Applicable	Surface Water Drainage Report
322	Part III	Submit plans for levees that include structural integrity	Required if Requested	301.34(1)	No		Not Applicable	Surface Water Drainage Report
323	Part III	Submit plans that show compatibility with existing hydraulic conditions.	Required if Requested	301.34(2)	No		Not Applicable	Surface Water Drainage Report
324	Part III	Submit a design that any proposed levee or other improvement will not increase flooding or divert waters in such a way that any person's life or property will be endangered or subjected to significantly increased flooding	Required if Requested	301.34(3)	No		Not Applicable	Surface Water Drainage Report
325	Part III	The rights of third parties affected by a proposed levee or other improvement must be considered	Informational	301.34(4)				Surface Water Drainage Report
326	Part III	The commission and the executive director shall assure that, as far as possible, levees or other improvements shall be designed with primary consideration to the topographic and hydrographic conditions, and in such a manner that each division of a project shall be a complete, united project forming a coordinate part of an ultimately finished series of projects, so constituted that the successful operation of each united project shall coordinate with the successful operation of other projects within the same hydraulic influence	Informational	301.34(5)				Surface Water Drainage Report
327	Part III	Provide a minimum freeboard of three feet above the 100-year design flood hydraulic gradient where levees furnish protection for urbanized or developing areas	Required if Requested	301.34(6)	No		Not Applicable	Surface Water Drainage Report
328	Part III	levees must not significantly restrict the flow of a 100-year frequency flood nor significantly reduce the temporary water storage capacity of the 100-year floodplain	Informational	330.307(b)(2)				Surface Water Drainage Report
329	Part III	The executive director may request any additional pertinent information from the applicant	Required if Requested	301.35	No		Not Applicable	Surface Water Drainage Report
330	Part III	Submit plans with PE design, signed & sealed	Required if Requested	301.36	No		Not Applicable	Surface Water Drainage Report
331	Part III	Submit, if constructed in a floodplain, the Preliminary Plan approval (along with the submitted application) from the governmental entity with jurisdiction under Texas Water Code, §16.236, as implemented by Chapter 301	Required if Requested	330.63(c)(2)(D)(i)	No		Not Applicable	Surface Water Drainage Report

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
337	Part III	Provide a design to control and contain spills and contaminated water from leaving the facility. Unenclosed containment areas shall also account for precipitation from a 25-year, 24-hour rainfall event	Required	330.63(d)(1)(B)	No		Not Applicable	Waste Management Unit Design
338	Part III	Provide the maximum amount of time processed and unprocessed waste are to remain on site	Required	330.63(d)(1)(C)	No		Not Applicable	Waste Management Unit Design
339	Part III	Submit an estimate of the amount and planned method for testing and final disposal of incinerator ash, and an estimate of the volume and method of treatment for process water	Required	330.63(d)(2)	No		Not Applicable	Waste Management Unit Design
340	Part III	Provide design specifications; including a plan view and a cross-section for surface impoundments	Required	330.63(d)(3)(A)	No		Not Applicable	Waste Management Unit Design
341	Part III	Provide a design that maintains the minimum freeboard and the basis of the design to prevent overtopping from a 25-year, 24-hour rainfall event	Required	330.63(d)(3)(B)	No		Not Applicable	Waste Management Unit Design
342	Part III	Provide a liner quality control plan for surface impoundments per 30 TAC 330.339	Required	330.63(d)(3)(C)	No		Not Applicable	Waste Management Unit Design
343	Part III	Provide all-weather operation during wet weather. Include interior access road locations and the type of surfacing on a facility plan. Provide control to minimize the tracking of mud onto the public road	Required	330.63(d)(4)(A)	Yes	Part III, Section 3.2		Waste Management Unit Design
344	Part III	Provide the landfill method proposed (e.g., moving-face cell trench, area fill, etc.)	Required	330.63(d)(4)(B)	Yes	Part III, Section 3.1		Waste Management Unit Design
345	Part III	Provide the elevation of deepest excavation, maximum elevation of waste, and maximum elevation of final cover	Required	330.63(d)(4)(C)	Yes	Part III, Section 3.1		Waste Management Unit Design
346	Part III	Provide a calculation for the estimated rate of solid waste deposition and operating life of the landfill unit	Required	330.63(d)(4)(D)	Yes	Part III, Section 2.2 and Appendix IIIA		Waste Management Unit Design
347	Part III	Provide cross-sections showing the top of the levee, top of the proposed fill, and top of the wastes	Required	330.63(d)(4)(E)	Yes	Part III, Section 3.1 and Attachment 2		Waste Management Unit Design
348	Part III	Provide sufficient number of cross-section w/ inset key map showing maximum elevation of proposed fill, existing ground, bottom of the excavations, and side slopes of trenches and fill areas	Required	330.63(d)(4)(E)	Yes	Attachment 2, Drawings 2.2, 2.3, 2.4		Waste Management Unit Design
349	Part III	Provide sufficient number of cross-section w/ inset key map gas vents or wells, groundwater monitoring wells, initial and static levels of any groundwater encountered	Required	330.63(d)(4)(E)	Yes	Attachment 4, Drawings 4C.2, 4C.3, 4C.4, 4C.5, 4C.6, 4C.7		Waste Management Unit Design
350	Part III	Provide sufficient number of cross-section w/ inset key map showing the top of the levee, top of the proposed fill, top of the wastes, maximum elevation of proposed fill, existing ground, bottom of the excavations, side slopes of trenches and fill areas, gas vents or wells, groundwater monitoring wells, initial and static levels of any groundwater encountered	Required	330.63(d)(4)(E)	Yes	Attachment 2, Drawings 2.2, 2.3, 2.4; and Attachment 4, Drawings 4C.2, 4C.3, 4C.4, 4C.5, 4C.6, 4C.7		Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
351	Part III	Provide cross-sections so as to accurately depict the existing and proposed depths of all fill areas within the site. The fill cross-sections shall go through or very near the soil borings in order to show boring logs on the profile.	Required	330.63(d)(4)(E)	Yes	Attachment 2, Drawings 2.2, 2.3, 2.4		Waste Management Unit Design
352	Part III	Provide cross-sections to depict construction and design details of proposed compacted perimeter or toe berms and aerial-fill waste disposal areas	Required	330.63(d)(4)(F)	Yes	Attachment 2, Drawings 2.2, 2.3, 2.4, and Drawings 6A.4, 6A.5, 6A.6, 6A.7, and 6A.8		Waste Management Unit Design
353	Part III	Submit a Liner Quality Control Plan, prepared by a PE to include construction methods, engineering practices & the installation & testing of geomembrane (if used)	Required	330.63(d)(4)(G)	Yes	Attachment 10		Waste Management Unit Design
354	Part III	Submit a liner design for Type I units constructed that ensures that the concentration values listed in Table 1 (Figure: 30 TAC§330.331(a)(1)) will not be exceeded in the uppermost aquifer at the point of compliance	Required	330.331(a)(1)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
355	Part III	Submit a liner design constructed with a composite liner, and a leachate collection system that is designed and constructed to maintain less than a 30-centimeter depth of leachate over the liner	Required	330.331(a)(2)	Yes	Part III, Section 3.5.2 and 3.5.3		Waste Management Unit Design
356	Part III	Submit a liner design that considers the hydrogeologic characteristics of the facility and surrounding land	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
357	Part III	Submit a liner design that considers the climatic factors of the area	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
358	Part III	Submit for a liner design that considers the volume and physical and chemical characteristics of the leachate	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
359	Part III	Submit for a liner design that considers the quantity, quality, and direction of flow of groundwater	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
363	Part III	Submit for a liner design that considers the public health, safety, and welfare effects; and	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
364	Part III	Submit for a liner design that considers the practicable capability of the owner or operator.	Required	330.331(c)	Yes	Part III, Section 3.5.2		Waste Management Unit Design
365	Part III	Submit a design for a liner system that includes at least four feet of in-situ soil between the deposited waste and groundwater. This in-situ soil liner must meet all the physical properties for a constructed liner as detailed in §330.339(c)(5) of this title (relating to Liner Quality Control Plan)	Required	330.331(d)(1)	No		Not Applicable	Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
366	Part III	Submit a design for a liner system that includes at least a three-foot thick re-compacted clay liner between the deposited waste and groundwater. The constructed liner must meet all the criteria detailed in §330.339	Required	330.331(d)(2)	No		Not Applicable	Waste Management Unit Design
367	Part III	Submit a design for a liner system that includes an alternative liner system, in accordance with §330.335 of this title (relating to Alternative Liner Design).	Required if Requested	330.331(d)(3)	No		Not Applicable	Waste Management Unit Design
368	Part III	Landfill units that accept Class 1 industrial solid wastes, other than asbestos-containing material, must provide dedicated cells that meet the requirements prescribed under 30 TAC 330.331(e) through (e)(2)(C)	Informational	330.331(e)			Not Applicable	Waste Management Unit Design
369	Part III	Demonstrate location compliance for a new landfill cell or an aerial expansion of an existing landfill cell as prescribed under 335.584(b)(1) and (2) relating to Location Restrictions.	Required if Requested	330.331(e)(3)	No		Not Applicable	Waste Management Unit Design
370	Part III	Provide a design for a leachate-collection and associated leachate-removal systems to be constructed of materials that are chemically resistant to the leachate expected to be generated	Required	330.333	Yes	Part III, Section 3.5.3, and Attachment 12, Section 3.4, and Appendix 12D		Waste Management Unit Design
371	Part III	Provide a design for a leachate-collection and associated leachate-removal systems to be constructed of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill	Required	330.333	Yes	Part III, Section 3.5.3, and Attachment 12, Section 3.3, and Appendix 12B		Waste Management Unit Design
372	Part III	Provide a design for a leachate-collection and associated leachate-removal systems to be designed and operated to function through the scheduled closure and post-closure care period of the landfill considering the factors prescribed under 30 TAC 330.333(A) through (G)	Required	330.333(A)-(G)	Yes	Attachment 12		Waste Management Unit Design
373	Part III	Submit an alternative liner designs that include a leachate management system, a demonstration by computerized design modeling that the maximum contaminant levels detailed in 30 TAC §330.331 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance	Required if Requested	330.335	No		Not Applicable	Waste Management Unit Design
374	Part III	Type IV landfills may be required to meet one or more provisions under 330.337 at ED’s discretion	Informational	330.337(a)			Not Applicable	Waste Management Unit Design
375	Part III	Submit calculations to demonstrate that the weight of liner & any ballast will offset uplift by a factor of 1.2	Required	330.337(b)(1)	Yes	Attachment 10, Sections 2.5, 3.6, 11.5 and Appendix 10C and 10D.		Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
376	Part III	Submit calculations to demonstrate that an active or passive dewatering system will reduce hydrostatic forces by a factor of 1.2	Required	330.337(b)(2)	Yes	Attachment 10, Sections 2.5, 3.6, 11.5 and Appendix 10C and 10D.		Waste Management Unit Design
377	Part III	Provide evidence to demonstrate that the soil surrounding the facility is so poorly permeable that GW cannot exert force on liner	Required if Requested	330.337(b)(3)	Yes	Attachment 10, Section 2.5.2		Waste Management Unit Design
378	Part III	Submit evidence that the seasonal high GW is below planned excavation	Required if Requested	330.337(b)(4)	No		See Attachment 10, Section 2.5, which includes a "so poorly permeable demonstration. Additionally, the liner design (see Attachment 10) includes consideration for short- and long-term groundwater controls.	Waste Management Unit Design
379	Part III	Provide for liner stability during filling through dewatering &/or ballasting approved by ED	Required	330.337(c)	Yes	Attatchment 10, Section 2.5.1 and Appendix 10D	Not Applicable	Waste Management Unit Design
380	Part III	Provide a leachate collection system capable of handling leachate and groundwater inflow. Submit the calculations for maximum GW inflow	Required	330.337(d)	Yes	Attachment 12, Section 3	Design for groundwater inflow into the leachate collection system for this landfill is not applicable.	Waste Management Unit Design
381	Part III	Provide a foundation evaluation that considers the stability, settlement, and constructability prior to excavating below the seasonal high water table	Required	330.337(e)	Yes	Attachment 5		Waste Management Unit Design
382	Part III	Provide a liner quality control plan to include methods & tests to verify liner will not uplift during construction & ballast placement	Required	330.337(f)(1)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
383	Part III	Provide measurements & test results verifying that the ballast meets criteria including inspections, compaction, weight, density, thickness, & top elevation	Required	330.337(f)(2)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
384	Part III	Provide designs for any dewatering systems used for liner construction and filling, and indicate that the system will be operated until the ED determines it is no longer required	Required if Requested	330.337(g)	No		Not Applicable	Waste Management Unit Design
385	Part III	Submit (if waste is to be used as ballast) an operating plan that provides for no brush or large items in first 5 ft. of thickness	Required if Requested	330.337(h)(1)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
386	Part III	Provide (if waste is to be used as ballast) for the use of a 40,000 lb. compactor or equivalent to achieve a 1,200 lbs. per cubic yard density	Required if Requested	330.337(h)(2)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
387	Part III	Submit (if waste is to be used as ballast) methods for verifying waste as ballast compaction density not less than 1200 lbs. per cubic yard, No method is required if a 40,000 lb. compactor is used	Required if Requested	330.337(h)(3)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
388	Part III	Submit a ballast evaluation report that verifies the use of a 40,000 lb. compactor or that 1,200 lbs. per cubic yard density was achieved and must be sufficient to offset hydrostatic forces by a factor of 1.5	Required if Requested	330.337(h)(4)	Yes	Attachment 10, Section 11.5		Waste Management Unit Design
389	Part III	Provide for the adjustment of seasonal high water table, if necessary, as new data is collected	Required	330.337(i)	Yes	Attachment 4, Section 11		Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
390	Part III	Acknowledge that a ballast evaluation report will be submitted upon completion of placement. If ED does not respond within 14 days, discontinue dewatering or ballasting	Acknowledgement	330.337(j)	Yes	Attachment 10, Section 11		Waste Management Unit Design
391	Part III	Acknowledge that a ballast evaluation report will be submitted to verify that the liner did not undergo uplift	Acknowledgement	330.337(j)(1)	Yes	Attachment 10, Section 11		Waste Management Unit Design
392	Part III	Acknowledge that a certification that ballasting met the criteria will be submitted and signed and sealed by a P.E, and signature of permittee	Acknowledgement	330.337(j)(2)-(3)	Yes	Attachment 10, Section 11		Waste Management Unit Design
393	Part III	Provide a liner quality control plan prepared under the direction of a licensed professional engineer.	Informational	330.339(a)			Attachment 10	Waste Management Unit Design
394	Part III	Provide in the liner quality control plan procedures that address the installation and testing of a geomembrane liner, if used	Required	330.339(a)	Yes	Attachment 10, Section 4		Waste Management Unit Design
395	Part III	Submit constructed liner details, depicted on cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts	Required	330.339(a)(1)	No		Not applicable, there are no existing cells, i.e., constructed liner at this landfill. See Attachment 6C and 12 for specifics on the proposed liner and leachate collection systems.	Waste Management Unit Design
396	Part III	Provide soil and liner quality-control testing procedures, to include sampling frequency, all field sampling and testing, both during construction and after completion	Required	330.339(a)(2)	Yes	Attachment 10, Appendix 10A, Table 10A-1		Waste Management Unit Design
397	Part III	Acknowledge that the professional of record who signs the soil liner evaluation report or his representative should be on site during all liner construction.	Acknowledgement	330.339(a)(2)	Yes	Attachment 10, Section 1.2		Waste Management Unit Design
398	Part III	Acknowledge that quality control of construction and quality assurance of sampling and testing procedures shall follow the latest technical guidelines of the executive director.	Acknowledgement	330.339(a)(2)	Yes	Attachment 10, Section 1.1, Paragraph 1		Waste Management Unit Design
399	Part III	Provide testing and reporting evaluation procedures to prepare the soil liner evaluation reports for the facility	Required	330.339(b)(1)	Yes	Attachment 10, Section 11.1 and Section 11.2		Waste Management Unit Design
400	Part III	Submit information to specify materials, equipment, and construction methods for the compaction of clay soils and depict on a drawing	Required	330.339(b)(2)	Yes	Attachment 10, Section 3.3 and Drawing 12.3		Waste Management Unit Design
401	Part III	Submit details and drawings for the over excavation and recompaction of the in-situ soils, or the compaction of soils from a borrow source, and cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts	Required	330.339(b)(2)(A)	Yes	Attachment 10, Section 2		Waste Management Unit Design
402	Part III	Submit procedures to be followed when excavations, cells, or disposal areas extend into or have the potential to extend into the groundwater; in accordance with 30 TAC 330.337	Required	330.339(b)(2)(B)	Yes	Attachment 10, Section 2.5		Waste Management Unit Design
403	Part III	Provide a description of installation methods, quality control testing, reporting, following the placement of geomembrane liners	Required	330.339(b)(3)	Yes	Attachment 10, Section 4		Waste Management Unit Design

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404	Part III	Provide quality control testing frequencies and procedures that are in accordance with the executive director's most recent guidelines	Required	330.339(c)	Yes	Attachment 10, Section 4, and Table 10A.2		Waste Management Unit Design
405	Part III	Provide a description of field sampling and testing procedures, both during construction and after completion of the lining, to be performed by a qualified professional	Required	330.339(c)(1)	Yes	Attachment 10, Appendix 10A, Table 10A.1 and Table 10A.2		Waste Management Unit Design
406	Part III	Provide for continuous on-site inspection during construction of the liner by the professional of record or his designated representative	Required	330.339(c)(2)	Yes	Attachment 10, Section 11 and Section 1.2.4, Paragraph 1		Waste Management Unit Design
407	Part III	Provide information to indicate the amount of compaction of clay liners expressed as a percentage of a maximum dry density based on a compaction test. Compaction shall have a coefficient of permeability of 1 x 10-7 centimeters per second (cm/sec) or less	Required	330.339(c)(3)	Yes	Attachment 10, Section 3.1 and 3.3.1		Waste Management Unit Design
408	Part III	Submit and define the frequency of testing These frequencies shall be expressed in numbers of tests per specific area of liner per lift or specific thickness of liner	Required	330.339(c)(4)	Yes	Attachment 10, Appendix 10A, Table 10A-1 and Table 10A-2		Waste Management Unit Design
409	Part III	Provide for laboratory permeability tests. Tests shall be either constant head with back pressure or falling head tests	Required	330.339(c)(4)(A)	Yes	Attachment 10, Section 3.2.1, and Appendix 10A, Table 10A-1		Waste Management Unit Design
410	Part III	Provide for permeability tests to include; sieve analysis, Atterberg limits, moisture-density relationships, moisture content, and thickness verification	Required	330.339(c)(4)(B) – (F)	Yes	Attachment 10, Appendix 10A, Table 10A-1		Waste Management Unit Design
411	Part III	Provide for soils used as constructed liners to have a plasticity index--equal to or greater than 15; a liquid limit--equal to or greater than 30; percent passing 200 mesh sieve (-200) equal to or greater than 30%; percent passing one-inch screen--100%; and coefficient of permeability less than or equal to 1 x 10-7 cm/sec.	Required	330.339(c)(5)(A)-(E)	Yes	Attachment 10, Section 3.1, Paragraph 2		Waste Management Unit Design
412	Part III	Acknowledge that permeability tests for proving the suitability of soils to be used in constructing clay liners shall be performed in the laboratory	Acknowledgement	330.339(c)(6)	Yes	Attachment 10, Section 3.2		Waste Management Unit Design
413	Part III	Provide field quality control with field density tests based on moisture-density compaction curves, Atterberg limits, and lab permeabilities of undisturbed field samples	Required	330.339(c)(6)	Yes	Attachment 10, Section 3.2		Waste Management Unit Design
414	Part III	Provide field permeability testing of in-situ soils or constructed soil liners for the floor of the excavation, in accordance with ASTM D5093	Required	330.339(c)(7)	Yes	Attachment 10, Section 3.2		Waste Management Unit Design
415	Part III	Provide field permeability testing of in-situ soils or constructed soil liners for sidewalls, in accordance with a variation of the Boutwell STEI field permeability test	Required	330.339(c)(7)	Yes	Attachment 10, Section 3.2		Waste Management Unit Design
416	Part III	Provide for quality control testing of soil liners to be performed during the construction of the liner	Required	330.339(c)(8)	Yes	Attachment 10, Section 3.2.2		Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
417	Part III	Provide for all soil testing and evaluation of in-situ soil or constructed soil liners to be completed prior to installing the leachate collection system	Required	330.339(c)(9)	Yes	Attachment 10, Section 3.2.2		Waste Management Unit Design
418	Part III	Calculate soil and liner density as a percentage of the maximum dry density and at the corresponding optimum moisture content. Soils tests must demonstrate a coefficient of permeability no greater than 1 x 10-7 cm/sec.	Required	330.339(d)	Yes	Attachment 10, Section 3.2.1, Paragraph 2, and Section 3.3.1, Bullet 6		Waste Management Unit Design
465	Part III	Provide a description of the liner system used for excavated waste storage, processing, and screening areas to control seepage and runoff	Required	330.63(d)(7)(C)	No		Not Applicable	Waste Management Unit Design
466	Part III	a description of how waste excavation activities will comply with the minimum design and operation requirements of §330.149, §330.151, §330.165, §330.167	Required	330.63(d)(7)(D)	No		Not Applicable	Waste Management Unit Design
467	Part III	The facility size shall be limited to a liquid waste processing rate no greater than 10,000 gallons per day	Informational	330.63(d)(9)(A)			Not Applicable	Waste Management Unit Design
468	Part III	Provide documentation that the facility design and operation will be coordinated with a consultant connected with an accredited college or university or with a consultant that has demonstrated the ability to carry out scientific experiments for demonstrating new and unproven waste handling methods and submitted to the executive director.	Required	330.63(d)(9)(B)	No		Not Applicable	Waste Management Unit Design
469	Part III	Indicate that the owner or operator shall submit to the executive director an annual and final status report to document the viability of the method being demonstrated. The report, at a minimum, must document the effluent standards and solid waste standards achieved.	Required	330.63(d)(9)(B)	No		Not Applicable	Waste Management Unit Design
470	Part III	Submit a Geology Report, prepared and signed by a qualified groundwater scientist and includes a geologic map of the region with text describing the stratigraphy and lithology of the map units.	Required	330.63(e)&(1)(A)	Yes	Attachment 4		Waste Management Unit Design
471	Part III	Provide a description of the generalized stratigraphic column in the facility area. Regional stratigraphic cross-sections should be provided and must include elements listed in 330.63(e)(1)(B).	Required	330.63(e)(1)(B)	Yes	Attachment 4: Section 3.1		Waste Management Unit Design
472	Part III	Provide a description of geologic active processes, faulting, subsidence	Required	330.63(e)(2)	Yes	Attachment 4: Section 3.1.2-3.1.4		Waste Management Unit Design
473	Part III	Provide a description of the regional aquifers in the vicinity of the facility based upon published and open-file sources	Required	330.63(e)(3)(A)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
474	Part III	Provide a description for the composition of the aquifer(s)	Required	330.63(e)(3)(B)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
475	Part III	Provide the hydraulic properties of the aquifer(s)	Required	330.63(e)(3)(C)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
476	Part III	Submit information on whether the aquifers are under water table or artesian conditions.	Required	330.63(e)(3)(D)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
477	Part III	Submit information for the hydraulic connectivity of aquifers	Required	330.63(e)(3)(E)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
478	Part III	Provide a regional water-table contour map or potentiometric surface map for each aquifer, if available;	Required	330.63(e)(3)(F)	No		Not Available	Waste Management Unit Design
479	Part III	Provide an estimate of the rate of groundwater flow	Required	330.63(e)(3)(G)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
480	Part III	Provide the typical values or a range of values for total dissolved solids content of groundwater from the aquifers	Required	330.63(e)(3)(H)	Yes	Attachment 4: Section 8.3		Waste Management Unit Design
481	Part III	Identify recharge areas to the aquifers within five miles of the site	Required	330.63(e)(3)(I)	Yes	Attachment 4: Section 4.1		Waste Management Unit Design
482	Part III	Identify what groundwater, withdrawn from vicinity aquifers is used for and provide the ID, location, & aquifer of each well within one mile of the facility	Required	330.63(e)(3)(J)	Yes	Attachment 4: Section 4.2, Appendix III-4.B		Waste Management Unit Design
483	Part III	Provide the results of investigations of subsurface conditions. This report must describe all borings drilled on site to test soils and characterize groundwater and must include a site map drawn to scale showing the surveyed locations and elevations of the borings.	Required	330.63(e)(4)	Yes	Attachment 4: Section 5, Appendix III-4.C		Waste Management Unit Design
484	Part III	Provided a sufficient no. of borings to characterize subsurface geology.	Required	330.63(e)(4)(A)	Yes	Attachment 4: Section 5.1		Waste Management Unit Design
485	Part III	Provide for borings to be sufficiently deep to identify uppermost aquifer, hydraulically connected aquifers, and underlying aquiclude; See Figure: 30 TAC §330.63(e)(4)(B)	Required	330.63(e)(4)(B)	Yes	Attachment 4: Section 5.1, Appendix III-4.B		Waste Management Unit Design
486	Part III	Provide all borings to be conducted in accordance with established field exploration methods.	Required	330.63(e)(4)(C)	Yes	Attachment 4: Section 5.1		Waste Management Unit Design
487	Part III	Provide GW well installation, abandonment, and plugging	Required	330.63(e)(4)(D)	Yes	Attachment 4: Section 5.1, Appendix III-4.E		Waste Management Unit Design
488	Part III	Number of borings & depth may be modified with ED approval	Informational	330.63(e)(4)(E)				Waste Management Unit Design
489	Part III	Electrical resistivity information may be used to reduce the number of borings with ED approval	Informational	330.63(e)(4)(F)				Waste Management Unit Design
490	Part III	Submit cross-sections prepared from the borings; depicting the generalized strata at the facility. For small waste management units, two perpendicular cross-sections will normally suffice	Required	330.63(e)(4)(G)	Yes	Attachment 4: Section 5.2, Figures III-4.10-4.15		Waste Management Unit Design
491	Part III	Provide a narrative that describes the investigator's interpretations of the subsurface stratigraphy based upon the field investigation	Required	330.63(e)(4)(H)	Yes	Attachment 4: Section 5.2, Section 5.3		Waste Management Unit Design
492	Part III	Provide geotechnical data that describes the geotechnical properties of the subsurface soil materials and a discussion with conclusions about the suitability of the soils and strata	Required	330.63(e)(5)	Yes	Attachment 4: Section 5.2, Section 5.3, Tables III-4.6-4.7, Attachment 5		Waste Management Unit Design

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493	Part III	Provide a laboratory report of soil characteristics determined from at least one sample from each soil layer or stratum that will form the bottom and side of the proposed excavation and from those that are less than 30 feet below the lowest elevation of the proposed excavation.	Required	330.63(e)(5)(A)	Yes	Attchment 4: Appendix III-4.F		Waste Management Unit Design
494	Part III	Provide permeability tests to be performed according to one of the standards on undisturbed soil samples. All test results shall indicate the type of tests used and the orientation of each tested sample.	Required	330.63(e)(5)(B)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
495	Part III	Submit test results for constant head w/ back pressure	Required	330.63(e)(5)(B)(i)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
496	Part III	Submit test results for falling head	Required	330.63(e)(5)(B)(ii)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
497	Part III	Submit test results for sieve analysis	Required	330.63(e)(5)(B)(iii)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
498	Part III	Submit test results for Atterberg limits	Required	330.63(e)(5)(B)(iv)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
499	Part III	Submit test results for moisture content	Required	330.63(e)(5)(B)(v)	Yes	Attachment 4: Tables III-4.6-4.7, Appendix III-4.F		Waste Management Unit Design
500	Part III	Submit information for the depth at which groundwater was encountered and records of after-equilibrium measurements in all borings. The cross-sections prepared in response to 330.63(e)(4)(G) must be annotated to note the level at which groundwater was first encountered	Required	330.63(e)(5)(C)	Yes	Attachment 4: Section 6.1, Table III-4.9		Waste Management Unit Design
501	Part III	Submit water levels in monitoring wells, historical water levels in table format for each monitoring well	Required	330.63(e)(5)(D)	Yes	Attachment 4: Section 6, Appendix III-4.K, Appendix III-4.L		Waste Management Unit Design
502	Part III	Submit a tabulation of GW monitoring data on-site or on adjacent units	Required	330.63(e)(5)(E)	Yes	Attachment 4: Section 6, Appendix III-4.K, Appendix III-4.L		Waste Management Unit Design
503	Part III	Identify the uppermost aquifer and any lower aquifers that are hydraulically connected to it beneath the facility	Required	330.63(e)(5)(F)	Yes	Attachment 4: Section 6		Waste Management Unit Design
504	Part III	Provide a Groundwater Sampling and Analysis Plan. Compost Permits submit per Chapter 332	Required	330.63(f)	Yes	Attachment 7		Groundwater Sampling & Analysis Plan
505	Part III	Provide a topographic map delineating waste area, property boundary, point of compliance, & GW monitoring wells	Required	330.63(f)(1)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
506	Part III	Provide a description of any contamination plume from the unit	Required	330.63(f)(2)	No		Not applicable	Groundwater Sampling & Analysis Plan
507	Part III	Provide a delineation of contaminate plume on the topographic map	Required	330.63(f)(2)(A)	No		Not applicable	Groundwater Sampling & Analysis Plan
508	Part III	Provide the concentration of each assessment constituent in the plume	Required	330.63(f)(2)(B)	No		Not applicable	Groundwater Sampling & Analysis Plan
509	Part III	Provide an analysis of most likely pollutant pathway, include any GW modeling data & results per 330.403(e)(2), consideration of GW flow changes from construction	Required	330.63(f)(3)	Yes	Attachment 4: Section 7		Groundwater Sampling & Analysis Plan
510	Part III	Provide detailed plans and an engineering report describing the proposed groundwater monitoring program to be implemented to meet the requirements of §330.403	Required	330.63(f)(4)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
511	Part III	Submit information; supporting data, analyses to establish detection monitoring program per 330.407; If hazardous constituents in 40 CFR 258 & 330.419 have not been detected	Required	330.63(f)(5)	Yes	Attachment 4: Section 8		Groundwater Sampling & Analysis Plan
512	Part III	Submit the proposed GW monitoring system	Required	330.63(f)(5)(A)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
513	Part III	Submit background values for each monitoring parameter or constituent listed in §330.419 of this title, or procedures to calculate such values;	Required	330.63(f)(5)(B)	Yes	Attachemnt 7: Section 4.2		Groundwater Sampling & Analysis Plan
514	Part III	Provide for a semiannual monitoring frequency	Required	330.407(a)	Yes	Attachment 7: Section 5.2		Groundwater Sampling & Analysis Plan
515	Part III	Provide for a minimum of four statistically independent background GW samples collected quarterly unless approved, background may be updated every 2 yrs. with representative of background demonstration	Required	330.407(a)(1)	Yes	Attachment 7: Section 5.1		Groundwater Sampling & Analysis Plan
516	Part III	ED may approve alternative sampling frequency but not less than annual	Informational	330.407(a)(2)				Groundwater Sampling & Analysis Plan
517	Part III	For establishing background, ED may consider previous data	Informational	330.407(a)(3)				Groundwater Sampling & Analysis Plan
518	Part III	Provide Notification of SSI to ED within 14 days of the 60-day SSI determination	Required	330.407(b)	Yes	Attachment 7: Section 5.2		Groundwater Sampling & Analysis Plan
519	Part III	Provide (if SSI is determined) a notice to the operating record immediately & establish an assessment monitoring program within 90 days, or provide for resampling within 60 days of SSI determination	Required	330.407(b)(1)-(2)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
520	Part III	Submit alternative source demonstration including Notification to ED & any local agency, within 14 days of the SSI determination, of the intent to submit ASD	Required	330.407(b)(3)-(A)	Yes	Attachment 7: Section 5.2.1.1		Groundwater Sampling & Analysis Plan
521	Part III	Submit ASD report to ED & any local agency, within 90 days of the SSI determination, certified by a qualified GW scientist	Required	330.407(b)(3)(B)	Yes	Attachment 7: Section 5.2.1.1		Groundwater Sampling & Analysis Plan
522	Part III	Provide for No filtering of samples for ASD, ED may require leachate analyses to support ASD	Required	330.407(b)(3)(C)	Yes	Attachment 7: Section 5.2.1.1		Groundwater Sampling & Analysis Plan
523	Part III	Owner/Operator may continue detection monitoring program	Informational	330.407(b)(3)(D)				Groundwater Sampling & Analysis Plan
524	Part III	Provide for assessment monitoring if no ASD satisfactory to the ED within 90 days of notice. ED may require additional point of compliance wells	Required	330.407(b)(4)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
525	Part III	Submit annual detection monitoring report within 90 days of last sampling even that includes the following	Required	330.407(c)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
526	Part III	Submit a statement regarding occurrences of SSIs	Required	330.407(c)(1)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
527	Part III	Submit GW monitoring results, background GW quality, statistical calculations, graphs, & drawings	Required	330.407(c)(2)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
528	Part III	Submit GW flow rate & direction based on detection sampling water elevations, any supporting documentation	Required	330.407(c)(3)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan

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529	Part III	Provide for piezometric water level contour map and supporting documentation	Required	330.407(c)(4)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
530	Part III	Submit recommendations for any changes	Required	330.407(c)(5)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
531	Part III	Submit any other information required by ED	Required	330.407(c)(6)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
532	Part III	Submit a permit amendment or modification, If detection monitoring program no longer satisfies 330.407	Required	330.407(d)	Yes	Attachment 7: Section 5.5.1		Groundwater Sampling & Analysis Plan
533	Part III	Provide a description of proposed sampling, analysis, and statistical comparison procedures to be utilized in evaluating groundwater monitoring data	Required	330.63(f)(5)(C)	Yes	Attachment 7: Section 2.4 & Section 4		Groundwater Sampling & Analysis Plan
534	Part III	Provide a statement that information, supporting data, and analyses to establish assessment monitoring program per 330.409 will be provided If hazardous constituents are present	Required	330.63(f)(6)	No		Not applicable.	Groundwater Sampling & Analysis Plan
535	Part III	Provide a statement indicating that assessment monitoring information and a description of any special waste previously handled at the facility will be provided	Required	330.63(f)(6)(A)	No		Not applicable.	Groundwater Sampling & Analysis Plan
536	Part III	Indicate that a characterization of the contaminated groundwater, including concentration of assessment constituents as defined in §330.409 of this title, will be provided	Required	330.63(f)(6)(B)	No		Not applicable.	Groundwater Sampling & Analysis Plan
537	Part III	Indicate that a list of assessment constituents as defined in §330.409 of this title for which assessment monitoring will be undertaken, will be provided	Required	330.63(f)(6)(C)	No		Not applicable.	Groundwater Sampling & Analysis Plan
538	Part III	Provide plans & engineering report describing GW monitoring system	Required	330.63(f)(6)(D)	No		Not applicable.	Groundwater Sampling & Analysis Plan
539	Part III	Provide a description of proposed sampling, analysis, and statistical comparison procedures to be utilized in evaluating groundwater monitoring data	Required	330.63(f)(6)(E)	No		Not applicable.	Groundwater Sampling & Analysis Plan
540	Part III	Provide, if hazardous constituents have exceeded the concentration limits, supporting data, and analyses to establish a corrective action program that meets the requirements of §330.411 and §330.413	Required	330.63(f)(7)	No		Not applicable.	Groundwater Sampling & Analysis Plan
541	Part III	Indicate that a characterization of the contaminated groundwater, including concentrations of assessment constituents as defined in §330.409	Required	330.63(f)(7)(A)	No		Not applicable.	Groundwater Sampling & Analysis Plan
542	Part III	Indicate that concentration limits for each constituent will be submitted	Required	330.63(f)(7)(B)	No		Not applicable.	Groundwater Sampling & Analysis Plan
543	Part III	Indicate that plans & an engineering report describing corrective action will be submitted	Required	330.63(f)(7)(C)	No		Not applicable.	Groundwater Sampling & Analysis Plan
544	Part III	Submit a description of how the monitoring program will demonstrate adequacy of corrective action	Required	330.63(f)(7)(D)	No		Not applicable.	Groundwater Sampling & Analysis Plan
545	Part III	Submit a schedule for submitting information required by 330.63(f)(7)(C) & (D)	Required	330.63(f)(7)(E)	No		Not applicable.	Groundwater Sampling & Analysis Plan
546	Part III	Criteria to determine if the facility is exempt from groundwater monitoring	Informational	330.401(a)-(c)				Groundwater Sampling & Analysis Plan

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547	Part III	Submit criteria for suspension of groundwater monitoring; the demonstration for suspension shall be certified by a qualified groundwater scientist and approved by the executive director	Required if Requested	330.401(d)	No		Not applicable.	Groundwater Sampling & Analysis Plan
548	Part III	Submit for suspension demonstration site specific data affecting contaminant fate & transport	Required	330.401(d)(1)	No		Not applicable.	Groundwater Sampling & Analysis Plan
549	Part III	Submit for suspension demonstration, contaminant fate & transport predictions	Required	330.401(d)(2)	No		Not applicable.	Groundwater Sampling & Analysis Plan
550	Part III	Provide for new solid waste management units a documented certification signed by a qualified groundwater scientist that the facility is in compliance with the groundwater monitoring requirements	Required	330.401(e)	Yes	Attachment 4: Section 9.3		Groundwater Sampling & Analysis Plan
551	Part III	Acknowledge that groundwater monitoring must be conducted throughout the active life and any required post-closure care period	Acknowledgement	330.401(f)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
552	Part III	Submit a GW monitoring system with sufficient no. of wells, location, depth to yield representative GW samples	Required	330.403(a)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
553	Part III	Provide information on background wells used to determine background GW quality	Required	330.403(a)(1)	No		Not applicable. No groundwater water chemistry available.	Groundwater Sampling & Analysis Plan
554	Part III	Provide/identify the point of compliance wells not >600 ft. unless modeling demonstration approved	Required	330.403(a)(2)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
555	Part III	Provide, if a multi-unit GW monitoring system is proposed; the number, spacing, and orientation of the solid waste management units within an overall waste management area; hydrogeologic setting; site history; engineering design of the units; and type of waste accepted at the units.	Required	330.403(b)(1)-(5)	No		Not applicable. Single unit monitoring system	Groundwater Sampling & Analysis Plan
556	Part III	The executive director may approve an alternative design for a groundwater monitoring system that uses other means in conjunction with monitoring wells	Informational	330.403(c)				Groundwater Sampling & Analysis Plan
557	Part III	Acknowledge that all parts of a groundwater monitoring system shall be operated and maintained so that they perform at least to design specifications	Acknowledgement	330.403(d)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
558	Part III	Provide a design certified by a qualified groundwater scientist.	Required	330.403(e)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
559	Part III	Provide the design of the monitoring system to be based on site-specific technical information	Required	330.403(e)(1)	Yes	Attachment 4: Section 9		Groundwater Sampling & Analysis Plan
560	Part III	Multi-dimensional fate & transport model may be used to support sampling point locations	Informational	330.403(e)(2)				Groundwater Sampling & Analysis Plan
561	Part III	Provide if a multi-dimensional model is proposed, documentation of the model's ability to represent GW flow & contaminant transport	Required	330.403(e)(2)(A)	No		Not applicable.	Groundwater Sampling & Analysis Plan
562	Part III	Provide if a multi-dimensional model is proposed, a sound set of equations based on accepted theory	Required	330.403(e)(2)(B)	No		Not applicable.	Groundwater Sampling & Analysis Plan

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563	Part III	Provide if a multi-dimensional model is proposed, a numerical solution methods based on mathematical principals with verification & checking techniques	Required	330.403(e)(2)(C)	No		Not applicable.	Groundwater Sampling & Analysis Plan
564	Part III	Provide if a multi-dimensional model is proposed, a model calibrated against site-specific field data	Required	330.403(e)(2)(D)	No		Not applicable.	Groundwater Sampling & Analysis Plan
565	Part III	Provide if a multi-dimensional model is proposed, a sensitivity analysis for major parameters	Required	330.403(e)(2)(E)	No		Not applicable.	Groundwater Sampling & Analysis Plan
566	Part III	Provide if a multi-dimensional model is proposed, mass-balance calculations	Required	330.403(e)(2)(F)	No		Not applicable.	Groundwater Sampling & Analysis Plan
567	Part III	Provide if a multi-dimensional model is proposed, a model based on field or lab measurements that document validity of parameter values	Required	330.403(e)(2)(G)	No		Not applicable.	Groundwater Sampling & Analysis Plan
568	Part III	Acknowledge that the owner or operator shall promptly notify the executive director, and any local pollution agency with jurisdiction that has requested to be notified, in writing of changes in facility construction or operation or changes in adjacent property that affect or are likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination from a solid waste management unit and that may require the installation of additional monitoring wells or sampling points and that such additional wells or sampling points require a modification of the site development plan.	Acknowledgement	330.403(e)(3)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
569	Part III	Provide sampling & analysis procedures that ensure accurate results of GW quality	Required	330.405(a)	Yes	Attachment 7: Section 2		Groundwater Sampling & Analysis Plan
570	Part III	Submit GW sampling & analysis plan prior to sampling, place a copy of the approved plan in the operating record	Required	330.405(b)	Yes	Attachment 7: Section 2		Groundwater Sampling & Analysis Plan
571	Part III	Provide procedures for sample collection, preservation & shipping, analytical procedures, COC control, & QA/QC	Required	330.405(b)(1)	Yes	Attachment 7: Section 2		Groundwater Sampling & Analysis Plan
572	Part III	Provide for GW elevations measured at each point, sample from high to low elevations unless contaminated, sample un-contaminated points prior to contaminated points	Required	330.405(b)(2)	Yes	Attachment 7: Section 2		Groundwater Sampling & Analysis Plan
573	Part III	Provide sampling & analysis methods appropriate for groundwater sampling	Required	330.405(b)(3)	Yes	Attachment 7: Section 2		Groundwater Sampling & Analysis Plan
574	Part III	Provide for Type I landfills – collection of samples necessary to establish GW quality data consistent with statistical procedures for detection, assessment, corrective measures	Required	330.405(b)(3)(A)	Yes	Attachment 7: Section 3.2		Groundwater Sampling & Analysis Plan
575	Part III	Provide for no field filtered GW samples prior to analysis	Required	330.405(c)	Yes	Attachment 7: Section 2.4.1.5		Groundwater Sampling & Analysis Plan
576	Part III	Provide and establish background GW quality for detection parameters	Required	330.405(d)	Yes	Attachment 7: Section 4.2		Groundwater Sampling & Analysis Plan
577	Part III	Provide 1 or more statistical methods to evaluate detection/assessment parameters	Required	330.405(e)	Yes	Attachment 7: Section 4.1		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
578	Part III	Provide parametric analysis of variance followed by multiple comparison procedures, contrast between well's mean & background mean	Required	330.405(e)(1)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
579	Part III	Provide analysis of variance based on ranks followed by multiple comparison procedures, contrast between well's median & background median	Required	330.405(e)(2)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
580	Part III	Provide tolerance or prediction interval procedures	Required	330.405(e)(3)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
581	Part III	Provide a control chart approach	Required	330.405(e)(4)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
582	Part III	Provide for any statistical method to meet the standards listed under 330.405(f)	Required	330.405(e)(5)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
583	Part III	Provide the statistical method chosen under 330.405(e) appropriate for the distribution	Required	330.405(f)-(1)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
584	Part III	Provide, if individual sampling point comparison to background or GW protection standard is used, for the test to be done at Type I error level not <0.01.	Required	330.405(f)(2)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
585	Part III	Provide, If control chart is used, the specific type of chart & its parameters must be protective, consider no. of samples, distribution, & concentration range	Required	330.405(f)(3)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
586	Part III	Provide the tolerance or prediction intervals used	Required	330.405(f)(4)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
587	Part III	Provide that the statistical method used accounts for data below detection	Required	330.405(f)(5)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
588	Part III	Provide for the statistical method to control or correct for seasonal, spatial variability & temporal correlation in data	Required	330.405(f)(6)	Yes	Attachment 7: Section 4		Groundwater Sampling & Analysis Plan
589	Part III	Indicate that assessment monitoring is required whenever the owner or operator determines there has been a statistically significant increase over background for one or more of the constituents listed in §330.419 of this title	Required	330.409(a)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
590	Part III	Indicate that within 90 days of determining that a statistically significant increase has occurred in accordance with §330.407(b) and not less than annually thereafter, the owner or operator shall sample and analyze the groundwater monitoring system for the full set of constituents listed in Appendix II to 40 Code of Federal Regulations (CFR) Part 258	Required	330.409(b)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
591	Part III	Indicate that a minimum of one sample shall be collected from each point of compliance well and analyzed for the 40 CFR Part 258, Appendix II constituents during each sampling event.	Required	330.409(b)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
592	Part III	Indicate that for any new constituent(s) detected in the point of compliance wells as a result of the complete Appendix II analysis, a minimum of four statistically independent samples from each background well shall be collected and analyzed to establish background levels for the additional constituent(s).	Required	330.409(b)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
593	Part III	Indicate that after sampling all point of compliance wells for Appendix II constituents, the executive director may specify an appropriate subset of wells to be sampled and analyzed for the Appendix II constituents during assessment monitoring and may delete any of the Appendix II constituents for a municipal solid waste management unit if the owner or operator can document that the removed constituents are not reasonably expected to be in or derived from the waste contained in the unit	Required	330.409(b)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
594	Part III	Provide, if the ED specifies, an alternative frequency for sampling Appendix II constituents	Required	330.409(c)(1)-(5)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
595	Part III	Indicate that Appendix II constituents results will be submitted within 60 days after each sampling event	Required	330.409(d)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
596	Part III	Indicate that within 90 days of reporting Appendix II results & semiannually thereafter, all wells will be resampled for Appendix I & any new constituent detected from Appendix II, and that the results of resampling will be submitted within 60 days after each sampling event	Required	330.409(d)(1)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
597	Part III	Provide background concentrations for additional Appendix II constituents detected	Required	330.409(d)(2)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
598	Part III	Provide groundwater protection standards for all constituents detected in point of compliance wells	Required	330.409(d)(3)	Yes	Attachment 7: Section 3.5		Groundwater Sampling & Analysis Plan
599	Part III	Provide notification to ED, If concentrations are at or below background for 2 consecutive sampling events, and return to detection monitoring	Required	330.409(e)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
600	Part III	Continue assessment monitoring If concentrations are above background but below GW protection standards	Required	330.409(f)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
601	Part III	Indicate that no later than 60 days after each sampling event a determination whether any 40 CFR Part 258, Appendix II constituents were detected at statistically significant levels above the groundwater protection standards. If exceeded the ED & local government will be notified within 7 days of determination	Required	330.409(g)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
602	Part III	Provide the characterization and extent of release by installing additional wells as necessary	Required	330.409(g)(1)-(A)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
603	Part III	Provide for the installation of wells adjacent to the well with exceedance before next sampling event & sample new well for Appendix I & additional constituents from Appendix II	Required	330.409(g)(1)(B)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
604	Part III	Provide Notification to all persons that own or occupy the land that overlies any part of the contamination plume	Required	330.409(g)(1)(C)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
605	Part III	Provide an assessment of corrective measures within 90 days of notice to ED	Required	330.409(g)(1)(D)	Yes	Attachment 7: Section 5.4		Groundwater Sampling & Analysis Plan
606	Part III	Notify ED within 14 days of exceedance determination and intent to submit an Alternate Source Demonstration (ASD)	Required	330.409(g)(2)-(A)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
607	Part III	Submit certified ASD report within 90 days of exceedance determination	Required	330.409(g)(2)(B)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
608	Part III	Provide for no filtering of samples for ASD, ED may require leachate analyses to support ASD and continue assessment monitoring program	Required	330.409(g)(2)(C)-(D)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
609	Part III	Provide for assessment monitoring If ASD is accepted by ED, otherwise implement assessment of corrective measures	Required	330.409(g)(3)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
610	Part III	Provide for a permit amendment or modification if assessment monitoring program is no longer compliant with 330.409,	Required	330.409(g)(4)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
611	Part III	Provide for/establish GW protection standards for Appendix II constituents in the point of compliance monitoring wells	Required	330.409(h)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
612	Part III	Provide for GW protection standard for constituents for which a maximum (MCL) has been promulgated under 40 CFR Part 141, Safe Drinking Water Act Maximum contaminant level (MCL)	Required	330.409(h)(1)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
613	Part III	Provide GW protection standard for constituents for which no MCL promulgated	Required	330.409(h)(2)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
614	Part III	Provide GW protection standard for background constituents higher than MCL or health-based level	Required	330.409(h)(3)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
615	Part III	Acknowledge that the ED may establish alternative GW protection standards in accordance with 30 TAC §330.409(i)	Acknowledgement	330.409(i)	Yes	Attachment 7: Section 5.3		Groundwater Sampling & Analysis Plan
616	Part III	Submit annual assessment monitoring report within 60 days of 2nd semiannual sampling event	Required	330.409(k)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
617	Part III	Submit a statement of any statistically significant exceedances of GW protection standards & the status of the exceedance	Required	330.409(k)(1)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
618	Part III	Submit GW monitoring results, summary of background, statistical calculations, graphs & drawings	Required	330.409(k)(2)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
619	Part III	Submit GW flow rate & direction based on data from sampling events, supporting documentation	Required	330.409(k)(3)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
620	Part III	Submit a Piezometric water level contour map and supporting documentation	Required	330.409(k)(4)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
621	Part III	Provide recommendations for any changes	Required	330.409(k)(5)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
622	Part III	Submit Any other information required by ED	Required if Requested	330.409(k)(6)	Yes	Attachment 7: Section 5.5.3		Groundwater Sampling & Analysis Plan
623	Part III	Provide detection monitoring for constituents listed in Appendix I, 40 CFR Part 258	Required	330.419(a)	Yes	Attachment 7: Section 3.3		Groundwater Sampling & Analysis Plan
624	Part III	ED may delete constituents from Appendix I if constituent not likely to be derived from waste disposed of in the landfill	Informational	330.419(b)				Groundwater Sampling & Analysis Plan
625	Part III	ED may establish alternative inorganic list, add organic or inorganic constituents based on consideration of the following	Informational	330.419(c)				Groundwater Sampling & Analysis Plan
626	Part III	Types, concentrations, quantities, persistence of waste constituents	Informational	330.419(c)(1)				Groundwater Sampling & Analysis Plan
627	Part III	Mobility, stability, persistence of constituents & their reaction products	Informational	330.419(c)(2)				Groundwater Sampling & Analysis Plan
628	Part III	Detectability of indicator & waste constituents & reaction products in groundwater	Informational	330.419(c)(3)				Groundwater Sampling & Analysis Plan
629	Part III	Concentrations & coefficients of variability of parameters or constituents in the groundwater background	Informational	330.419(c)(4)				Groundwater Sampling & Analysis Plan
630	Part III	Provide for the construction of monitoring wells to provide integrity, representative samples, prevent migration of water in bore hole, well construction must follow prescribed specifications	Required	330.421(a)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
631	Part III	Provide that wells to be drilled by a qualified TX licensed drill & supervised by PG or PE	Required	330.421(a)(1)(A)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
632	Part III	Provide a drilling method that shall not introduce contaminants. If fluid used in drilling, then use clean city water unless approved by ED. If water used provide analysis	Required	330.421(a)(1)(B)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
633	Part III	Provide borings to be at least 4 in. larger than casing. If boring in rock, a smaller annulus may be approved by the executive director	Required	330.421(a)(1)©	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
634	Part III	Provide a log of boring, signed, sealed & dated by PG or PE	Required	330.421(a)(1)(D)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
635	Part III	Provide designs for casing, screen, filter pack, & seal	Required	330.421(a)(2)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
636	Part III	Provide casing specifications; the casing should be 2 to 4 inch schedule 40 or 80 PVC, and must meet other requirements of 30 TAC §330.421(a)(2)(A)	Required	330.421(a)(2)(A)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
637	Part III	Provide screen specifications that are compatible with the casing and does not include glue, solvents, field-cut slots or filter cloths	Required	330.421(a)(2)(B)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
638	Part III	Provide filter pack specifications – clean silica sand or glass, 1 to 4 ft. above screen, etc.	Required	330.421(a)(2)(C)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
639	Part III	Provide annular seal specifications – 2 ft. thick, placed in zone of saturation, etc.	Required	330.421(a)(2)(D)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
640	Part III	Provide casing seal specifications – placed on top of annular seal, bentonite grout or cement-bentonite mix, etc.	Required	330.421(a)(2)(E)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
641	Part III	Provide specifications for the concrete pad to be placed on top of the casing seal, including the type of structural concrete used from casing seal to surface	Required	330.421(a)(3)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
642	Part III	Provide protective collar specifications – steel collar around casing, set 1 ft. into surface pad, etc.	Required	330.421(a)(4)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
643	Part III	Provide protective barrier specifications – 3 to 4 6-12 in. diameter pipes set in concrete, other types of barriers may be approved by ED	Required	330.421(a)(5)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
644	Part III	Acknowledge that when wells are installed in unusual conditions, all aspects must be approved in writing by the ED	Acknowledgement	330.421(b)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
645	Part III	Provide the removal of artifacts once monitoring well is installed and open water-bearing zones for max flow into well	Required	330.421(c)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
646	Part III	Identify well location & elevation surveyed, permanently marked	Required	330.421(d)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
647	Part III	Provide a well installation report to be submitted within 60 days of completion including boring log, description of development procedures, any sample data & sit map showing location	Required	330.421(e)	Yes	Attachment 4: Section 9.2		Groundwater Sampling & Analysis Plan
648	Part III	Provide a Landfill Gas Management Plan to comply with Subchapter I	Required	330.63(g)	Yes	Attachment 11		Landfill Gas Management Plan
649	Part III	Submit information to specify that methane concentration cannot exceed 1.25% by volume in facility structures	Required	330.371(a)(1)	Yes	Attachment 11, Section 1.2		Landfill Gas Management Plan
650	Part III	Submit information to specify that methane concentrations cannot exceed 5% by volume at permitted boundary wells, probes, subsurface soils, or other matrices	Required	330.371(a)(2)	Yes	Attachment 11, Section 1.2		Landfill Gas Management Plan
651	Part III	Provide a plan to implement routine methane monitoring where the type and frequency of monitoring is based on soil, hydrogeologic, and hydraulic conditions	Required	330.371(b)(1)(A)-(C)	Yes	Attachment 11, Section 3.1		Landfill Gas Management Plan
652	Part III	Provide a plan to implement routine methane monitoring where the type and frequency of monitoring is based on locations of facility structures, property boundaries and utility or pipelines that cross the facility boundary	Required	330.371(b)(1)(D)&(E)	Yes	Attachment 11, Section 3.2		Landfill Gas Management Plan
653	Part III	Indicate that methane monitoring will be conducted, at a minimum, quarterly.	Required	330.371(b)(2)	Yes	Attachment 11, Section 2.1, Paragraph 2		Landfill Gas Management Plan
654	Part III	Provide in the plan the necessary steps to take if methane concentrations exceed 1.25% in structures and/or 5% in boundary matrices; including notification to the ED, local officials, emergency officials, & the public	Required	330.371(c)-(1)	Yes	Attachment 11, Section 4		Landfill Gas Management Plan
656	Part III	Indicate that a remediation plan will implemented within 60 days of detection that describes the nature, extent of the problem, and the proposed remedy, The ED may require additional remedial measures	Required	330.371(c)(3)	Yes	Attachment 11, Section 5		Landfill Gas Management Plan
657	Part III	Indicate that the ED may establish alternative schedule for monitoring & exceedance actions	Required	330.371(d)	Yes	Attachment 11, Section 5		Landfill Gas Management Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
658	Part III	Provide for continuing methane monitoring and control for 30 yrs. after certification of final closure for Type I & IAE facilities. & 5 yrs. for Type IV & IVAE. Gas monitoring may be reduce with an approved no gas migration demonstration	Required	330.371(e)	Yes	Attachment 11, Section 3.3		Landfill Gas Management Plan
659	Part III	Provide for continuing methane monitoring and control for 30 yrs. after certification of final closure for Type I & IAE facilities.	Required	330.371(e)	Yes	Attachment 11, Section 1.1 and Section 3.3		Landfill Gas Management Plan
660	Part III	Provide for continuing methane monitoring and control for 5 yrs. after certification of final closure for Type IV & IVAE facilities.	Required	330.371(e)	No		Not Applicable	Landfill Gas Management Plan
661	Part III	Indicate that information may be submitted to the ED, to reduce gas monitoring and control. The information must demonstrate no potential for gas migration beyond the property boundary or into on-site structures.	Required	330.371(e)	Yes	Attachment 11, Section 3.3		Landfill Gas Management Plan
662	Part III	Provide for gas monitoring & control to be revised & maintained as needed; post-closure land use shall not interfere with the gas monitoring system and all utility trenches crossing the facility shall be vented & monitored	Required	330.371(f)	Yes	Attachment 11, Section 1, Paragraph 1		Landfill Gas Management Plan
663	Part III	Provide a description of how gases be managed & controlled	Required	330.371(g)-(1)	Yes	Attachment 11, Section 2.1, Paragraphs 2 & 3		Landfill Gas Management Plan
664	Part III	Provide a description of the proposed system, installation procedures, installation timeline, monitoring & maintenance procedures	Required	330.371(g)(2)	Yes	Attachment 11, Section 3.1.1 and Section 3.2		Landfill Gas Management Plan
665	Part III	Provide a backup plan for breakdowns	Required	330.371(g)(3)	Yes	Attachment 11, Section 3.4.		Landfill Gas Management Plan
666	Part III	Installation of an initial perimeter monitoring network at Type IAE and Type IVAE ands larger landfills may consist of portable equipment and probes provided there are no habitable structures within 3000 feet of the waste placement boundary.	Informational	330.371(h)(1)				Landfill Gas Management Plan
667	Part III	Indicate that a permanent gas monitoring system will be installed if test results show the presence of methane gas above a concentration of .5% by volume	Required	330.371(h)(1)	No		Not Applicable	Landfill Gas Management Plan
668	Part III	Provide a permanent gas monitoring system at Type I and Type IV facilities	Required	330.371(h)(2)	Yes	Attachment 11 and Drawing 11.1		Landfill Gas Management Plan
669	Part III	Provide a monitoring network design to monitor on-site structures, and any other areas that have potential gas buildup	Required	330.371(i)	Yes	Attachment 11, Section 3.2.1 and 3.2.2		Landfill Gas Management Plan
670	Part III	Provide for all monitoring probes and on-site structures to be sampled for methane during the monitoring period	Required	330.371(j)	Yes	Attachment 11, Section 3.2.1 and 3.2.2		Landfill Gas Management Plan
676	Part III	Provide a demonstration that above ground disposal area final cover slopes shall not exceed 25%. Topmost portion of final cover shall be between 2% & 6%.	Required	330.453(c)	Yes	Attachment 3, Drawings 3.1, 3.2, and 3.3, and Appendix 9A, Table 6		Closure Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
677	Part III	Provide a demonstration that a design with an excess of 25% final cover slopes may be submitted. The design must demonstrate the management of drainage, such as control flumes, diversion terraces, spillways or other acceptable methods	Required if Requested	330.453(c)	No		Not Applicable	Closure Plan
678	Part III	An alternative final cover design may be submitted to demonstrate an equivalent reduction in infiltration as the clayey soil cover infiltration layer specified under 330.453(a).	Required if Requested	330.453(d)(1)	No		Not Applicable	Closure Plan
679	Part III	An alternative final cover design may be submitted to demonstrate approved alternative final cover that achieves equivalent protection from wind & water erosion	Required if Requested	330.453(d)(2)	No		Not Applicable	Closure Plan
680	Part III	Submit information to comply with post-closure care once closure of a Type IV facility is complete	Required	330.453(f)	No		Not Applicable	Closure Plan
681	Part III	Provide designs for a final cover system consisting of not less than two feet of soil cover.	Required	330.457(a)	Yes	Attachment 9, Section 2.1 and Drawing 6C.2		Closure Plan
682	Part III	For landfills with a synthetic bottom liner, provide a final cover system design that includes a synthetic membrane with a permeability less than or equal to the bottom	Required	330.457(a)(1)	Yes	Attachment 9, Section 2.2, Paragraph 2		Closure Plan
683	Part III	Provide designs for a synthetic liner with minimum thickness of 20 mils, or 60 mils in the case of high-density polyethylene, to ensure proper seaming	Required	330.457(a)(1)	Yes	Attachment 9, Section 2.2, Paragraph 2		Closure Plan
684	Part III	For landfills with no synthetic bottom liner, provide a final cover system design that includes a minimum 18-inch thick clay-rich soil cover layer with a coefficient of permeability less than or equal to any constructed bottom liner or natural subsoil present. The coefficient of permeability shall not exceed 1 x 10-5 cm/sec	Required	330.457(a)(2)	No		Not Applicable	Closure Plan
685	Part III	Provide designs for an erosion layer that consist of at least six inches of soil capable of sustaining native plant growth and that will be seeded or sodded immediately following the application of the final cover	Required	330.457(a)(3)	Yes	Attachment 9, Section 2.3.8.2		Closure Plan
686	Part III	Provide designs for cover of a Class 1 cell that consist of 4ft. clay with permeability not > $1x10^{-7}$ overlain by 18in. Topsoil. If waste is to be placed above Class 1 cell, it must first be covered with a four-foot layer of compacted clay-rich soil and must meet the requirements of 330.457 and include a flexible membrane component.	Required if Requested	330.457(b)	No		Not Applicable	Closure Plan
687	Part III	Provide for permeability quality control testing of the 18-inch cover at no less than 1 test/acre and submit data to ED	Required	330.457(c)	Yes	Attachment 9, Section 2.3.1.2, Table 9-2-2		Closure Plan
688	Part III	Demonstrate that the alternative final cover will achieve equivalent reduction in infiltration as the clay-rich soil cover layer specified under 330.457(a)(1) or (2)	Required if Requested	330.457(d)(1)	No		Not Applicable	Closure Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
689	Part III	Demonstrate that the alternative final cover will provide equivalent wind & water erosion protection as the erosion layer specified in 330.457(a)(3)	Required if Requested	330.457(d)(2)	No		Not Applicable	Closure Plan
690	Part III	Submit a written closure plan describing the steps necessary to close units at any time and a description of the final cover design, methods, and procedures to install the final cover	Required	330.457(e)(1)	Yes	Attachment 9		Closure Plan
691	Part III	Provide an estimate of the largest area needing final cover	Required	330.457(e)(2)	Yes	Attachment 9, Section 3.2.1		Closure Plan
692	Part III	Provide an estimate of max volume of waste ever on-site	Required	330.457(e)(3)	Yes	Attachment 9, Section 3.2.2		Closure Plan
693	Part III	Provide a schedule for completing closure activities	Required	330.457(e)(4)	Yes	Attachment 9, Section 4		Closure Plan
694	Part III	Provide a final contour map – depicting proposed final contours, top & side slopes, surface drainage features, and 100yr flood protection	Required	330.457(e)(5)	Yes	Attachment 3, Drawings 3.1, 3.2, and 3.3		Closure Plan
695	Part III	Provide the specifics for the implementation of closure plan and place a copy of the plan in the operating record by the initial receipt of waste	Required	330.457(f)(1)	Yes	Attachment 9, Section 1		Closure Plan
696	Part III	Notify the ED in writing of the intent to close the facility, 45 days prior to initiation of closure activities	Required	330.457(f)(2)	Yes	Attachment 9, Section 4.1		Closure Plan
697	Part III	Specify in the closure plan that the operator will begin closure no later than 30 days after final receipt of waste or no later than one year if the unit has remaining capacity and additional waste may be received	Required	330.457(f)(3)	Yes	Attachment 9, Section 4.1		Closure Plan
698	Part III	Provide for closure activities to be completed within 180 days of initiation	Required	330.457(f)(4)	Yes	Attachment 9, Section 4.1		Closure Plan
699	Part III	Provide for post-closure care requirements following completion of closure. Submit PE certification of closure by registered mail with supporting documentation.	Required	330.457(f)(5)	Yes	Attachment 9, Section 4.1		Closure Plan
700	Part III	Acknowledge that following receipt of closure documents and the inspection report by the TCEQ region, the ED may acknowledge termination of operation & closure & deem the facility properly closed	Acknowledgement	330.457(f)(6)	Yes	Attachment 9, Section 4.1		Closure Plan
701	Part III	Submit a certified copy within 10 days after landfill unit closure, of the “Affidavit to the Public”. The Owner and Operator shall record a certified notation to the deed that the land has been used as a landfill facility	Required	330.457(g)	Yes	Attachment 9, Section 4.1		Closure Plan
702	Part III	Indicate that notice of closure will be published in the newspaper of largest circulation 90 days prior to the initiation of a final facility closure. The notice shall provide the name, address, and physical location of the facility; the TCEQ authorization number; and the last date of intended receipt of waste.	Required	330.461(a)	Yes	Attachment 9, Section 4.1		Closure Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
704	Part III	Acknowledge that least one closure sign will be posted at every point of access and notify all persons who utilize the facility of the date of closure and the prohibition against further receipt of waste materials.	Acknowledgement	330.461(b)	Yes	Attachment 9, Section 4.1		Closure Plan
710	Part III	Submit a closure plan for Storage and Processing units to remove all waste, waste residues, and any recovered materials. Units shall be dismantled and removed off-site or decontaminated.	Required	330.459(a)	No		Not Applicable	Closure Plan For Processing Facilities
711	Part III	Provide plans for the evacuation of all material on-site to an authorized facility and the disinfecting of all contaminated water handling units, tipping areas, processing and post-processing areas (as applicable)	Required	330.459(b)	No		Not Applicable	Closure Plan For Processing Facilities
712	Part III	Acknowledge that if there is evidence of a release, the ED may require an investigation, assessment, and or corrective action.	Acknowledgement	330.459(c)	No		Not Applicable	Closure Plan For Processing Facilities
713	Part III	Submit a plan (if combustible material is stored outdoors) for closure of a recycling facility that includes collecting processed and unprocessed materials, and transporting the materials to an authorized facility for disposition	Required	330.459(d)(1)	No		Not Applicable	Closure Plan For Processing Facilities
714	Part III	Provide for the closure plan to be implemented (if combustible material is stored outdoors) and completed within 180 days following the most recent acceptance of processed or unprocessed materials	Required	330.459(d)(2)	No		Not Applicable	Closure Plan For Processing Facilities
715	Part III	Submit a Post-Closure Plan that includes a PE certification of closure, and specify that the owner or operator shall retain the right of entry to and maintain all rights-of-way in order to conduct periodic inspections for a minimum 5 yrs. after certification of closure.	Required	330.63(i)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
716	Part III	Provide for maintenance and control of cover material, erosion control, vegetative growth, leachate or methane migration, and subsidence or ponding of water on the unit. If any of these problems persist for longer than the first five years of post-closure care, the owner or operator shall be responsible for their correction	Required	330.463(a)(1)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
717	Part III	Acknowledge that the ED may reduce the post-closure period for the unit if all wastes and waste residues have been removed during closure	Acknowledgement	330.463(a)(1)	No		Not Applicable	Post-Closure Plan
718	Part III	Provide for continued monitoring programs, i.e., groundwater monitoring, resistivity surveys, methane monitoring, etc.; during the post-closure care period.	Required	330.463(a)(2)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
719	Part III	Acknowledge that the ED may require an investigation into the nature and extent of any release from the facility and an assessment to correct an impact to groundwater	Acknowledgement	330.463(a)(3)	Yes	Attachment 9, Section 6.3		Post-Closure Plan
720	Part III	Provide for 30-year post-closure care after PE certification of closure	Required	330.463(b)(1)	Yes	Attachment 9, Section 6.1, Paragraph 1		Post-Closure Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
721	Part III	Provide for right of entry and the maintenance of all rights-of-way, conduct site maintenance and/or remediation, maintain final cover, vegetation, drainage & correct as needed	Required	330.463(b)(1)(A)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
722	Part III	Provide maintenance and operation of the leachate collection system	Required	330.463(b)(1)(B)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
723	Part III	Provide for maintenance and monitoring of the groundwater monitoring system per requirements of Subchapter J	Required	330.463(b)(1)(C)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
724	Part III	Provide for maintenance and monitoring of gas system per requirements of Subchapter I	Required	330.463(b)(1)(D)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
725	Part III	Provide for continued earth electrical resistivity surveys per site development plan	Required	330.463(b)(1)(E)	No		Not Applicable	Post-Closure Plan
726	Part III	Place a copy of the post-closure plan in the operating record by initial receipt of waste.	Required	330.463(b)(3)	Yes	Attachment 9, Section 1		Post-Closure Plan
727	Part III	Submit a description of the monitoring and maintenance activities required and the frequency at which these activities will be performed	Required	330.463(b)(3)(A)	Yes	Attachment 9, Section 6.1		Post-Closure Plan
728	Part III	Provide the name, address, & phone number of responsible person	Required	330.463(b)(3)(B)	Yes	Attachment 9, Section 7		Post-Closure Plan
729	Part III	Provide a description of the planned use of closed unit during the post closure period	Required	330.463(b)(3)(C)	Yes	Attachment 9, Section 8		Post-Closure Plan
730	Part III	Provide a detailed written estimate of the cost of post-closure care maintenance and any corrective action as described in the post-closure care plan or required by the ED per Subchapter L	Required	330.463(b)(3)(D)	Yes	Attachment 9, Section 9 and Attachment 8		Post-Closure Plan
731	Part III	Indicate that a certification of completion of post-closure care signed by a PE will be submitted at the end of the post-closure care period	Required	330.465(a)	Yes	Attachment 9, Section 6.4		Post-Closure Plan
739	Part III	Provide a closure cost estimate that equals the costs of closure of the facility, including disposition of the maximum inventories of all waste; processed and unprocessed combustible materials stored outdoors on site during the life of the facility	Required	330.505(a)(2)(A)	Yes	Attachment 9, Section 5, amd Attachment 8		Closure Cost Estimates
740	Part III	Provide a closure cost estimate that is based on the costs of hiring a third party that is not affiliated with the owner or operator; and is based on a per cubic yard and/or short ton measure for collection and disposition costs.	Required	330.505(a)(2)(B-(C)	Yes	Attachment 9, Section 5, and Attachment 8, Section 2		Closure Cost Estimates
741	Part III	Provide for the closure cost estimate & financial assurance to be increased if conditions change which increase the maximum cost of closure at any time during the active life of the facility	Required	330.505(a)(3)	Yes	Attachment 8, Section 4		Closure Cost Estimates
742	Part III	A reduction in the closure cost estimate and the amount of financial assurance may be approved if the cost estimate exceeds the maximum cost of closure at any time during the remaining life of the facility.	Required if Requested	330.505(a)(4)	Yes	Attachment 8, Section 4		Closure Cost Estimates

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
743	Part III	Provide for the maintenance of financial assurance for Recycling facilities that store combustible materials outdoors or that pose a risk	Required	330.505(b)(1)	No		Not Applicable	Closure Cost Estimates
744	Part III	Provide for the maintenance of financial assurance until closure is approved by ED.	Required	330.505(b)(2)	Yes	Attachment 8, Section 1		Closure Cost Estimates
745	Part III	Submit a Post-Closure Care Cost Estimates for the cost of hiring a third party to conduct post-closure care activities. The cost estimate shall account for the total costs of conducting post closure care for the largest area that could possibly require post-closure care in the year to follow over the entire post closure care period.	Required	330.507(a)	Yes	Attachment 8, Section 3 and Appendix 8C		Post-Closure Care Cost Estimates for Landfills
746	Part III	Submit an increase in the post-closure care cost estimate and the amount of financial assurance if changes in the post-closure care plan or the unit conditions increase the maximum costs of post-closure care	Required if Requested	330.507(a)(1)	No		Not Applicable	Post-Closure Care Cost Estimates for Landfills
747	Part III	Submit a reduction in the post-closure care cost estimate and the amount of financial assurance if the cost estimate exceeds the maximum costs of post-closure care remaining and a notice is provided to the ED of the detailed justification for the reduction of the cost estimate and the amount of financial assurance as a permit modification.	Required	330.507(a)(2)	Yes	Attachment 8, Section 4		Post-Closure Care Cost Estimates for Landfills
748	Part III	Implement a corrective action program and a detailed written cost estimate of the cost of hiring a third party to perform the corrective action program. The corrective action cost estimate shall account for the total costs of corrective action activities	Required if Requested	330.509(a)	No		Not Applicable	Corrective Action Cost Estimate
749	Part III	The corrective action cost estimate and the amount of financial assurance shall be increased if changes in the corrective action program or unit conditions increase the maximum costs of corrective action	Required if Requested	330.509(a)(1)	No		Not Applicable	Corrective Action Cost Estimate
750	Part III	A reduction in the cost estimate and the amount of financial assurance for corrective action may be approved if the cost estimate exceeds the maximum remaining costs of corrective action at any time during the remaining corrective action period	Required if Requested	330.509(a)(2)	No		Not Applicable	Corrective Action Cost Estimate
751	Part III	Provide financial assurance for the costs of the most recent corrective action program. Continuous financial assurance coverage for each corrective action program shall be provided until the facility is officially released in writing by the ED	Required if Requested	330.509(b)	No		Not Applicable	Corrective Action Cost Estimate
752	Part III	Provide financial assurance per Chapter 37, Subchapter R	Required	330.503(b)	Yes	Attachment 8, Section 3		Financial Assurance

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
753	Part III	Provide for financial assurance for post-closure cost. Continuous financial assurance coverage for post-closure care shall be provided	Required	330.507(b)	Yes	Attachment 8, Section 3		Financial Assurance
754	Part III	Provide Maps/Drawings with elements referenced under 330.57(h)(1)-(6) (Legible, Standard Engineering Scale, Dated Title and Revision Blocks, Seal, Drawing and Page No., North Arrow, Base Map Source, Legend, Section Lines)	Required	330.57(h)(1)-(6)	Yes	Attachments 1, 2, 3, and other attachments with drawings		Format-Maps/Drawings
755	Part IV	A site operating plan shall cover all on-site units in accordance with Subchapters D & E of Chapter 330.	Informational	330.65(a)			Part IV	Site Operating Plan
756	Part IV	A facility that has an environmental management system that meets both the minimum standards described in 30 TAC §90.32 of this title and the United States Environmental Protection Agency's National Environmental Performance Track is not subject to site operating plan requirements	Informational	330.65(b)			Not Applicable	Site Operating Plan
757	Part IV	In the event the executive director terminates authorization to operate under an environmental management system, the facility will comply with the site operating plan requirements within 90 days.	Informational	330.65(b)			Not Applicable	Site Operating Plan
758	Part IV	Provide procedures for recirculating leachate or gas condensate	Required if Requested	330.65(c)	Yes	Part IV, Section 4.22		Site Operating Plan
759	Part IV	Acknowledge that the site development plan, site operating plan, final closure plan, post-closure maintenance plan, landfill gas management plan, & all other documents are operating requirements & part of the operating record.	Acknowledgement	330.121(a)	Yes	Part IV, Section 7.1		Site Operating Plan
760	Part IV	Acknowledge that any deviation from the permit and incorporated plans or other related documents associated with the permit is a violation of this chapter	Acknowledgement	330.121(a)	Yes	Part IV, Section 7.1		Site Operating Plan
761	Part IV	Acknowledgment that the SLER will be submitted to the ED 14 days prior to waste disposal operations for each new disposal area	Acknowledgement	330.123	Yes	Part IV, Section 7.3		Site Operating Plan
762	Part IV	Acknowledge that all information required to be in the site operating record to be placed in the operating record within seven (7) days of completion or receipt	Acknowledgement	330.125(b)	Yes	Part IV, Section 7.1		Site Operating Plan
763	Part IV	Acknowledge that all location restriction demonstrations will be maintained in the site operating record	Acknowledgement	330.125(b)(1)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
765	Part IV	Acknowledge that all results of gas monitoring & any remediation plans relating to explosive and other gases will be maintained in the site operating record	Acknowledgement	330.125(b)(3)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
766	Part IV	Acknowledge that all unit design documentation regarding placement of leachate or gas condensate will be maintained in the site operating record	Acknowledgement	330.125(b)(4)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
767	Part IV	Acknowledge that all demonstration, certification, findings, monitoring, testing, and analytical data relating to groundwater monitoring and corrective action will be maintained in the site operating record	Acknowledgement	330.125(b)(5)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
768	Part IV	Acknowledge that all closure and post-closure care plans and any monitoring, testing, or analytical data relating to post-closure requirements will be maintained in the site operating record	Acknowledgement	330.125(b)(6)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
769	Part IV	Acknowledge that all cost estimates and financial assurance documentation relating to financial assurance for closure and post-closure will be maintained in the site operating record	Acknowledgement	330.125(b)(7)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
770	Part IV	Acknowledge that all documentation of compliance with small community exemption criteria will be maintained in the site operating record	Acknowledgement	330.125(b)(8)	No		Not Applicable	Site Operating Plan
771	Part IV	Acknowledge that copies of all correspondence and responses relating to the operation of the facility, modifications to the permit, approvals, and other matters pertaining to technical assistance will be maintained in the site operating record	Acknowledgement	330.125(b)(9)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
772	Part IV	Acknowledge that all documents, manifests, shipping documents, trip tickets, etc., involving special waste will be maintained in the site operating record	Acknowledgement	330.125(b)(10)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
773	Part IV	Acknowledge that records of the application rate and total amount of any spray-applied alternative daily cove applied to the working face will be maintained in the site operating record.	Acknowledgement	330.125(b)(11)	No		Not Applicable	Site Operating Plan
774	Part IV	Acknowledge that any other documents specified by the permit or Executive Director will be maintained in the site operating record	Acknowledgement	330.125(b)(12)	Yes	Part IV, Section 7.1, Paragraph 2		Site Operating Plan
775	Part IV	Acknowledge that the site operating record will maintain all required documents in an organized format and in accordance with the time frames specified in 330.125(b), and will be furnished upon request to the executive director and must be made available for inspection by the executive director	Acknowledgement	330.125(c)	Yes	Part IV, Section 7.1		Site Operating Plan
776	Part IV	Indicate that the operating record will be maintained for life & post-closure period of the facility	Required	330.125(d)	Yes	Part IV, Section 7.1,		Site Operating Plan
777	Part IV	Indicate that all training records will be maintained in accordance with 30 TAC §335.586(d) & (e)	Required	330.125(e)	Yes	Part IV, Section 7.1		Site Operating Plan
778	Part IV	Indicate that personnel operating licenses issued under 30 TAC Chapter 30, Subchapter F will be maintained in the site operating record	Required	330.125(f)	Yes	Part IV, Section 7.1		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
779	Part IV	Indicate that the executive director may set alternative schedule for recordkeeping & notification	Required	330.125(g)	No		Not Applicable	Site Operating Plan
780	Part IV	Indicate that records documenting the annual waste acceptance rate will be maintained in the site operating record	Required	330.125(h)	Yes	Part IV, Section 7.1		Site Operating Plan
781	Part IV	Indicate that documentation of waste acceptance rate will include maintaining annual & quarterly waste summary reports required by 30 TAC §330.675	Required	330.125(h)	Yes	Part IV, Section 7.1,; and Part IV, Section 4.1		Site Operating Plan
782	Part IV	Indicate that the facility will provide the reports required by 30 TAC §330.675 to the Executive Director	Required	330.675	Yes	Part IV, Section 7.2		Site Operating Plan
783	Part IV	Indicate that if the annual waste acceptance rate exceeds the rate estimated in the landfill permit application and the waste increase is not due to a temporary occurrence, the owner or operator shall file an application to modify the permit application, including the revised estimated waste acceptance rate, in accordance with 30 TAC §305.70(k) of this title (relating to Municipal Solid Waste Permit and Registration Modifications), within 90 days of the exceedance as established by the sum of the previous four quarterly summary reports.	Required	330.125(h)	Yes	Part IV, Section 7.2		Site Operating Plan
784	Part IV	Provide a description of the function & minimum qualifications of key personnel	Required	330.127(1)	Yes	Part IV, Section 2.1		Site Operating Plan
785	Part IV	Provide a description of the minimum number, size, type and function of the equipment to be utilized at the facility	Required	330.127(2)	Yes	Part IV, Section 3, Table 3.1		Site Operating Plan
786	Part IV	Provide a description of the provisions for back-up equipment during periods of breakdown or maintenance of this listed equipment	Required	330.127(2)	Yes	Part IV, Section 3, Paragraph 2		Site Operating Plan
787	Part IV	Provide general instructions for personnel concerning operational requirements	Required	330.127(3)	Yes	Part IV, Section 2.1		Site Operating Plan
788	Part IV	Identify all applicable training requirements under 30 TAC §335.586(a) & (c) that must be followed	Required	330.127(4)	Yes	Part IV, Section 2.2, Table 2.2		Site Operating Plan
789	Part IV	Provide procedures for the detection and prevention of the disposal of prohibited wastes, including hazardous waste & PCB wastes	Required	330.127(5)	Yes	Part IV, Section 5.1		Site Operating Plan
790	Part IV	Provide procedures for random inspections of incoming loads including the inspection of compactor vehicles.	Required	330.127(5)(A)	Yes	Part IV, Section 5.2		Site Operating Plan
791	Part IV	Indicate that trained staff shall observe each load that is disposed at the landfill	Required	330.127(5)(A)	Yes	Part IV, Section 5.2		Site Operating Plan
792	Part IV	Indicate that records will be kept of all waste load inspections	Required	330.127(5)(B)	Yes	Part IV, Section 5.3		Site Operating Plan
793	Part IV	Indicate that facility personnel inspecting or observing loads must have training to recognize prohibited waste	Required	330.127(5)(C)	Yes	Part IV, Section 5.1 ang 5.4		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
794	Part IV	Indicate that notification will be provide to executive director and to any local pollution agency with jurisdiction that has requested to be notified, of the receipt or disposal of hazardous or PCB waste	Required	330.127(5)(D)	Yes	Part IV, Section 5.5		Site Operating Plan
795	Part IV	Provide provisions for remediation of hazardous or PCB waste that has been received for disposal at the facility	Required	330.127(5)(E)	Yes	Part IV, Section 5.1, Bullet 8 and Section 5.5		Site Operating Plan
796	Part IV	Indicate that the facility will maintain a source of earthen material available to extinguish fires, sized to cover waste not covered with six inches of earthen material within one hour of detecting a fire.	Required	330.129	Yes	Part IV, Section 6.1, Bullet 6		Site Operating Plan
797	Part IV	Provide a demonstration, including calculations, showing that sufficient on-site equipment and earthen material stockpile is available to cover any waste not already covered with six inches of earthen material within one hour of detecting a fire.	Required	330.129	Yes	Part IV, Section 6.1		Site Operating Plan
798	Part IV	Indicate that sufficient on-site equipment must be provided to place a six-inch layer of earthen material to cover any waste not already covered with six inches of earthen material within one hour of detecting a fire	Required	330.129	Yes	Part IV, Section 6.1		Site Operating Plan
799	Part IV	Provide fire protection standards & training procedures	Required	330.129	Yes	Part IV, Section 2.2;and Section 6.2		Site Operating Plan
800	Part IV	Identify other activities requiring fire protection and provide protection measures specific to each individual activity	Required	330.129	Yes	Part IV, Section 6.3		Site Operating Plan
801	Part IV	Indicate that if a fire occurs that is not extinguished within ten minutes of detection, the commission's regional office must be contacted immediately after detection, but no later than four hours by telephone, and in writing within 14 days with a description of the fire and the resulting response.	Required	330.129	Yes	Part IV, Section 6.2		Site Operating Plan
802	Part IV	Provide provisions for access control to the facility	Required	330.131	Yes	Part IV, Section 4.1		Site Operating Plan
803	Part IV	Provide an inspection and maintenance schedule for access control features	Required	330.131	Yes	Part IV, Section 4.1.1		Site Operating Plan
804	Part IV	Indicate that the commission's regional office, and any local pollution agency with jurisdiction that has requested to be notified, must be notified of the breach within 24 hours of detection. Indicate that the breach must be temporarily repaired within 24 hours of detection and must be permanently repaired by the time specified to the commission's regional office when it was reported in the initial breach report. Indicate that if a permanent repair can be made within eight hours of detection, no notice to the commission's regional office is required.	Required	330.131	Yes	Part IV, Section 4.1.1		Site Operating Plan
805	Part IV	Identify all unloading areas and specify maximum size of each unloading area.	Required	330.133(a)	Yes	Part IV, Section 4.2.1 and Section 4.2.2		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
806	Part IV	Indicate that trained staff will monitor incoming loads at each unloading area	Required	330.133(a)	Yes	Part IV, Section 4.2.1 and Section 4.2.2		Site Operating Plan
807	Part IV	Indicate that the unloading of waste in unauthorized areas is prohibited.	Required	330.133(b)	Yes	Part IV, Section 4.2		Site Operating Plan
814	Part IV	At Type IV landfills, only brush, C&D, & rubbish free of putrescible and household waste are allowed	Informational	330.133(e)			Not Applicable	Site Operating Plan
815	Part IV	Submit a written procedure that will ensure that containers with any putrescible wastes are not accepted at the landfill	Required	330.133(f)(1)	No		Not Applicable	Site Operating Plan
816	Part IV	Submit a written procedure for the immediate removal of any putrescible wastes and other prohibited waste disposed of at the landfill	Required	330.133(f)(2)	No		Not Applicable	Site Operating Plan
817	Part IV	Provide a procedure for transporter certifications that will be retained at the landfill and available for inspection by the executive director	Required	330.133(f)(3)	No		Not Applicable	Site Operating Plan
818	Part IV	Acknowledge that Type IV landfills may only accept waste in enclosed containers or enclosed vehicles in accordance with 30 TAC §330.169	Acknowledgement	330.133(g)	No		Not Applicable	Site Operating Plan
819	Part IV	Provide a description of wastes that are not allowed and state the landfill's requirements for transporters	Required	330.133(h)	No		Not Applicable	Site Operating Plan
820	Part IV	Specify waste acceptance and operating hours	Required	330.135(a)	Yes	Part IV, Section 4.3		Site Operating Plan
821	Part IV	The waste acceptance hours of a municipal solid waste facility may be any time between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday, unless otherwise approved in the authorization for the facility. Waste acceptance hours within the 7:00 a.m. to 7:00 p.m. weekday span do not require other specific approval. Transportation of materials and heavy equipment operation must not be conducted between the hours of 9:00 p.m. to 5:00 a.m., unless otherwise approved in the authorization for the facility. Operating hours for other activities do not require specific approval.	Informational	330.135(a)			Part IV, Section 4.3	Site Operating Plan
822	Part IV	Specify alternative operating hours of up to five days in a calendar year to accommodate special occasions, special purpose events, holidays, or other special occurrences	Required If Requested	330.135(b)	Yes	Part IV, Section 4.3		Site Operating Plan
823	Part IV	Indicate that the facility will record in the site operating record the dates, times, and duration when any alternative operating hours are utilized	Required	330.135(d)	Yes	Part IV, Section 4.3		Site Operating Plan
824	Part IV	Indicate that a sign measuring at least 4' X 4' with letters at least three inches in height must be displayed at all entrances.	Required	330.137	Yes	Part IV, Section 4.4		Site Operating Plan
825	Part IV	Indicate that information on the sign must include the facility type, hours and days of operation, an emergency 24hr. Contact number, local fire department number & permit number	Required	330.137	Yes	Part IV, Section 4.4		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
826	Part IV	Indicate that windblown waste and litter at the working face must be controlled by using engineering methods or measures, including portable panels, temporary fencing, and perimeter fencing or comparable engineering controls.	Required	330.139(1)	Yes	Part IV, Section 4.5		Site Operating Plan
827	Part IV	Provide a plan for daily management of litter scattered throughout the site, along fences and access roads, and at the gate	Required	330.139(2)	Yes	Part IV, Section 4.5		Site Operating Plan
828	Part IV	Indicate that no unloading, storage, disposal, or processing operations will occur within easements, buffer zones, or rights-of-way that crosses the site, and that no disposal shall occur within 25 feet of the center line of any utility line or pipeline easement, unless otherwise authorized by the executive director	Required	330.141(a)	Yes	Part IV, Section 4.6.1 and Section 4.6.2		Site Operating Plan
829	Part IV	Indicate that all pipeline and utility easements must be clearly marked with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet	Required	330.141(a)	Yes	Part IV, Section 4.6.1		Site Operating Plan
830	Part IV	Indicate that a minimum separating distance shall be maintained between solid waste processing and disposal activities within and adjacent to the facility boundary on property owned or controlled by the owner or operator as determined by the requirements of 30 TAC §330.543. The buffer zone must provide for safe passage for fire-fighting and other emergency vehicles.	Required	330.141(b)	Yes	Part IV, Section 4.6.2		Site Operating Plan
831	Part IV	Indicate that the visibility of all required landfill markers and the benchmark must be maintained	Required	330.143(a)	Yes	Part IV, Section 4.7		Site Operating Plan
832	Part IV	Indicate that landfill markers must be inspected on a monthly basis and records of all inspections placed in the site operating record	Required	330.143(a)	Yes	Part IV, Section 4.7, Paragraph 1		Site Operating Plan
833	Part IV	indicate that all markers must be replaced within 15 days of removal, destruction, or a determination that the markers do not meet regulatory requirements.	Required	330.143(a)	Yes	Part IV, Section 4.7		Site Operating Plan
834	Part IV	Landfill markers must be installed to clearly mark significant features and that the executive director may modify specific marker requirements to accommodate unique site-specific conditions.	Required	330.143(b)	Yes	Part IV, Section 4.7		Site Operating Plan
835	Part IV	Indicate that markers must be posts extending 6ft. above ground and not obscured	Required	330.143(b)(1)	Yes	Part IV, Section 4.7		Site Operating Plan
836	Part IV	Provide the color coding for on-site markers that is in compliance with 330.143(b)(1)(A) – (F)	Required	330.143(b)(1)(A) – (F)	Yes	Part IV, Section 4.7		Site Operating Plan
837	Part IV	Indicate that boundary markers must be placed at each corner of the facility and along boundary line at intervals not greater than 300 ft.	Required	330.143(b)(2)	Yes	Part IV, Section 4.7		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
838	Part IV	Indicate that markers identifying the buffer zone will placed along each buffer zone boundary at intervals of no greater than 300 ft.	Required	330.143(b)(3)	Yes	Part IV, Section 4.7		Site Operating Plan
839	Part IV	Indicate that easement and right-of-way markers must be placed along the centerline of an easement and along the boundary of a right-of-way at each corner within the facility and at the intersection of the facility boundary	Required	330.143(b)(4)	Yes	Part IV, Section 4.7		Site Operating Plan
840	Part IV	Indicate that a landfill grid system must be installed unless written approval from the executive director has been received.	Required	330.143(b)(5)	Yes	Part IV, Section 4.7		Site Operating Plan
841	Part IV	Indicate that grid system will encompass at least the area expected to be filled within the next three-year period and that marks must be spaced no greater than 100 feet apart measured along perpendicular lines and that where markers cannot be seen from opposite boundaries, intermediate markers must be installed, where feasible.	Required	330.143(b)(5)	Yes	Part IV, Section 4.7		Site Operating Plan
842	Part IV	Indicate that soil liner or geomembrane markers will be placed so that areas under evaluation can be determined & maintained through construction & operation period.	Required	330.143(b)(6)	Yes	Part IV, Section 4.7		Site Operating Plan
843	Part IV	Indicate that the location of the liner markers must be tied into the landfill grid system and must be reported on each soil liner evaluation report or geomembrane liner evaluation report submitted	Required	330.143(b)(6)	Yes	Part IV, Section 4.7		Site Operating Plan
844	Part IV	Indicate that liner area markers must not be placed inside constructed areas.	Required	330.143(b)(6)	Yes	Part IV, Section 4.7		Site Operating Plan
845	Part IV	Indicate that flood protection markers must be installed for any area within a solid waste disposal facility that is within the 100-year floodplain and that areas subject to flooding must be clearly marked by means of permanent posts not more than 300 feet apart or closer if necessary to retain visual continuity.	Required	330.143(b)(7)	Yes	Part IV, Section 4.7		Site Operating Plan
846	Part IV	Indicate that a permanent benchmark must be established and accessible and must be a bronze survey marker in concrete stamped with elevation and date stamped on it and that the benchmark must be surveyed from a known United States Coast and Geodetic Survey benchmark or other reliable benchmark	Required	330.143(b)(8)	Yes	Part IV, Section 4.7		Site Operating Plan
847	Part IV	Indicate that the facility owner or operator shall take steps to encourage that vehicles hauling waste to the facility are enclosed or provided with a tarpaulin, net, or other means to effectively secure the load in order to prevent the escape of any part of the load by blowing or spilling.	Required	330.145	Yes	Part IV, Section 4.8		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
848	Part IV	Indicate that the owner or operator shall take actions such as posting signs, reporting offenders to proper law enforcement officers, adding surcharges, or similar measures.	Required	330.145	Yes	Part IV, Section 4.8		Site Operating Plan
849	Part IV	Indicate that on days when the facility is in operation, the owner or operator shall be responsible for at least once per day cleanup of waste materials spilled along and within the right-of-way of public access roads serving the facility for a distance of two miles in either direction from any entrances used for the delivery of waste to the facility.	Required	330.145	Yes	Part IV, Section 4.8		Site Operating Plan
850	Part IV	Indicate that the facility operator will consult with the Texas Department of Transportation, county, and/or local governments with maintenance authority over the roads concerning cleanup of public access roads and rights-of-way	Required	330.145	Yes	Part IV, Section 4.8		Site Operating Plan
851	Part IV	Indicate that large, heavy, bulky items that cannot be incorporated in the regular spreading, compaction, and covering operations at landfill should be recycled and that a large item salvage area should be established & items removed often enough to prevent nuisance or discharge	Required	330.147(a)	Yes	Part IV, Section 4.9		Site Operating Plan
852	Part IV	Indicate the items that can be classified as large, heavy, or bulky. This can include, but is not limited to, white goods (household appliances), air conditioner units, metal tanks, large metal pieces, and automobiles.	Required	330.147(b)	Yes	Part IV, Section 4.9		Site Operating Plan
853	Part IV	Indicate that refrigerators, freezer, air conditioners, and any other items containing CFCs must be handled in accordance with 40 CFR 82.156(f)	Required	330.147(c)	Yes	Part IV, Section 4.9		Site Operating Plan
854	Part IV	Provide an odor management plan that addresses the sources of odors and includes general instructions to control odors or the sources of odors. The plans for odor management must include the identification of wastes that require special attention such as septage, grease trap waste, dead animals, and leachate	Required	330.149	Yes	Part IV, Section 4.10.2		Site Operating Plan
855	Part IV	Provide procedures for the control of on-site populations of disease vectors including the use of proper compaction and daily cover procedures, and the use of other approved methods when needed. The general methods and performance-based frequencies for disease vector control must be specified	Required	330.151	Yes	Part IV, Section 4.11		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
856	Part IV	Provide a description for all weather access roads from the facility to public roads and within the facility. Indicate that tracked mud & debris on public roadway removed once a day on days when mud and associated debris are being tracked onto the public roadway. Provide a description of the specific method for controlling mud & debris	Required	330.153(a)	Yes	Part IV, Section 4.12		Site Operating Plan
857	Part IV	Indicate that tracked mud & associated debris on public roadway removed once a day on days when mud and associated debris are being tracked onto the public roadway.	Required	330.153(a)	Yes	Part IV, Section 4.12		Site Operating Plan
858	Part IV	Provide a description of the specific method for controlling mud & debris	Required	330.153(a)	Yes	Part IV, Section 4.12		Site Operating Plan
859	Part IV	Specify method of dust control or suppression	Required	330.153(b)	Yes	Part IV, Section 4.12		Site Operating Plan
860	Part IV	Provide a description, including frequency, of how all on site roadways will be maintained to minimize depressions, ruts, and potholes	Required	330.153(c)	Yes	Part IV, Section 4.12		Site Operating Plan
861	Part IV	Indicate that litter and any other debris must be picked up at least daily and taken to the working face for disposal	Required	330.153(c)	Yes	Part IV, Section 4.12		Site Operating Plan
862	Part IV	Indicate that salvaging operations must not interfere with prompt sanitary disposal of solid waste or to create public health nuisances.	Required	330.155	Yes	Part IV, Section 4.13		Site Operating Plan
863	Part IV	Indicate that salvaged items will be removed often enough to prevent becoming a nuisance, preclude the discharge of any pollutants, or to prevent an excessive accumulation of material.	Required	330.155	Yes	Part IV, Section 4.13		Site Operating Plan
864	Part IV	Indicate that Class 1 industrial and other special wastes received at the disposal facility must not be salvaged.	Required	330.155	Yes	Part IV, Section 4.13		Site Operating Plan
865	Part IV	Indicate that pesticide, fungicide, rodenticide, and herbicide containers must not be salvaged unless being salvaged through a state-supported recycling program.	Required	330.155	Yes	Part IV, Section 4.13		Site Operating Plan
866	Part IV	Indicate that scavenging is prohibited.	Required	330.155	Yes	Part IV, Section 4.13		Site Operating Plan
867	Part IV	Specify criteria for the protection of identified endangered species	Required	330.157	Yes	Part IV, Section 4.14		Site Operating Plan
868	Part IV	Indicate that landfill gas report and submittals must be maintained in operating record	Required	330.159	Yes	Part IV, Section 4.15		Site Operating Plan
869	Part IV	Indicate that within 30 days of discovery, notice will be provide to the executive director of the location of any and all existing or abandoned water wells, oil wells, natural gas wells or other wells situated within the facility.	Required	330.161(a)-(b)	Yes	Part IV, Section 4.16		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
870	Part IV	Indicate that within 30 days of discovery, the facility will provide the executive director with notification and written certification that the water well has been capped, plugged, and closed in accordance with all applicable rules and regulations of the commission or other state agency	Required	330.161(a)	Yes	Part IV, Section 4.16		Site Operating Plan
872	Part IV	Indicate that the executive director may approve any well used to supply water at the facility that is located within the permit boundary if it is determined that the well is outside the waste footprint, it is not impacted by landfill operations, it can be demonstrated that well design and installation will prevent any cross-contamination from the waste management unit to the water well production zone and between any water bearing zones, and an approved sampling plan to include frequency and parameters is in place.	Required	330.161(a)	No		Not Applicable	Site Operating Plan
873	Part IV	Indicate that any water or other type of wells under the jurisdiction of the commission must be plugged in accordance with all applicable state requirements or additional requirements imposed by the executive director and that a copy of the well plugging report required to be submitted to the appropriate state agency and must also be submitted to the executive director within 30 days after the well has been plugged.	Required	330.161(c)	Yes	Part IV, Section 4.16		Site Operating Plan
874	Part IV	Indicate that any proposed changes to the liner installation plan as a result of any well abandonment will be submit for executive director approval as permit modification	Required	330.161(d)	Yes	Part IV, Section 4.16		Site Operating Plan
875	Part IV	Specify the methods of compaction of waste	Required	330.163	Yes	Part IV, Section 4.17		Site Operating Plan
876	Part IV	Indicate that the landfill must apply six inches of well-compacted earthen material not previously mixed with garbage, rubbish, or other solid waste at the end of each operating day to control disease vectors, fires, odors, windblown litter or waste, and scavenging, unless the executive director requires a more frequent interval.	Required	330.165(a)	Yes	Part IV, Section 4.18.2		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
877	Part IV	Indicate that the landfill must apply six inches of well-compacted earthen material not previously mixed with garbage, rubbish, or other solid waste at least weekly to control disease vectors, fires, odors, windblown litter or waste, and scavenging, unless the executive director requires a more frequent interval.	Required	330.165(b)	No		Not Applicable	Site Operating Plan
878	Part IV	Landfills that operate on a 24-hour basis must cover the working face or active disposal area at least once every 24 hours. The executive director may require a chemical analysis of any landfill cover material. Runoff from areas that have intact daily cover is not considered as having come into contact with the working face or leachate.	Informational	330.165(a)				Site Operating Plan
879	Part IV	Indicate that all areas that have received waste but will be inactive for longer than 180 days must provide intermediate or final cover.	Required	330.165(c)	Yes	Part IV, Section 4.18.2		Site Operating Plan
880	Part IV	Indicate that all intermediate cover will be six inches of suitable earthen material that is capable of sustaining native plant growth and must be seeded or sodded following its application in order to control erosion, or must be a material approved by the executive director that will otherwise control erosion. This intermediate cover must not be less than 12 inches of suitable earthen material. The intermediate cover must be graded to prevent ponding of water. Plant growth or other erosion control features must be maintained. Runoff from areas that have intact intermediate cover is not considered as having come into contact with the working face or leachate.	Required	330.165(c)	Yes	Part IV, Section 4.18.3		Site Operating Plan
881	Part IV	Indicate that alternative daily cover may only be allowed by a temporary authorization under §305.62(k)(1)(A) of this title (relating to Municipal Solid Waste Permit and Registration Modifications) followed by a major amendment or a modification in accordance with §305.70(k)(1) of this title. Use of alternative daily cover is limited to a 24-hour period after which either waste or daily cover as defined in subsection (a) of this section must be placed.	Required If Requested	330.165(d)	No		Not Applicable	Site Operating Plan
882	Part IV	Provide a alternative daily cover operating plan that includes the information required by 30 TAC §330.165(d)(1)(A) - (E)	Required If Requested	330.165(d)(1)(A)-(E)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
883	Part IV	Indicate that status reports on the alternative daily cover must be submitted on a two-month basis to the executive director during the temporary authorization period describing the effectiveness of the alternative material, any problems that may have occurred, and corrective actions required as a result of such problems.	Required If Requested	330.165(d)(2)	No		Not Applicable	Site Operating Plan
884	Part IV	Indicate that alternative daily cover must not be allowed when the landfill is closed for a period greater than 24 hours, unless the executive director approves an alternative length of time	Required If Requested	330.165(d)(3)	No		Not Applicable	Site Operating Plan
885	Part IV	Indicate that the constituents of concern in contaminated soils used as shall not exceed the concentrations listed in Table 1, Constituents of Concern and Their Maximum Leachable Concentrations, located in 30 TAC §335.521(a)(1)	Required If Requested	330.165(d)(4)	No		Not Applicable	Site Operating Plan
886	Part IV	Indicate that contaminated soils used as ADC will not contain PCB waste subject to 40 CFR Part 761	Required If Requested	330.165(d)(4)(A)	No		Not Applicable	Site Operating Plan
887	Part IV	Indicate that contaminated soils used as ADC will not contain TPH concentrations greater that 1,500 ppm unless ED approves a suitability demonstration	Required If Requested	330.165(d)(4)(B)	No		Not Applicable	Site Operating Plan
888	Part IV	ADC must not exceed constituent limits imposed on waste disposed at the facility	Required If Requested	330.165(d)(5)	No		Not Applicable	Site Operating Plan
889	Part IV	Indicate that the executive director may require the facility to test runoff from areas that have alternative daily cover for compliance with Texas Pollutant Discharge Elimination System storm water discharge limits or manage the runoff as contaminated water.	Required If Requested	330.165(d)(6)	No		Not Applicable	Site Operating Plan
890	Part IV	Provide a demonstration if there are any extreme seasonal climatic conditions that make meeting requirements of 30 TAC §330.165(a) - (d) impractical. Based on this demonstration the executive director may grant a temporary waiver from the requirements of subsections 30 TAC §330.165(a) - (d)	Required If Requested	330.165(e)	No		Not Applicable	Site Operating Plan
891	Part IV	Indicate that final cover for the landfill must be in accordance with the site closure plan and Subchapter K of Chapter 330.	Required	330.165(f)	Yes	Part IV, Section 4.18.4, Paragraph 1		Site Operating Plan
901	Part IV	indicate that enclosed containers or enclosed vehicles must only be accepted at their designated time and on the specified day in accordance with this section, commission permits, or other orders of the commission.	Required If Requested	330.169(1)(C)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
902	Part IV	Indicate that a commission inspector shall be on site and shall witness the unloading process to ensure that no putrescible waste or household waste is present and that any waste considered non-allowable by the inspector must be removed from the working face and subsequently from the facility in accordance with 30 TAC §330.133	Required If Requested	330.169(1)(D)	No		Not Applicable	Site Operating Plan
903	Part IV	Indicate that each transporter delivering waste in enclosed containers or enclosed vehicles must, prior to discharging the load, provide to the landfill operator a transporter trip ticket for the route being delivered. Trip tickets must be maintained as part of the operating record.	Required If Requested	330.169(1)(E)	No		Not Applicable	Site Operating Plan
904	Part IV	Stationary compactors permitted in accordance with 30 TAC §330.7 of this title (relating to Permit Required) and municipalities having transporter routes permitted in accordance with 30 TAC §330.7 of this title are exempt from the requirements of 30 TAC §330.169(1)-(3)	Informational	330.169(4)			Not Applicable	Site Operating Plan
905	Part IV	Indicate that the landfill operator must obtain from the transporter a hauler trip ticket for a municipal transporter route or stationary compactors, as appropriate, prior to allowing discharge of the material at the landfill. These trip tickets must be maintained as a part of the operating record.	Required	330.169(4)	No		Not Applicable	Site Operating Plan
906	Part IV	Indicate that the landfill may accept special wastes consistent with the limitations established in 30 TAC §330.5(a)(2) of this title (relating to Classification of Municipal Solid Waste Facilities) and the waste acceptance plan required by 30 TAC §330.61(b) of this title (relating to Contents of Part II of the Application).	Required	330.171(a)	No		Not Applicable	Site Operating Plan
907	Part IV	Indicate that special waste not identified in 30 TAC §330.171(c)-(d) require prior written approval from the executive director.	Required	330.171(b)	Yes	Part IV, Section 4.20		Site Operating Plan
908	Part IV	Approvals will be waste-specific and/or site-specific and will be granted only to appropriate facilities operating in compliance with this chapter.	Required	330.171(b)(1)	No		Not Applicable	Site Operating Plan
909	Part IV	Indicate that requests for approval to accept special wastes must be submitted by the generator to the executive director or to a facility with an approved plan	Required	330.171(b)(2)	No		Not Applicable	Site Operating Plan
910	Part IV	Indicate that requests for approval to accept special wastes must include a description of chemical & physical characteristics of waste and a statement as to whether or not each waste is a Class 1 industrial waste as defined in §330.3 of this title, and the quantity and rate at which each waste is produced and/or the expected frequency of disposal	Required	330.171(b)(2)(A)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
911	Part IV	Indicate that a hazardous waste determination as required by 30 TAC §335.6 will be included for all Class 1 industrial waste	Required	330.171(b)(2)(B)	No		Not Applicable	Site Operating Plan
912	Part IV	Indicate that all requests for approval to accept special wastes must that include an operational plan containing the proposed procedures for handling each waste and listing required protective equipment for operating personnel and on-site emergency equipment	Required	330.171(b)(2)(C)	No		Not Applicable	Site Operating Plan
913	Part IV	Indicate that all requests for approval to accept special wastes must that include a contingency plan outlining responsibility for containment and cleanup of any accidental spills occurring during the delivery and/or disposal operation	Required	330.171(b)(2)(D)	No		Not Applicable	Site Operating Plan
915	Part IV	Indicate that soils contaminated by petroleum products, crude oils, or chemicals in concentrations of greater than 1,500 milligram per kilogram (mg/kg) total petroleum hydrocarbons; or contaminated by constituents of concern that exceed the concentrations listed in Table 1, Constituents of Concern and Their Maximum Leachable Concentrations in 30 TAC §335.521(a)(1) of this title (relating to Appendices) must be disposed in dedicated cells that meet the requirements of 30 TAC §330.331(e) of this title (relating to Design Criteria).	Required	330.171(b)(4)	No		Not Applicable	Site Operating Plan
916	Part IV	Indicate that the executive director may authorize the receipt of special waste with a written concurrence from the facility, however, the facility operator is not required to accept the waste.	Required	330.171(b)(5)	No		Not Applicable	Site Operating Plan
917	Part IV	Indicate that the executive director may revoke an authorization to accept special waste if the owner or operator does not maintain compliance with these rules or conditions imposed in the authorization to accept special waste.	Required	330.171(b)(6)	No		Not Applicable	Site Operating Plan
918	Part IV	Indicate that special waste listed under 330.171(c) may be accepted if managed per the handling procedures for each waste identified in 330.171(c)(1) - (7)	Required	330.171(c)	Yes	Part IV, Section 4.20		Site Operating Plan
919	Part IV	Indicate that used oil filters from internal combustion engines must not be intentionally and knowingly accepted for disposal at landfills permitted under this chapter except as provided in 330.171(d)(1) & (2)	Required	330.171(d)	Yes	Part IV, Section 4.20.7		Site Operating Plan
920	Part IV	Indicate that Class 1 industrial solid waste shall not be disposed in the landfill	Required	330.173(a)	Yes	Part IV, Section 5.1		Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
921	Part IV	Indicate that wastes that are Class 1 only because of asbestos content may be accepted at any Type I or Type IAE landfill that is authorized to accept regulated asbestos-containing material (RACM). Authorization to accept this waste is implied in the authorization to accept RACM unless the acceptance of industrial wastes is prohibited by the permit. All Class 1 industrial asbestos wastes will be manifested and the owner or operator of the landfill facility shall comply with the requirements of 30 TAC §330.173(g) & (h)	Required	330.173(c)	No		Not Applicable	Site Operating Plan
922	Part IV	Indicate that the operator may not accept Class 1 without written approval and a manifest per 30 TAC §335.10	Required	330.173(b)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
923	Part IV	Indicate that requests for authorization to accept Class 1 solid wastes must be submitted in writing to the executive director	Required	330.173(d)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
924	Part IV	Indicate that a request to accept Class 1 waste must include a description of chemical & physical characteristics of the waste per 30 TAC §335.587, a hazardous waste statement, and the quantity, rate, and frequency of disposal	Required	330.173(d)(1)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
925	Part IV	Indicate that a request to accept Class 1 waste must include operating plan containing handling procedures, personnel protective & on-site emergency equipment	Required	330.173(d)(2)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
926	Part IV	Indicate that a request to accept Class 1 waste must include a written contingency plan meeting the requirements of 30 TAC §335.589	Required	330.173(d)(3)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
927	Part IV	Unless specifically authorized by the facility permit, a Type I or Type IAE landfill facility permitted after October 9, 1993, may not accept Class 1 industrial solid wastes in excess of 20% of the total amount of waste (not including Class 1 wastes) accepted during the current or previous year. The amount of waste may be determined by volume or by weight, but the same unit of measure must be used for each year, unless a variance is authorized by the executive director.	Informational	330.173(e)			Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
928	Part IV	Indicate that any authorization to accept Class 1 waste is subject to the site operating in compliance with 30 TAC §330.173 and any specific conditions required under any letter(s) of authorization. Failure to operate the site in compliance with 30 TAC §330.173 or any special conditions imposed by the executive director may result in revocation of the authorization to accept a Class 1 waste.	Required If Requested	330.173(f)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
929	Part IV	Indicate that Class 1 waste must be accompanied by a manifest that must be signed by the operator and copies retained for 3 yrs.	Required If Requested	330.173(g)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
930	Part IV	Indicate that a Class 1 waste acceptance report must be submitted by 25th of the month	Required If Requested	330.173(h)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
931	Part IV	Indicate that the facility will accepted Class 2 waste provided the acceptance of this waste does not interfere with facility operation and its acceptance is in accordance with any applicable limitations in §330.5(a)(2) and the waste acceptance plan required by §330.61(b)	Required	330.173(i)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
932	Part IV	Indicate that the facility will accepted Class 3 waste provided the acceptance of this waste does not interfere with facility operation	Required	330.173(j)	No		Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
933	Part IV	Indicate that the executive director may require visual screening	Required	330.175	Yes	Part IV, Section 4.21		Site Operating Plan
934	Part IV	Provide procedures for leachate or gas condensate recirculation	Required If Requested	330.177	Yes	Part IV, Section 4.22, Paragraph 2		Site Operating Plan
935	Part IV	If facility manages Class 1, then it shall comply with 30 TAC §330.179(a)(1)-(6)	Informational	330.179(a)			Not Applicable. Class I industrial waste is prohibited.	Site Operating Plan
936	Part IV	Provide a schedule for inspecting monitoring equipment, safety and emergency equipment, and operating and structural equipment that are important to preventing, detecting, or responding to environmental or human health hazards	Required If Requested	335.585(b)	No		Not Applicable (for industrial solid waste and municipal hazardous waste)	Site Operating Plan
937	Part IV	Indicate that the inspection schedule will be maintained at facility	Required If Requested	335.585(b)(1)	No		Not Applicable	Site Operating Plan
938	Part IV	Specify the type of problems to be looked for during Class 1 waste inspection	Required If Requested	335.585(b)(2)	No		Not Applicable	Site Operating Plan
939	Part IV	Specify the frequency of inspections that is consistent with 40 CFR 264.303, and indicate that unloading areas will be inspected daily	Required If Requested	335.585(b)(3)	No		Not Applicable	Site Operating Plan
940	Part IV	Indicate that the facility must remedy any deterioration or malfunction of equipment or structures that the inspection reveals on a schedule that ensures that the problem does not lead to an environmental or human health hazard. Indicate that where a hazard is imminent or has already occurred, remedial action must be taken immediately.	Required If Requested	335.585(c)	No		Not Applicable	Site Operating Plan
941	Part IV	Indicate that the facility will maintain inspection logs that include date/time of inspection, inspectors name, observations made, date & nature of repairs	Required If Requested	335.585(d)	No		Not Applicable	Site Operating Plan
942	Part IV	Indicate that facility personnel must successfully complete a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures the facility's compliance with the requirements of this 30 TAC §330.586	Required If Requested	335.586(a)	No		Not Applicable (for industrial solid waste and municipal hazardous waste)	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
943	Part IV	Indicate that training will provided by a person trained in waste management procedures, and must include instruction that teaches facility personnel waste management procedures (including contingency plan implementation) relevant to the positions in which they are employed	Required If Requested	335.586(a)(1)	No		Not Applicable	Site Operating Plan
944	Part IV	Indicate that the training program must be designed to ensure that facility personnel are able to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency systems	Required If Requested	335.586(a)(2)	No		Not Applicable	Site Operating Plan
945	Part IV	Provide procedures for using, inspecting, repairing, & replacing emergency & monitoring equipment; communications or alarm systems; response to fires or explosions; response to GW contamination; & shutdown of operations	Required If Requested	335.586(a)(2)(A)-(E)	No		Not Applicable	Site Operating Plan
946	Part IV	Indicate that personnel training must be completed within 6 months	Required If Requested	335.586(b)	No		Not Applicable	Site Operating Plan
947	Part IV	Indicate that facility personnel must take part in an annual review of initial training	Required If Requested	335.586(c)	No		Not Applicable	Site Operating Plan
948	Part IV	Indicate that facility will maintain personnel records required in 335.586 in the site operating record	Required If Requested	335.586(d)	No		Not Applicable	Site Operating Plan
949	Part IV	Indicate that facility will record title of each position & employee name in that position, job description, description of type & amount of training for each position, records of training & job experience	Required If Requested	335.586(d)(1) – (4)	No		Not Applicable	Site Operating Plan
950	Part IV	indicate that training records on current personnel must be kept until closure of the facility and training records on former employees must be kept for at least three years from the date the employee last worked at the facility	Required If Requested	335.586(e)	No		Not Applicable	Site Operating Plan
951	Part IV	Indicate that the facility will follow the waste analysis requirements of 335.587	Required If Requested	335.587(a)	No		Not Applicable	Site Operating Plan
952	Part IV	Provide procedures in compliance with 335.587 to obtain chemical & physical analysis of representative samples	Required If Requested	335.587(a)(1)	No		Not Applicable	Site Operating Plan
953	Part IV	Indicate that a waste generator's records of analyses performed on the waste before the effective date of these regulations, or studies conducted on waste generated from processes similar to that which generated the waste to be managed at the facility, may be included in the data base required to comply with this paragraph. Indicate that the facility may arrange for the generator of the waste to supply the information required by this paragraph. Indicate that if the generator does not supply the information, and the owner or operator chooses to accept a waste, the owner or operator is responsible for obtaining the information required to comply with this section.	Required If Requested	335.587(a)(1)(A)-(B)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
954	Part IV	Indicate that the waste analysis may include data developed under Subchapter R of Chapter 335 (relating to Waste Classification), and existing published or documented data on a waste or on such waste generated from similar processes.	Required If Requested	335.587(a)(2)	No		Not Applicable	Site Operating Plan
955	Part IV	Indicate that waste analysis must be repeated as necessary to ensure that it is accurate and up-to-date, when the owner or operator is notified, or has reason to believe, that the process or operation generating the waste has changed and when the results of the inspection required in 335.587 indicate that the waste received at the facility does not match the waste designated on the accompanying manifest or shipping paper.	Required If Requested	335.587(a)(3)	No		Not Applicable	Site Operating Plan
956	Part IV	Indicate that the owner or operator shall inspect and, if necessary, analyze each waste received at the facility to determine whether it matches the identity of the waste specified on the accompanying manifest or shipping paper	Required If Requested	335.587(a)(4)	No		Not Applicable	Site Operating Plan
957	Part IV	Provide a waste analysis plan that describes the procedures which the owner or operator will carry out to comply with 335.587(b)	Required If Requested	335.587(b)	No		Not Applicable	Site Operating Plan
958	Part IV	Provide procedures to prevent the ignition or reaction of wastes	Required If Requested	335.588(a)	No		Not Applicable	Site Operating Plan
959	Part IV	Indicate that the facility will take precautions to prevent, extreme heat or pressure, fire or explosions, violent reactions, toxic mist, dust, fumes, gases, flammable fumes & gases, damage to devices or facility, or threaten human health or the environment	Required If Requested	335.588(b)(1)-(5)	No		Not Applicable	Site Operating Plan
960	Part IV	Indicate that the facility will maintain documentation of compliance with 335.588(a)-(b)	Required If Requested	335.588(c)	No		Not Applicable	Site Operating Plan
961	Part IV	Provide a contingency plan that is designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of waste or constituents of such waste to air, soil, or surface water	Required If Requested	335.589(a)(1) & (2)	No		Not Applicable	Site Operating Plan
962	Part IV	The contingency plan must describe personnel action in response to fires, explosions, or any unplanned sudden or non-sudden release of waste or constituents of such waste to air, soil, or surface water at the facility.	Informational	335.589(b)(1)			Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
963	Part IV	Provide revisions sufficient to comply with requirements of Chapter 335 to any current Spill Prevention, Control, and Countermeasures (SPCC) Plan that is in accordance with Title 40 Code of Federal Regulations (CFR) Part 112, 40 CFR Part 1510, or some other approved emergency or contingency plan, if the facility manages waste in tanks	Required If Requested	335.589(b)(2)	No		Not Applicable	Site Operating Plan
964	Part IV	Describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services.	Required If Requested	335.589(b)(3)	No		Not Applicable	Site Operating Plan
965	Part IV	Indicate that the owner or operator will maintain a list of names, addresses, and phone numbers (office and home) of all persons qualified to act as emergency coordinator (see subsection (e) of this section), and this list must be kept up-to-date and at the facility. Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates.	Required If Requested	335.589(b)(4)	No		Not Applicable	Site Operating Plan
966	Part IV	Provide in the contingency plan a list of emergency equipment including location, physical description, & capabilities of equipment	Required If Requested	335.589(b)(5)	No		Not Applicable	Site Operating Plan
967	Part IV	Include in the contingency plan an evacuation plan for personnel including signals for evacuation, route and alternate routes	Required If Requested	335.589(b)(6)	No		Not Applicable	Site Operating Plan
968	Part IV	Indicate that copies of the contingency plan will be maintained on-site, submitted to police, fire, hospitals, State & local emergency response services	Required If Requested	335.589(c)(1) & (2)	No		Not Applicable	Site Operating Plan
969	Part IV	Indicate that the contingency plan must be reviewed, and immediately updated, if necessary, whenever he facility permit is revised, the plan fails in an emergency, the facility changes in its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of waste or constituents of such waste, or changes the response necessary in an emergency or the list of emergency equipment changes	Required If Requested	335.589(d)(1)-(4)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
970	Part IV	Indicate that at all times, there must be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator shall be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.	Required If Requested	335.589(e)	No		Not Applicable	Site Operating Plan
971	Part IV	Indicate that whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) shall immediately activate facility alarms or communication systems, where applicable, to notify all facility personnel and notify appropriate state or local agencies with designated response roles if their help is needed	Required If Requested	335.589(f)(1)(A)-(B)	No		Not Applicable	Site Operating Plan
972	Part IV	Indicate that whenever there is a release, fire, or explosion, the emergency coordinator shall immediately identify the character, exact source, amount, and areal extent of any released materials.	Required If Requested	335.589(f)(2)	No		Not Applicable	Site Operating Plan
973	Part IV	Indicate that the emergency coordinator shall assess possible hazards to human health or the environment that may result from the release, fire, or explosion.	Required If Requested	335.589(f)(3)	No		Not Applicable	Site Operating Plan
974	Part IV	Indicate that if the emergency coordinator determines that the facility has had a release, fire, or explosion that could threaten human health, or the environment, outside the facility and if the emergency coordinator's assessment indicates that evacuation of local areas may be advisable, the emergency coordinator shall immediately notify appropriate local authorities, and must be available to help appropriate officials decide whether local areas should be evacuated.	Required If Requested	335.589(f)(4)	No		Not Applicable	Site Operating Plan
975	Part IV	Indicate that the emergency coordinator must notify either government official or National Response Center and provide a report that includes the name & phone number of reporter, name and address of facility, time and type of incident, name and quantity of material involved, extent of injuries, and possible hazards	Required If Requested	335.589(f)(5)(A) - (F)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
976	Part IV	Indicate that the emergency coordinator shall take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other waste at the facility	Required If Requested	335.589(f)(6)	No		Not Applicable	Site Operating Plan
977	Part IV	Indicate that the emergency coordinator shall monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate if the facility stops operations in response to a fire, explosion, or release	Required If Requested	335.589(f)(7)	No		Not Applicable	Site Operating Plan
978	Part IV	Indicate that the emergency coordinator shall provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility and shall classify all recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility	Required If Requested	335.589(f)(8)	No		Not Applicable	Site Operating Plan
979	Part IV	Indicate that the emergency coordinator shall ensure that, in the affected area(s) of the facility, no waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed and all emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed	Required If Requested	335.589(f)(9)(A) & (B)	No		Not Applicable	Site Operating Plan
983	Part IV	Indicate that nonhazardous industrial waste may be placed above natural grade provided that the conditions in §335.590(24)(F)(i) - (vi) of this title are met, except as provided in §335.590(24)(F)(vii)	Required If Requested	330.179(b)	No		Not Applicable	Site Operating Plan
984	Part IV	Provide plans and designs for the placement of nonhazardous waste above natural grade in commercial industrial nonhazardous waste landfill units that is in compliance with the requirements of 335.590(24)(F)	Required If Requested	335.590(24)(F)	No		Not Applicable	Site Operating Plan
998	Part IV	Provide for a quarterly report to be submitted that will include volume of waste received, percent solids, and the method of determining the percent solids, processed, disposed, and recycled or reused.	Required	330.9(g)(1)	No		Not Applicable (for Type V facility)	Site Operating Plan
999	Part IV	Provide in the quarterly report, the method(s) utilized to achieve at least 10% recycling or reuse of incoming material	Required	330.9(g)(1)	No		Not Applicable	Site Operating Plan
1004	Part IV	Indicate that all wastes generated by a facility must be processed or disposed at an authorized solid waste management facility	Required	330.205(b)	No		Not Applicable (for storage and processing facility)	Site Operating Plan
1005	Part IV	Indicate that all wastewaters generated by a facility shall be managed as contaminated water in accordance with 330.207	Required	330.205(c)	No		Not Applicable	Site Operating Plan
1006	Part IV	Indicate that the facility shall be designed and operated in a manner that sludges produced pass the Paint Filter Liquids Test.	Required If Requested	330.205(d)	No		Not Applicable	Site Operating Plan

ID	App. Part	Checklist Item	Item Type	Citation	Complete?	Location	Comments	Application Area
1009	Part IV	The owner or operator shall not discharge contaminated water without specific written authorization.	Informational	330.207(a)			Not Applicable	Site Operating Plan
1023	Part IV	Provide plans for process area of transfer stations that recover material from putrescibles or liquid waste. Such plans shall provide for the storage of processed and unprocessed waste & recycled materials in enclosed buildings, vessels, or containers.	Required If Requested	330.209(c)	No		Not Applicable	Site Operating Plan
1024	Part IV	Provide a plan that describes how all waste containing food wastes shall be stored in covered or closed containers that are leak-proof, durable, and designed for safe handling and easy cleaning	Required	330.211	No		Not Applicable	Site Operating Plan
1025	Part IV	Indicate that nonreusable containers shall be of suitable strength to minimize vector scavenging or rupturing.	Required	330.211(1)	No		Not Applicable	Site Operating Plan
1026	Part IV	Indicate that reusable containers must be maintained in a clean condition as not to constitute a nuisance, harbor, feed, and propagate vectors.	Required	330.211(2)	No		Not Applicable	Site Operating Plan

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN NARRATIVE

Prepared for:

CITY OF WACO

Solid Waste Services
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Prepared by:

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Revision 0 – April 2020
SCS Project No. 16216088.00

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SCS Engineers
TBPE Reg. # F-3407

LIST OF ACRONYMS

ADC - Alternate daily cover
AIPG - American Institute of Professional Geologists
ASTM - American Society for Testing and Materials
BER - Ballast Evaluation Report
bgl - below ground level
BMPs - best management practices
CFR - Code of Federal Regulations
CCS - Citizens' Collection Station
CN - curve number
COC - chain-of-custody
COE - U.S. Army Corps of Engineers
CQA - construction quality assurance
EDE - estimated depth of excavation
EPA - U.S. Environmental Protection Agency
FEMA - Federal Emergency Management Agency
FIRM - Flood Insurance Rate Map
FM - farm-to-market
FMC - flexible membrane cover
FML - flexible membrane liner
FTB - film tear bond
FWS - U.S. Fish and Wildlife Service
GLER – Geomembrane Liner Evaluation Report (also referred to as FMLER)
GP - Geotechnical Professional
GQCP - Geotechnical Quality Control/Quality Assurance Professional
GWSAP - groundwater sampling and analysis plan
HDPE - high density polyethylene
HELP - Hydrologic Evaluation of Landfill Performance
LCS - leachate collection system
LEL - lower explosive limit
LFG - landfill gas
LL - liquid limit
LLDPE - linear low density polyethylene
LSOP - laboratory standard operating procedures
MCLs - maximum contaminant levels
rnsl - mean sea level
MSW - municipal solid waste
MSWR - Municipal Solid Waste Regulations
NMOCs - Nonmethane Organic Compounds
NPDES - National Pollutant Discharge Elimination System
NSPS - New Source Performance Standards
NWP - Nationwide Permit
O&M - operations and maintenance
OMC - optimum moisture content

LIST OF ACRONYMS (Continued)

PCBs - polychlorinated biphenyls
P.I. - plasticity index
POR - Professional of Record
POTW - publicly owned treatment works
PQLS - practical quantitation limits
PVC - polyvinyl chloride
QA/QC - quality-assurance/quality-control
RCRA - Resource Conservation Recovery Act
RPD - relative percent difference
SCS - Soil Conservation Service
SDP - Site Development Plan
SDR - standard dimension ratio
SLER - soils and liner evaluation report
SLQCP - soil and liner quality control plan
SOP - site operating plan
SSC - statistically significant change
TAC - Texas Administrative Code
TDS - total dissolved solids
TCEQ - Texas Commission on Environmental Quality
TPDES – Texas Pollutant Discharge Elimination System
TPWD - Texas Parks and Wildlife Department
TWDB -Texas Water Development Board
TxDOT - Texas Department of Transportation
UEL - upper explosive limit
USCS - Unified Soil Classification System
USGS - U.S. Geological Survey
USLE - Universal Soil Loss Equation
VOCs - volatile organic compounds

1 INTRODUCTION (30 TAC §330.63)

The City of Waco (Owner) proposes to develop and operate a Type I Municipal Solid Waste (MSW) Landfill on 502.5 acres of land located in McLennan and Limestone Counties, Texas. The landfill entrance will be located approximately 0.4 miles south of the intersection of State Highway 31 and T K Parkway (also known as Farm-to-Market [FM] 939). The waste disposal footprint will encompass approximately 175.7 acres, separated into two (2) disposal areas, with the East Disposal Area comprised of approximately 112.9 acres and West Disposal Area comprised of approximately 62.8 acres. Refer to Attachment 1 for drawings that depict the existing conditions, landfill permit boundary, waste footprint, and general site layout.

The landfill will serve residences, businesses, and industries in the communities of McLennan and Limestone County and other nearby counties transported to the landfill by municipal, private, and public haulers. The landfill will accept municipal solid waste, household waste, yard waste, commercial solid waste, Class 2 and Class 3 non-hazardous industrial wastes, construction-demolition waste, and special wastes as authorized by the Texas Commission on Environmental Quality (TCEQ). The categories of waste that will be accepted at the landfill are defined in Part I/II, Section 2.2.2 of this permit application. Any special waste accepted at the landfill will be in accordance with 30 TAC §330.171. Consistent with 30 TAC §330.15(e) the facility will not accept regulated hazardous waste, polychlorinated biphenyls (PCBs), and all other prohibited waste defined therein. Additionally, Class 1 industrial solid waste will not be accepted at this facility.

This permit application for the City of Waco Landfill has been prepared consistent with the Municipal Solid Waste Regulations (MSWR), Title 30 of the Texas Administrative Code (TAC), Chapter 330. This Site Development Plan (SDP) Narrative provides a brief overview of the contents of the permit application, including the attachments of the SDP. The SDP has been separated into Attachments 1 through 12, which were prepared consistent with 30 TAC §330.63.

2 SOLID WASTE DATA (30 TAC §330.63(D)(4)(D))

The landfill will serve residences, businesses, and industry in the communities of McLennan and Limestone Counties and other nearby counties. As discussed in Parts I/II, Section 2.2, the landfill is expected to initially receive approximately 305,000 tons per year of solid waste (1,070 tons per day based on a 286-day operating schedule). The initial year of operation is anticipated following completion of disposal operations at the existing City of Waco Landfill (Permit No. MSW-948A), which is estimated to be 2024. The waste inflow rate is estimated to increase at a rate of approximately 1.25 percent annually over the life of the landfill. Over the life of the landfill, it is anticipated that the waste rate received at the landfill may vary as warranted by the needs of the area, market conditions, and recycling and waste diversion practices.

Consistent with 30 TAC §330.63(d)(4)(D), the following subsections describe the population equivalent and site operating life for the landfill.

2.1 POPULATION EQUIVALENT

As discussed in Parts I/II, Section 2.2.1, it is anticipated that the population served by the landfill will change over the life of the landfill as warranted by the needs of the area and market conditions. Based on an estimated 6.7 pounds of waste generated daily per person (ref: HOTCOG Regional Solid Waste Plan, 2013 Update) and an initial disposal rate of 1,070 tons per day, the number of people served by the landfill initially will be approximately 319,000 persons.

The major classifications of solid waste to be accepted at the landfill include municipal solid waste, household waste, yard waste, commercial solid waste, Class 2 and Class 3 non-hazardous industrial wastes, construction-demolition waste, and special wastes. Consistent with 30 TAC §330.15(e), the facility will not accept regulated hazardous waste, polychlorinated biphenyls (PCBs), and other prohibited waste defined herein. Additionally, Class 1 industrial solid waste will not be accepted at this facility. Waste classifications and further information on types of wastes expected to be received at the facility are included in Parts I/II, Section 2.2.2 - Properties and Characteristics of Waste.

2.2 SITE OPERATING LIFE PROJECTION

The landfill configuration provides an approximate estimate of 33 years of site operating life. Calculations and assumptions for the site operating life estimate are included in Appendix IIIA – Site Life Calculations.

3 DESIGN DATA

3.1 LANDFILL METHODS (30 TAC §330.63(D)(4)(B),(C),(E))

The proposed landfill development method for the site is a combination of area excavation fill followed by aerial fill to the proposed landfill completion height. The landfill will be developed in two separate disposal areas, East Disposal Area and West Disposal Area. The East Disposal Area will be comprised of eight sectors, 1 through 8; and the West Disposal Area will be comprised of four sectors, 9 through 12. Each sector may be developed in multiple cells at the discretion of Owner.

The excavation sideslopes will be no steeper than 3H:1V, with an elevation of deepest excavation (EDE) of 505 feet mean sea level (ft MSL). The EDE will be achieved in the bottom of the leachate collection sump in Sector 8. Aerial fill sideslopes will be no steeper than 4H:1V and the aerial fill topslope will be no flatter than 5 percent (or 20H:1V). The maximum elevation of final cover will be no higher than 697.7 ft MSL and 661.3 ft MSL for East and West Disposal Areas, respectively. Final cover placement and closure of sectors will be in accordance with procedures set forth in the closure plan provided in Attachment 9 of this permit application.

Attachments to this application include drawings depicting the landfill development. Specifically, Attachment 1 through Attachment 3 include the following:

- **Attachment 1** – Site Layout Plans, include existing site contours (July 3, 2018 topography, see Drawing 1.1), excavation, elevation of deepest excavation, disposal area layout, sector layout, and sequence of sector development.

- **Attachment 2** – Fill Cross Sections, include cross-sections depicting the base grades, top of liner grades, maximum elevation of waste, maximum elevation of final cover, and geologic borings along the cross-sections.

- **Attachment 3** – Landfill Completion Plan, include proposed final contours, surface water management system, and general facility layout at landfill completion.

3.2 WET-WEATHER OPERATIONS (30 TAC §330.63(D)(4)(A)

The landfill access roads (see Attachment 1 – Site Layout Plans), including perimeter roads and other constructed interior haul roads will be constructed of crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other suitable material and will provide access from the site entrance road to the disposal area(s). The landfill access roads will be passable under inclement weather conditions to allow access to the active disposal area. To enhance operating efficiency during wet weather, the Owner may reserve an active disposal area close to the all-weather roads for wet-weather operations where development sequence allows. Furthermore, the tracking of mud and trash onto public access roadways will be minimized by removing mud and associated debris from the landfill roads and site entrance, as described in Part IV – Site Operating Plan (SOP).

3.3 SITE ACCESS (30 TAC §330.63(B)(1))

3.3.1 Access from Highway

The main public roadways providing access to the site are State Highway (SH) 31 and T K Parkway (also known as Farm-to-Market [FM] 939). The landfill entrance will be located off FM 939, approximately 0.4 miles south of the intersection of SH 31 and FM 939. Refer to Parts I/II, Section 8 - Transportation for site access and other transportation information.

The site entrance is detailed on Attachment 1, Drawing 1.5 - Entrance Facility Plan. The site entrance consists of an all-weather road, site entrance gates, scale house, and scales (initially one inbound and one outbound scale). The site entrance will also include two inbound queue lanes that provide approximately 3,300 feet of queuing length from the scales back to FM 939. Furthermore, at some point in the future, an additional inbound scale may be installed to accommodate increases in the waste acceptance rate over the site operating life.

3.3.2 All-Weather Access

The site entrance road includes an asphalt or concrete paved roadway, or other suitable material that transitions into landfill access roads, either perimeter or interior haul roads, constructed of crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other suitable material and will provide access from the site entrance road to the waste disposal area(s). The site entrance road will serve as mud control for waste hauling vehicles prior to exiting the site and returning to public-access roads. The perimeter roads will be maintained for all-weather access by site personnel. Crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other similar material will be made available, as necessary, for use in maintaining passable perimeter roads. Grading equipment or other appropriate equipment will be used to control or remove mud accumulation at least once per day on days when mud and associated debris are being tracked onto FM 939, as specified in the SOP.

3.3.3 Access Control

Vehicle access to the landfill will be controlled at the site entrance by signs that direct all landfill traffic to the working face or Citizens' Collection Station (CCS) during site operating hours. Personnel on duty at the scale house will regulate access to the landfill. The site entrance will be secured by two gates (primary and secondary entrance gates). The primary entrance gate will be opened at 5:30 AM on days that the facility is in operation to minimize queuing on FM 939, as described in the Transportation Impact Analysis (Part I/II, Appendix I/IID-2) The secondary entrance gate will remain locked outside operating hours to prevent unauthorized vehicle access to the landfill. A fence, either barbed wire, chain link, privacy, or a combination thereof will limit access around the perimeter of the landfill at the permit boundary, as described in the SOP.

The Owner will permit entry to the landfill to designated landfill personnel, solid waste haulers (including landfill customers) authorized to use the facility, TCEQ personnel, and properly identified persons whose entry is authorized by the Landfill Manager or designee. Owner reserves the right to deny access to the landfill to persons not demonstrating a legitimate purpose for visiting. Visitors will be allowed on the active disposal area of the landfill only when accompanied by the Landfill Manager or designee.

3.4 GEOLOGY AND GEOTECHNICAL REPORTS (30 TAC §330.63(E))

The regional and local stratigraphy and lithology for the proposed landfill are summarized in Parts I/II, Section 9 and described in detail in Attachment 4 – Geology Report, including depth, thickness, geometry, soil classifications, hydraulic conductivity, and depositional history of the local geological formations. In view of the depth of low-permeability clay and shale at the facility, the geologic setting of the site is considered suitable for landfill development.

Attachment 4 also includes the results of the subsurface investigation performed at the facility. Onsite geology is characterized by three layers as follows, from the ground surface downward to a maximum drilled depth of 100 feet:

- Unit 1: consists of surficial clayey and loamy alluvium overlying silty or sandy clays with small subrounded gravel. The transition from Unit I to the underlying Unit II is transitional, and marked by increasing hardness and increasing fissility.

- Unit 2: beneath Unit I, consists of weathered silty shale with varying calcareous content. Some publications use the term “marl” to describe calcareous shale. The Unit II silty shale has thin, interbedded limestone and sand/silt partings/lenses, calcite-filled joints, and marine shell fragment fossils. Above the Unit II/Unit III line, the stratigraphy is generally more variable in color but are generally lighter-colored and have evidence of oxidation such as various rust- and yellow/brown colors. Below the Unit II/Unit III line, the stratigraphy is a homogenous very dark color, trending to black. Unit III also is less fissile than Unit II.

- Unit 3: beneath Unit II, consists of unweathered dark gray to black calcareous shale bedrock with thin, interbedded limestone and sand/silt lenses, and marine shell fragment fossils.

Attachment 5, Geotechnical/Stability Analyses, addresses the geotechnical properties of the landfill, including evaluation of the geotechnical properties of the subsurface soils, stability of the soils and strata for development of the landfill, and slope stability of the landfill.

3.5 GROUNDWATER PROTECTION (30 TAC §330.63(F) & §330.63(D)(4)(G))

3.5.1 Groundwater Monitoring System

Attachment 4, Geology Report, includes the result of the subsurface investigation, including the groundwater depth, if encountered, in the soil borings and piezometers. Also, Attachment 4 includes the elevations and gradient of groundwater across the landfill property and a detailed description of the proposed groundwater monitoring system, which will be used to verify the integrity of the liner system. Details of the plan for performing groundwater sampling, analysis, and reporting are addressed in Attachment 7 - Groundwater Sampling and Analysis Plan.

3.5.2 Liner Design

Consistent with 30 TAC §330.331(b), a soil-geomembrane composite liner system for a Type I landfill, is proposed for the landfill. Beginning from the waste and working down, the bottom liner system will be comprised of the following components:

- 24-inch thick soil protective cover;
- Single-sided geocomposite (non-woven geotextile on the top side only of geonet);
- 60-mil high-density polyethylene (HDPE) geomembrane (smooth);
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

The sideslope liner system will be comprised of the following components (from waste and working down):

- 24-inch thick soil protective cover;
- Double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil textured HDPE geomembrane (textured on both sides);
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

The proposed liner system for the landfill is designed to meet the requirements outlined in 30 TAC §330.331. Attachment 10 – Soil and Liner Quality Control Plan (SLQCP) contains the construction quality control and quality assurance requirements for construction of the composite liner for the landfill.

3.5.3 Leachate Collection System

A leachate collection system (LCS) has been designed to control the accumulation of leachate within the waste disposal area during the active periods of landfilling, and after landfill closure; including being designed to meet Type I landfill requirements (30 TAC §330.331(a)(2) and §330.333) and maintaining leachate head over the liner of less than 30 centimeters. The LCS layout is shown on drawings included in Attachments 1 and 12 of this permit application. Design of the LCS is discussed in Attachment 12 - Leachate and Contaminated Water Management Plan. Information regarding materials and construction quality control and quality assurance are included in the SLQCP. The following provides a summary description of the

LCS and associated features. Additional description is provided in Attachment 12. Representative details of the LCS are presented on drawings included in Attachment 12.

The primary collection component of the LCS is the leachate drainage layer, which consists of a geonet-geotextile composite (referred to as geocomposite) placed directly over the bottom and sideslope liner systems. The geocomposite consists of a HDPE geonet with a non-woven geotextile heat bonded to one or both sides of the geonet, where single-sided geocomposite will be placed on the bottom, and double-sided geocomposite will be placed on the sideslopes of the landfill. The geocomposite will have hydraulic properties that will provide adequate drainage of leachate to the leachate collection piping and sump, thereby maintaining less than 30-cm leachate head above the bottom liner system. Calculations demonstrating the minimum required material properties for the geocomposite are presented in Attachment 12.

A 2-foot-thick protective cover will be placed over the geocomposite prior to waste placement. To facilitate drainage into the leachate collection system, chimney drains, comprised of aggregate wrapped in a non-woven geotextile, will be constructed over the leachate collection piping. Leachate entering the LCS piping will discharge into sumps located at the perimeter of the landfill. Leachate collected in the sumps will be removed via submersible pumps lowered into the sumps through a riser pipe extending up the cell sideslope.

Additional descriptions of the LCS piping and sumps, including but not limited to pipe spacing and grading; sump sizing calculations; and demonstration that pipes and perforations will be resistant to clogging and collapse, are presented in Attachment 12. Leachate and contaminated water management, including storage and disposal, is presented in Attachment 12, Sections 4 and 5, respectively.

3.6 SURFACE WATER PROTECTION (30 TAC §330.63(C)(1))

3.6.1 General

The proposed landfill is located within the drainage basin of the Brazos River. Surface water generally drains southeast from the western portion of the property towards Horse Creek and generally drains south/southwest from the eastern portion of the property towards Horse Creek and Packwood Creek.

Stormwater runoff from the developed landfill will be conveyed through a surface water management system designed in accordance with 30 TAC §330.63(c), as described in Section 3.6.3. Stormwater will be conveyed from the landfill property into natural drainage features, including Horse and Packwood Creeks. These creeks are tributaries of Soil Conservation Services Site 19 Reservoir, which discharges into Williams Creek located south of the property and eventually flows into Tehuacana Creek approximately 11 miles southwest of the property. Tehuacana Creek discharges into the Brazos River approximately 15 miles southwest of the property.

In accordance with 30 TAC §330.15(h), the landfill has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code (§26.121) and the Federal Clean Water Act (§404), respectively. As described in Part I/II, Section 10.2, the Owner will file a notice of intent (NOI) with the TCEQ and develop and implement a Stormwater Pollution Prevention Plan prior to the commencement of landfill operations to obtain coverage under the Texas Pollutant Discharge Elimination System (TPDES) General Permit, TXR050000 for Stormwater Discharges associated with Industrial Activity.

3.6.2 Site Drainage Patterns

Consistent with 30 TAC §330.63(c), the surface water management system design for the landfill complies with 30 TAC §330.303. A complete description of the site drainage patterns for both the pre- and post-development landfill conditions is presented in Attachment 6A – Surface Water Drainage Plan of this permit application. As presented in Attachment 6A, the surface water drainage features, aerial fill controls and perimeter drainage system, have been designed to avoid adversely altering existing drainage patterns, as a result of landfill development, in accordance with 30 TAC §330.63(c)(1)(D)(iii). This has been demonstrated by evaluating pre- and post-development peak discharge rates and total discharge volumes at off-site discharge locations. Furthermore, the post-development locations of off-site discharges have been designed to be consistent with the pre-development conditions. The pre- and post-development hydrologic and hydraulic analysis are presented in Attachment 6A, including a description of the methodology, calculations, and results of said calculations.

3.6.3 Perimeter Drainage System

The stormwater controls for the landfill have been designed consistent with the 30 TAC §330 requirements for Type I MSW landfills. The perimeter drainage system is comprised of final cover controls (described in Section 3.6.5), perimeter drainage channels and detention basins. The perimeter drainage system has been designed for a 25-year, 24-hour storm event. The drainage features will be installed concurrent with the construction of up-gradient landfill disposal cells, such that when the cell grades are above existing grade, down-gradient drainage features are in-place, as described in Attachment 6A. Details and sizing criteria for the perimeter drainage system and associated calculations, including peak velocities, flow depths, and discharge rates are included in Attachment 6A of this permit application.

3.6.4 Below Grade

Control of stormwater run-on and runoff within excavation areas will be achieved using temporary diversion berms, ditches, and containment areas as needed. The temporary stormwater control structures will be used to divert stormwater away from the working face, thus reducing the volume of contaminated water generated during a storm event. Uncontaminated stormwater will be discharged consistent with the requirements of the TPDES General Permit.

Contaminated stormwater consists of stormwater that has come into contact with waste. Control of contaminated stormwater will be provided through temporary containment berms. Water that infiltrates into the underlying waste will be managed as leachate. Contaminated stormwater will be contained and managed at the working face in accordance with the guidelines set forth in Attachment 12 of this permit application.

3.6.5 Aerial Fill Controls

Additional stormwater controls will be necessary as the site is brought above grade. Temporary diversion and containment berms, channels, and containment areas will be used to separate and control uncontaminated and contaminated stormwater run-on and runoff for the aerial fill portions of the landfill.

As intermediate and final cover are placed on the landfill, vegetation will be established to provide erosion protection, as described in Attachment 6A and the SOP. Furthermore, as intermediate and final cover are placed, drainage features will be installed to control erosion and convey stormwater run-on and run-off from the landfill cover to the perimeter drainage system, as described in Section 3.6.6. Drainage features installed on the intermediate and final cover have been designed to convey stormwater associated with the 25-year, 24-hour storm event. Design details and sizing calculations, including peak velocity, flow depth, and discharge rate, for intermediate and final cover drainage features are described in Attachment 6A. In all cases, surface water run-on and runoff will be managed consistent with the 30 TAC §330, Subchapter G.

Areas that have received waste, but will be inactive for longer than 180 days will receive intermediate cover. Consistent with 30 TAC §330.165(a) and (c), runoff from areas with intact daily and/or intermediate cover will be considered uncontaminated. Also, by implementing: (1) the site design and proper operating practices; and (2) ongoing placement of daily, intermediate and final cover (as further described in Attachment 9 - Final Closure and Post-Closure Plan), contaminated water and leachate will be minimized. Details of the final cover design are provided in Attachments 6C and 9 of this permit application.

3.6.6 Erosion and Sedimentation Control Plan

On-site erosion and sedimentation control will be provided as follows: (1) during construction activities; and (2) as part of the ongoing operation of the landfill. Erosion and sedimentation control includes structural and non-structural controls for the intermediate and final cover systems and the perimeter drainage system. An Erosion and Sedimentation Control Plan is presented in Attachment 6A – Surface Water Drainage Plan, Section 6. Landfill management will control erosion and offsite sedimentation by implementing interim controls, as specified in §330.305(e)(2), as described in Attachment 6A, Section 6. Furthermore, permanent erosion and sedimentation controls have been incorporated into the design of the landfill at completion and the perimeter drainage system.

Additionally, in accordance with §330.305(d), the landfill design will provide effective erosional stability to top dome surfaces and embankment sideslopes during all phases of landfill operation, including the closure and post-closure care period. The Erosion and Sedimentation Control Plan (Attachment 6A, Section 6) describes and includes the following:

- Erosion calculations using the Universal Soil Loss Equation (USLE)/Revised Universal Soil Loss Equation (RUSLE) to demonstrate that erosion on intermediate and final cover will be below permissible soil losses.

- Hydraulic calculations using standard engineering principles to demonstrate that velocities in drainage swales and downchutes and on intermediate and final cover slopes will be below permissible velocities.

- Operational requirements and guidelines for implementing erosion and offsite sedimentation controls, such as non-structural and structural best management practices (BMPs) for daily cover and soil stockpiles, intermediate cover, and final cover.

These features include perimeter drainage channels that have been designed with non-erosive velocities, or in areas where erosive velocities are anticipated, erosion protection or armoring of the channels in the form of rip rap, turf reinforcement matting, rock ditch checks, gabions, dissipation blocks, or other suitable structures will be provided, as needed. Permanent drainage and erosion protection measures for the final cover system (e.g., drainage swales and downchutes) are shown in Attachment 3 - Landfill Completion Plan. Erosion control practices for daily and intermediate cover are discussed in detail in Attachment 6A. Establishing vegetation on the intermediate and final cover, drainage swales, perimeter drainage system, and buffer zones will be ongoing as the site is developed (see Part III, Attachment 9 - Final Closure and Post-Closure Plan).

3.6.7 Wetlands

Information regarding wetlands is provided in Parts I/II, Section 11.2 and Appendix I/IIE – Section 404 Jurisdictional Determination in accordance with 30 TAC §330.553(b).

3.7 FLOODPLAIN PROTECTION (30 TAC §330.63(C)(2))

A portion of the Site is within the 100-year floodplains of Horse and Packwood Creeks. The floodplain limits were obtained from the currently effective Flood Insurance Rate Maps (Panels 48309C0250C dated September 26, 2008, and 48293C0125C dated September 16, 2011) obtained from FEMA for portions of McLennan and Limestone Counties. The floodplain limits have been designated by FEMA as Zone A, which indicates that no flood elevations have yet been determined along these creeks on the Site. The proposed waste disposal footprint is located entirely outside the limits of the 100-year floodplain. In accordance with 30 TAC §330.547(a), no solid waste disposal operations will take place within the 100-year floodplain, and therefore no development is proposed in the 100-year floodplain.

Because the floodplain for the project area has been classified as Zone A, an additional flood study was performed to confirm that the proposed landfill and perimeter drainage system will not be impacted by a 100-year storm event. This 100-year flood study is presented in Attachment 6B – Floodplain Evaluation. As presented in this attachment, the waste disposal limits are not located within the 100-year flood study area, and will not be impacted by a water surface generated by a 100-year storm event. Additionally, the landfill has been designed with a perimeter berm above existing grade, which prevents washout from the 100-year storm event. Furthermore, the landfill has been designed such that there will be no surface water run-on from Horse and Packwood Creeks into the perimeter drainage system associated with a 100-year storm event. Therefore, the landfill and perimeter drainage system will not be impacted by the 100-year storm event.

Additionally, in accordance with 30 TAC §330.547(b), site operations and development will not restrict the flow or reduce the temporary storage capacity of the 100-year floodplain; nor will the site operations result in washout of solid waste associated with the 100-year floodplain, since construction within the 100-year floodplain is not proposed. Therefore, §330.63(c)(2)(D) is not applicable to this application. Furthermore, in accordance with 30 TAC §330.547(c), all storage and processing facilities (e.g., onsite citizen's collection station) will be located outside of the 100-year floodplain as delineated by FEMA and will not be impacted by the 100-year storm event, as shown in Attachment 6B.

3.8 LANDFILL CLOSURE AND POST CLOSURE-CARE (30 TAC §330.63(H), (I) & (J))

3.8.1 Final Cover Design

The final cover system will be a soil-geomembrane composite meeting the requirements of 30 TAC §330.457. Beginning from the surface and working down, the final cover system on the landfill topslopes will be comprised of the following components:

- Vegetation (native and/or introduced grasses);
- 24-inch thick (minimum) soil erosion layer, with the top six inches capable of sustaining vegetation;
- 60-mil HDPE or 40-mil linear low density polyethylene (LLDPE) geomembrane (smooth);
- 18-inch thick (minimum) clayey soil infiltration layer ($k \leq 1x10^{-5}$ cm/sec); and
- 6-inch-thick daily cover or 12-inch-thick intermediate cover.

Beginning from the surface and working down, the final cover system on the landfill sideslopes will be comprised of the following components:

- Vegetation (native and/or introduced grasses);
- 24-inch thick soil erosion layer, with the top six inches capable of sustaining vegetation
- Double-sided geocomposite (geotextile on both sides of geonet);
- 60-mil HDPE or 40-mil LLDPE geomembrane (textured on both sides);
- 18-inch thick (minimum) clayey soil infiltration layer ($k \leq 1x10^{-5}$ cm/sec); and
- 6-inch-thick daily cover or 12-inch-thick intermediate cover.

The Final Closure and Post-Closure Care Plan, which is provided in Attachment 9, includes the final closure schedule, certification of closure, and an estimate of the largest area that will ever require final cover at the landfill in the year to follow closure. The final closure cost estimate for this area is provided in Attachment 8 – Closure and Post-Closure Care Cost Estimates.

3.8.2 Post Closure Care

At the time of closure, consistent with 30 TAC Subchapter K, the landfill will enter the 30-year post-closure care period. A description of the activities required during post-closure care are described in Attachment 9 of this application. A post-closure care cost estimate is provided in Attachment 8.

3.9 LANDFILL GAS MANAGEMENT (30 TAC §330.63(G))

Attachment 11 – Landfill Gas Management Plan provides procedures for monitoring landfill gas at the landfill perimeter and within onsite structures, layout or the perimeter landfill gas monitor probes, frequency for landfill gas monitoring, and procedures to be implemented in the event landfill gas is detected above regulatory limits. Drawing 11.1 – Landfill Gas Monitoring Probe Plan, provided in Attachment 11, depicts the layout of the perimeter landfill gas monitoring probe system.

3.10 PROTECTION OF ENDANGERED SPECIES (30 TAC §330.63(B)(5))

Information regarding the protection of endangered species in accordance with 30 TAC §330.157 is provided in Parts I/II, Section 12 – Protection of Endangered or Threatened Species.

APPENDIX IIIA

SITE LIFE CALCULATIONS

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER

5/13/2020

SCS Engineers
TBPE Reg. # F-3407

Inclusive of pages III-A-1 to III-A-3

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW - 2400
WASTE DISPOSAL CAPACITY AND SITE OPERATING LIFE CALCULATIONS

Required: **Perform Disposal Capacity and Site Operating Life Calculations for Landfill**

1. Estimate Capacity of East Disposal Area.
2. Estimate Capacity of West Disposal Area
3. Estimate Total Waste Capacity of Landfill
4. Estimate Site Operating Life of Landfill

Solution: 1. Estimate Capacity of East Disposal Area.

a.	Gross airspace from AutoCAD volume calculation =	18,619,819	cy
b.	Airspace consumed by final cover (cy) = 112.9 acres at 3.5 feet thick =	-637,509	cy
c.	Airspace consumed by Bottom Liner and Protective Cover = 112.9 acres at 4 feet thick =	-728,581	cy
d.	Adjusted Gross Airspace Volume =	17,253,729	cy
e.	Percent of airspace consumed by Daily and Intermediate cover =	20	percent
f.	Net Airspace Available for Waste Disposal =	13,802,983	cy
g.	In-place waste density =	1,200	lb/cy
h.	Total East Waste Disposal Capacity =	8,281,790	tons

Available East Waste Disposal Capacity (tons) = 8,281,790 tons

2. Estimate Capacity of West Disposal Area

a.	Total airspace from AutoCAD volume calculation =	8,489,129	cy
b.	Airspace consumed by final cover (cy) = 62.8 acres at 3.5 feet thick =	-354,611	cy
c.	Airspace consumed by Bottom Liner and Protective Cover (assume 4' liner, Sideslopes Only) = 62.8 acres at 4 feet thick =	-405,269	cy
d.	Adjusted Airspace Volume =	7,729,249	cy
e.	Percent of Airspace Consumed by Daily and Intermediate Cover =	20	percent (1)
f.	Net Total Airspace Available for Waste Disposal =	6,183,399	cy
g.	In-place Waste Density =	1,200	lb/cy
h.	Total West Waste Disposal Capacity =	3,710,040	tons

Available West Waste Disposal Capacity (tons) = 3,710,040 tons

3. Estimate Total Waste Capacity of Landfill

From above:
Available East Waste Disposal Capacity (tons) = 8,281,790 tons
Available West Waste Disposal Capacity (tons) = 3,710,040 tons

Maximum Inventory of Waste at Time of Closure = 11,991,829 tons

4. Estimate Site Operating Life of Landfill

For the Site operating life calculations, the Waste Acceptance Rate is based on the following assumptions:

Days of operation per year =	286	days
Initial Daily Waste Acceptance Rate =	1,070	tpd
Assumed Growth Rate (Life of Landfill) =	1.25	% (annually)
Initial Annual Waste Acceptance Rate =	305,000	tpy
Maximum Inventory of Waste at Time of Closure =	11,991,829	tons

The following table calculates the waste stream growth, assuming the growth rates describe above, and the projected cumulative airspace consumed.

Year	MSW Inflow (tons/yr)	Cumulative Disposal Capacity Consumed (tons)	Disposal Capacity Remaining (tons)	Disposal Year
2024	305,000	305,000	11,686,829	1
2025	308,813	613,813	11,378,017	2
2026	312,673	926,485	11,065,344	3
2027	316,581	1,243,066	10,748,763	4
2028	320,538	1,563,605	10,428,225	5
2029	324,545	1,888,150	10,103,680	6
2030	328,602	2,216,751	9,775,078	7
2031	332,709	2,549,461	9,442,369	8
2032	336,868	2,886,329	9,105,500	9
2033	341,079	3,227,408	8,764,421	10
2034	345,343	3,572,751	8,419,079	11
2035	349,659	3,922,410	8,069,419	12
2036	354,030	4,276,440	7,715,389	13
2037	358,456	4,634,896	7,356,934	14
2038	362,936	4,997,832	6,993,997	15
2039	367,473	5,365,305	6,626,524	16
2040	372,066	5,737,371	6,254,458	17
2041	376,717	6,114,088	5,877,741	18
2042	381,426	6,495,515	5,496,315	19
2043	386,194	6,881,708	5,110,121	20
2044	391,021	7,272,730	4,719,100	21
2045	395,909	7,668,639	4,323,191	22
2046	400,858	8,069,497	3,922,333	23
2047	405,869	8,475,366	3,516,464	24
2048	410,942	8,886,308	3,105,522	25
2049	416,079	9,302,387	2,689,443	26
2050	421,280	9,723,666	2,268,163	27
2051	426,546	10,150,212	1,841,617	28
2052	431,878	10,582,090	1,409,740	29
2053	437,276	11,019,366	972,463	30
2054	442,742	11,462,108	529,721	31
2055	448,276	11,910,384	81,445	32
2056	453,880	12,364,264	-372,435	33

Remaining available capacity will be consumed during 2056
Site life is projected to be approximately 33 years.

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 1
SITE LAYOUT PLANS

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

Drawings

STATE OF TEXAS
RYAN R. KUNTZ
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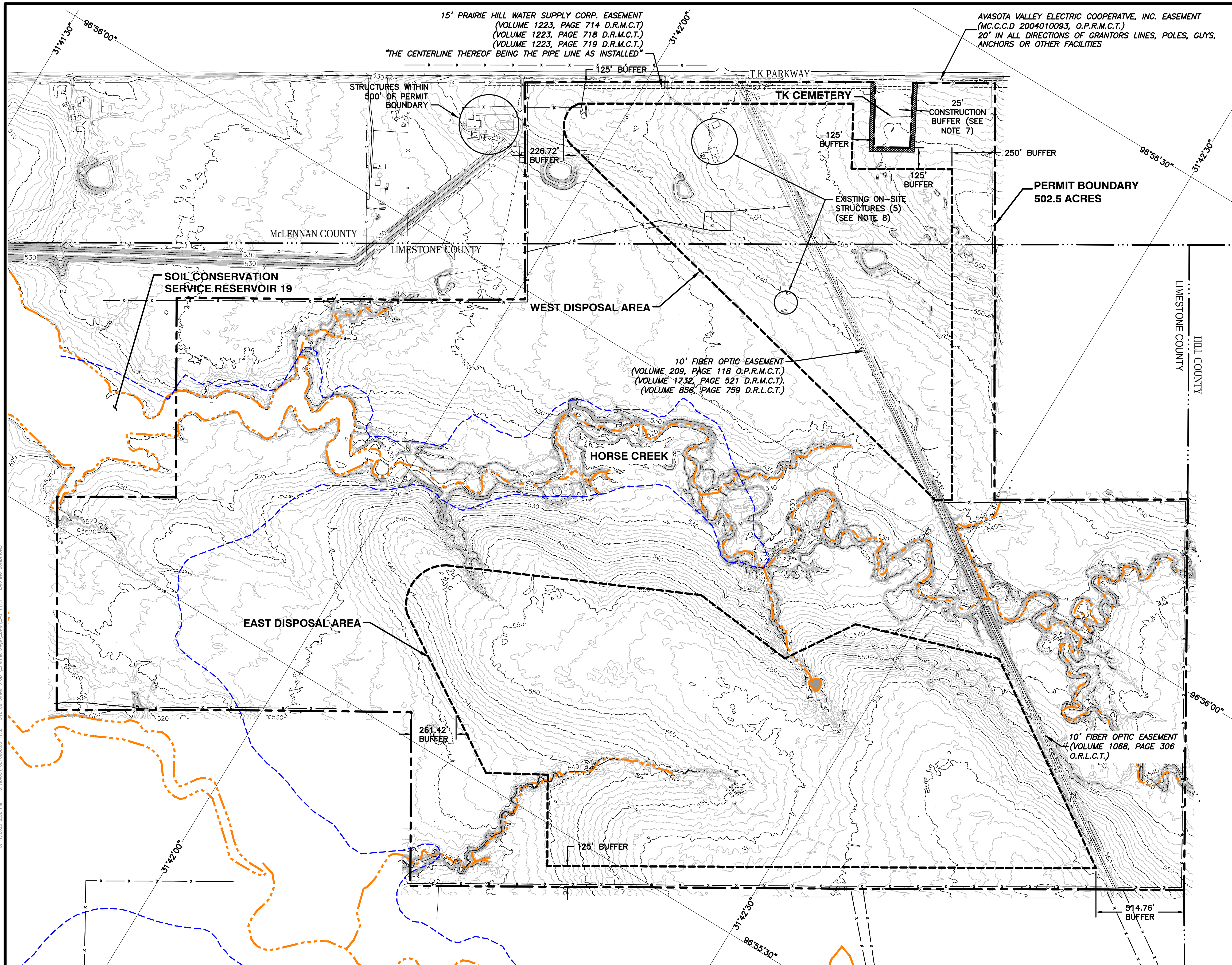
5/13/2020

SCS Engineers
TBPE Reg. # F-3407



LEGEND

— — —	PERMIT BOUNDARY
- - - -	LIMITS OF WASTE
——560——	EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
— · · · —	COUNTY LINE
—— x ——	EXISTING FENCE
- - - - (blue)	100–YEAR FLOOD PLAIN (SEE NOTE 2)
— · — (orange)	POTENTIAL JURISDICTIONAL WATER LOCATION (SEE NOTE 4)
—96°55'30"—	LATITUDE/LONGITUDE LINES

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. CONSISTENT WITH TCEQ REGULATIONS A MINIMUM BUFFER ZONE OF 125' WILL BE MAINTAINED BETWEEN THE WASTE LIMIT BOUNDARY AND PERMIT BOUNDARY.
4. THE LOCATION OF THE POTENTIAL JURISDICTIONAL WATERS ARE REFERENCED FROM THE REPORT GENERAL JURISDICTION DETERMINATION PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC. (SEE APPENDIX I/IIA, AGENCY COORDINATION WITH THE COE).
5. FIBER OPTIC LINE EASEMENT, VOLUME 209, PAGE 118 MCLENNAN CO. RECORDS, IF EXISTING AT TIME OF LANDFILL DEVELOPMENT, WILL BE RELOCATED PRIOR TO CONSTRUCTION OF SECTORS 9 THROUGH 13 AND WILL BE VACATED. IF FIBER LINE IS NOT INSTALLED WITHIN EASEMENT, THEN EASEMENT IS ABANDONED ON ITS OWN TERMS.
6. A FLOWAGE EASEMENT EXISTS ON THE PROPERTY THAT IS UNDER THE JURISDICTION OF THE TECHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER (1) OF LEROY, TEXAS SUBJECT TO THE EASEMENT RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.
7. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
8. THE EXISTING STRUCTURES WITHIN THE BOUNDARY OF WASTE DISPOSAL AREA (WDA) WILL BE ABANDONED AND DEMOLISHED PRIOR TO DEVELOPMENT OF THE RESPECTIVE SECTORS (I.E. SECTORS 10 AND 11) OF THE WDA WHERE THE EXISTING STRUCTURE IS LOCATED.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EXISTING CONDITIONS PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.1 – EXISTING CONDITIONS

DATE: 04/2020

SCALE: AS SHOWN

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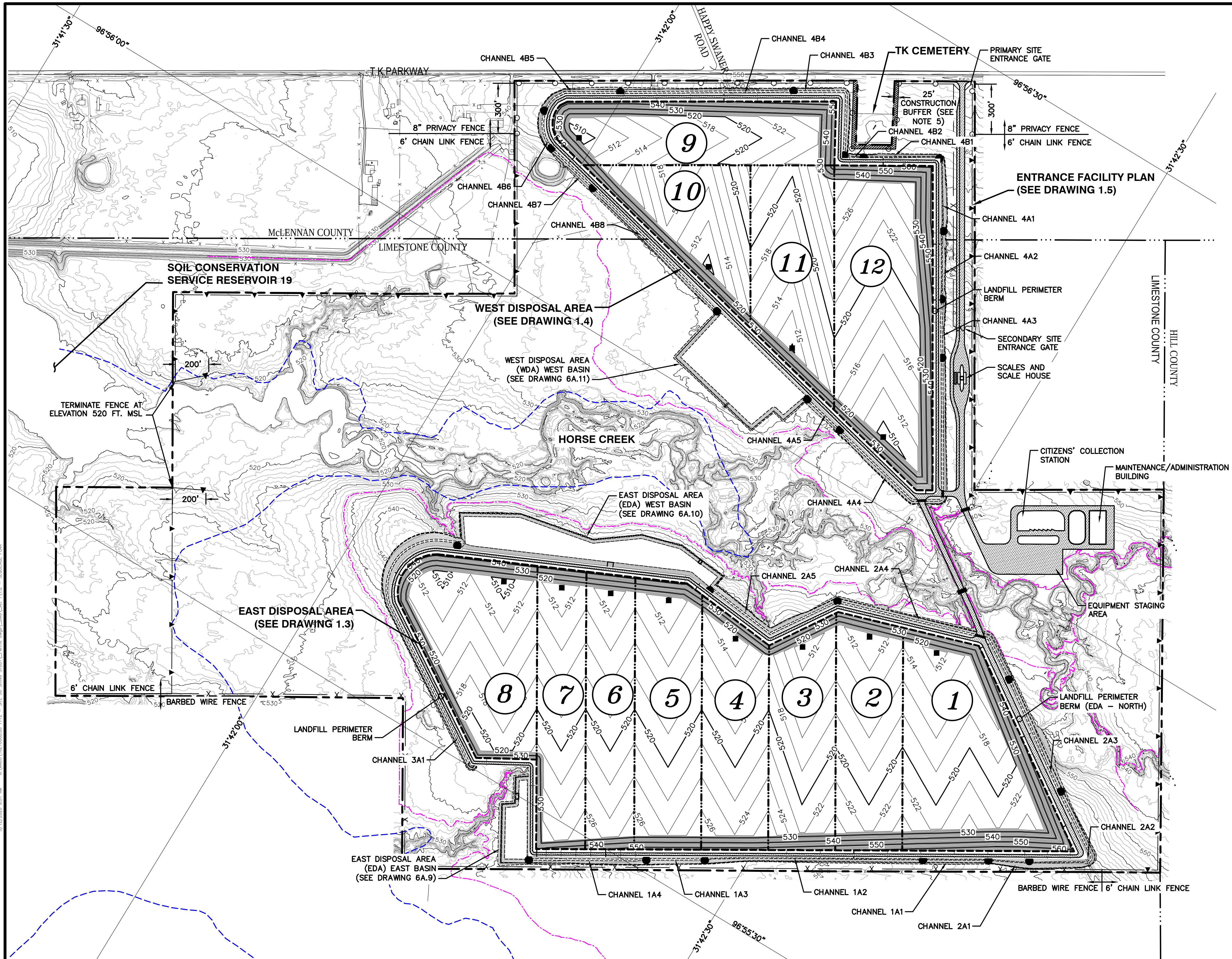

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X PROPOSED/EXISTING BARBED WIRE FENCE
- PROPOSED 6' CHAIN LINK FENCE
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- 96°55'30" LATITUDE/LONGITUDE LINES
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN–GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

STATE OF TEXAS
RYAN R. KUNTZ
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LICENSED
PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV. DATE DESCRIPTION BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: DETAILED FACILITY LAYOUT AND SEQUENCE PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW – PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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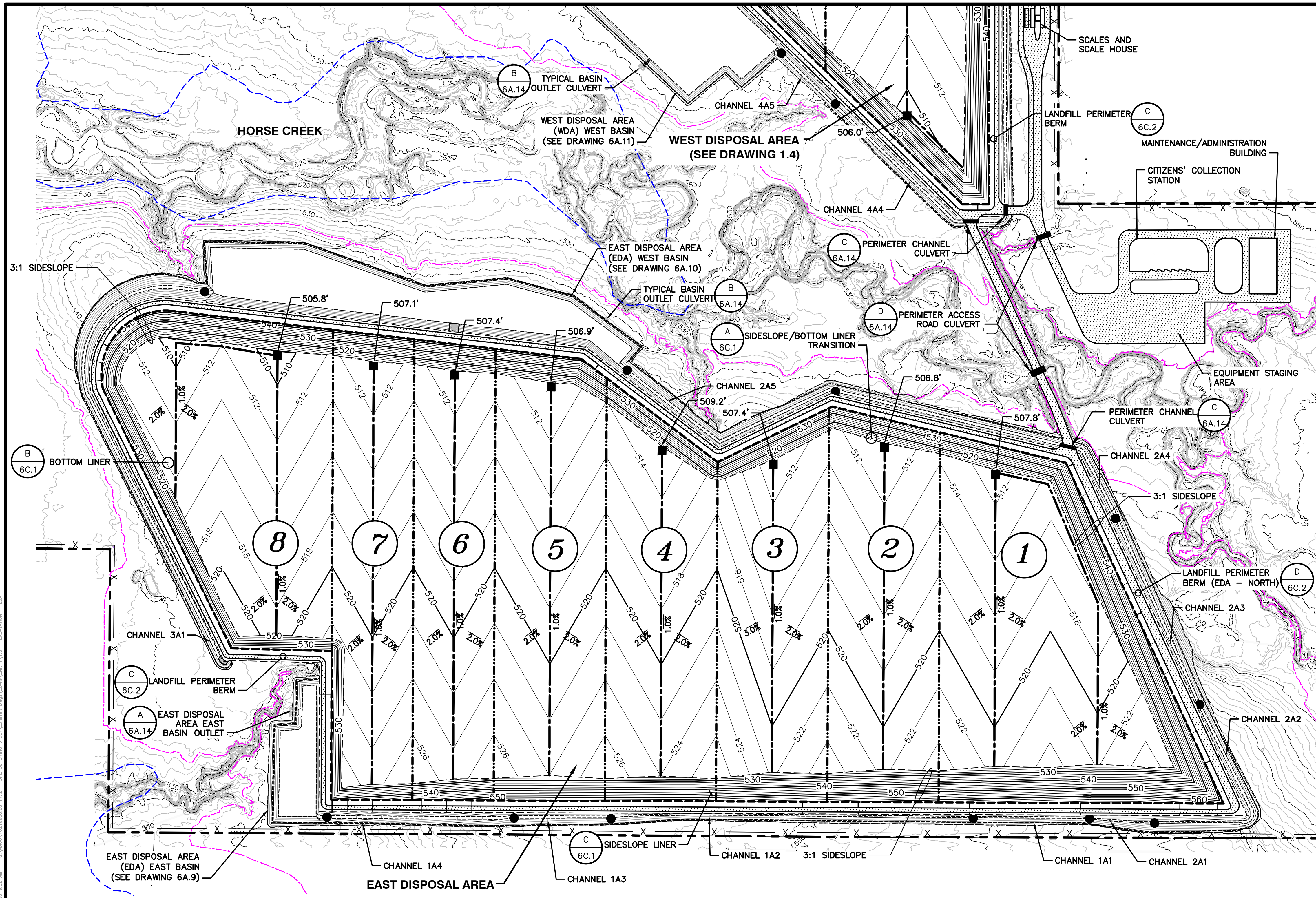
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.2 – SEQUENCE PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 1.2



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION
- 506.0' BOTTOM OF SUMP ELEVATION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
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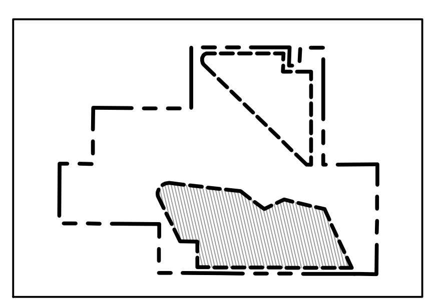
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
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5/13/2020

FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EAST DISPOSAL AREA EXCAVATION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

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DATE: 04/2020

SCALE: AS SHOWN

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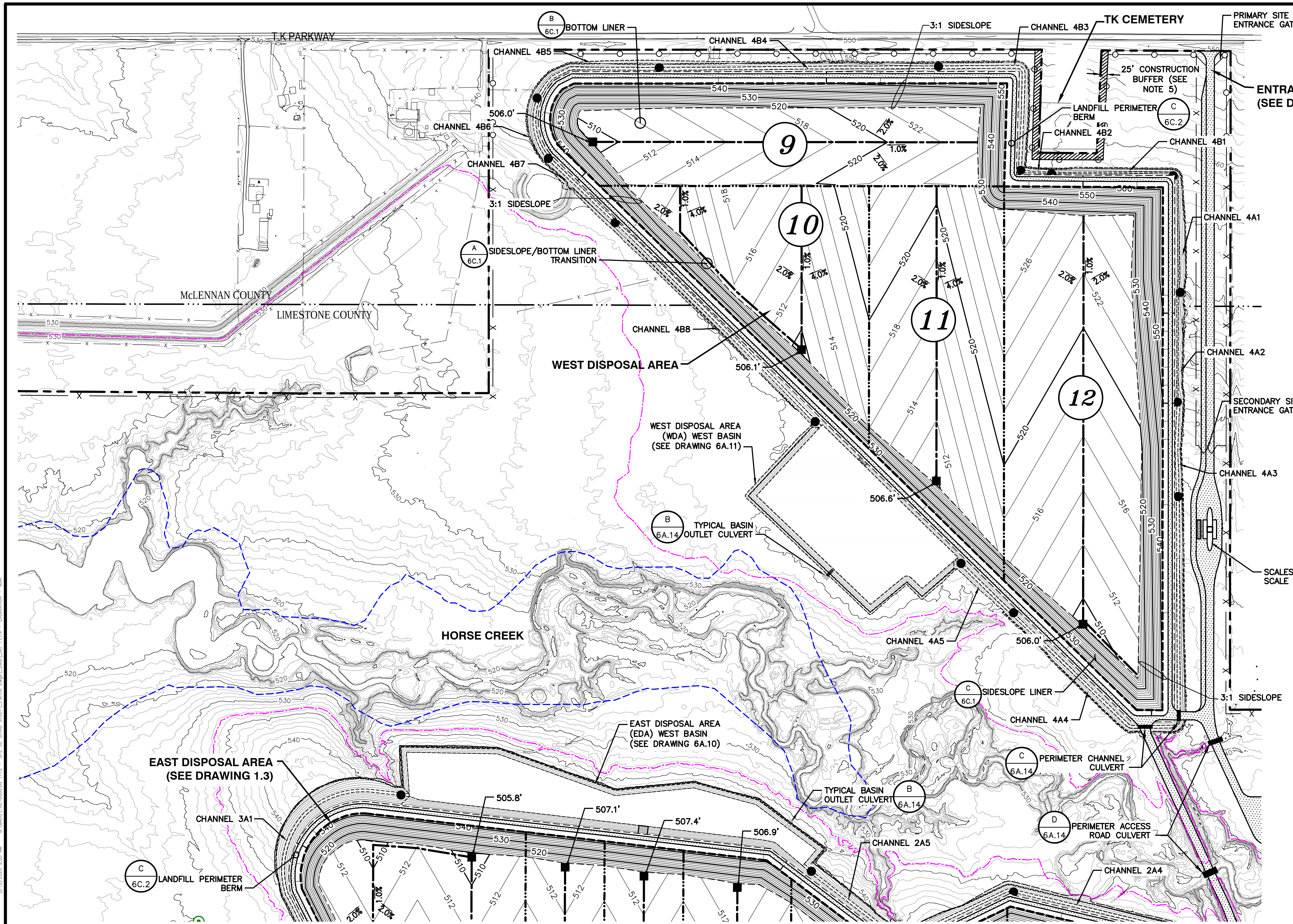

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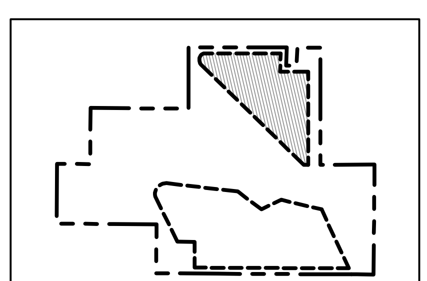
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION
- 506.0' BOTTOM OF SUMP ELEVATION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN-GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: WEST DISPOSAL AREA EXCAVATION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

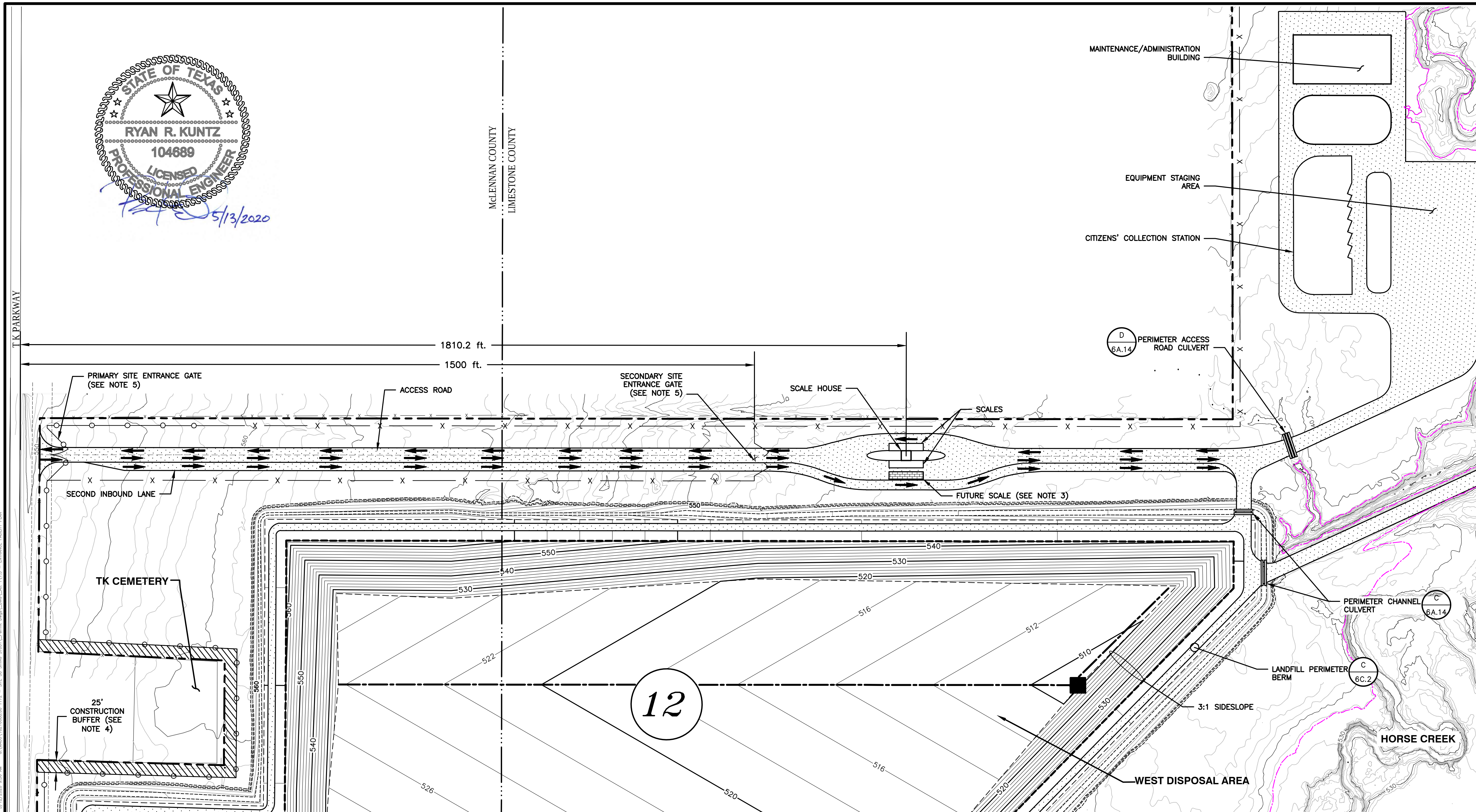
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.4 - EXCAVATION - WDA

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 1.4



LEGEND

0 100 200
SCALE IN FEET

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X — PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 520 — EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 2)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- TRAFFIC FLOW ARROW

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
3. FUTURE INBOUND SCALE WILL BE INSTALLED AS NEEDED TO ACCOMMODATE INCREASES IN THE WASTE ACCEPTANCE RATE OVER THE SITE OPERATING LIFE.
4. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
5. THE PRIMARY ENTRANCE GATE WILL BE OPENED AT 5:30 AM ON DAYS THE SITE IS IN OPERATION TO ALLOW VEHICLE QUEUING PRIOR TO OPENING THE SITE FOR WASTE ACCEPTANCE.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: **ENTRANCE FACILITY PLAN**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.5 - ENTRANCE FACILITY PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. **1.5**

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 2
FILL CROSS SECTIONS

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

Prepared by:

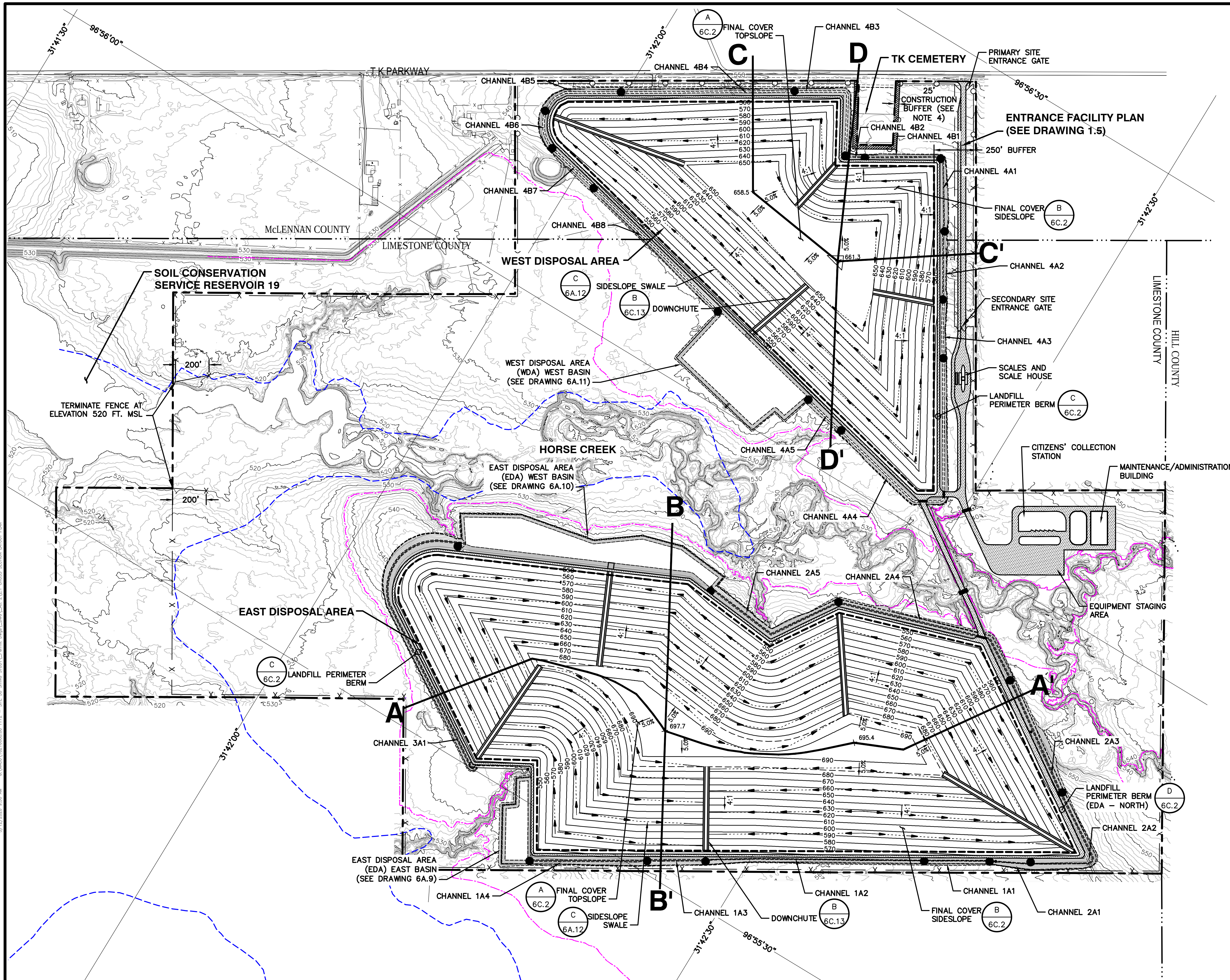
SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

Drawings

SCS Engineers
TBPE Reg. # F-3407



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- A - A' CROSS–SECTION LOCATIONS

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION LAYOUT PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

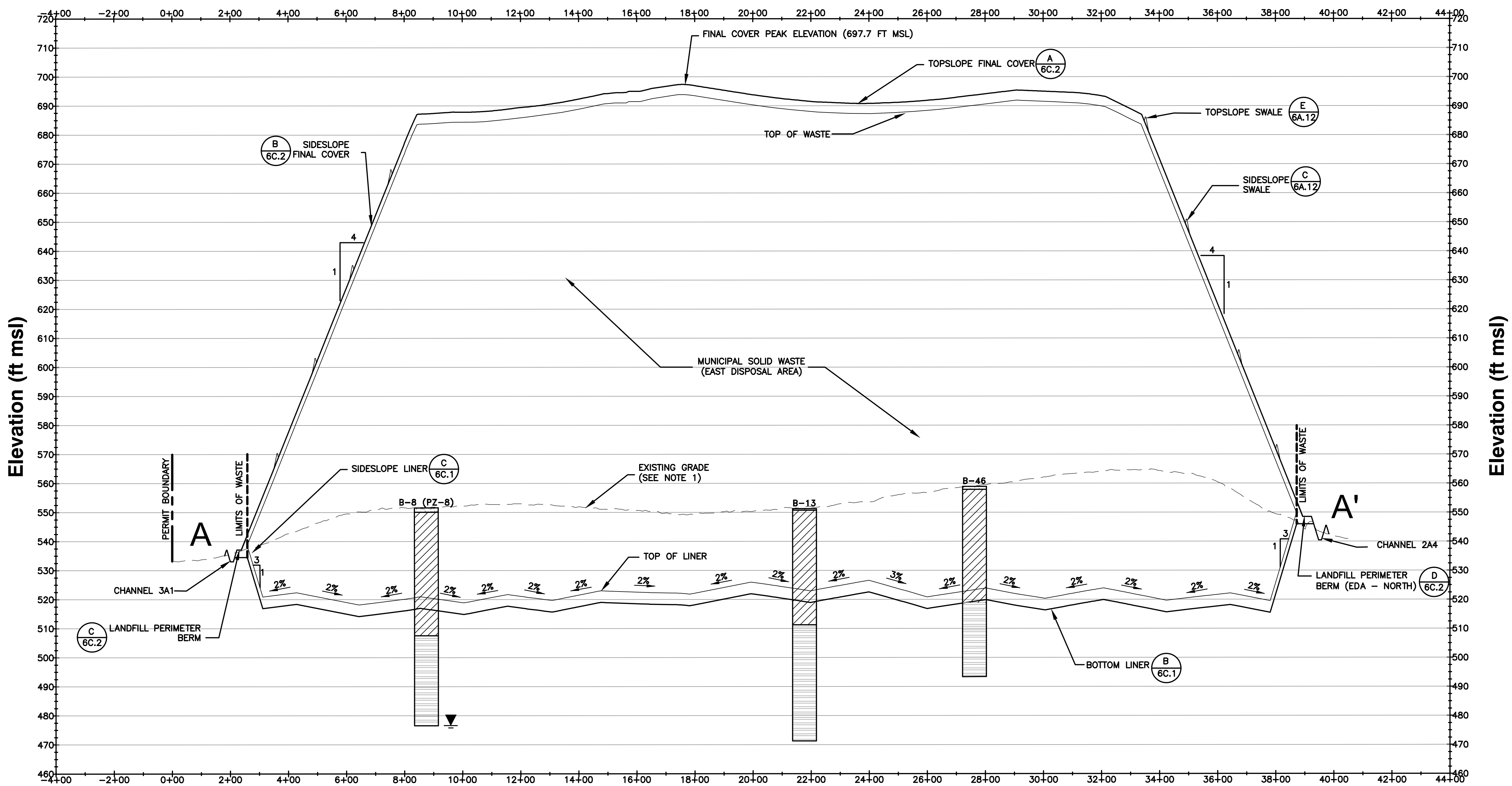
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 2.1 CROSS SECTION LAYOUT PLAN

DATE: 04/2020

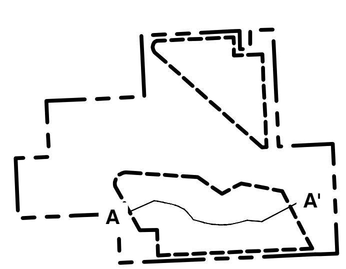
SCALE: AS SHOWN

DRAWING NO. 2.1



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE
- WATER LEVEL IN PIEZOMETER (05/01/2019)



KEY MAP

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EAST DISPOSAL AREA CROSS SECTION A-A'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

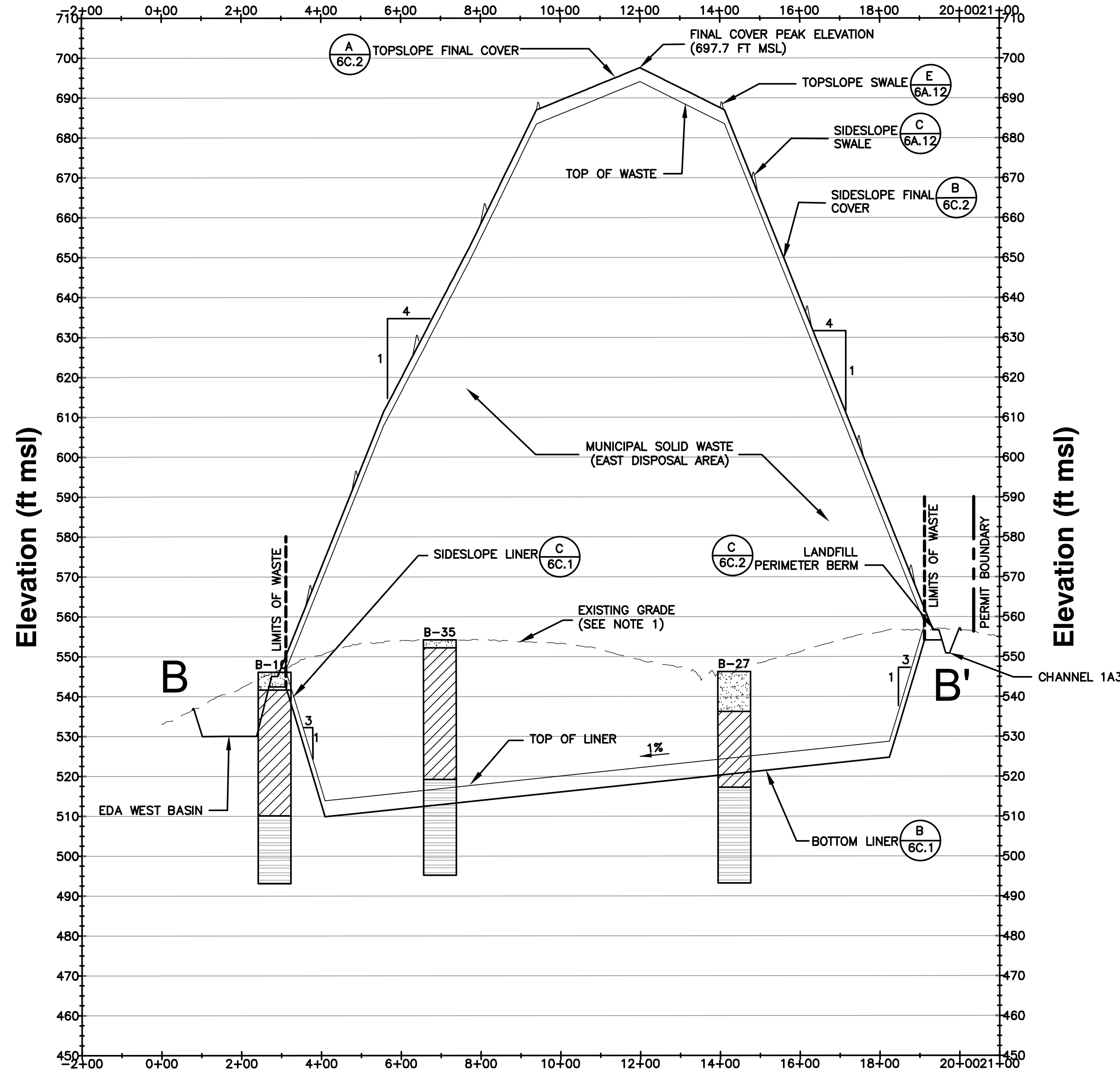
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

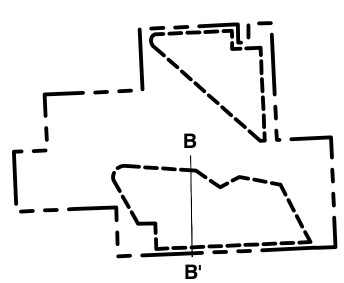
CADD FILE: 2.2 - 2.5 CROSS SECTIONS EAST AND WEST DISPOSAL AREAS

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 2.2





KEY MAP

LEGEND

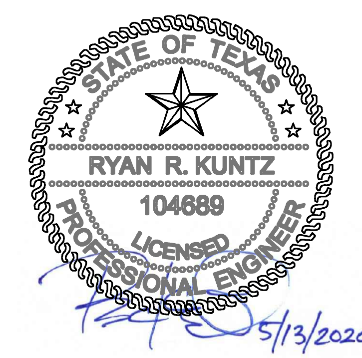
- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.



FOR PERMITTING PURPOSES ONLY

REV DATE DESCRIPTION BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
EAST DISPOSAL AREA
CROSS SECTION B-B'

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

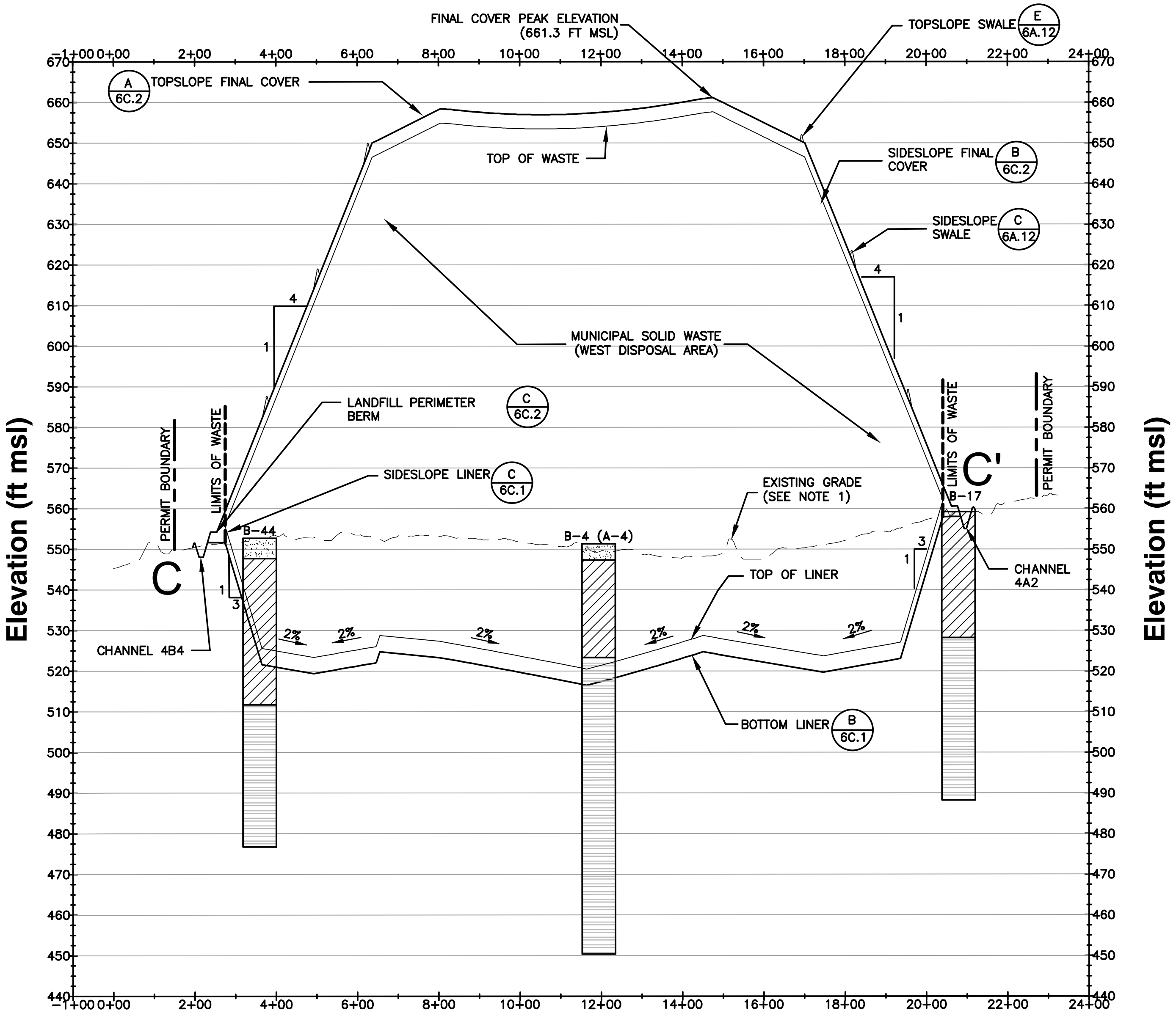
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

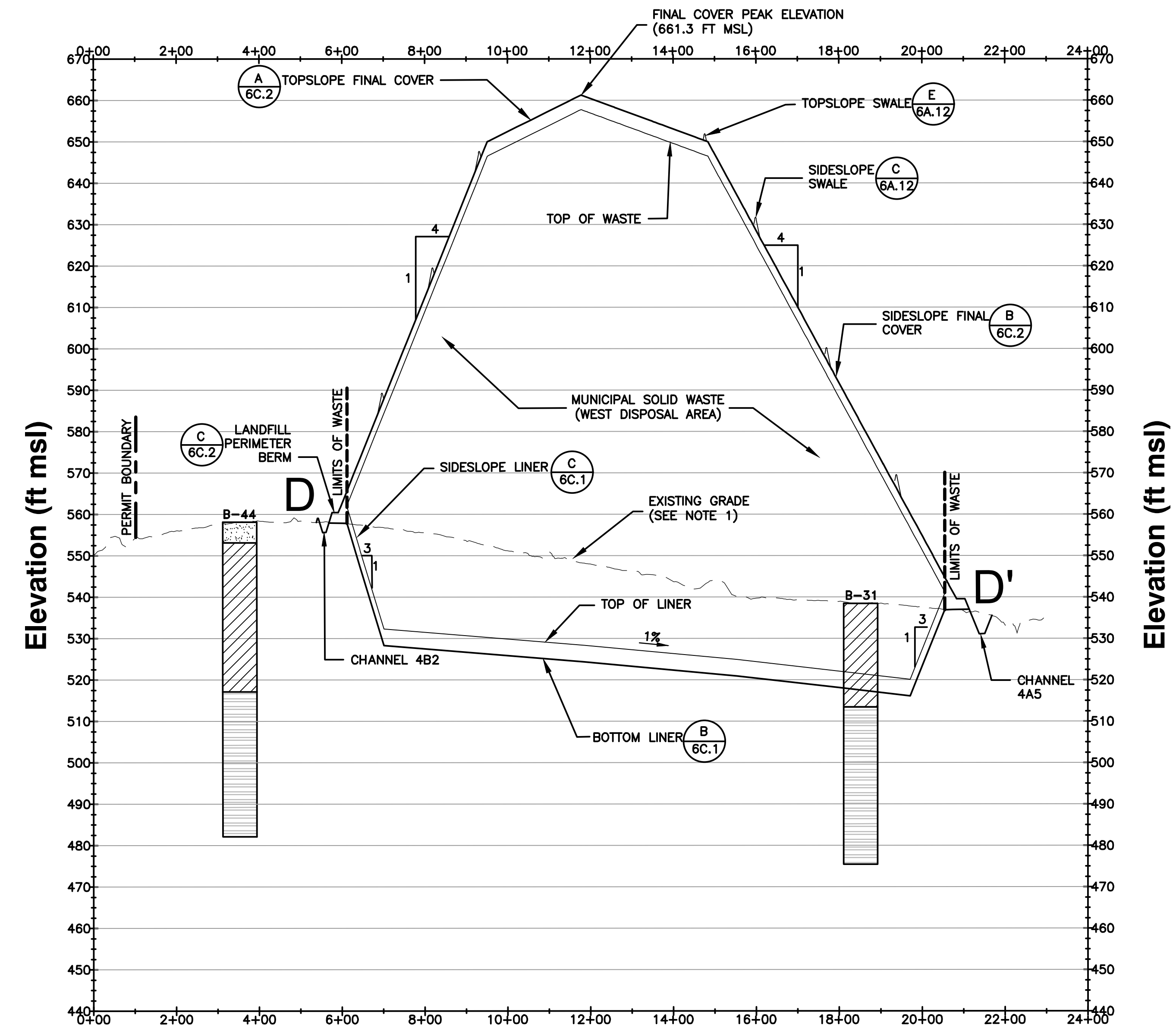
CADD FILE: 2.2 - 2.5 CROSS SECTIONS EAST AND WEST DISPOSAL AREAS

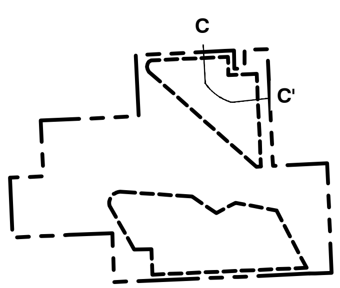
DATE: 04/2020

SCALE: AS SHOWN

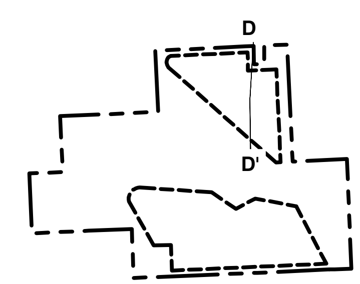
DRAWING NO.
2.3







KEY MAP



KEY MAP

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: WEST DISPOSAL AREA CROSS SECTIONS C-C' AND D-D'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 2.2 - 2.5 CROSS SECTIONS EAST AND WEST DISPOSAL AREAS

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 2.4

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 3
LANDFILL COMPLETION PLAN

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
SCS Project No. 16216088.00

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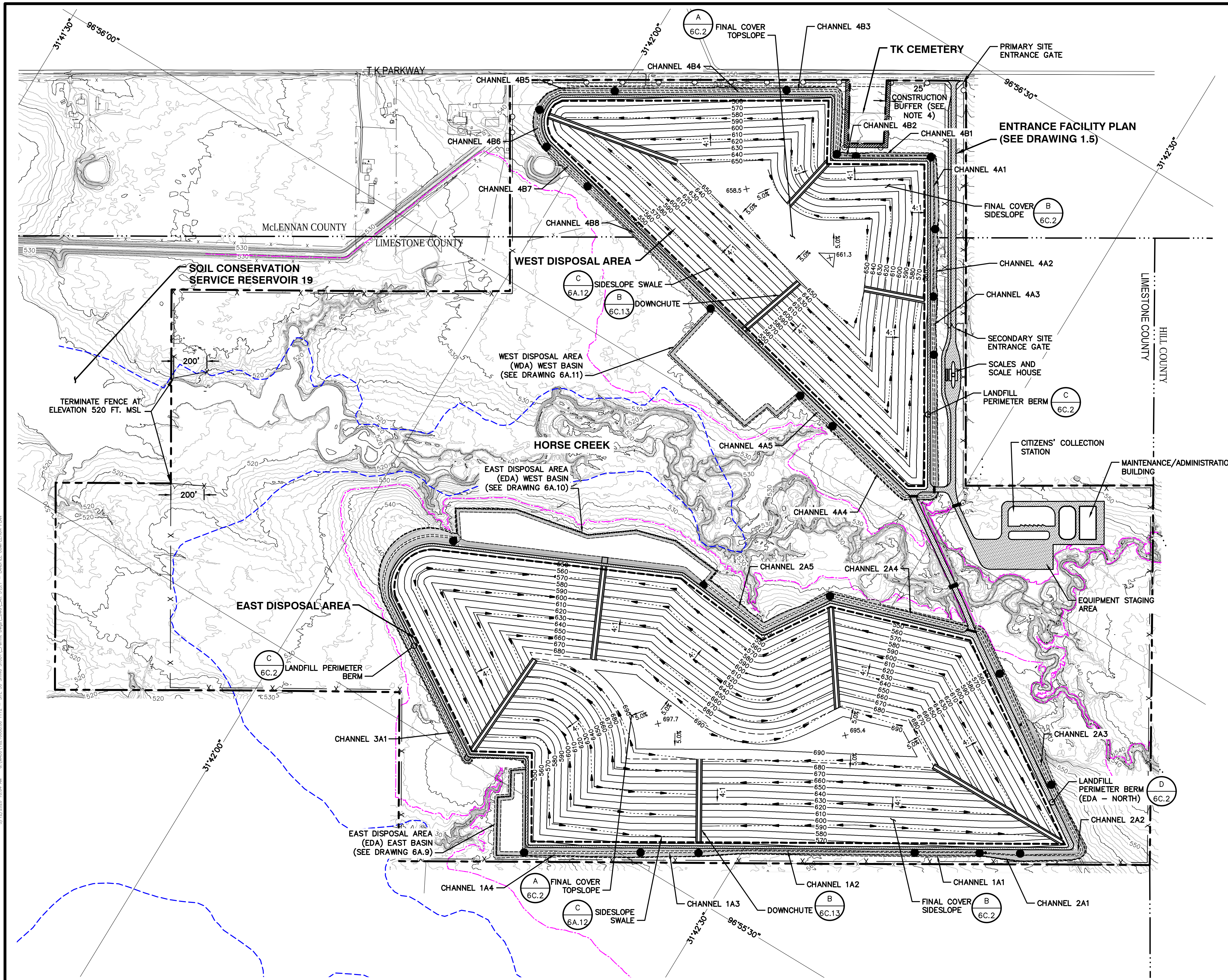
Drawings

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER

5/13/2020

SCS Engineers
TBPE Reg. # F-3407



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

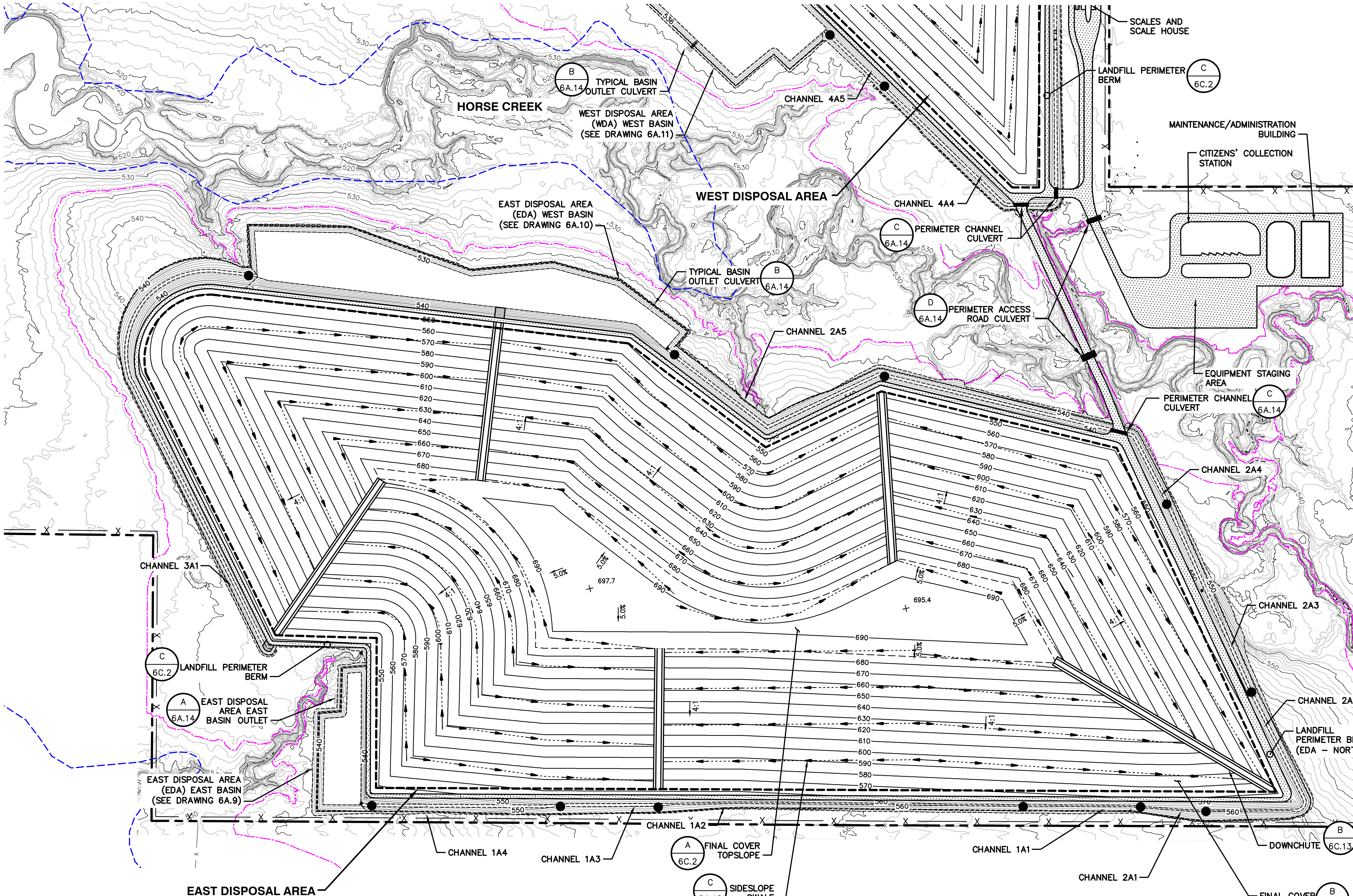
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 3.1 – LANDFILL COMPLETION PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 3.1



N

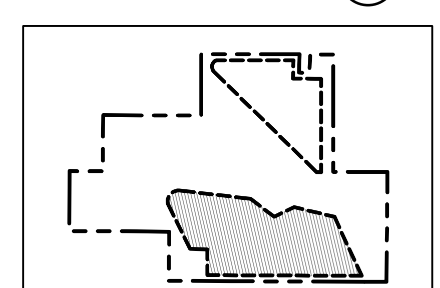
0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. 100–YEAR STORM EVENT WATER SURFACE IS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
4. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
5/13/2020

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EAST DISPOSAL AREA LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

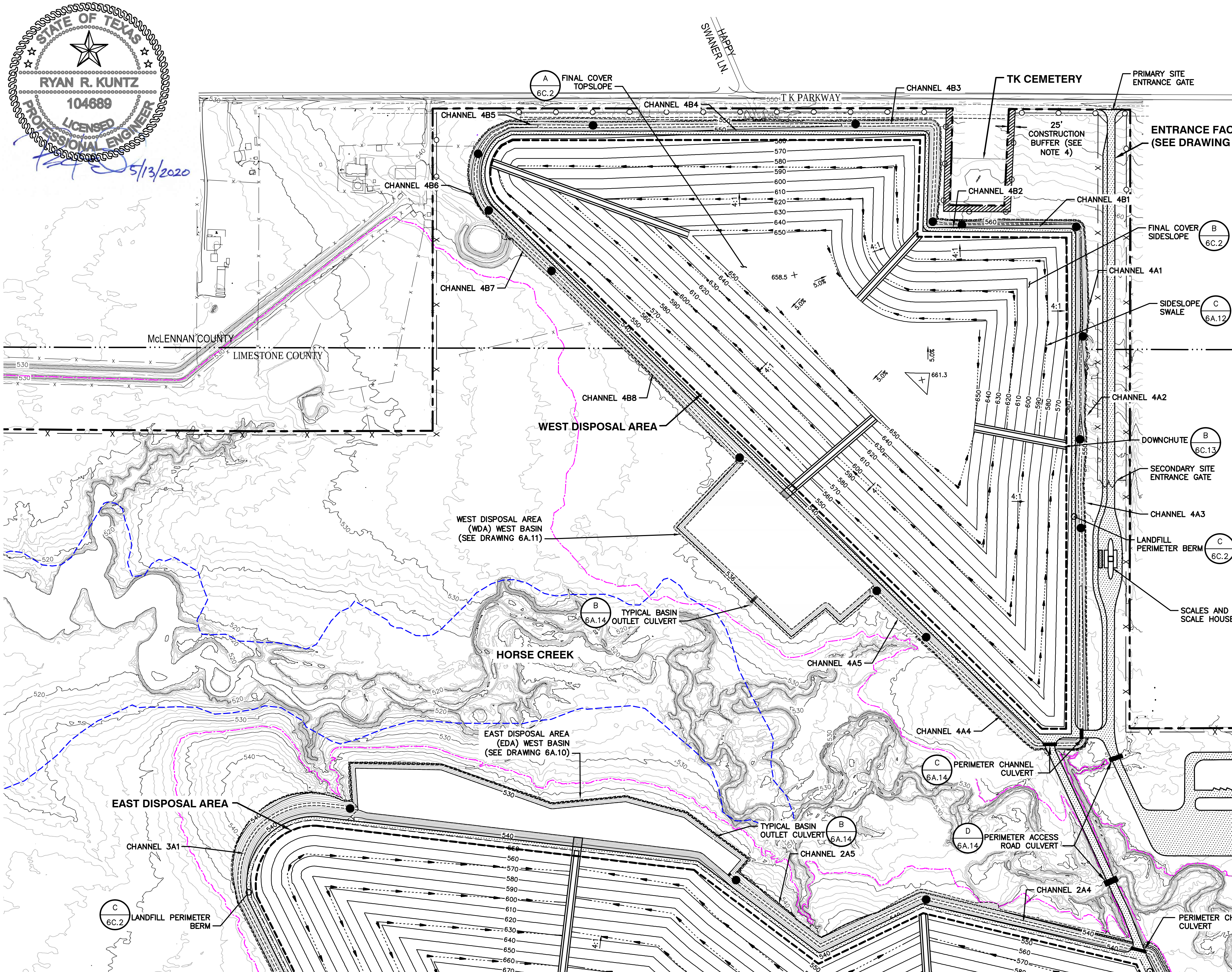
PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 3.2 – EAST LANDFILL COMPLETION PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 3.2



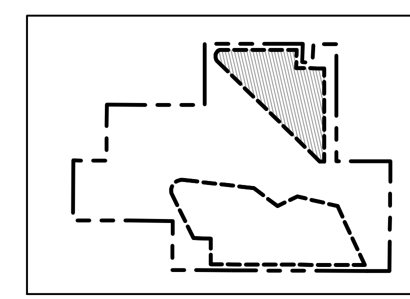
0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. 100-YEAR STORM EVENT WATER SURFACE IS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
4. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.



KEY MAP

FOR PERMITTING PURPOSES ONLY

REV. DATE DESCRIPTION BY	
TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407	
DRAWING TITLE	WEST DISPOSAL AREA LANDFILL COMPLETION PLAN
PROJECT TITLE	CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION
CLIENT	CITY OF WACO SOLID WASTE SERVICES
SCS ENGINEERS	STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, 1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021, PH (817) 571-2288 FAX NO. (817) 571-2188
PROJ. NO.	16216088.00
DSN. BY:	SS
DWN. BY:	SS
CHK. BY:	RRK
Q/A RVW BY:	RRK
APP. BY:	RRK
CADD FILE:	3.3 - WEST LANDFILL COMPLETION PLAN
DATE:	04/2020
SCALE:	AS SHOWN
DRAWING NO.	3.3

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 4
GEOLOGY AND GROUNDWATER REPORT

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

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Revision 0 – May 2020
SCS Project No. 16216088.

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5-13-2020

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1 INTRODUCTION

This document is the Geology and Groundwater Report for the City of Waco Landfill, Permit No. MSW-2400 (Landfill), and has been prepared in accordance with 30 Texas Administrative Code (TAC) §330.63(e). The landfill is a Type I municipal solid waste (MSW) landfill as defined in 30 TAC §330.5. This report summarizes available data related to regional and site-specific geologic and hydrogeologic conditions, as well as aquifers in the area of the Landfill in accordance with 30 TAC §330.63(e). This document also includes sections related to Groundwater Characterization and establishes a Groundwater Monitoring System design in accordance with 30 TAC §330.63(f).

2 REGIONAL PHYSIOGRAPHY, TOPOGRAPHY, AND CLIMATE

2.1 PHYSIOGRAPHY AND TOPOGRAPHY

The Landfill will be located approximately 0.4 miles south of the intersection of State Highway 31 and T K Parkway (also known as Farm-to-Market [FM] 939) (Figure-4.1). The Landfill lies in the eastern portion of the Great Plains physiographic province of Texas, near the boundary between the Great Plains Province and the Coastal Plains Province (Wermund, 1996, Figure-4.2). In earlier publications, this area was referred to as the Black Prairie Subprovince, which occupied the central and north central regions of Texas. The Black Prairie Subprovince is bounded on the north by the Red River and on the south by the Colorado River. This area consists of gently rolling hills that are occasionally broken by streams flowing west to east through the region that generally form wide, shallow valleys (Figure-4.3). Elevations in this region vary from approximately 400 feet mean sea level (ft-msl) to 750 ft-msl (Hill, 1901).

Horse Creek flows through the center of the landfill property, separating topographic highs to the east and west that drain into the creek. Horse Creek transports waters from a northern watershed and the landfill property topographic highs to a dammed reservoir (Soil Conservation Service, Site 19 Reservoir) south of the property. Packwood Creek and Williams Creek both flow generally from east to west and are located east and southeast of the Landfill property. Horse Creek and Packwood Creek/Williams Creek transport surface waters from north and east, respectively, and discharge into the referenced reservoir that releases into Williams Creek. In the most eastern area of the Landfill, water is transported into Packwood Creek via unnamed tributaries. Regional physiography is shown on Figure-4.2. The distances to local surface water bodies and drainage features are shown in Table III-4.1.

The minimum surface elevation of the property is approximately 515 ft-msl around the lake area in the southern area of the site. The maximum elevation of the property is approximately 570 ft-msl located near the northeast boundary (Figure-4.3).

2.2 CLIMATE

The climate in the Waco area is sub-humid, with area rainfall averaging approximately 34.7 inches per year (averaged between 1981 and 2010 at the Waco-McGregor Municipal Airport; source: www.usclimatedata.com). A table with the average monthly rainfall in the Waco area over the 29 years is provided in Table III-4.2.

3 GEOLOGY

3.1 GEOLOGIC SETTING

The regional geology is comprised primarily of geologic formations of the Late Cretaceous Gulfian and Comanche Series (McCoy et al, 1992). Figure-4.4 depicts the surface geology in the region. Regional geology and stratigraphy is depicted in Table III-4.3 with the Landfill stratigraphic position shown (Baker et al., 1990; Tetco, 1987). Rocks exposed at the surface in McLennan and Limestone Counties generally consist of Cretaceous Taylor Group (Wolfe City Formation) shale-marl, sand, silt, and clay, as well as near-surface Tertiary/Quaternary sands, gravels, silts, and clay sediments deposited near and along stream channels (U.S. Department of Agriculture, 1991 and 1992). The Cretaceous rocks of the Great Plains region of Texas represent shallow to marginal marine depositional environments caused by a series of transgressions and regressions (Hill, 1901). These deposits consist primarily of sandstones, shales, and carbonates, which represent different stages in the transgression-regression sequence.

Site stratigraphy details, including geologic age, lithology, variations in lithology, thickness, depth, geometry, hydraulic conductivity, and depositional history are included below and in Section 5.2. A geologic map of the area is included as Figure-4.4 and a regional structural cross-section depicting the distribution of geologic units is included as Figure-4.5.

Regional geologic units as depicted on the Geologic Atlas of Texas, Waco sheet (excerpted in Figure-4.4), include the Lower and Upper Cretaceous Systems from the Travis Peak Formation to the Pecan Gap Chalk, with Tertiary/Quaternary sediments deposited near and along stream channels. These formations consist of clastic materials, with grain sizes ranging from clay to sand and gravel. Most stratigraphic units of the Great Plains thicken towards the Gulf of Mexico as a result of subsidence of the depositional basin and rising of the land surface (Figure-4.5). Formation outcrops generally trend north-northeast to south-southwest, sub-parallel with the coast.

The Taylor Group is the uppermost geologic unit in the region of the Landfill property, consisting of the Pecan Gap Chalk, Wolfe City Formation and the Ozan Formation (Table III-4.3) and is generally overlain by Tertiary/Quaternary sediments deposited near and along stream channels. The Pecan Gap Chalk consists of chalk in the lower part grading up to a chalky marl. The Wolfe City Formation consists of shale-marl, sand, silt, and clay. The Ozan Formation consists of a calcareous claystone with increasing upward contents of silt and sand (Barnes, 1967; 1970). Underlying the Taylor Group are the Austin and Eagle Ford Groups, consisting primarily of chalk and calcareous shale with interbedded limestone lenses and numerous bentonite layers (Charvat, 1985; Barnes, 1970).

Underlying the Austin and Eagle Ford Groups is the Pepper Shale Formation (Woodbine Group) consisting of very dark grey, non-calcareous, pyritic shale; grading into the Woodbine Formation sand north of the Brazos River (Barnes, 1970). Underlying the Pepper Shale, the Del Rio Clay Formation (Washita Group) is mostly clay, with some thin lenticular beds of highly calcareous siltstone and limestone (Barnes, 1970). The Del Rio Clay is known as the Grayson Marl in some publications (Barnes, 1970).

Underlying the Del Rio Clay are the Georgetown Limestone Formation and the Main Street Limestone, which are medium grained, chalky limestones with some calcareous shale interbeds (Barnes, 1970). Underlying the Georgetown Formation and the Main Street Limestone are the

Pawpaw Formation, and Weno Limestone undivided, which are described as marl with interbedded limestone, and limestone with interbedded marl, respectively (Barnes, 1970).

Underlying the Pawpaw Formation and Weno Limestone are the Denton Clay, Fort Worth Limestone, and Duck Creek Limestone (Barnes, 1970). These formations are comprised primarily of limestone and represent the lower part of the Washita Group and are underlain by the Kiamichi Clay and Edwards Limestone. In some areas the units of the Washita Group from the Main Street Limestone to the Duck Creek Limestone are mapped as Georgetown Formation (Barnes, 1970). The Kiamichi Clay is clay, shale, and limestone. The Edwards Limestone is a massive limestone with abundant chert nodules; together these represent the upper units of the Fredericksburg Group (Barnes, 1970). The Kiamichi Clay is discontinuous and is mapped with the Edwards Limestone. Underlying the Edwards Limestone is the Comanche Peak Limestone and the Walnut Clay. The Comanche Peak Limestone is a hard limestone with numerous shale interbeds. The Walnut Clay consists primarily of clay, limestone, and shale (Barnes, 1970) and acts as the confining unit for the Trinity Aquifer (U.S.G.S., 1996). Underlying the Walnut Clay is the Paluxy Sand and Glen Rose Formation of the Trinity Aquifer. The Paluxy Sand is a quartz sand, fine to very fine-grained, with thin interbeds of shale and limestone. The Glen Rose Formation consists of limestone, clay, marl, and sand (Barnes, 1970). The Paluxy Sand and Glen Rose Formations represent the uppermost formations of the Trinity Aquifer (U.S.G.S., 1996).

Stratigraphic positions of these geologic units, with corresponding hydrogeologic units, are presented in Table III-4.3. Figure-4.5 depicts a regional geologic cross section.

3.1.1 Fault Areas

A site-specific fault and seismic impact zone evaluation was conducted as part of a permit application by SCS Engineers. The fault study for this characterization conducted by SCS consisted of the following:

1. Review of published geologic maps, literature, and fault/structural studies of the area.
2. Review of published surficial fault maps.
3. Review of aerial photographs.
4. A site field investigation which included inspections of existing stream cut walls and surrounding roads for surface displacement.

Figure-4.6 depicts seismic impact zones. Figure-4.7 is a regional tectonic map. The fault, seismic, and tectonic maps indicate that the Landfill is located between two fault zones: the Balcones Fault Zone and the Mexia-Talco-Luling Fault Zone. The Balcones Fault Zone is located south and west of the Landfill, while the Mexia-Talco-Luling Fault Zone is located to the east. The closest mapped faults to the Landfill are normal faults downthrown to the east; all of which are well over a mile away. The closest fault lies within the Balcones Fault Zone, and is probably structurally related to this family of faults. The most prominent tectonic feature on Figure-4.7 is the Ouachita Tectonic Front (Ewing, 1991), which is a deep-seated thrust fault zone located over 10 miles west of the Landfill. Faults in this zone are identified only by deep seismic data and other geophysical data and do not propagate to the ground surface.

The Waco Uplift is a structural feature approximately eight miles wide (east-west) by 80 miles long (north-south) associated with the Balcones/Ouachita trend. The western boundary is approximately twenty miles west of the Landfill (Caran, 1981).

Baylor University (located in the City of Waco) has conducted geologic, structural, and fault studies of the Waco area. Hayward (1978) identified small displacement faults in the Waco area Austin Chalk Formation which are thought to be growth faults. The description and photographs of these faults were used to assist in the site field investigation described in Section 5.0.

Based on review of the aforementioned documentation, the Landfill is not located within one-half mile of an active fault nor experiences differential subsidence; therefore, the requirements of 30 TAC §330.555(a, b) are met.

3.1.2 Seismic Impact Zones

The location restriction criterion in 30 TAC §330.557 requires that new disposal units and lateral expansions not be located in seismic impact zones unless the owner or operator can demonstrate that all containment structures, including liners, leachate collection systems, and surface water control systems are designed to resist the maximum horizontal acceleration in lithified earth material for the Landfill. A seismic impact zone is defined as an area with a 10 percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 250 years. If the maximum horizontal acceleration is less than or equal to 0.10 g, then the design of the unit will not need to incorporate an evaluation of seismic effects.

Areas within the United States where seismic effects need to be evaluated, as determined by the United States Geological Survey (USGS), are shown on Figure-4.6. As indicated on this figure, the Landfill property is not located within a seismic impact zone as defined by 30 TAC §330.557.

3.1.3 Unstable Areas

The location restriction criteria in 30 TAC §330.559 require engineering measures to be incorporated into the design of a disposal unit located in an unstable area to ensure that the integrity of the structural components of the disposal unit will not be disrupted. Unstable areas, by definition, are areas susceptible to natural or human-induced events or forces that are capable of impairing the integrity of some or all structural components (e.g., liners, leachate collection systems, final covers, etc.) of a disposal unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movement, salt domes, or karst terrain.

Based on information from existing geological and geotechnical data, unstable areas due to poor foundation conditions, areas susceptible to mass movement, salt domes, or karst terrain do not exist at, or immediately adjacent to the Landfill.

3.1.4 Erosion Potential

30 TAC §330.63(e)(2) requires an evaluation of active geologic processes in the vicinity of the Landfill, including the potential for erosion. The potential for erosion due to surface water processes, such as overland flow, channeling, gullying, and fluvial processes, including meandering streams and undercut banks, has been evaluated by SCS.

The Landfill surface drainage generally flows towards the north-south trending Horse Creek located near the center of the Landfill and/or to the south towards the Soil Conservation Service Site 19 Reservoir within or beyond the southerly limits of the property. Thus, the eastern Landfill drainage is generally to the west and south, whereas the western Landfill drainage is to the east and south. Erosional processes are primarily limited to those produced by periods of heavy rainfall. The Landfill topography results in moderate surface erosion during periods of heavy rainfall. This erosion is limited by the vegetation with cohesive clay-rich soils and sediments that outcrop over most of the Landfill area. Mass wasting has not been observed at the Landfill.

The General Soil Map of Texas (USDA, 2008) shows that the Landfill is located within the Texas Blackland Prairie area that includes Houston Black-Heiden-Wilson soils. The Limestone and McLennan County Soil Surveys (U.S. Department of Agriculture, 1991 and 1992) along with the USDA Web Soil Survey (2008), provided in Appendix III-4.A, indicate the following soil associations occur on the Landfill area:

- Axtell fine sandy loam, 1 to 3 percent slopes,
- Crockett loam, 1 to 3 percent slopes,
- Crockett loam, 3 to 5 percent slopes,
- Ferris clay, 5 to 15 percent slopes, eroded,
- Ferris-Heiden complex, 2 to 5 percent slopes, eroded,
- Heiden clay, 1 to 3 percent slopes,
- Heiden clay, 3 to 5 percent slopes,
- Tinn clay, 0 to 1 percent slopes, frequently flooded,
- Whitesboro loam, frequently flooded,
- Wilson clay loam, 0 to 2 percent slopes.

Aerial photographs (consistent with site observations) indicate that the predominant soil associations present at the Landfill are the Axtell fine sandy loam series and the Wilson clay loam series. These series consist of moderately well drained, moderately low to high permeable soils that are derived from clay and clay loam materials from Upper Cretaceous shales, marls, and/or mudstones. Typically, the Axtell series is found on steeper slopes than the Wilson series. The surface sediments consist of dark brown to dark gray silty clays and clay loams. The available water holding capacity of the Axtell and Wilson series is moderate.

The topographic high on the northwestern side of the Landfill consists primarily of the Crockett loam and Heiden clay series. These series consist of moderately well to well drained, very low to moderately low permeability soils that are derived from clayey residuum weathered from Upper Cretaceous shales, marls, and mudstones. The surface sediments consist of dark grayish brown clay and the available water holding capacity is moderate. Portions of the Landfill's east side also are covered in Heiden clay series.

Aerial photographs (consistent with site observations) also indicate the presence of the Tinn clay series on the topographic low areas of the Landfill along Horse Creek and associated drainages. This series, which frequently floods, consists of moderately well drained, very low to moderately low permeable soils that are derived from Holocene-age sediments along the stream. Whitesboro loam is also located along a topographic low of the Packwood Creek near the southeast corner of the Landfill, consisting of moderately well drained, moderately high to highly permeable soils derived from loamy alluvium of Holocene age of mixed sources. The available water holding capacity of the Tinn clay and Whitesboro loam series is moderate to high, respectively.

Other lesser distributed soil series include the Ferris clay and Ferris-Heiden complex series located in northern portions of the east and west sides of the Landfill. Both soils consist of well drained, very low to moderately permeable soils that formed from clayey residuum materials from Upper Cretaceous shales, marls, and/or mudstones. The available water holding capacity of both series is moderate.

4 HYDROGEOLOGY

4.1 REGIONAL HYDROGEOLOGY

The Trinity Aquifer is the State-defined major aquifer in this region, underlying an area of approximately 41,000 square miles (U.S.G.S., 1996; Ashworth and Hopkins, 1995). The regional extent of the Trinity Aquifer is depicted in Figure-4.8. Approximately 800 feet of stratigraphy separates the base of the Landfill from the top of the Trinity Aquifer (Figure-4.5); at least 500 feet of this geology has a low hydraulic conductivity. (Holloway, 1961; Klemt et al., 1975; Nordstrom, 1982) therefore, there is no hydraulic connection between shallow groundwater at the Landfill and the Trinity Aquifer. The Trinity Aquifer is composed primarily of Cretaceous sandstone, sand, silt, clay, shale, conglomerate, and carbonates. The stratigraphic units that make up the Trinity Aquifer are the Travis Peak, Glen Rose, and Paluxy Formations (U.S.G.S., 1996); see Figure-4.5 and Table III-4.3.

The beds of the Trinity Aquifer dip gently to the south-southeast, towards the Gulf of Mexico, and aquifer thickness increases in that direction. Groundwater gradient is to the southeast except where affected by local pumping, which has created water-level declines of up to 400 feet in the Waco area (Baker et al., 1990). The transmissivity of the Trinity Aquifer varies widely due to lithology changes, from about 80 to 5,700 square feet per day (ft2/d), and the storage coefficient ranges from about 0.00002 to 0.026 (U.S.G.S., 1996). Wells in the Trinity Aquifer generally yield 50 to 500 gallons per minute (gpm), though some have yielded as much as 2,000 gpm (U.S.G.S., 1996). Recharge to the Trinity Aquifer is primarily from precipitation falling in the outcrop areas, over 50 miles west of the Landfill (Baker et al., 1990).

The Trinity Aquifer within the area of the Landfill is under confined conditions (STGCD, 2015). The basal Walnut Clay of the Fredericksburg Group functions as the regional upper confining unit to the underlying Trinity Aquifer (Baker et al., 1990). The Walnut Clay is approximately 125 to 175 feet thick in the vicinity of the Landfill (Table III-4.3) (Barnes, 1970).

The approximate altitude of water levels in the Trinity aquifer from local water wells is shown on Table III-4.4. A regional water-table contour map or potentiometric surface map of the Trinity Aquifer is not available for this region.

4.2 LOCAL GROUNDWATER USE

Water supply wells were identified by a review of records on file at the Texas Water Development Board and in accordance with §330.56(d)(4)(J). No wells were identified within the Landfill boundaries (other than the piezometers installed as part of this investigation). The only wells within one mile of the Landfill were installed for oil and gas exploration, as identified in Parts I/II, Section 7.2. The closest water supply wells are greater than 3 miles from the Landfill. There were no water wells located by the records search within a one-mile radius of the Landfill, also as described in Parts I/II, Section 7.2.

The closest water wells to the Landfill noted in the records search are located between 3 and 7 miles from the Landfill. Most of these wells were installed for domestic-public supply purposes and completed in the geologic formations that comprise the Trinity Aquifer. The Trinity Aquifer wells are located northeast, northwest, southwest and south of the Landfill. Only two wells east and southeast of the Landfill were screened in shallow deposits, e.g., the Navarro-Taylor units.

Table III-4.4 and Appendix III-4.B provide well search data. Table III-4.4 provides the locations for these wells and the aquifers in which they are completed (30 TAC §330.63(e)(3)(J)). The closest water well utilized for public supply is approximately 3.6 miles southwest of the Landfill.

The Landfill is unlikely to impact these wells for several reasons. First, the minimum horizontal distance of all the wells from the Landfill is greater than 3.5 miles. Most of the wells produce water from the Trinity Aquifer, which is located approximately 800 feet vertically below the Landfill (Holloway, 1961). Secondly, the soil liner systems that will be installed in the disposal cells provide a low-permeability barrier to prevent the release of potential contaminants. Finally, in the unlikely event a release were to occur, the low-permeability of the natural soils and bedrock below the Landfill will restrict groundwater flow and the groundwater monitoring wells installed on the perimeter will detect the release, which will prompt measures to mitigate the release.

5 SUBSURFACE INVESTIGATION REPORT

5.1 PREVIOUS INVESTIGATION PROGRAMS

A soil boring plan for the Landfill was submitted September 7, 2018 and approved by the TCEQ in a letter dated October 4, 2018. Soil boring investigations of the Landfill began with drilling conducted in January 2018. A total of 5 borings (A-1 through A-5) were completed at that time, with depths ranging from 48 feet to 101 feet-bgs. A second phase of drilling occurred during October 2018 through January 2019, in which an additional 42 borings (B-6 through B-47) were advanced between 28 to 80 feet in depth (see Appendix III-4.C – Soil Boring Plan). In December 2019, additional deep borings were drilled adjacent to B-9 and B-43 to depths of 135 feet and 150 feet, respectively. Conventional standpipe piezometers were installed in the following ten borings: B-1 (PZ-1), B-3 (PZ-3), B-8 (PZ-8), B-9 (PZ-9), B-18 (PZ-18), B-20 (PZ-20), B-33 (PZ-33), B-41 (PZ-41), B-43 (PZ-43), and B-47 (PZ-47). Boring logs are included in Appendix III-4.D. State well reports are included in Appendix III-4.E.

Water level measurements obtained in the ten conventional standpipe piezometer installations described above indicated groundwater was observed in four out of ten piezometers. In order to obtain additional groundwater data, Vibrating Wire Piezometers [VWPs] were installed in 24 locations. VWPs are further described in Section 6.2. Initially, 17 shallow VWPs were installed at locations correlating to the existing conventional standpipe piezometers [10 VWPs] and seven other locations of interest corresponding to existing borings. Subsequently, in order to observe deeper Unit III conditions, an additional seven deep VWPs were installed at locations corresponding to existing conventional standpipe piezometers, for a total of 24 VWPs installed during the investigation.

The number and depth of borings were included in the determination to meet the requirements of 30 TAC §330.63(e)(4)(A) and (B) for the Landfill, as described in the boring plan that was approved by the TCEQ (Appendix III-4.C). A summary of borings with elevations and coordinates is provided in Table III-4.5. The Elevation of Deepest Excavation (EDE) is 505 ft-msl. As listed, 22 borings were advanced to an elevation 30 feet below the EDE and 2 borings [9D and 43D] were advanced to an elevation 100 feet below the EDE, whereas the total depth of the remaining 23 borings were generally drilled to an elevation 5-10 feet below the EDE. The locations of all the Landfill borings are shown on Figure-4.9.

The borings were advanced using hollow stem augers and were either completed as piezometers to provide groundwater elevation data or were plugged in accordance with 16 TAC §76.702 and §76.1004. Soil samples were collected during auger advancement utilizing Shelby tubes, two-foot split spoons (also used to collect standard penetration tests for geotechnical purposes), or five-foot NX continuous split barrels.

The boring logs from the site investigations are attached as Appendix III-4.D. Laboratory data on soil samples obtained during the investigations are found in Appendix III-4.F and summarized in Part III, Attachment 5, Geotechnical/Stability Analysis.

5.2 SITE STRATIGRAPHY

Site stratigraphy is consistent with the regional geologic setting described in Section 3.1. Site stratigraphy is illustrated through a series of 6 cross-sections (A-A' to F-F'), as shown on Figure-4.10 through Figure-4.15. These cross-sections utilize the borings completed by SCS Engineers.

Various parts of this application use the terms "shale" and "clay". Shale is classified by geologists as a rock-like material consisting primarily of the mineral clay. In shallower [near-surface] stratigraphy, where the lithology is a softer, more plastic material, the term "clay" is used as the descriptor. In deeper sections, the clay lithifies (hardens) due to overburden pressures and transitions to a more rock-like, fissile material termed "shale". This change from overlying clay to underlying shale is often transitional.

The geology observed in the site exploration program consisted primarily of clay and shale, with minor amounts of larger grain sizes. Three stratigraphic units have been identified at the Landfill:

- Unit I consists of surficial clayey and loamy alluvium overlying silty or sandy clays with small subrounded gravel. The Unit I thickness ranged between 1.5 and 29 feet. The transition from Unit I to the underlying Unit II is transitional, and marked by increasing hardness and increasing fissility.
- Unit II, beneath Unit I, consists of weathered silty shale with varying calcareous content. Some publications use the term "marl" to describe calcareous shale. The Unit II silty shale has thin, interbedded limestone and sand/silt partings/lenses, calcite-filled joints, and marine shell fragment fossils. The top of Unit II was encountered at elevations ranging from approximately 503.3 feet-msl to 558.1 feet-msl. The thickness of Unit II ranged between 7 and 37.5 feet. The transition from Unit II to the underlying Unit III is marked by a color change caused by the downward limit of oxidation. Above the Unit II/Unit III line, the stratigraphy is generally more variable in color but are generally lighter-colored and have evidence of oxidation such as various rust- and yellow/brown colors. Below the Unit II/Unit III line, the stratigraphy is a homogenous very dark color, trending to black. Unit III also is less fissile than Unit II.
- Unit III, beneath Unit II, consists of unweathered dark gray to black calcareous shale bedrock with thin, interbedded limestone and sand/silt lenses, and marine shell fragment fossils. The top of Unit III was encountered at elevations ranging from approximately 492.0 feet-msl to 531.85 feet-msl. Landfill borings did not encounter the bottom of Unit III.

The bottom of the landfill excavation will be founded in Unit II or Unit III, depending on the location and depth of the cell excavation. Laboratory testing has been completed on samples of all three units, in accordance with the requirements of 30 TAC §330.63(e)(5). The geotechnical evaluation of Landfill materials and slope/waste stability is included in Part III, Attachment 5, Geotechnical/Stability Analysis. This design report presents the geotechnical summary and engineering evaluations and analyses. These analyses indicate that the soils at the Landfill are suitable for the intended purpose.

5.3 SOIL ENGINEERING PROPERTIES

Table III-4.6 summarizes the engineering properties of Unit II, based on the results from geotechnical investigations conducted by SCS Engineers. The test method utilized during the investigation is listed in the table. No piezometers were screened exclusively in Unit II. Hydraulic conductivity values obtained during the investigation [see Section 6.3] by slug test represent values at the screened interval at the Unit II/Unit III interface.

Table III-4.7 summarizes the properties of Unit III, based on the results from geotechnical investigations conducted by SCS Engineers. The test method utilized during the investigation is listed in the table. Hydraulic conductivity results obtained during the investigation are based on slug test results performed on the piezometers screened in Unit III.

6 GROUNDWATER INVESTIGATION REPORT

6.1 STANDPIPE PIEZOMETERS

Subsurface soil borings have been drilled at the landfill for geological and hydrogeological characterization. Standpipe piezometers were installed in ten of these borings, as described in Section 5.1. A map of standpipe piezometer locations is provided in Figure-4.16. Piezometer completion information is tabulated in Table III-4.8. Stabilized water level data are tabulated in Table III-4.9. Six of ten existing standpipe piezometers did not have groundwater present. To provide additional data, vibrating wire piezometers were installed as further detailed below.

6.2 VIBRATING WIRE PIEZOMETERS

Vibrating wire piezometers (VWP) are pressure transducers that measure pore-water pressure. VWPs can detect pore-water pressure faster than conventional standpipe piezometers in low-permeability materials, because a newly installed standpipe piezometer may fill with water very slowly as it comes to equilibrium with groundwater. A newly installed VWP has a relatively much smaller cavity to fill with water, and therefore comes to equilibrium faster.

The VWP system consists of a pressure transducer, signal cable, and a readout device. It is installed as a dedicated instrument using a conventional drilling rig. After a borehole is drilled, the device is placed at the desired depth in filter media sand, and grouted from there to the ground surface.

After installation, pore-water enters the transducer through a filter and presses upon a diaphragm. This causes the diaphragm to deflect. This deflection is measured as a change in tension and frequency of vibration of the vibrating wire element. The square of the vibration frequency is directly proportional to the pressure applied to the diaphragm. The resulting pressure reading is a measure of water head pressure at that location. This water head pressure can be converted to a calculated groundwater elevation using device calibration information supplied for each device by the manufacturer. The Geokon 4500 VWP device was used for this investigation. The User Manual for the Geokon 4500 series and the calibration forms for each device are provided in Appendix III-4.G.

Seventeen VWP installations occurred in July 2019 through August 2019, two VWP installations occurred in October 2019, and five VWP installations occurred in December 2019; for a total of 24 VWP installations. Piezometer and VWP completion data are included in Appendix III-4.H and Appendix III-4.I, respectively. A summary of the VWP installations is provided in Table III-4.10. A map of VWP locations is provided in Figure-4.17.

6.2.1 Shallow VWPs

From July 2019 through August 2019, 17 VWPs were installed at various depths to provide a spatial distribution of these VWPs to characterize the weathered/unweathered shale formation. Results showed that 5 of 17 VWPs (VWP-1, VWP-3, VWP-18, VWP-30, and VWP-44) indicated the presence of water, resulting in calculated groundwater elevations shown in Table III-4.11. Therefore, the data indicate the remaining 13 VWPs and the six adjacent dry standpipe piezometers were completed above any saturated zone.

Initial readings from VWP-20 indicated a small amount of water may have been carried down the borehole during drilling, but this dissipated to the in situ condition of no water indicated at this location.

6.2.2 Deep VWPs

In October 2019, to verify whether a continuous zone of saturation was located below existing dry standpipe piezometers and VWPs, two additional VWPs (VWP 41D and VWP 47D) were installed to a target elevation of 400 feet msl. Both VWPs indicated the presence of water, resulting in calculated groundwater elevations of 422 ft-msl (VWP-41D) and 416 ft-msl (VWP-47D) (see Table III-4.11). These data provide evidence of an existing continuous lower groundwater system.

To verify data from VWP-41D and VWP-47D, in December 2019, five additional deep VWPs (VWP-8D, VWP-9D, VWP-18D, VWP-33D, VWP-43D) were installed to the same target elevation of 400 feet msl. All five VWPs indicated the presence of water, resulting in calculated groundwater elevations ranging from approximately 408 feet to 518 feet (see Table III-4.11).

Due to shallow groundwater indicated by adjacent groundwater elevation readings of 519 feet at PZ-18 and 523 feet at VWP-18, casing was used during the installation of VWP-18D to eliminate infiltration from the upper groundwater system to the lower system within the borehole (Appendix III-4.I). Casing was set to an elevation of 461 feet. VWP-18D exhibits a stabilized calculated groundwater elevation of approximately 484 feet.

VWP-8D and VWP-9D both exhibited calculated groundwater elevations above the elevations of adjacent shallow VWPs (VWP-8 and VWP-9) and elevations of the bottom of screen elevation for adjacent standpipe piezometers (PZ-8 and PZ-9) at their corresponding locations. VWP-8 and VWP-9 transducers have zero water pressure, and PZ-8 and PZ-9 have both remained dry. The higher calculated groundwater elevations of VWP-8D and VWP-9D are attributed to being under elevated pore pressure not propagated to the elevations of the adjacent [higher] shallow VWPs and standpipe piezometers, due to the very low hydraulic conductivity and resulting slow travel/equilibration time. These observations indicate that shallower groundwater may occur in isolated pods.

6.3 GROUNDWATER INVESTIGATION RESULTS

Two groundwater zones were identified as a result of site field investigations, classified by elevation as “shallow” and “deep” zones that are not marked by significant changes in lithology. The shallow zone is considered unconfined and consists of isolated “pods” of saturation that are not always present everywhere at the site. The unconfined nature of this shallow saturation is due to the shallow occurrence and proximity to the ground surface. These zones of shallow saturation are discontinuous and do not appear to be connected to each other or to the deep zone. The deep zone is considered confined and is continuously saturated. The confined nature of this deep saturation zone is due to the depth, isolation from the atmosphere, and elevated pressure readings of some of the deep VWPs [see Section 6.2.2].

A comparison of precipitation records and water level data from newly installed piezometers in the east and west units of the Landfill is presented as Appendix III-4.J. Tabulated historic water level data, collected from piezometers from October 2018 to February 2020, are provided in Appendix III-4.K. Tabulated historic water level data, collected from VWPs from July 2019 to

February 2020, are provided in Appendix III-4.L. Using the deep VWP data, a potentiometric map of the groundwater flow system present on the Landfill was prepared and is included as Figure-4.18. The slug test results from the Landfill piezometers are provided in Appendix III-4.M.

Groundwater flow direction was determined using deep VWP data. The Landfill groundwater flows towards the south-southeast (Figure-4.18), consistent with local and regional topography. Shallow VWP and piezometer data were excluded from the flow direction interpretation because of the limited, disconnected nature of isolated pockets of groundwater at higher elevations.

6.3.1 Slug Testing

Slug testing was implemented in piezometers to determine hydraulic properties (Appendix III-4.M). The shale of lower Unit II and uppermost Unit III contains isolated pockets of groundwater. In limited locations, this is the uppermost water bearing unit below the landfill. The slug testing was conducted in piezometers with groundwater from the shallow zone, which is considered unconfined [see Section 6.3]. Seven of the ten piezometers installed were screened in the lower Unit II/upper Unit III zone. Slug tests were performed on PZ-1, PZ-3, PZ-18, and PZ-20 in the east and west areas to determine hydraulic conductivity. Results are summarized in Table III-4.12; Appendix III-4.M provides slug test data. A summary of hydraulic conductivity calculations is presented in Table III-4.12.

Slug tests performed at PZ-1 and PZ-18 used both the falling and rising head methods. The falling head method is implemented by introducing a “slug” into the water column, causing a temporary rise in head. The rising head method requires removing the “slug” from the water column, causing a temporary fall in head. The drop or rise in water level was then monitored with respect to time to determine hydraulic conductivity, using a logging pressure transducer. The results were analyzed using the Bouwer and Rice method.

An alternative falling head method was employed at PZ-3 and PZ-20 because the well screens were not fully submerged. Ten gallons of potable water were introduced into each well, such that the well screen was fully submerged. As the water level fell, a logging transducer recorded the falling head. The results were calculated using the Bouwer and Rice method.

6.3.2 Horizontal Flow Calculation

Horizontal travel velocities were estimated for the Unit II/III interface using the following formula:

$V_a = (K*I)/(7.5*N)$ (Driscoll, 1986)

where:
V_a = actual travel velocity
K = hydraulic conductivity of the aquifer (geometric mean)
I = hydraulic gradient
N = effective porosity (5%) (Driscoll, 1986)

The hydraulic gradient was measured as the difference in water elevations between VWP-18D (483.9 feet-msl) and VWP-33D (408.1 feet-msl) divided by the distance between the two VWPs in feet (3,120 feet). Measurements were taken from the February 2020 potentiometric map (see Figure-4.18).

Horizontal travel times of the uppermost groundwater (Unit II/Unit III interface) were determined to represent (1) the overall Landfill area, (2) the overall Landfill area regarding Unit II, (3) the eastern area of the Landfill, and (4) the western area of the Landfill. An upper and lower bound predicted horizontal flow rate was also determined using the highest and lowest hydraulic conductivities recorded from SCS performed slug tests. Values used for horizontal flow calculations and horizontal flow rates are as shown in Table III-4.13.

The highest hydraulic conductivity value was recorded at PZ-3. The predicted upper horizontal flow rate from this location was 0.035 feet per year.

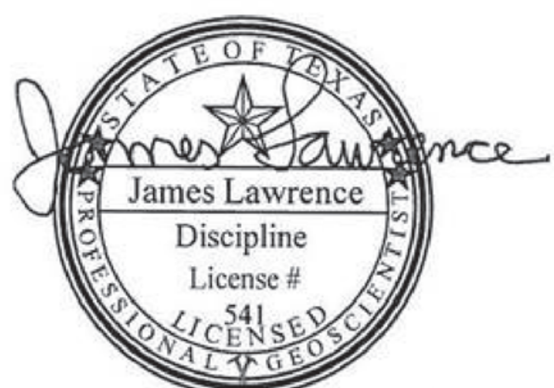
The lowest hydraulic conductivity value was recorded at PZ-18. The predicted lower horizontal flow rate from this location was 0.007 feet per year.

The horizontal travel time of the uppermost groundwater (Unit II/Unit III interface) across the entire Landfill area (PZ-1, PZ-3, PZ-18, PZ-20) was determined to be approximately 0.012 feet per year.

The horizontal travel time of the uppermost water across the Landfill area for Unit II (PZ-1, PZ-3, and PZ-20) was determined to be approximately 0.014 feet per year.

The horizontal travel time of the uppermost groundwater (lower Unit II/upper Unit III interface) in the eastern area of the Landfill (PZ-18, PZ-20) was approximately 0.009 feet per year.

The horizontal travel time of the uppermost groundwater (Unit II/Unit III interface) in the western area of the Landfill (PZ-1, PZ-3) was approximately 0.014 feet per year.



5-13-2020

7 POLLUTANT PATHWAYS

Regionally, the groundwater generally flows in a southeast direction towards the Gulf of Mexico. Locally, the groundwater flows in a similar south to southeast direction. Excavation in the area of the Landfill will likely alter the groundwater flow path by creating a depression in the water table, and a resulting inward gradient. This may cause shallow groundwater in the eastern unit of the Landfill to flow west, and the western unit to flow east.

The sidewalls of the Landfill will be excavated partly in the weathered shale (Unit II), and partly in the underlying unweathered shale (Unit III). The base is generally in the unweathered shale. A potential release to the weathered shale zone would be expected to generally follow flow paths shown in Figure-4.18, moving downgradient to the south-southeast. Any potential leachate release in the unweathered shale is expected to also generally follow flow paths shown in Figure-4.18, moving down-gradient to the south-southeast. Potential leachate releases to the weathered zone or shallow unweathered zone (beneath the base of the Landfill) would be expected to move laterally and down-gradient. Potential releases are not expected to migrate downward into the lower-permeability zones of the unweathered shale because this is a lower-permeability, higher-resistance flow path. The predicted lateral flow of groundwater along bedding planes is due to horizontal hydraulic conductivity being generally greater than vertical hydraulic conductivity in flat lying sedimentary rocks, as hydraulic conductivity decreases with increasing depth (Heath, 1983; Harlow and Lecain, 1993). The Landfill groundwater monitoring system is designed to monitor the uppermost formation capable of yielding significant quantities of ground water (sufficient groundwater present in a well that can be sampled) encountered below the Landfill. Section 9.0 addresses the design of the proposed groundwater monitoring system.

The Facility will promptly notify, in writing, the Texas Commission on Environmental Quality (TCEQ), and any local pollution agency with jurisdiction that has requested to be notified, of future changes in facility construction or operation or changes in adjacent properties that affect, or are likely to affect, the direction and rate of groundwater flow and the potential for detecting groundwater contamination from a solid waste management unit.

7.1 LOCAL HYDROGEOLOGY

The Trinity Aquifer [see Section 4.1], which underlies the Landfill property, all of McLennan County, and the northwest corner of Limestone County, produces the majority of the total groundwater used in the area surrounding the Landfill (STGCD, 2015). In the Landfill area, Gulfian and Upper Comanche Series deposits (Table III-4.3) represent the upper most stratigraphy and are not considered hydrogeologic/aquifer type units due to their low permeability. The shallow stratigraphy in the Landfill vicinity does contain water, but is not considered a regional or local aquifer due to the inability to deliver enough usable water to a water supply well. The shallow clay/shale stratigraphy primarily transmit fluids via higher weathered zones with increased fissility/joints. The shallowest groundwater at the Landfill is at the base of Unit II. In the Landfill area, the deeper unweathered shale-marl stratigraphy of Unit III will act as an aquitard that inhibits vertical movement of groundwater due to decreased fissility and increased hardness, and resulting lower permeability.

8 GROUNDWATER QUALITY CHARACTERIZATION

This section presents information on the current groundwater monitoring program and groundwater quality data at the Landfill to address the groundwater quality findings in accordance with 30 TAC §330.63(f)(5) through (7). Details of the proposed groundwater monitoring program are discussed in Section 9.0 of this report.

8.1 OVERVIEW OF THE EXISTING GROUNDWATER MONITORING SYSTEM

This Landfill is a solid waste landfill. It has no existing groundwater monitoring system.

8.2 GROUNDWATER MONITORING DATA

Groundwater at the Landfill has not been sampled or analyzed. There are no existing monitoring wells at the Landfill.

8.3 REGIONAL GROUNDWATER QUALITY

Water quality varies throughout the Trinity Aquifer. Well records searched in the area of the Landfill show total dissolved solids (TDS) concentrations typically ranging from to 700-3,400 (mg/L). The majority of the wells in the vicinity of the Landfill are completed in the Hosston member of the Travis Peak Formation, which has a mean TDS concentration of 915 mg/1 (Baker et al., 1990). The approximate altitude of water levels in the Trinity aquifer are listed in Table III-4.4.

The basal Walnut Clay of the Fredericksburg Group functions as the regional upper confining unit to the underlying Trinity Aquifer (Baker et al., 1990). The Walnut Clay is approximately 125 to 175 feet thick in the vicinity of the Landfill (Table III-4.3) (Baker et al., 1990 and Tetco, 1987). The base of the Walnut-i.e., the top of the Trinity Aquifer—is approximately 800 feet below the Landfill.

9 GROUNDWATER MONITORING PLAN

9.1 EXISTING GROUNDWATER MONITORING SYSTEM

No groundwater monitoring wells currently exist at the Landfill.

9.2 PROPOSED GROUNDWATER MONITORING SYSTEM

The locations and depths of the monitoring wells are designed to determine the quality of groundwater passing the point of compliance and to detect groundwater impact from the waste units, and prior to any contaminants entering deeper portions of the stratigraphy interpreted as the Wolfe City Formation (30 TAC §330.403(a)(2)). The potential pathways for contaminant movement from the waste units are expected to be lateral [horizontal] via shale fractures that develop primarily horizontally as the overlying sediments unload over geologic time due to erosion.

Site drilling indicates that groundwater was generally not initially observed upon completion of a boring. Due to the sporadic distribution of site groundwater, two monitoring wells will be installed at each location, one with a specified shallow depth (“A” series) and the other with a specified deep depth (“B” series). Each well will be installed with a 40-foot monitoring well screen due to the sporadic distribution of groundwater. A map of the proposed groundwater monitoring system is provided in Figure-4.19.

Based on the groundwater conditions shown on Figure-4.18, the proposed monitoring system will consist of twelve upgradient wells and fifty-six downgradient wells (Figure-4.19).

Initial proposed monitoring well installations will begin at the eastern disposal area of the Landfill, where waste will first be disposed. The eastern side monitoring well names begin with the designation ‘P1’; western side well names begin with ‘P2’. The letter ‘A’ denotes a shallow well and the letter ‘B’ denotes a deep well. Fourteen proposed monitoring wells will be installed prior to landfill operation (P1-MW 1 A/B, P1-MW 2 A/B, P1-MW 16 A/B, P1-MW 17 A/B, P1-MW 18 A/B, P1-MW 19 A/B, P1-MW 20 A/B). The remaining proposed monitoring wells will be installed when waste is within 1,000 feet of the proposed monitoring well location. Installation details for proposed monitoring wells are described below and in Table III-4.14. The new monitoring wells will be sampled for background data for eight quarters in accordance with the Groundwater Sampling and Analysis Plan (GWSAP, see Attachment 7). Semiannual detection monitoring will then be implemented in accordance with GWSAP.

Monitoring wells will be constructed in accordance with the Proposed Monitoring Well Construction Details indicated in Figure-4.20, which is in conformance with requirements outlined within 30 TAC §330.421(a)(2). A qualified Texas-licensed driller will drill and install monitoring wells using equipment and methods that are appropriate for the Landfill conditions. A licensed professional geoscientist or engineer who is familiar with the geology of the area will supervise drilling, develop a detailed lithologic description of the boring, monitor well installation, and oversee well development (30 TAC §330.421(a)(1)(A)). The boring will be at least 4-inches larger than the outer diameter of the well casing and screen. If water is used in drilling, it will be from a potable source, and a current chemical analysis will be provided with the monitoring well installation report. A licensed professional geoscientist or engineer who is familiar with the geology of the area will supervise or make a boring log for each monitoring well and shall seal, sign, and date the boring log.

After a monitoring well is installed, it will be developed until excessive turbidity due to drilling/installation has been removed and field measurements of pH, specific conductance, and temperature have stabilized in accordance with 30 TAC §330.421(c). Development may be accomplished through the use of pumping and/or bailing.

Upon completion of well installation activities, a registered professional surveyor will survey the locations with vertical measurements to the nearest 0.01-foot and referenced to mean sea level (with year of the sea-level datum shown). Survey points for each well will include the top of PVC casing (with referenced point marked), top of protective cap, and ground surface adjacent to the well pad. Horizontal locations will be determined to the nearest tenth of a second for latitude and longitude or accurately located relative to the Landfill grid system (30 TAC §330.421(d)).

Within 60 days of well completion, well installation and construction information will be submitted to the TCEQ on current forms. The report will include a detailed geologic log, any test results, a description of development procedures, and a site map (to scale) showing the location of all monitoring wells and the point of compliance (30 TAC §330.421(e)). Any monitoring well that is damaged to the extent that it is no longer suitable for sampling will be reported to the TCEQ with a recommendation to repair or replace the well (30 TAC §330.421(f)). Any monitoring well that is no longer used shall be properly abandoned and plugged in accordance with 16 TAC §76.702 and 76.1004 with prior authorization in writing from the TCEQ.

The wells will be operated and maintained so that they will yield representative groundwater samples for the appropriate hydrogeologic unit throughout the life of the groundwater monitoring program (30 TAC §330.421(a) and (e) and §330.403(d)). Groundwater monitoring will be conducted throughout the active life and the closure and post-closure care period of the Landfill.

9.3 GROUNDWATER MONITORING SYSTEM CERTIFICATION

I, James Lawrence, Texas P.G. #541, have reviewed the groundwater monitoring well system installation plan for the Landfill. In my professional opinion, the proposed groundwater monitoring system has been designed in accordance with 30 TAC §330.63(f) and §330.401(e).

James Lawrence

Signature of Qualified Groundwater Scientist

Seal

10 GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS

In accordance with 30 TAC §330.63(f) and 330.405, a Groundwater Sampling and Analysis Plan (GWSAP) was developed, which describes sampling and analysis procedures that are designed to ensure monitoring results provide an accurate representation of groundwater quality at the background and point of compliance monitoring wells. This plan is included in Attachment 7.

11 SUMMARY

This report, prepared in accordance with 30 Texas Administrative Code (TAC) §330.63(e), summarizes available data from site investigations and previous reports related to regional and local geology and aquifers in the area, the occurrence and distribution of groundwater in the area of the Landfill, and establishes a groundwater monitoring system design.

The Landfill is underlain by bedrock material of the Cretaceous Taylor Group (Wolfe City Formation) consisting primarily of calcareous clay/shale, with minor amounts of sand and silt, as well as near-surface Tertiary/Quaternary sands, gravels, silts, and clay sediments deposited near and along stream channels (U.S. Department of Agriculture, *Soil Survey of McLennan County*, 1992; U.S. Department of Agriculture, *Soil Survey of Limestone County*, 1991). After the subsurface investigation, strata at the Landfill were divided into three units (Unit I, Unit II, Unit III). Unit I consists of surficial alluvial silts overlying silty or sandy clays with small subrounded gravel. Unit II consists of weathered calcareous shale with calcareous silty clay and thin, interbedded limestone and sand/silt lenses, calcite filling joints, and fossils. Unit III consists of unweathered gray calcareous shale with thin, interbedded limestone, sand/silt lenses, and fossils. The Landfill will be excavated into Units I, II, and III, which will provide a stable foundation. The low permeability of this stratigraphy provides additional containment beyond that provided by the engineered liner system. The uppermost water-bearing unit at the Landfill is the Unit II/III shale, which is confined with depth by the unweathered, lower permeability material.

Based on a review of this data, and on the results of geotechnical investigations conducted at the Landfill, the Landfill is suitable for use as a Type I MSW landfill.

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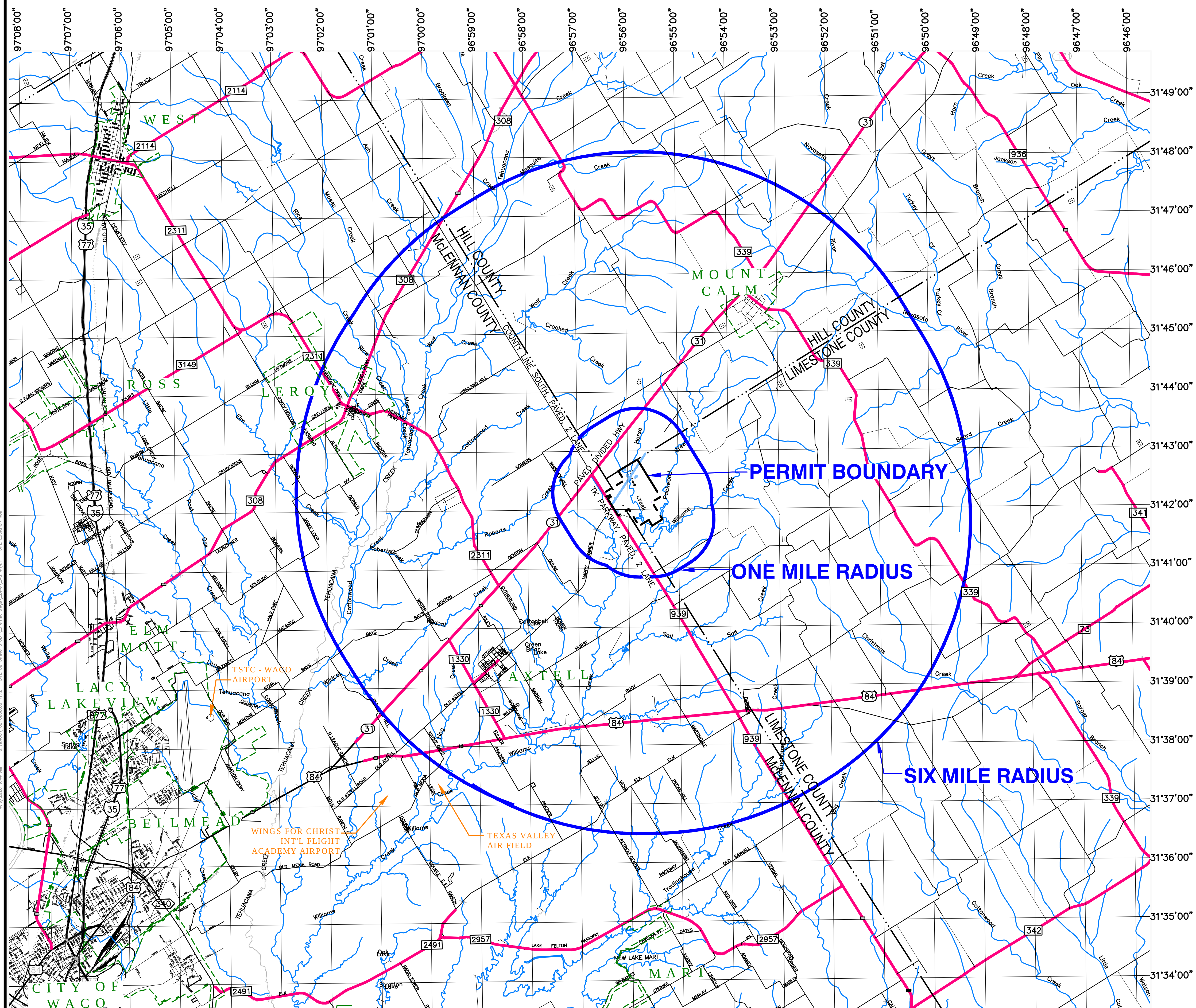
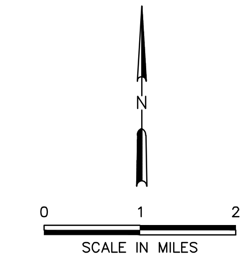
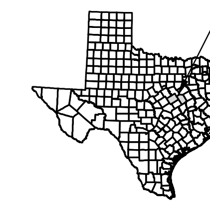
FIGURES







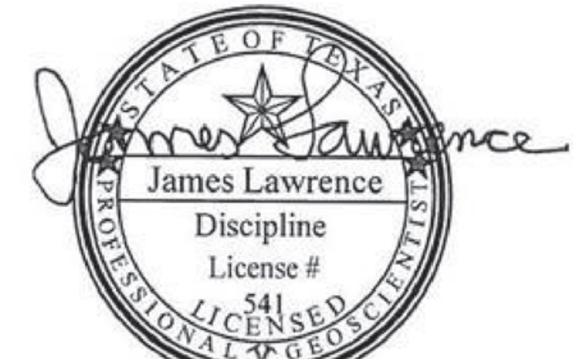
COUNTY LOCATION

LEGEND

1503	FARM TO MARKET ROAD
37	STATE HIGHWAY
38	STATE HIGHWAY LOOP
82	US NUMBERED HIGHWAY
	STREAM
	CEMETRY
	COUNTY LINE
96°55'30"	LATITUDE/LONGITUDE LINES

NOTE:

1. INFORMATION SHOWN IS FROM THE TEXAS DEPARTMENT OF TRANSPORTATION DIGITAL COUNTY MAPBOOK 2014.



5-13-2020

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: SITE LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00	DWN. BY: JLJ/NR	Q/A RVW BY: RRK
DSN. BY: AB/JL	CHK. BY: BJD/AB	APP. BY: JL

CADD FILE: 4.1 – SITE LOCATION MAP

DATE: 04/2020

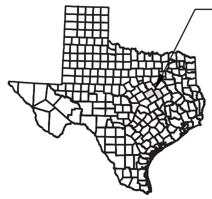
SCALE: AS SHOWN

FIGURE: **4.1**

JAMES LAWRENCE

STATE OF TEXAS
James Lawrence
Discipline
License #
541
PROFESSIONAL GEOSCIENTIST LICENSED

5-13-2020



COUNTY LOCATION

PROVINCE	MAX. ELEV. (ft)	MIN. ELEV. (ft)	TOPOGRAPHY	GEOLOGIC STRUCTURE	BEDROCK TYPES
Gulf Coastal Plains					
Coastal Prairies	300	0	Nearly flat prairie, <1 ft/mi to Gulf	Nearly flat strata	Deltaic sands and muds
Interior Coastal Plains	800	300	Parallel ridges (questas) and valleys	Beds tilted toward Gulf	Unconsolidated sands and muds
Blackland Prairies	1000	450	Low rolling terrain	Beds tilted south and east	Chalks and marls
Grand Prairie	1250	450	Low stairstep hills west; plains east	Strata dip east	Calcareous east; sandy west
Edwards Plateau					
Plateau	3000	450	Flat upper surface with box canyons	Beds dip south; normal faulted	Limestones and dolomites
Pecos Canyons	2000	1200	Steep-walled canyons		Limestones and dolomites
Stockton Plateau	4200	1700	Mesa-formed terrain; highs to west	Unfaulted, near-horizontal beds	Carbonates and alluvial sediments
Central Texas Uplift	2000	800	Knobby plain; surrounded by questas	Centripetal dips, strongly faulted	Granites; metamorphics; sediments
North Central Plains	3000	900	Low north-south ridges (questas)	West dip; minor faults	Limestones; sandstones; shales
High Plains					
Central	4750	2900	Flat prairies slope east and south	Slight dips east and south	Eolian silts and fine sands
Canadian Breaks	3800	2350	Highly dissected; local solution valleys		
Southern	3800	2200	Flat; many playas; local dune fields		
Basin and Range	8750	1700	North-south mountains and basins	Some complex folding and faulting	Igneous; metamorphics; sediments

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
PHYSIOGRAPHIC MAP OF TEXAS

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00
DSN. BY: AB/JL
DWN. BY: JLJ/NR
CHK. BY: BJD/AB
Q/A RVW BY: RRK
APP. BY: JL

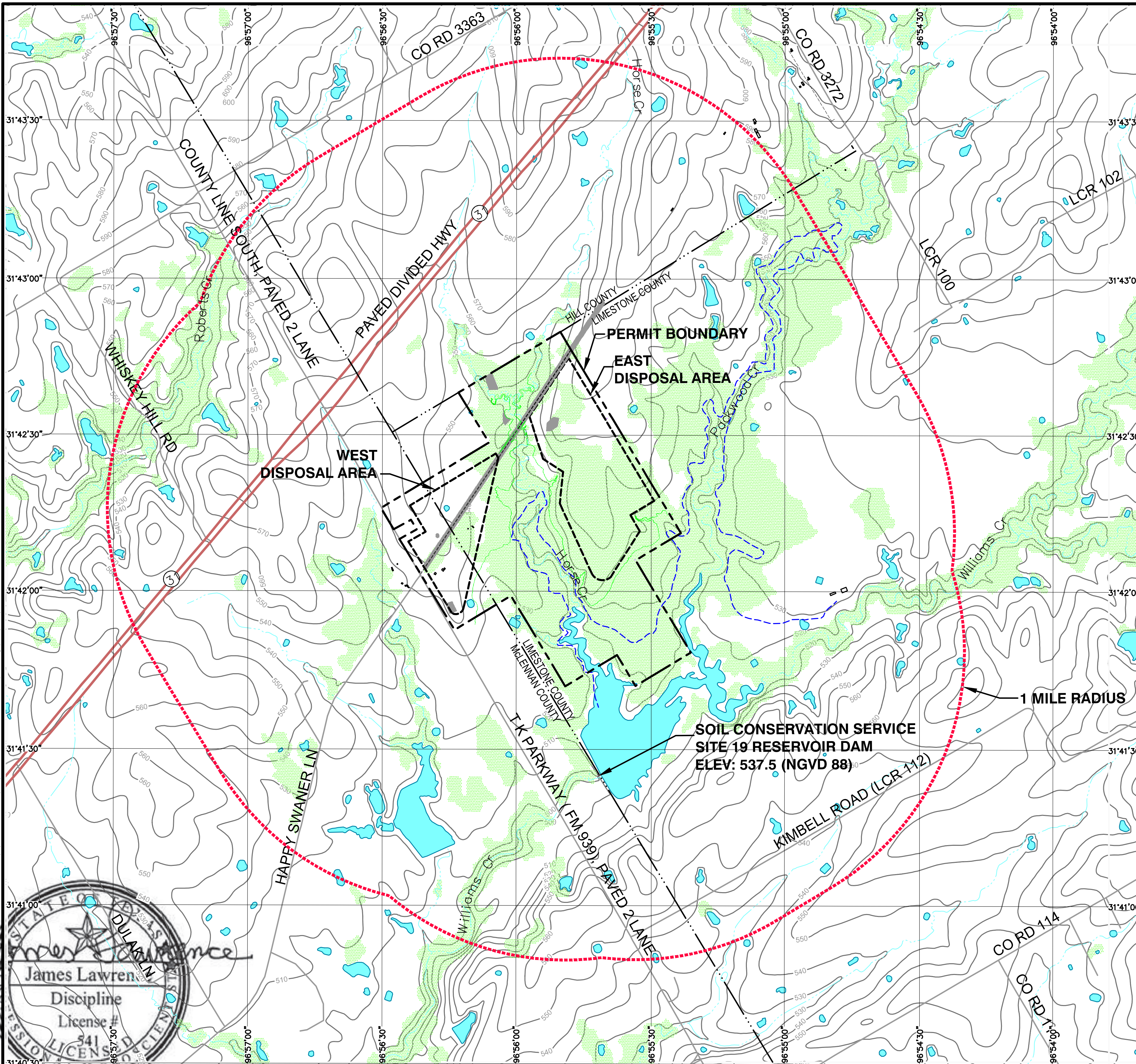
CADD FILE: 4.2 – PHYSIOGRAPHIC MAP OF TEXAS

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: **4.2**

4/9/2020 9:47 AM G:\WACO\16216088.00 T172 – SITE 50 SITING STUDY_Permit Dwgs_DWG_Att 4\4.2 – Physiographic Map of Texas



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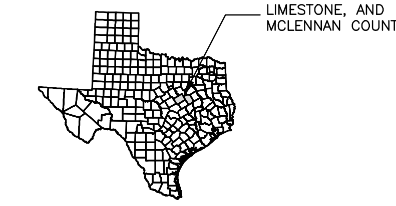
SCALE IN FEET



COUNTY LOCATION

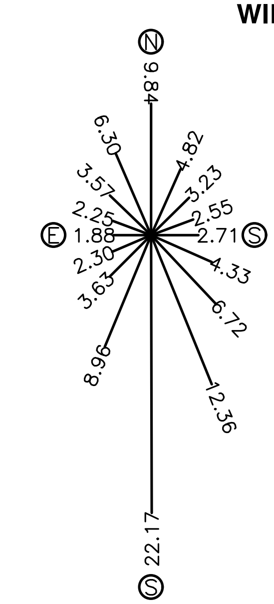
LEGEND

PERMIT BOUNDARY
ONE MILE RADIUS
LIMITS OF WASTE
COUNTY LINE
EXISTING CONTOURS (SEE NOTE 1)
FLOOD PLAIN (SEE NOTE 2)
LATITUDE/LONGITUDE LINES

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

WIND ROSE



CALM 2.81%
WIND ROSE REPRESENTS AVERAGE PERCENT OF TIME WIND BLOWS FROM EACH OF THE 16 COMPASS POINTS SHOWN.

SOURCE:
TNRCC-EPA
STATION TX03927
AVERAGE VALUES
PERIOD ANALYZED: 1984–1992

NOTES:

1. CONTOURS SHOWN ARE FROM THE 24K QUAD MAP FOR AXTELL, TEXAS (2016) PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. THERE ARE NO KNOWN WATER WELLS WITHIN 500 FT. OF THE PROPOSED PERMIT BOUNDARY IN ACCORDANCE WITH PARTS I/II, SECTION 7.2.
4. BASED ON SCS' SITE INVESTIGATIONS, NO SPRINGS WERE OBSERVED ON THE SITE.

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License # 541
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5-13-2020

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP
PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION
CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
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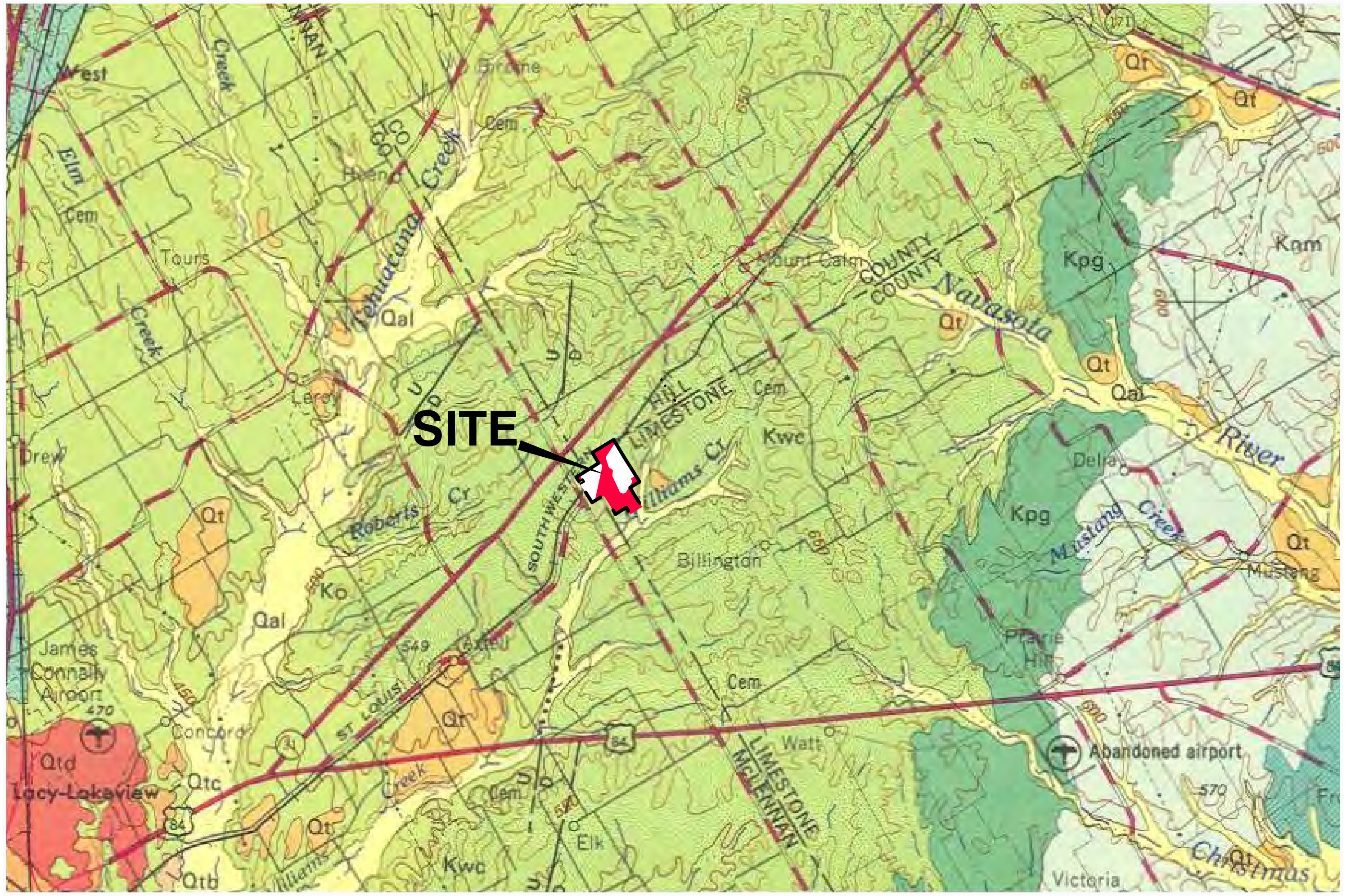
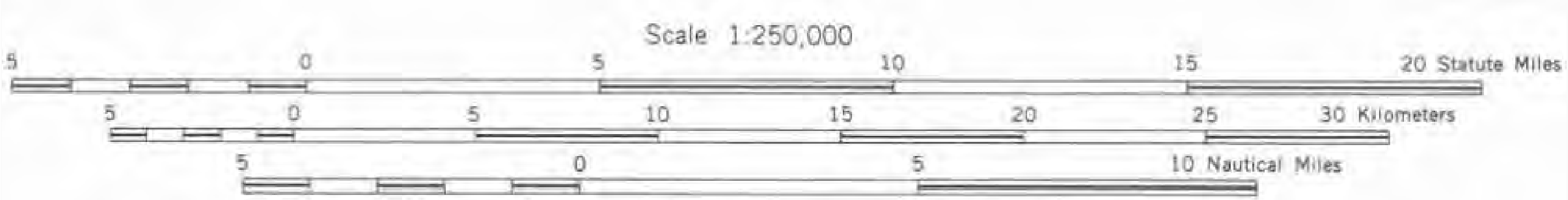
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

CADD FILE: 4.3 - USGS TOPO
DATE: 04/2020
SCALE: AS SHOWN
FIGURE: 4.3

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407





CONTOUR INTERVAL 50 FEET

TRANSVERSE MERCATOR PROJECTION

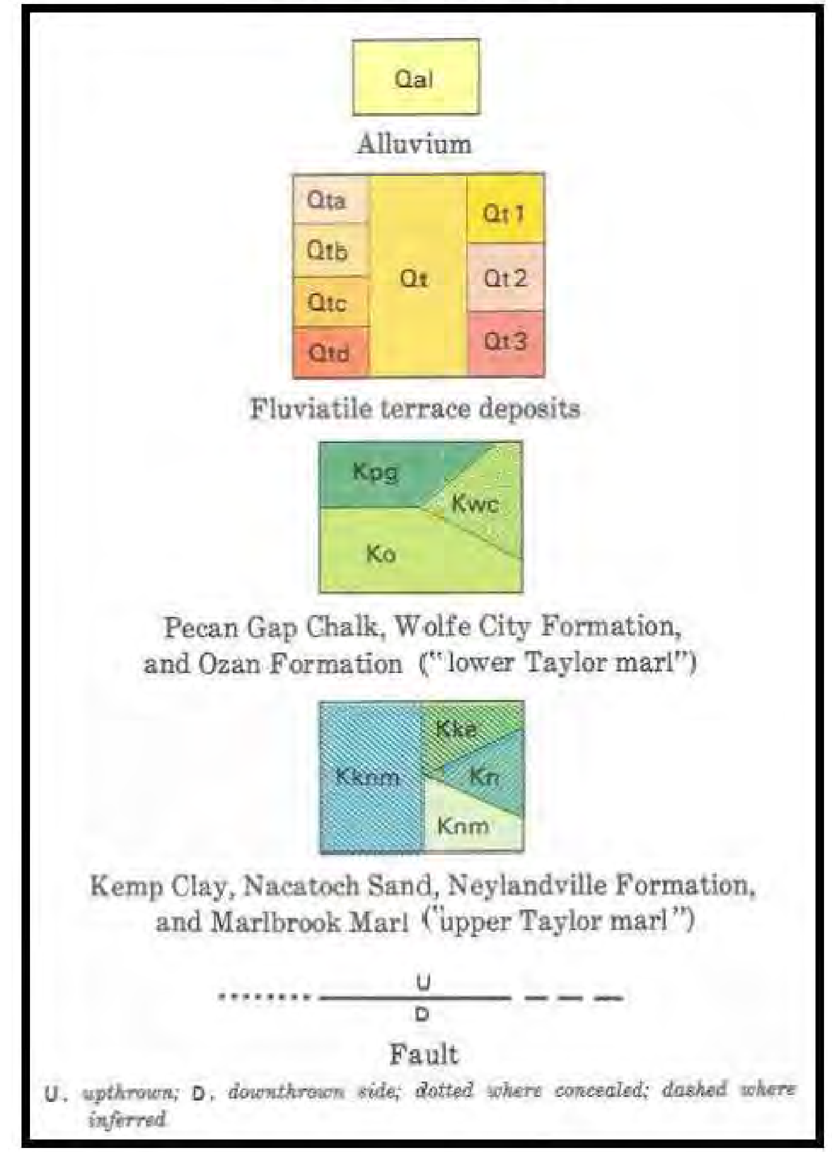
1960 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 9°30' EASTERLY FOR THE CENTER OF THE WEST EDGE TO 8°30' EASTERLY FOR THE CENTER OF THE EAST EDGE. MEAN ANNUAL CHANGE IS 0°02' WESTERLY.

GEOLOGIC ATLAS OF TEXAS, WACO SHEET

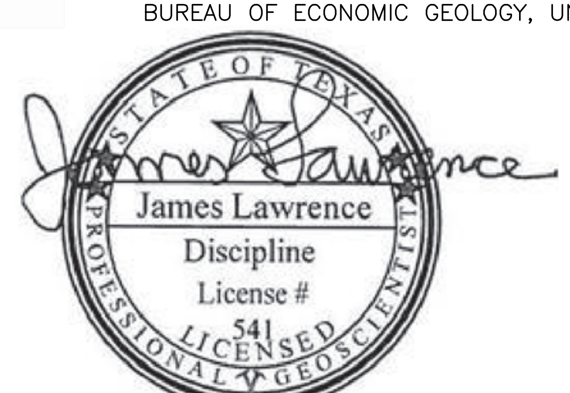
LLOYD WILLIAM STEPHENSON MEMORIAL EDITION

REPRINTED 1979

EXPLANATION



SOURCE:
BUREAU OF ECONOMIC GEOLOGY, UNIVERSITY OF TEXAS AT AUSTIN.



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REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
GEOLOGIC MAP

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
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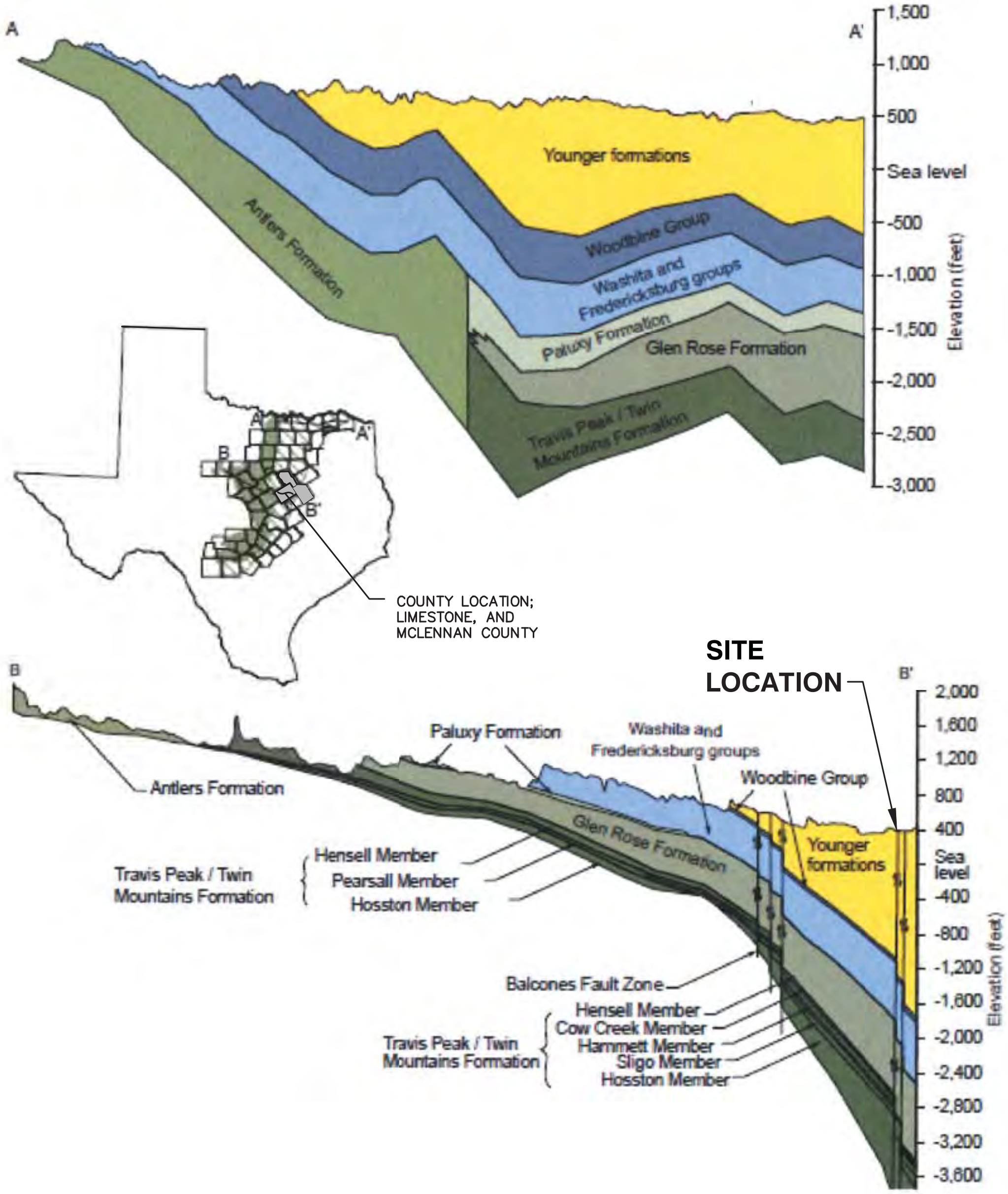
CADD FILE: 4.4 - GEOLOGIC MAP

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: 4.4

Structural Cross Sections of the Trinity Aquifer



Structural cross sections across the northern Trinity Aquifer, shown in shades of green (image modified from Klemt, et al., 1975; Nordstrome, 1982).

Source:

George, Peter G., Robert E. Mace, Rima Petrossian, 2011, Aquife

Board Report 380. Pg. 69.

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4/9/2020 9:52 AM G:\WACO\16216088.00 T172 - SITE 50 SITING STUDY_Permit Dwgs_DWG_Att 4\4.5 - Structual Cross Sections of the Trinity Aquifer

REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
STRUCTURAL CROSS SECTIONS OF THE TRINITY AQUIFER

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
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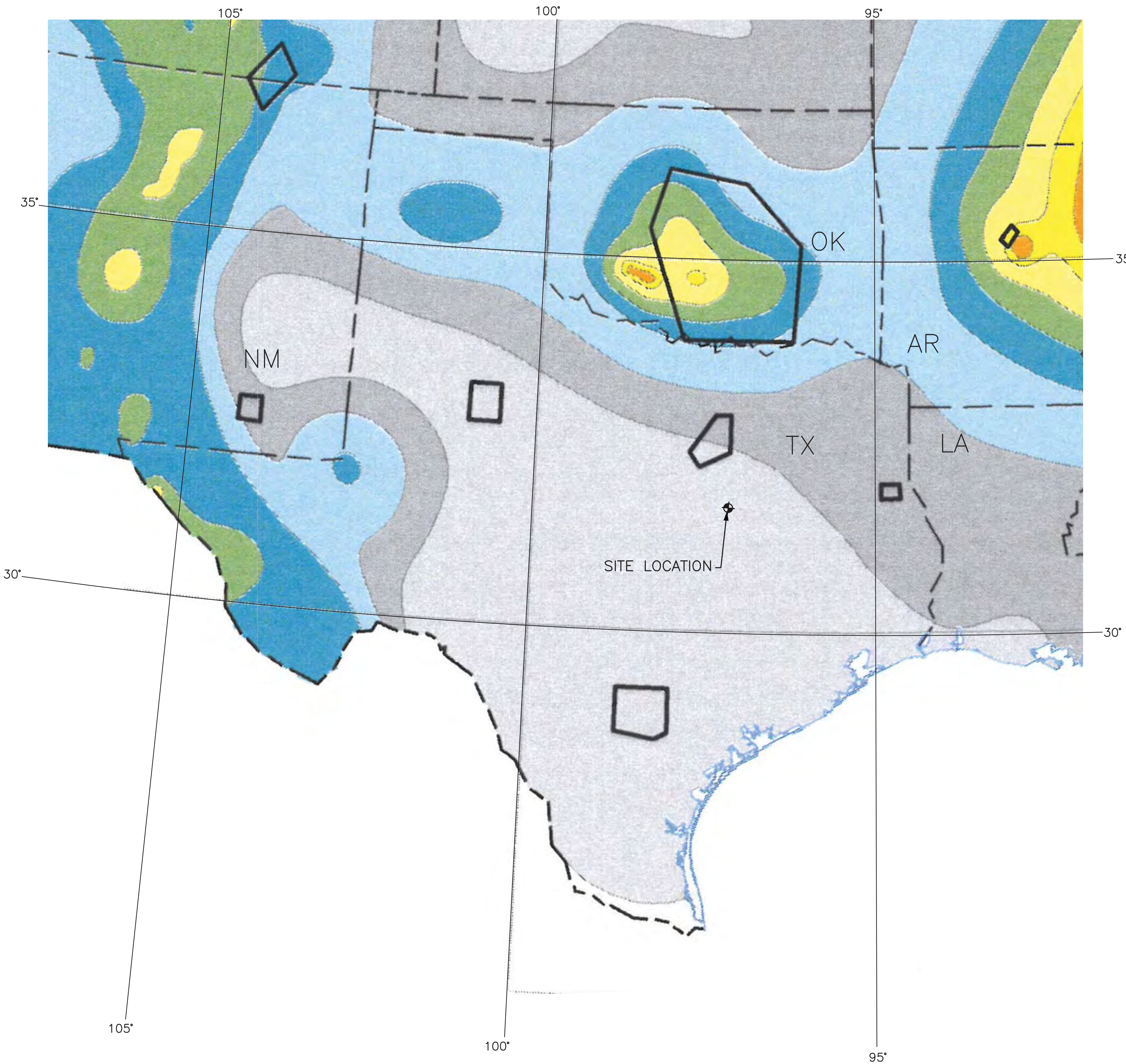
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

CADD FILE: 4.5 - STRUCTUAL CROSS SECTIONS OF THE TRINITY AQUIFER

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: 4.5



LEGEND

Areas where suspected nontectonic earthquakes have been detected

EXPLANATION

Peak acceleration, expressed as a fraction of standard gravity (g)

0.8
0.4
0.3
0.2
0.14
0.1
0.06
0.04
0.02
0

SOURCE:
SEISMIC IMPACT ZONE MAP TAKEN FROM THE U.S. GEOLOGICAL SURVEY, UPDATED 2014.

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DRAWING TITLE
SEISMIC IMPACT MAP

PROJECT TITLE
CITY OF WACO LANDFILL
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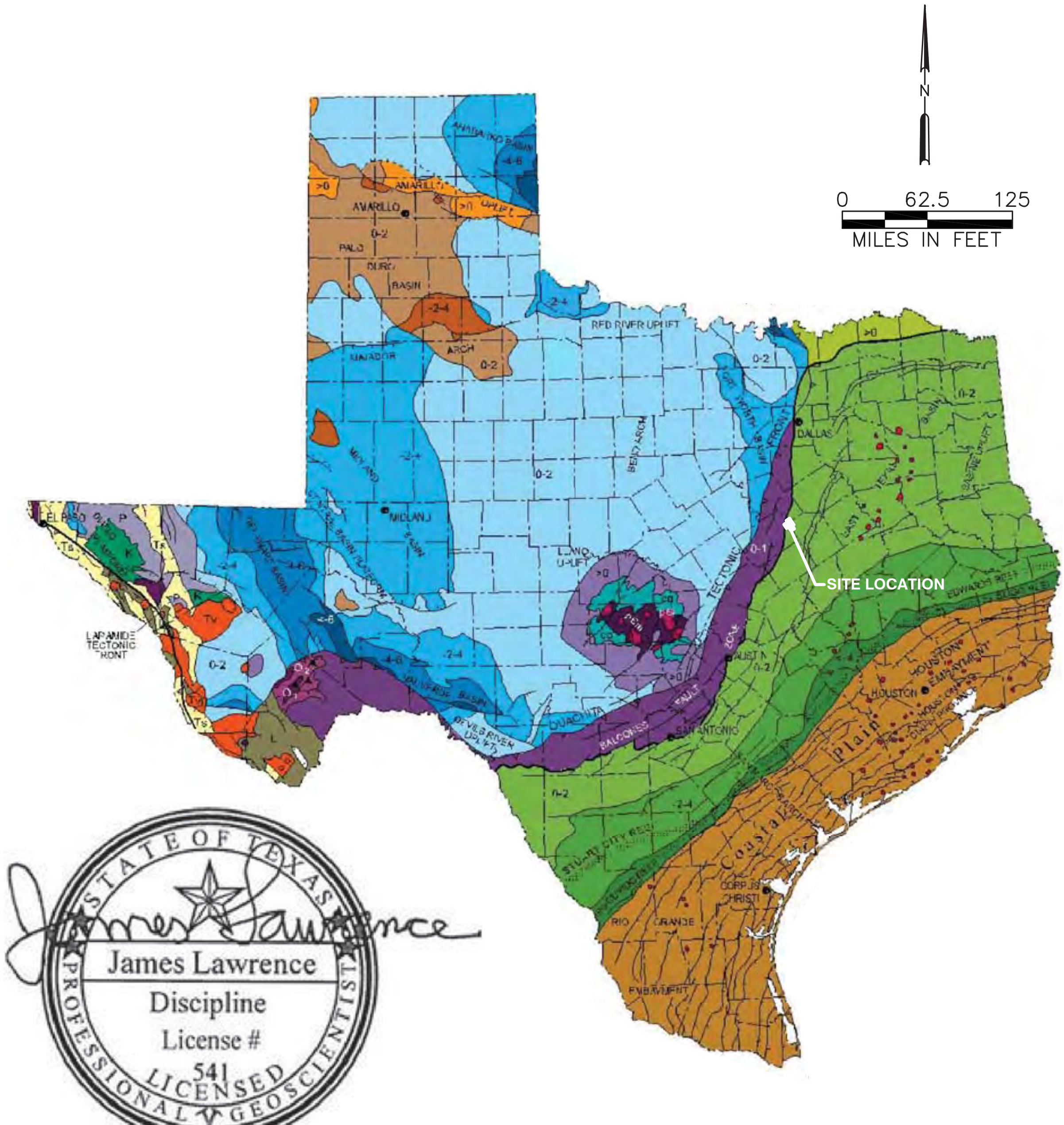
CHK. BY: BJD/AB
Q/A RVW BY: RRK
APP. BY: JL

CADD FILE: 4.6 – SEISMIC IMPACT ZONE

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: **4.6**



5-13-2020

TECTONIC EPISODE	EXPOSED UNITS*	
Tertiary	Ts	Late Tertiary extensional basin
	Tv	Trans-Pecos igneous
Laramide	L	Deformed Cretaceous strata
Gulf Coast	K	Cretaceous strata
Ouachita		Foreland:
	P	Upper Paleozoic
	OO	Lower Paleozoic
		Marathon:
	O_2	Upper Paleozoic flysch
	O_1	Lower Paleozoic
Llano	p€	Precambrian igneous
	p€m	Precambrian metamorphic

SUBSURFACE CONTOURS* (elevation in kilometers**)

Top of pre-Tertiary: <-4

Base of Austin Chalk or Top of Edwards Group Cretaceous: >0 | 0 to -2 | -2 to -4 | <-4

Top of Ellenburger Paleozoic: >0 | 0 to -2 | -2 to -4 | -4 to -6 | <-6

Top of Precambrian: >0 | 0 to -2 | -2 to -4

Buried Ouachita facies Paleozoic: 0 to -1

* Note changes in mapped horizon

** >0, elevation greater than sea level; >-6, depths greater than 6 km below sea level

OTHER FEATURES

- Caldera
- Salt diapirs
- Lower Cretaceous reef trend
- Normal fault, indicating downthrown side
- Thrust fault, teeth on upper plate

TECTONIC FRONTS

- Laramide tectonic front
- Ouachita tectonic front
- Gulf Basin margin

REFERENCE: BUREAU OF ECONOMIC GEOLOGY THE UNIVERSITY OF TEXAS AT AUSTIN

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: **TECTONIC MAP OF TEXAS**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

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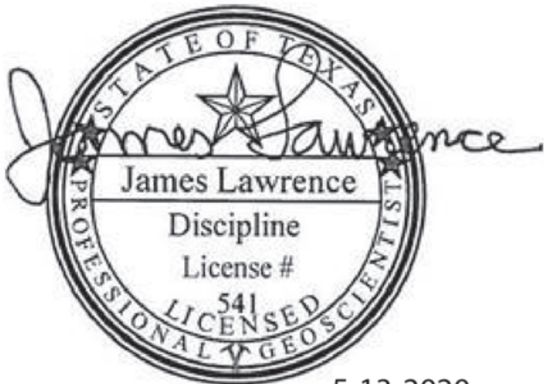
CADD FILE: 4.7 – REGIONAL TECTONIC MAP

DATE: 04/2020

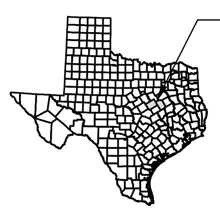
SCALE: AS SHOWN

FIGURE: **4.7**

5/21/2020 12:32 PM \\BED-FS02\Data\Civil 3D Projects\CADD\WACO\16216088.00 T172 – SITE 50 SITING STUDY_Permit Dwgs_DWG_Att 4\4.7 – REGIONAL TECTONIC MAP



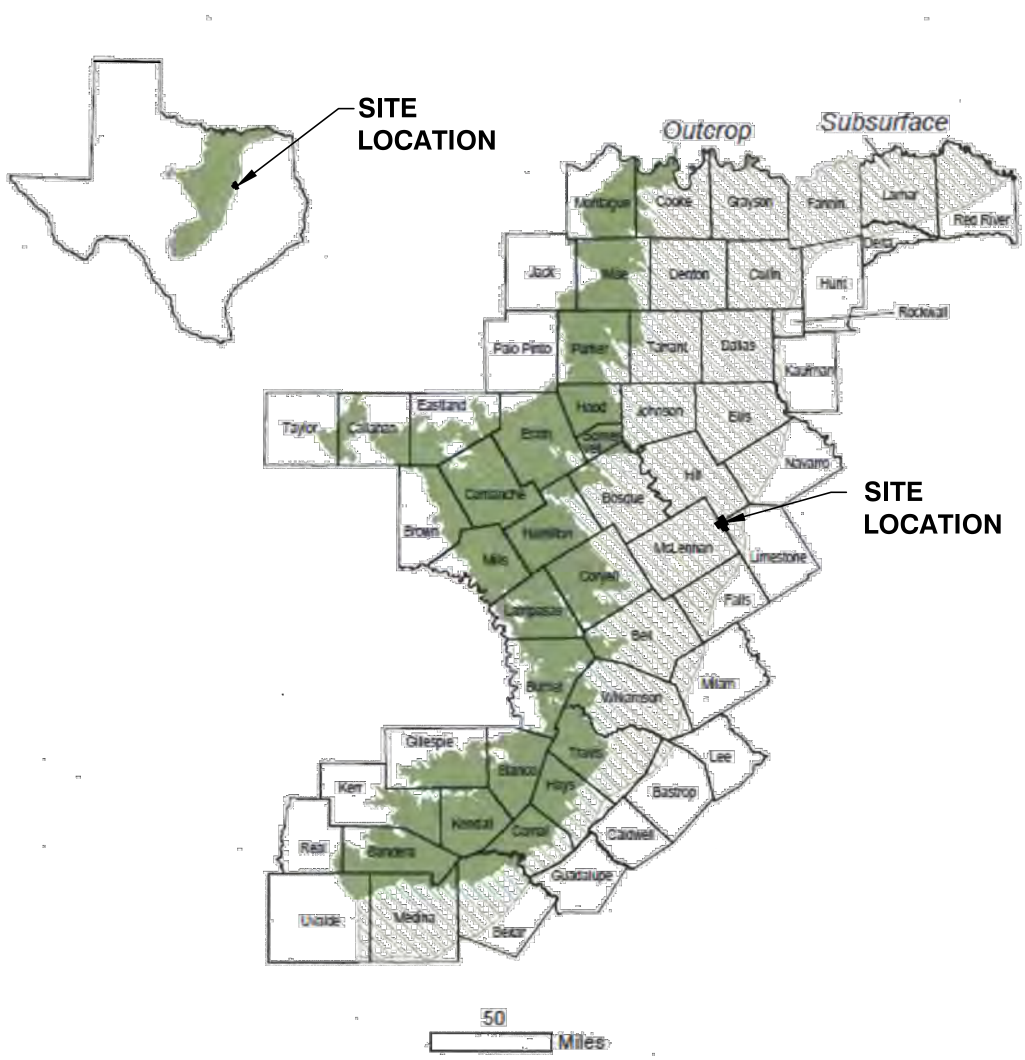
5-13-2020



COUNTY LOCATION

N

Trinity Aquifer



Map showing the spatial distribution of the northern Trinity Aquifer, as depicted in shades of green. The proposed Site is located at and near the northwest corner of Limestone County and parts of eastern McLennan County.

Source:

George, Peter G., Robert E. Mace, Rima Petrossian, 2011, Aquifers of Texas: Texas Water Development Board Report 380. Pg. 67.

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4/20/2020 12:37 PM G:\WACO\16216088.00 T172 - SITE 50 SITING STUDY_Permit Dwgs_DWG_Att 4\4.8 - Trinity Aquifer

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: TRINITY AQUIFER

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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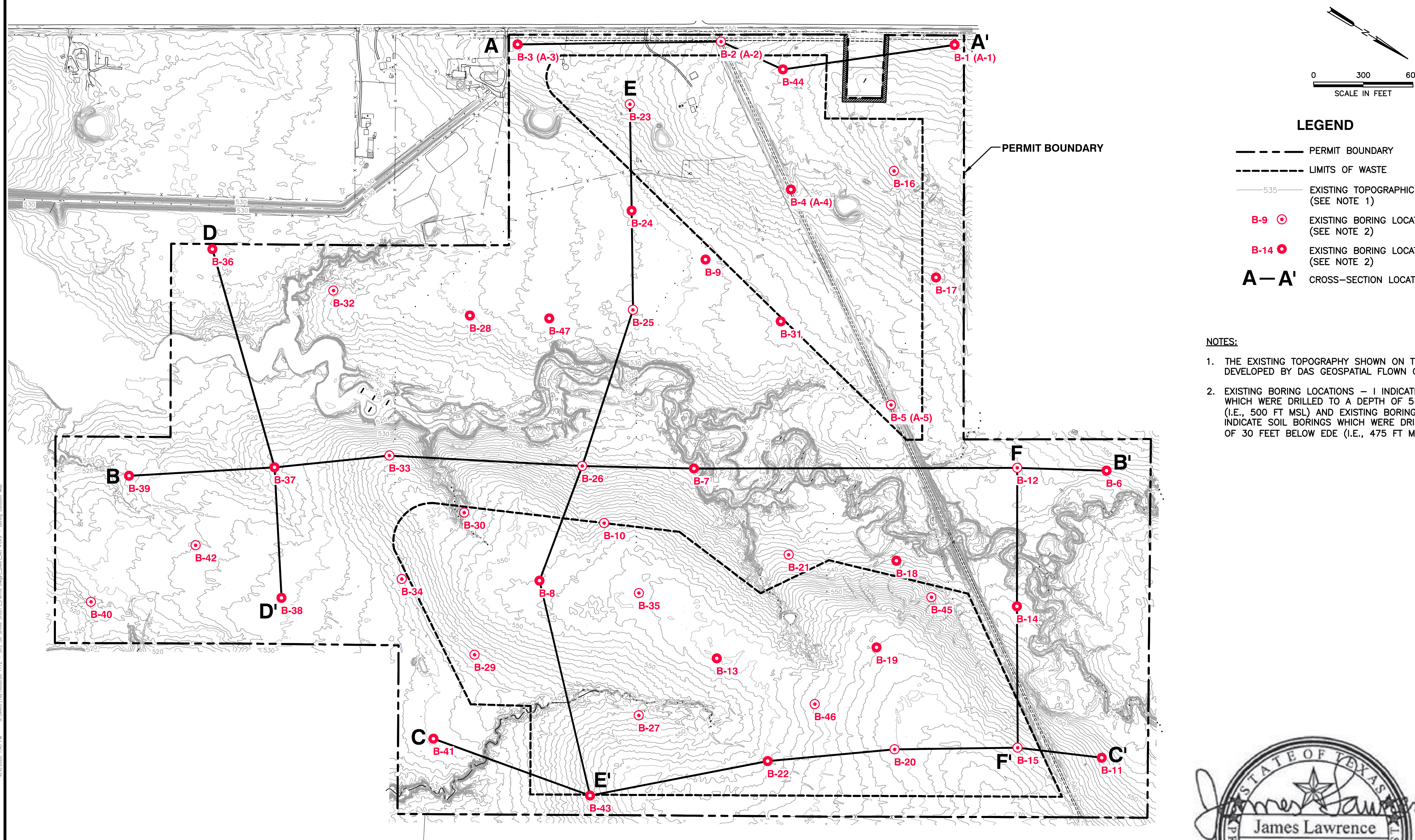
CADD FILE: 4.8 – TRINITY AQUIFER

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: **4.8**



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- B-9 EXISTING BORING LOCATION – I (SEE NOTE 2)
- B-14 EXISTING BORING LOCATION – II (SEE NOTE 2)
- A—A' CROSS–SECTION LOCATIONS

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. EXISTING BORING LOCATIONS – I INDICATE SOIL BORINGS WHICH WERE DRILLED TO A DEPTH OF 5–FEET BELOW EDE (I.E., 500 FT MSL) AND EXISTING BORING LOCATIONS – II INDICATE SOIL BORINGS WHICH WERE DRILLED TO A DEPTH OF 30 FEET BELOW EDE (I.E., 475 FT MSL).

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DRAWING TITLE
BORING LOCATION MAP

PROJECT TITLE
CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO SOLID WASTE SERVICES

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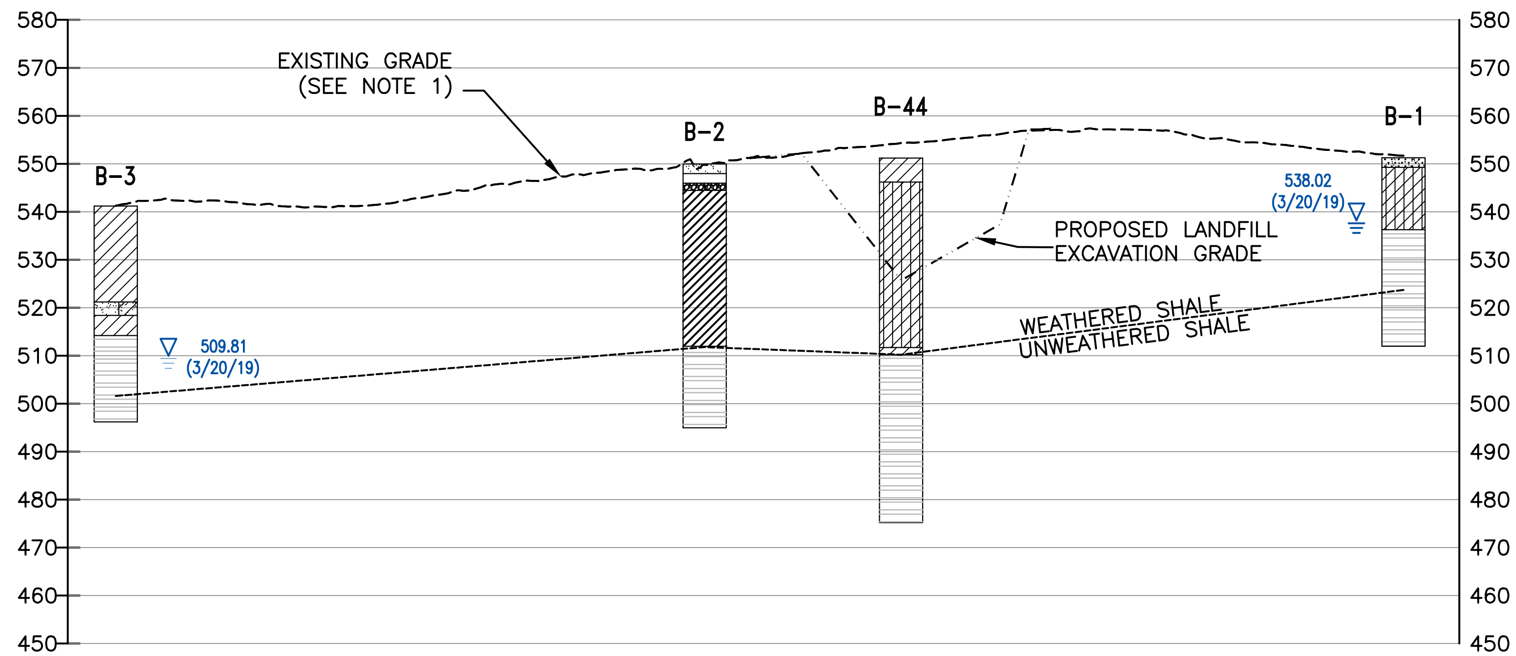
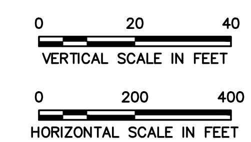
CADD FILE: 4.9 – BORING LOCATION MAP

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: **4.9**





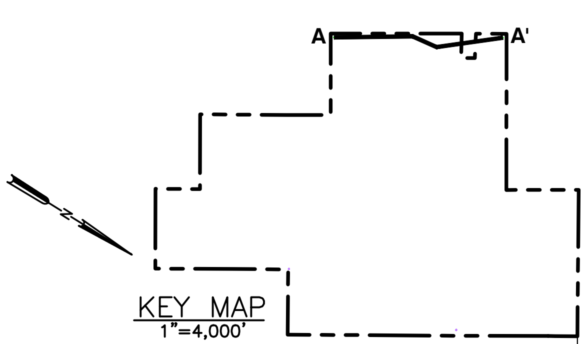
CROSS SECTION A-A'

LEGEND:

— — — — — —	EXISTING GRADE (SEE NOTE 1)
- - - - - - - - - - -	WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
— · — · — · —	PROPOSED LANDFILL EXCAVATION GRADE
538.02 ▽ (3/20/19)	WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III–4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
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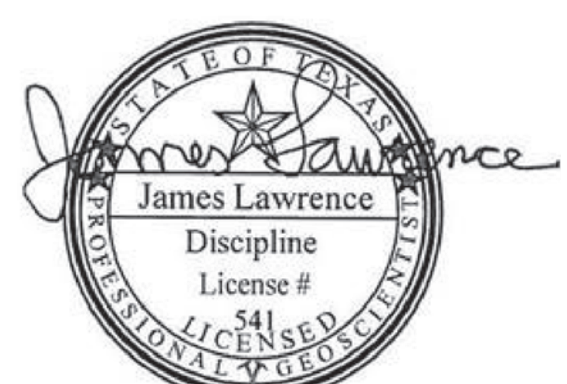

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION A-A'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
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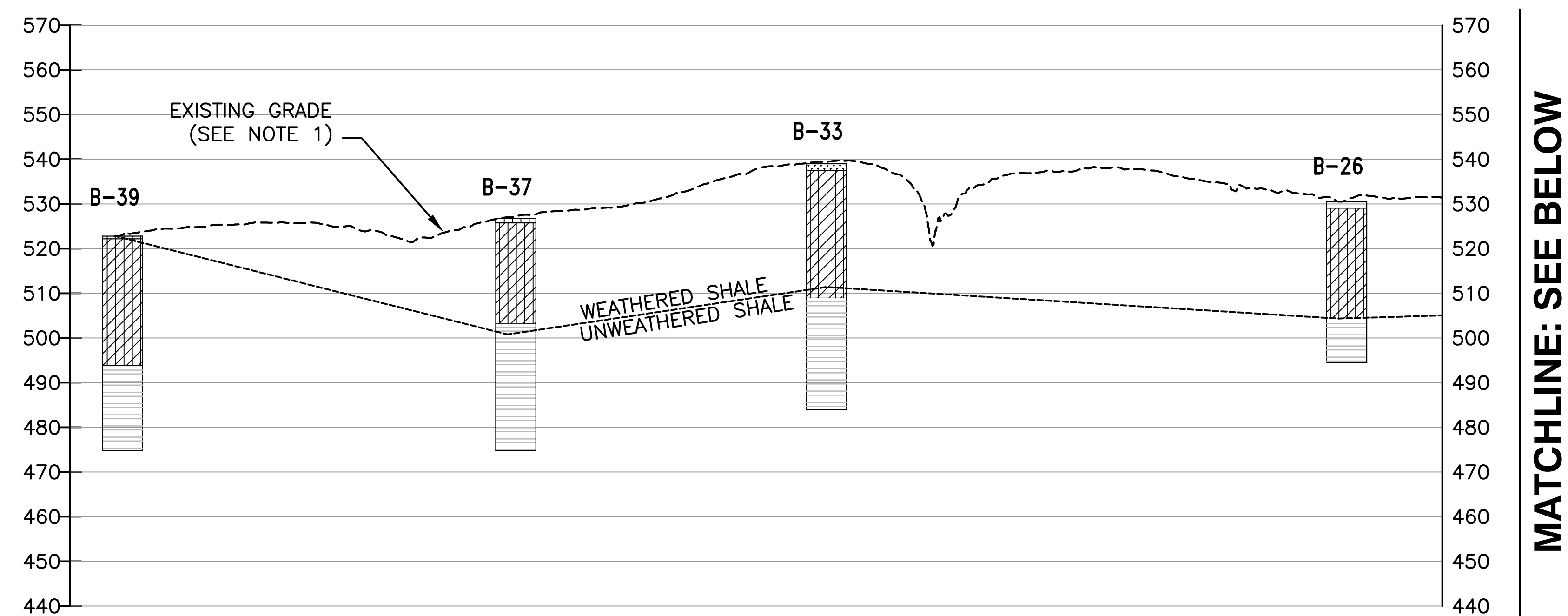
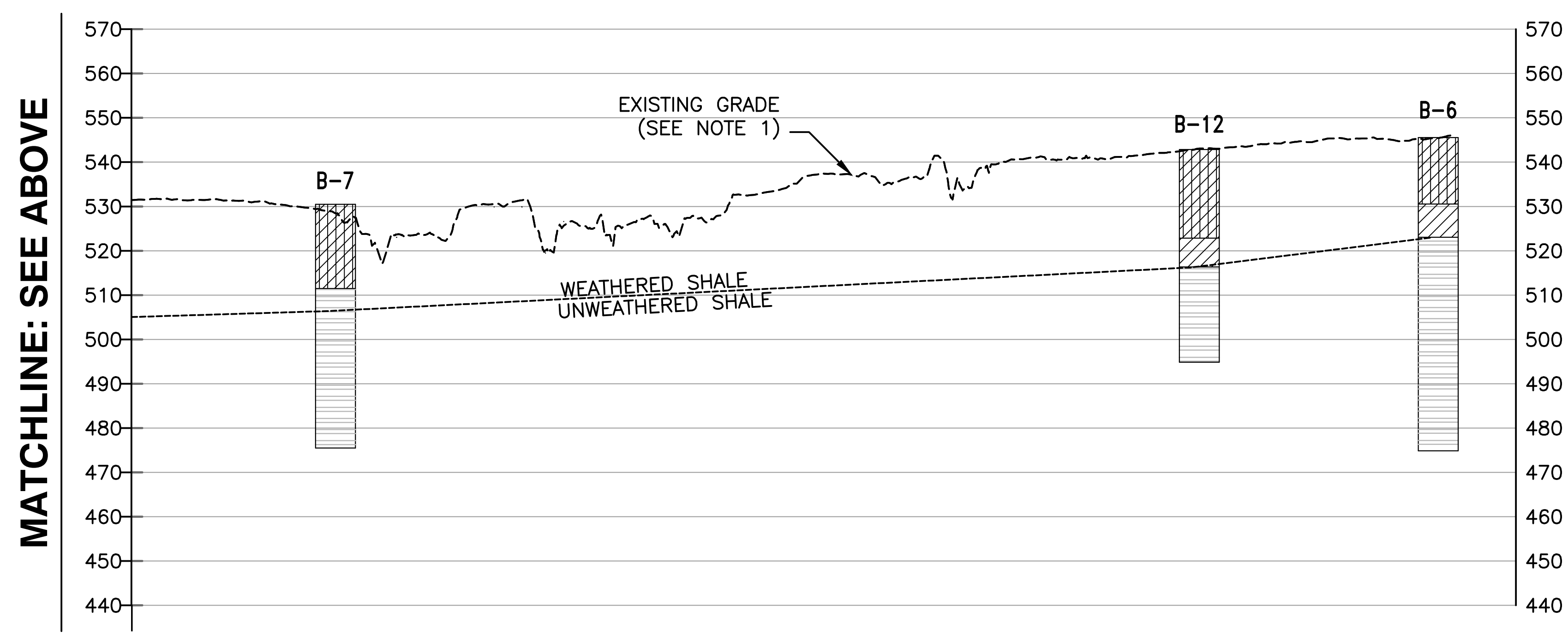
CADD FILE: 4.10–4.15 – GEOLOGIC CROSS SECTIONS

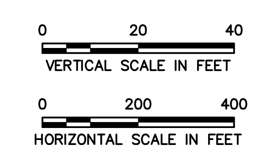
DATE: 05/2020

SCALE: AS SHOWN

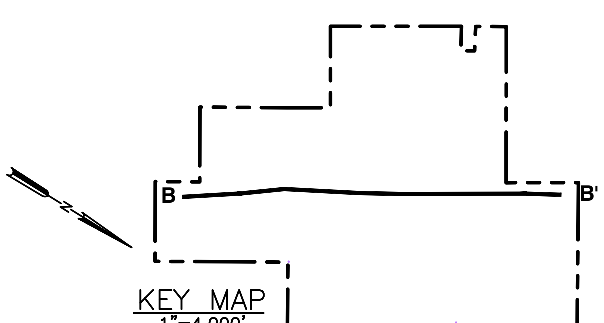
FIGURE: 4.10







CROSS SECTION B-B'



KEY MAP
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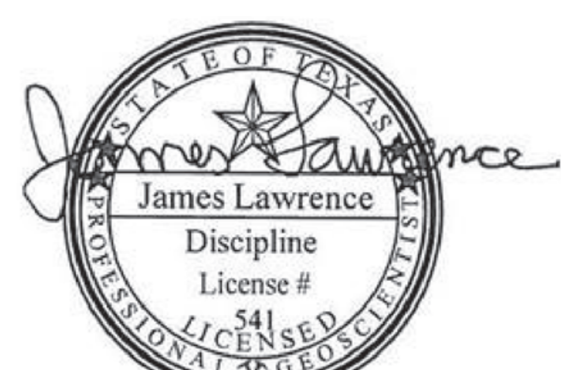

5-13-2020

LEGEND:

- - - - - - - EXISTING GRADE (SEE NOTE 1)

-------------- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS SECTION B-B'

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
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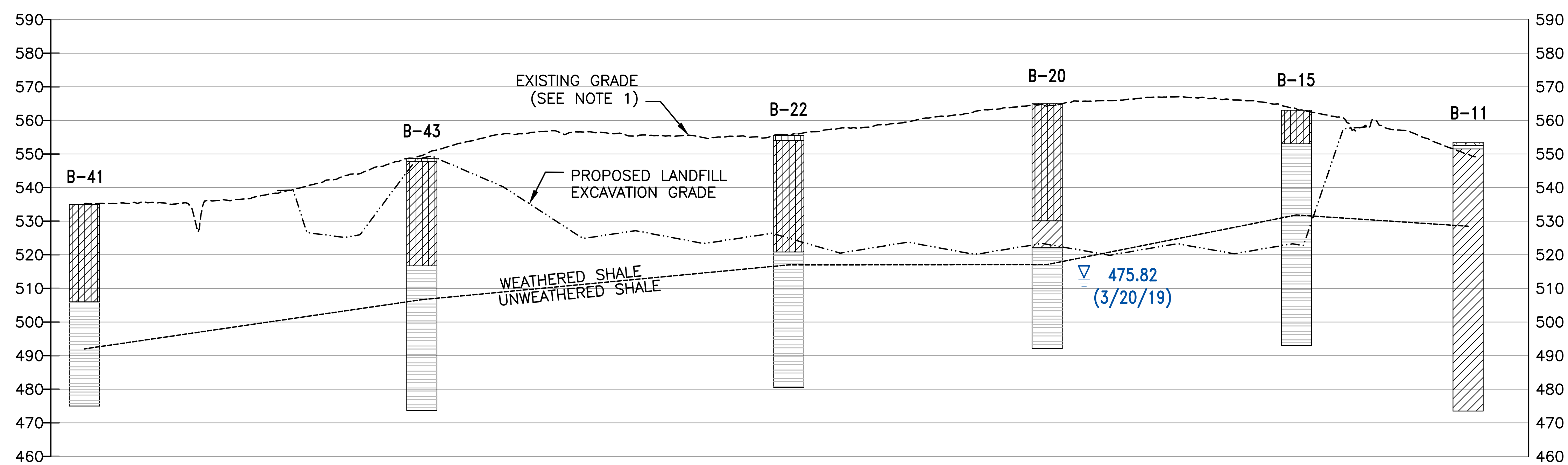
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.11



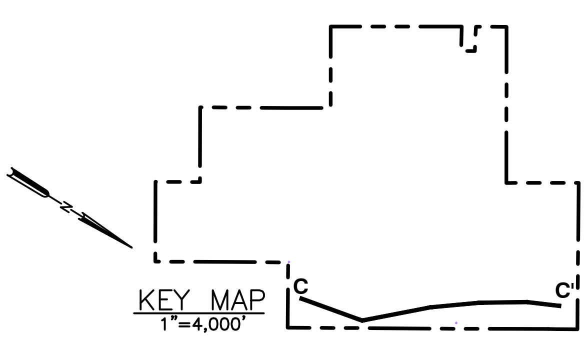
CROSS SECTION C-C'

LEGEND:

--------	EXISTING GRADE (SEE NOTE 1)
....	WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
-·-·-·-	PROPOSED LANDFILL EXCAVATION GRADE
475.82 ▽ (3/20/19)	WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
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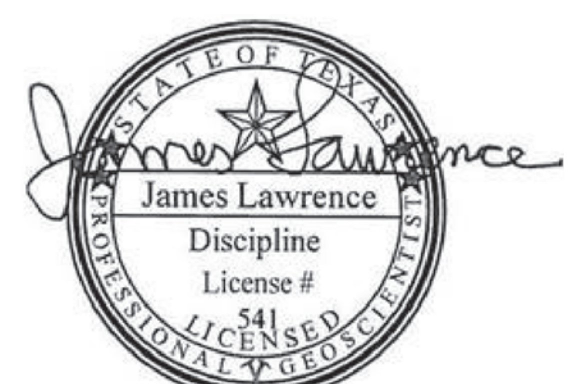

5-13-2020

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION C-C'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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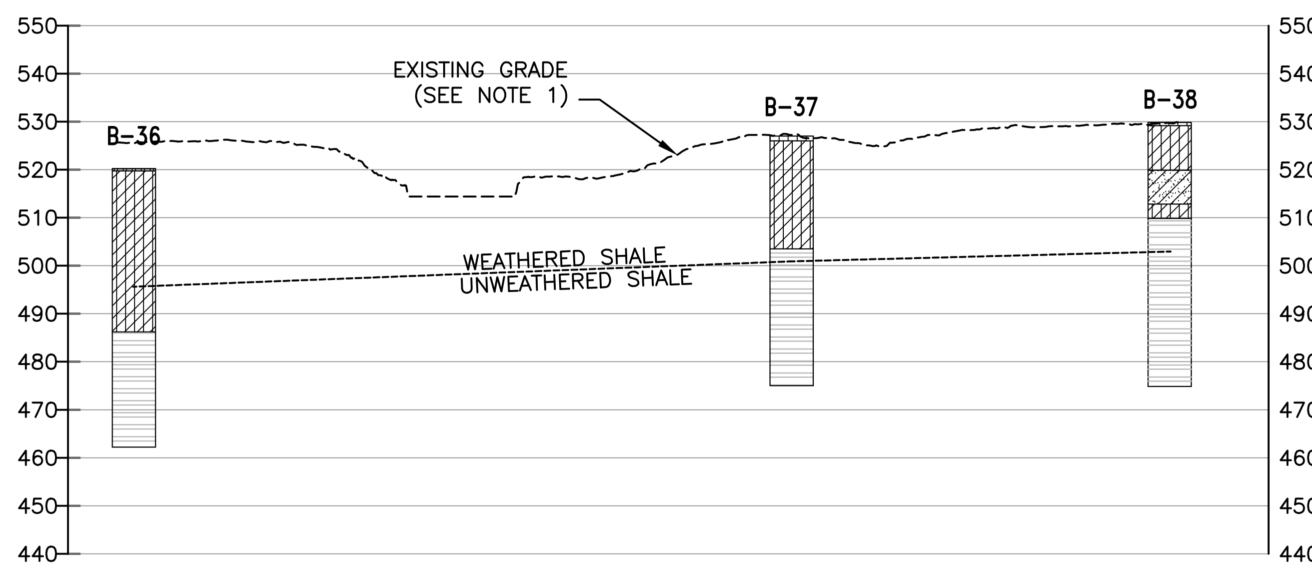
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.12



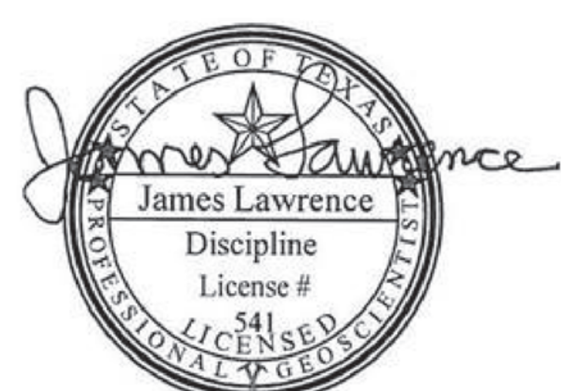
VERTICAL SCALE IN FEET: 0, 20, 40

HORIZONTAL SCALE IN FEET: 0, 200, 400

CROSS SECTION D-D'

LEGEND:

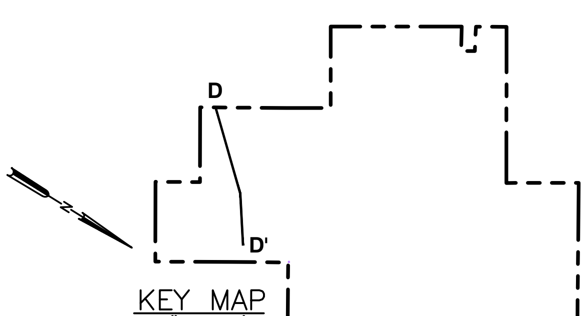
- - - - - - -	EXISTING GRADE (SEE NOTE 1)
--------------	WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT



5-13-2020

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III–4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
1"=4,000'

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION D-D'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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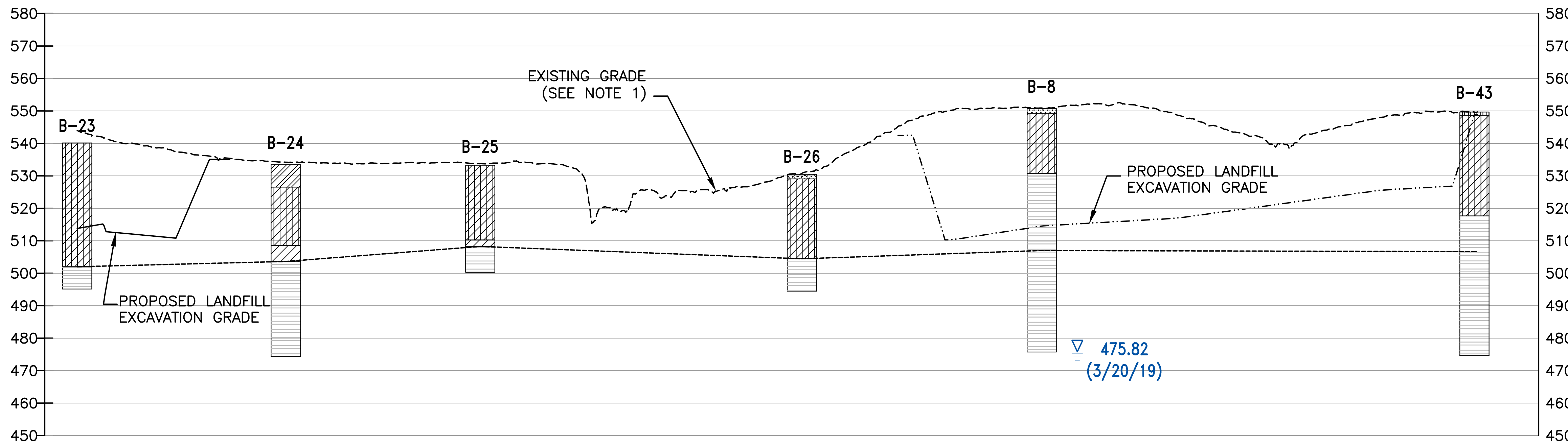
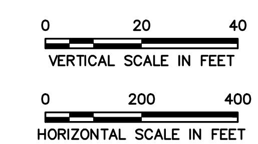
CADD FILE: 4.10–4.15 – GEOLOGIC CROSS SECTIONS

DATE: 05/2020

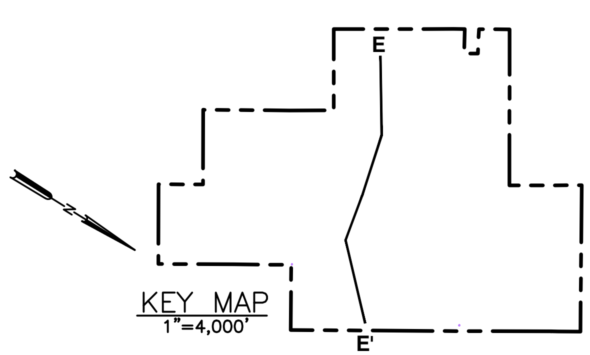
SCALE: AS SHOWN

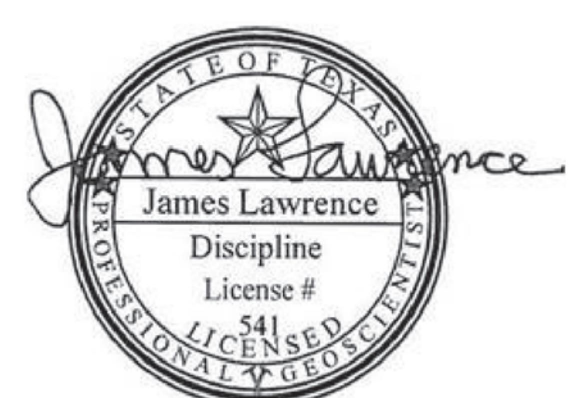
FIGURE: 4.13





CROSS SECTION E-E'





5-13-2020

LEGEND:

- - - - - - -	EXISTING GRADE (SEE NOTE 1)
....	WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
— · — · —	PROPOSED LANDFILL EXCAVATION GRADE
475.82 ▽ (3/20/19)	WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.

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TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION E-E'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

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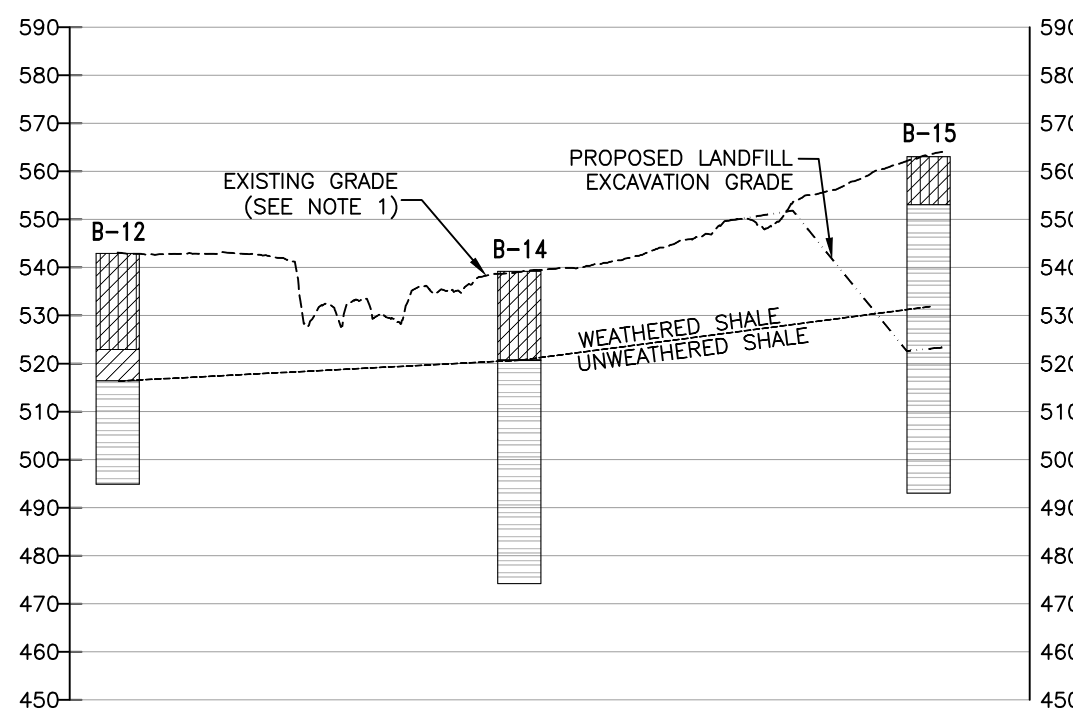
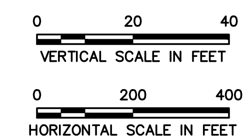
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.14

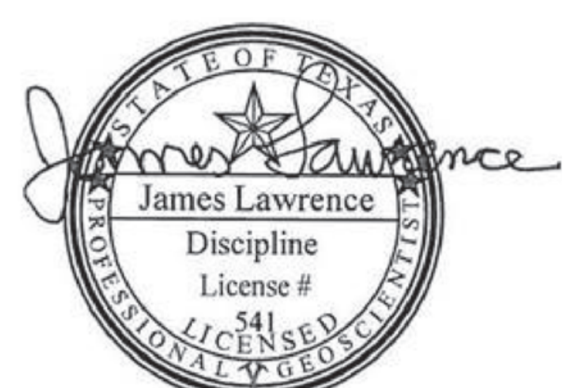




CROSS SECTION F-F'

LEGEND:

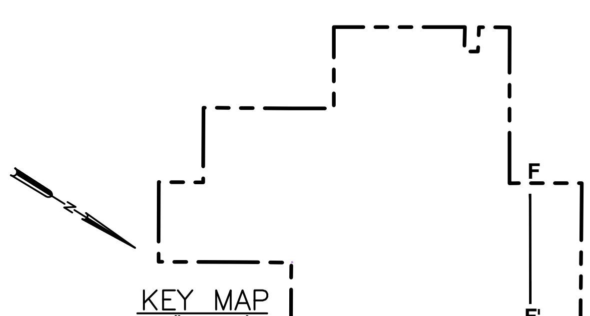
– – – – – – –	EXISTING GRADE (SEE NOTE 1)
- - - - - - - - - - -	WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
– · – · – · –	PROPOSED LANDFILL EXCAVATION GRADE



5-13-2020

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
1"=4,000'

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION F-F'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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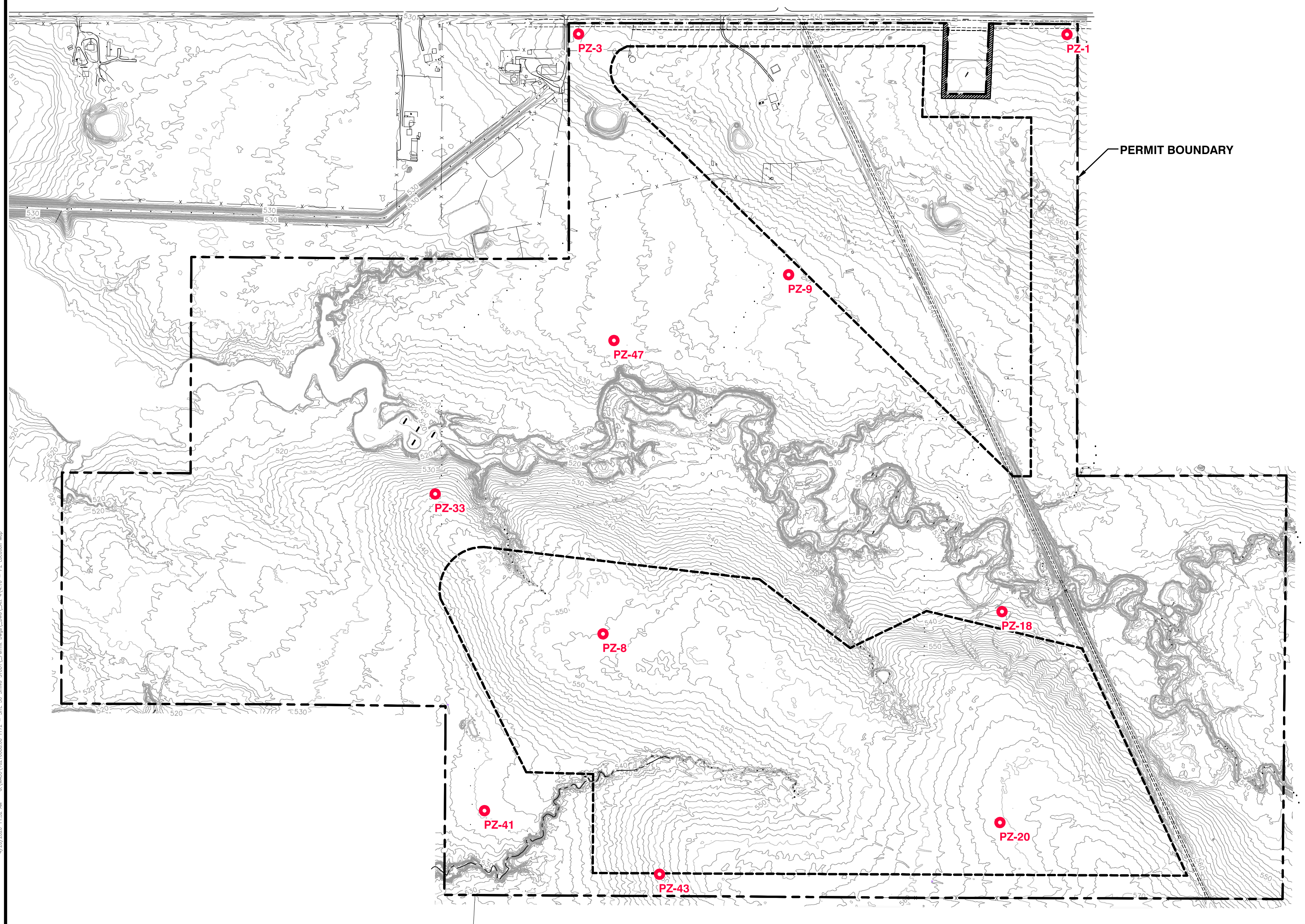
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.15



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PZ-1 EXISTING PIEZOMETER LOCATION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. SHALLOW AND/OR DEEP VWPS ARE LOCATED ADJACENT TO CONVENTIONAL PIEZOMETERS AS SHOWN ON FIGURE 4.17.

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: PIEZOMETER LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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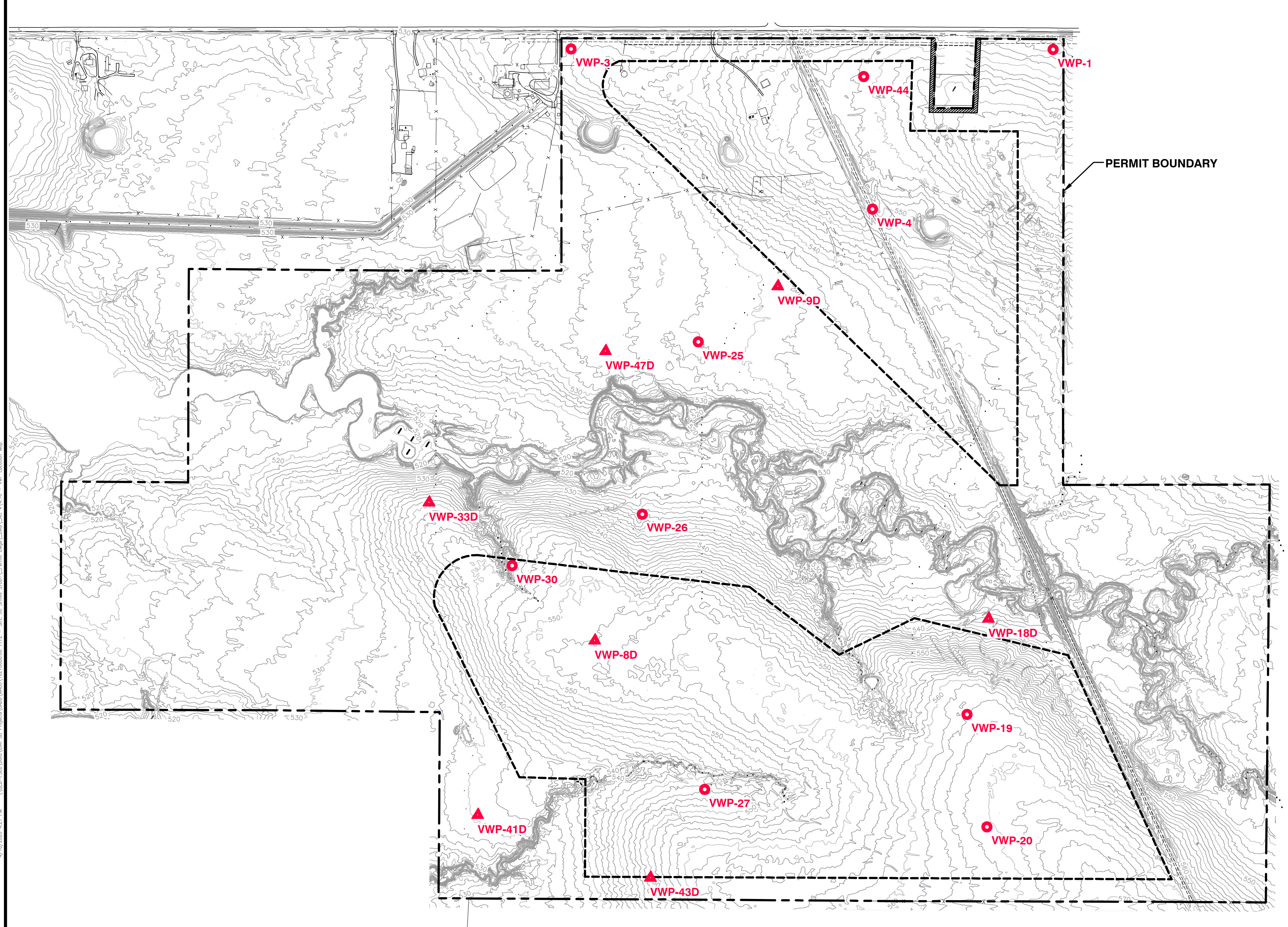
CADD FILE: 4.16 – PZ LOCATION MAP

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: 4.16



0 300 600
SCALE IN FEET

LEGEND

	PERMIT BOUNDARY
	LIMITS OF WASTE
535	EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
VWP-1	VWP LOCATION – SHALLOW
VWP-8D	VWP LOCATION – SHALLOW/DEEP

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.

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REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: VWP LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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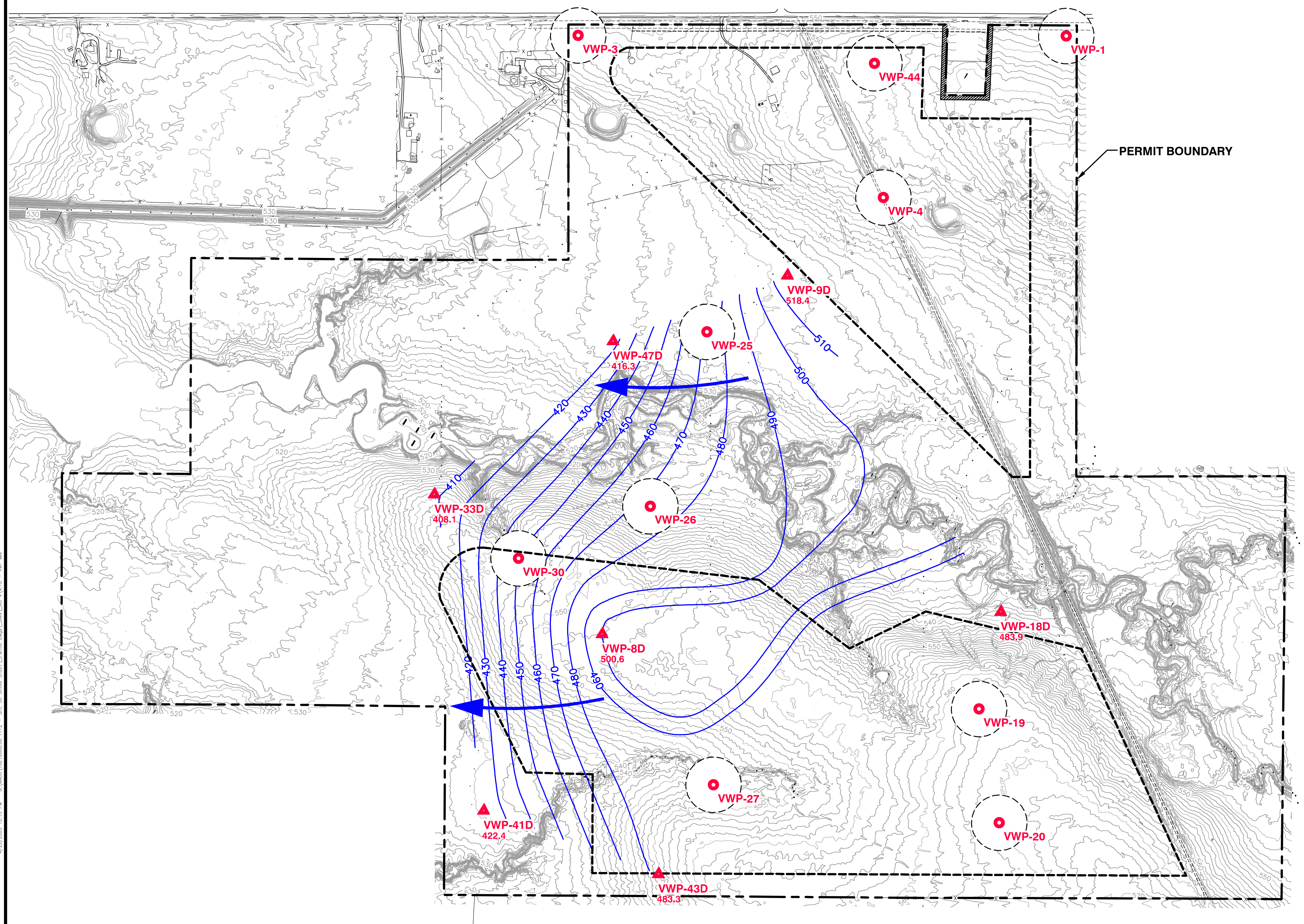
PROJ. NO. 16216088.00	DWN. BY: JLJ/NR	Q/A RVW BY: RRK
DSN. BY: AB/JL	CHK. BY: BJD/AB	APP. BY: JL

CADD FILE: 4.16 – VWP LOCATION MAP

DATE: 04/2020

SCALE: AS SHOWN

4.17



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 510 POSITIVE PRESSURE CONTOURS
- VWP-1 VWP LOCATION – SHALLOW
- VWP-8D VWP LOCATION – DEEP
- 517.0 CALCULATED GROUNDWATER MSL ELEVATION
- VWP-25 VWP LOCATION WITH NO WATER OBSERVED
- INFERRED GROUNDWATER FLOW DIRECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.

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5-13-2020

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DRAWING TITLE: POTENTIOMETRIC MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

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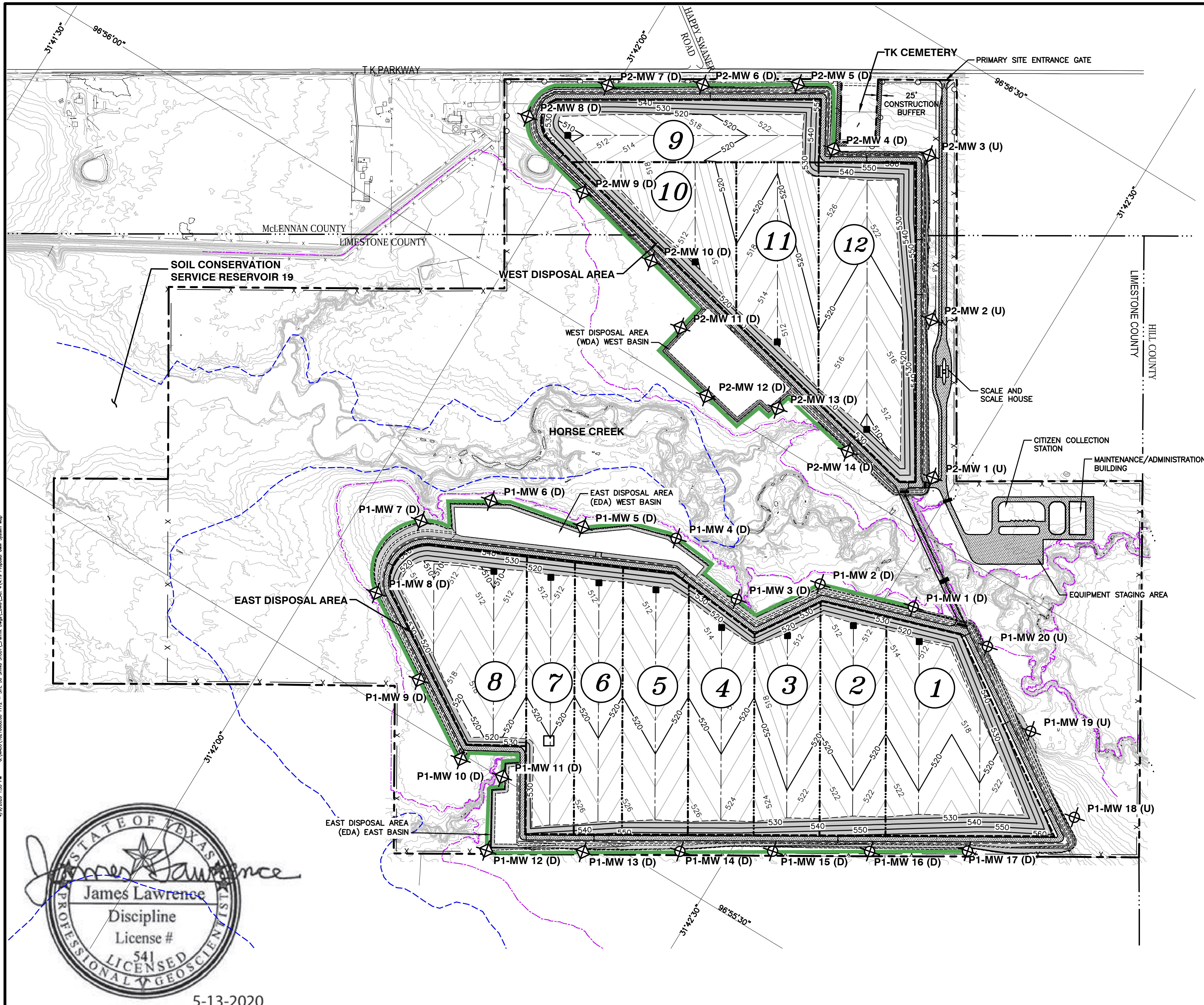
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

CADD FILE: 4.18 – VWP MAP

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: 4.18



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 4)
- EXISTING UNDERGROUND WATER LINE
- X PROPOSED PERIMETER FENCE
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- 96°55'30" LATITUDE/LONGITUDE LINES
- TOE/TOP OF SLOPE
- LEACHATE COLLECTION TRENCH
- POINT OF COMPLIANCE
- P1-MW 20 (U) GMW INSTALLED PRIOR TO LANDFILL OPERATION (SEE NOTES 5, 6)
- P2-MW 1 (U) GMW INSTALLED WHEN WASTE < 1,000 FEET (SEE NOTES 5, 6)
- X SECTOR DESIGNATION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ELEVATIONS SHOWN ON THIS DRAWING ARE EXCAVATION GRADES OR BOTTOM OF LINER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. 100-YEAR STORM EVENT WATER SURFACE IS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
5. ALL GROUND MONITORING WELLS DEPICTED IN THIS FIGURE WILL INCLUDE A SHALLOW AND DEEP WELL AS DEFINED IN ATTACHMENT 4, SECTION 9.
6. A "(U)" IN THE MONITORING WELL LABEL INDICATES A UPGRADIENT WELL AND "(D)" INDICATES A DOWNGRADIENT WELL.

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DRAWING TITLE: PROPOSED GWM SYSTEM MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

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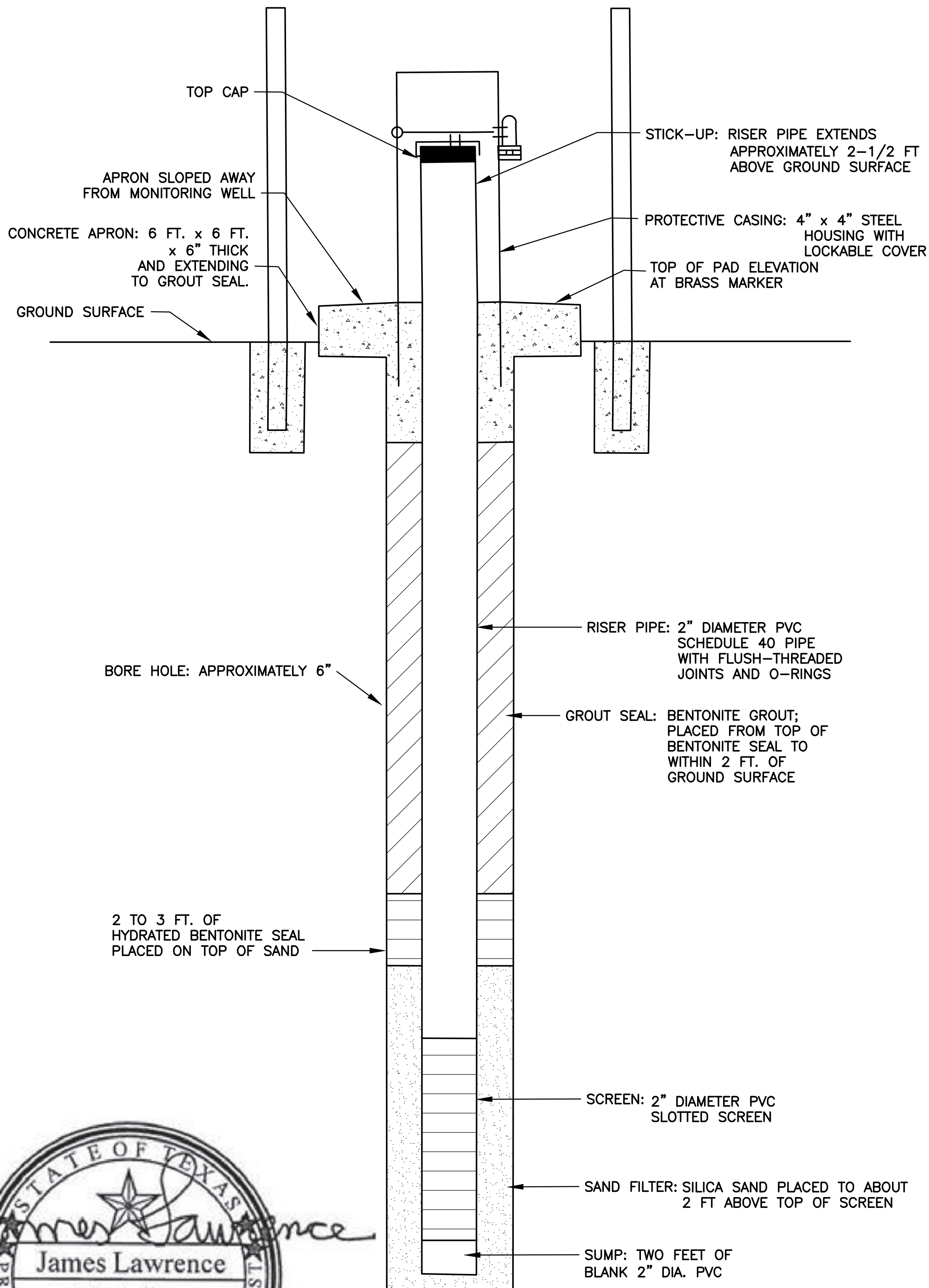
CADD FILE: 4.19 PROPOSAL GWM SYSTEM MAP

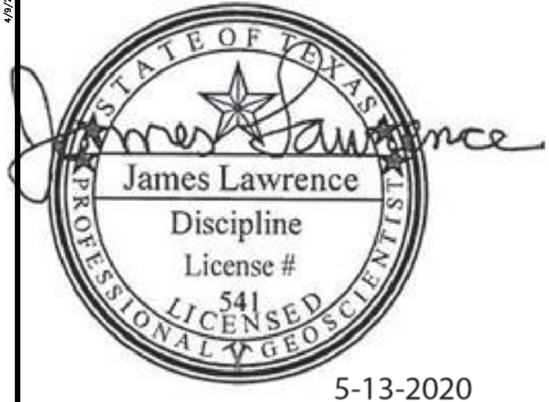
DATE: 04/2020

SCALE: AS SHOWN

FIGURE: 4.19

TYPICAL MONITORING WELL DETAIL





5-13-2020

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4/9/2020 1:52 PM G:\WACO\16216088.00 T172 - SITE 50 SITING STUDY_Permit Dwgs_DWG_Att 4\4.20 - monitor well dtl

REV	DATE	DESCRIPTION	BY
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TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
TYPICAL MONITORING WELL DETAIL

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
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CADD FILE: 4.20 - MONITOR WELL DTL

DATE: 04/2020

SCALE: AS SHOWN

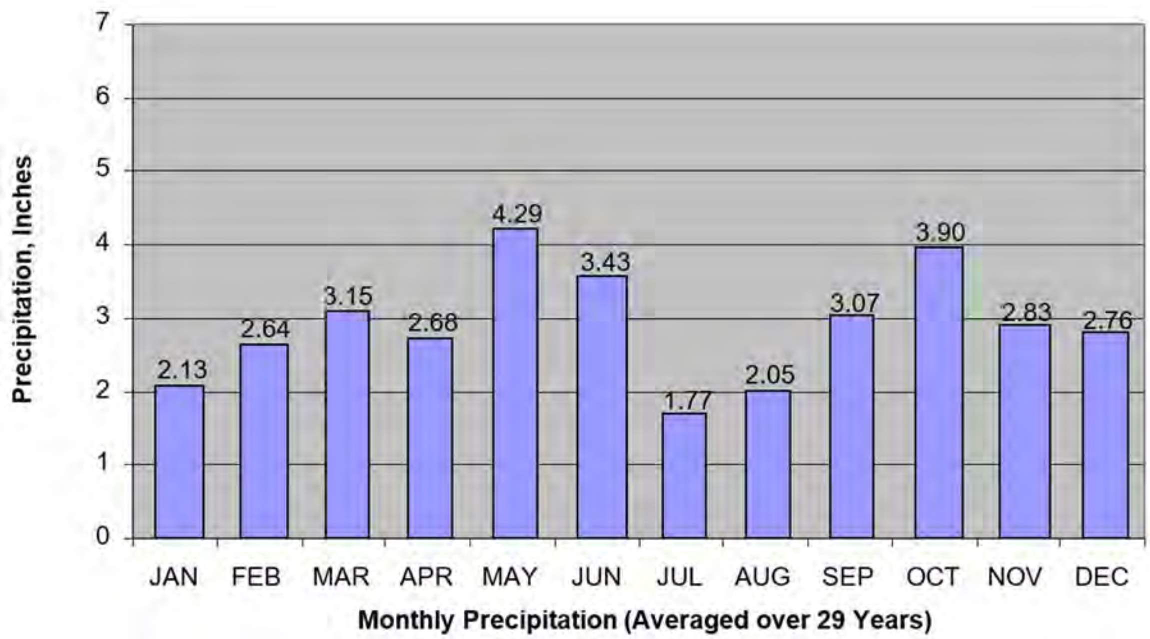
FIGURE: **4.20**

TABLES

Table III-4.1 Regional Physiography

Body of Water	Approximate Distance from the Landfill Property	Direction from the Landfill
Horse Creek	0 ft	Within, North to South
Unnamed Lake (soil conservation service site 19 reservoir)	0+ ft	Within, South
Packwood Creek	400 ft	East
Williams Creek	1,700 ft	South

Table III-4.2 Waco Average Monthly Rainfall



(Averaged between 1981 and 2010 at the Waco-Mcgregor Municipal Airport; source: www.usclimate.com).

Table III-4.3 Geologic Units and their Water-Bearing Properties (Modified From Baker et al., 1990; Tetco, 1987)

System	Series	Group	Formation	Hydrogeologic Unit	Approximate Thickness in Site Vicinity (ft)
Cretaceous	Gulfian	Taylor **Site ->**	Pecan Gap Chalk	Not a named hydrogeologic unit	0
			Wolfe City Formation	“	300
			Ozan Formation	“	500-775
		Austin	Austin Chalk	“	30
		Eagle Ford	South Bosque Shale	“	120
			Lake Waco Formation	“	75
		Woodbine	Pepper shale	“	60
	Upper Comanche Series	Washita	Del Rio Clay	“	70-90
			Georgetown Formation and Main Street Limestone	“	25-35
			Pawpaw Formation and Weno Limestone	“	16-55
			Denton Clay, Fort Worth Limestone, and Duck Creek Limestone	“	53-76
		Fredericksburg	Edwards Limestone and Kiamichi Clay Comanche Peak Limestone	“	20-77
				“	50-100
			Walnut Clay	“	125-175
	Lower Comanche Series	Trinity	Paluxy Sand	Upper Trinity Aquifer	<71
			Glen Rose Formation	Middle Trinity Aquifer	200-375
			Travis PeakJHensell Sand Member	Middle Trinity Aquifer	175
			Travis Peak/Pearsall Member	Middle Trinity Aquifer	85
			Travis Peak/Cow Creek Member	Middle Trinity Aquifer	130
			Travis Peak/Hammet Shale Member	Middle Trinity Aquifer	140
			Travis Peak/Sligo and Hosston Member	Lower Trinity Aquifer	1,680

Table III-4.4 Recorded Wells Within 1 Mile of the Landfill and Beyond

Aquifer*	Well Number - Grid	Use	Owner	Well Depth (ft BGS)	Altitude of Land Surface (ft MSL)	Date	Depth to Water (ft BGS)	Water Level Elev (ft MSL)
Wells within the one-mile radius								
N/A	3917201 39-17-2	Unused (Oil or Gas)	S.H. Riggs	2030	560 (from topo)	1951	N/A	N/A
N/A	3917601 39-17-6	Unused (Oil or Gas)	Ralph Spence, Bill Hughes (Paul Collins No. 1)	3187	531 (from topo)	1961	N/A	N/A
Closest water wells beyond the one-mile radius								
N/A (3.7 mi NW)	299719 39-17-1	Closed-Loop Geothermal	New Residence	300 (of clay)	510 (from topo)	9/21/12	N/A	N/A
Trinity-Hosston (5.3 mi NW)	4024301 40-24-3	Public Supply	Leroy-Tours-Gerald WSC Well #1	2863	495	1958	52-435	443-60
Trinity-Travis Peak (5.1 mi NW)	4024302 40-24-3	Industrial	#2	2312	492			
Trinity-Hosston (6.9 mi NW)	4024201 40-20-2	Public Supply	Leroy-Tours-Gerald WSC Whiskey Hollow	2620	522	7/1980	132	390
Trinity-Hosston (6.9 mi NW)	4024201 40-24-2	Public Supply	Leroy-Tours-Gerald WSC #2	2670	522	7/1980	132	390
Trinity (3.6 mi SW)	3917701 39-17-7	Public Supply	Axtell WSC Well #1	3129	529	1959	9.67	519.33
Trinity-Hosston (5.8 mi SW)	3917702 39-17-7	Public Supply	Moore Water System	3250	457	7/16/83	390	67
Trinity (6.4 mi SW)	277481 40-32-3	Irrigation	Stuart Parsons	3001	451 (from topo)	11/22/11	499	-48
Trinity-Hosston	3925201 39-25-2	Public Supply	Elk-Oaklake WSC	3148	517	6/9/80	399-863	118- -346

Aquifer*	Well Number - Grid	Use	Owner	Well Depth (ft BGS)	Altitude of Land Surface (ft MSL)	Date	Depth to Water (ft BGS)	Water Level Elev (ft MSL)
(5.5 mi SW)								
Trinity-Hosston (4 mi S)	3917901 39-17-9	Public Supply	Prairie Hill WSC	3375	561	6/25/65	80-494	481-67
Trinity-Hosston (4.4 mi S)	3917903 39-17-9	Public Supply	Prairie Hill WSC	3275	529	6/9/80	483	46
Navarro Taylor (6.6 mi SE)	3918801 39-18-8	Domestic	Mary Whitten	19	622	3/1/65	2.3-18	619.7-604
Trinity-Hosston (6.8 mi SE)	3918802 39-18-8	Public Supply	Prairie Hill WSC	3942	595 (from topo)	1963	47-88	548-507
Navarro Taylor (3.8 mi East)	3918101 39-18-1	Historical Observation Well (plugged)	Grady Crawford	22	621 (from topo)	2010	4.21-13.21	616.8-607.8
Trinity-Hosston (4.2 mi NE)	3909902 39-09-9	Public Supply	Birome WSC Well #1	3250	621	9/10/65	145-205	476-416
Trinity-Hosston (4.2 mi NE)	3909903 39-09-9	Public Supply	Birome WSC Well #2	3311	623	10/16/92	144	479

* (direction from Landfill)

Table III-4.5 Coordinates and Elevations of Borings Advanced at the Site by SCS Engineers

Boring Number	Easting	Northing	Hollow Stem Auger Type	Ground Elevation (ft-msl)	Depth Drilled (ft-bgs)	Elevation of Bottom (ft-msl)
B-1 (PZ-1)	3353867.3	10599904.81	7 ¼	551.74	39.5	512.24
B-2	3354595.81	10598697.6	7 ¼	549.78	55.0	494.78
B-3 (PZ-3)	3355259.69	10597665.32	7 ¼	541.20	45.0	496.2
B-4	3355130.33	10599528	7 ¼	550.04	101.0	449.04
B-5	3355913.87	10600728.3	7 ¼	541.38	47.0	494.38
B-6	3355562.96	10602041.9	7 ¼	545.55	70.7	474.85
B-7	3356670.83	10599929.6	8 ¼	530.50	55.5	475
B-8 (PZ-8)	3357935.82	10599489.18	8 ¼	550.34	75.0	475.34
B-9 (PZ-9)	3355762.31	10599314.37	8 ¼	535.30	40.0	495.30
B-9 cont.	3355762.31	10599314.37	8 ¼	535.30	135.0	400.30
B-10	3356199.16	10602404.1	8 ¼	545.40	53.0	492.4
B-11	3357048	10602933.5	7 ¼	553.50	78.5	475
B-12	3355833.07	10601575	8 ¼	542.85	48.0	494.85
B-13	3357768.09	10600645.6	8 ¼	555.15	80.0	475.15
B-14	3356543.77	10602016.3	8 ¼	539.20	65.5	473.7
B-15	3357265.27	10602471.1	7 ¼	563.35	70.0	493.35
B-16	3354706.01	10599996.8	8 ¼	560.25	61.0	499.25
B-17	3355568.96	10600519.6	7 ¼	546.75	71.0	475.75
B-18 (PZ-18)	3356694.76	10601254.04	8 ¼	534.84	56.0	478.84
B-19	3357202	10601429	7 ¼	562.05	87.0	475.05
B-20 (PZ-20)	3357666.42	10601846.53	7 ¼	564.68	73.0	491.68
B-21	3357008	10600682	8 ¼	538.75	45.0	493.75
B-22	3358132.03	10601234	8 ¼	555.00	80.0	475
B-23	3355207.68	10598431	8 ¼	540.08	45.7	494.38
B-24	3355746.69	10598780.1	7 ¼	533.63	59.2	474.43
B-25	3356251.06	10599102.9	7 ¼	533.25	33.0	500.25
B-26	3356929.04	10599457.3	8 ¼	530.45	36.0	494.5
B-27	3358308.89	10600427.7	8 ¼	546.65	53.0	493.65
B-28	3356800.71	10598286.7	8 ¼	529.6	55.0	474.6
B-29	3358523.03	10599393	8 ¼	540.25	45.0	495.25
B-30	3357828.13	10598886.4	8 ¼	543.05	48.0	495.05
B-31	3355837.8	10599897	8 ¼	537.55	63.0	474.55
B-32	3357077.27	10597864.5	8 ¼	526.3	32.0	494.3
B-33 (PZ-33)	3357774.62	10598320.64	8 ¼	539.20	55.0	484.2
B-34	3358367.31	10598778.6	8 ¼	535.65	41.0	494.65
B-35	3357682.18	10600037.4	8 ¼	553.3	59.0	494.3
B-36	3357239.12	10596730.2	8 ¼	532.5	58.0	474.5
B-37	3358201.19	10597770.6	8 ¼	526.9	52.0	474.9
B-38	3358847.64	10598223.2	8 ¼	529.85	55.0	474.85
B-39	3358709.87	10597052.3	8 ¼	522.95	48.0	475
B-40	3359476.22	10597259.9	8 ¼	522.80	28.0	494.8
B-41 (PZ-41)	3359083.91	10599450.64	8 ¼	534.62	60.0	474.62
B-42	3358523.73	10597484.3	8 ¼	527.00	32.0	495.0
B-43 (PZ-43)	3358875.54	10600433.69	8 ¼	548.86	75.0	473.86
B-43 cont.	3358875.54	10600433.69	8 ¼	548.86	150	398.86
B-44	3354540.62	10599103.1	7 ¼	551.20	76.0	475.20
B-45	3356769.83	10601549.1	8 ¼	545.50	51.0	494.5

Boring Number	Easting	Northing	Hollow Stem Auger Type	Ground Elevation (ft-msl)	Depth Drilled (ft-bgs)	Elevation of Bottom (ft-msl)
B-46	3357689.45	10601293.2	8 ¼	559.25	65.4	493.85
B-47 (PZ-47)	3356561.53	10598701.96	8 ¼	532.48	57.4	475.08

msl = mean sea level
b.g.s indicates depth is measured from below ground surface

Table III-4.6 Properties of Unit II

Lab Test	East Disposal Area		West Disposal Area		Test Method
	Average	Number of Tests	Average	Number of Tests	
Moisture Content	17	19	19	16	ASTM D2216
Liquid Limit	63	21	68	18	ASTM D4318
Plasticity Index	42	21	46	18	ASTM D4318
Permeability (cm/s)	1.94 x 10^{-8}	1	1.94 x 10^{-8}	1	EM 1110-2-1906
Hydraulic Conductivity (cm/s)**	2.14 x 10^{-8}	2	2.31 x 10^{-8}	2	EM 1110-2-1906
Hydraulic Conductivity (cm/s) (geometric mean)	2.05 x 10^{-8}	1	3.07 x 10^{-8}	3	Slug Test

** Both arithmetic (a) and geometric (g) mean used in calculating average.

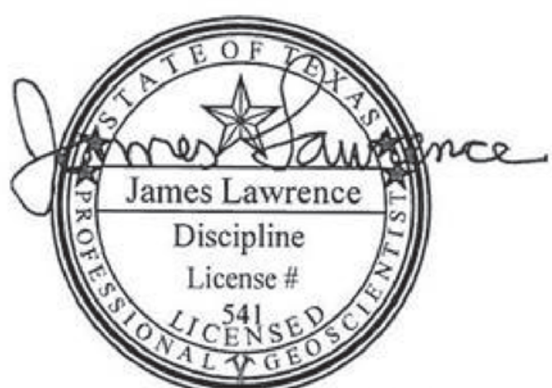


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Table III-4.7 Properties of Unit III

Lab Test	East Disposal Area		West Disposal Area		Test Method
	Average	Number of Tests	Average	Number of Tests	
Moisture Content	14	17	16	10	ASTM D2216
Liquid Limit	58	17	65	10	ASTM D4318
Plasticity Index	38	17	43	10	ASTM D4318
Permeability (cm/s)	n/a	n/a	n/a	n/a	EM 1110-2-1906
Hydraulic Conductivity (cm/s)**	n/a	n/a	n/a	n/a	EM 1110-2-1906
Hydraulic Conductivity (cm/s) (geometric mean)	1.84×10^{-8}	2	n/a	n/a	Slug Test

** Both arithmetic (a) and geometric (g) mean used in calculating average.

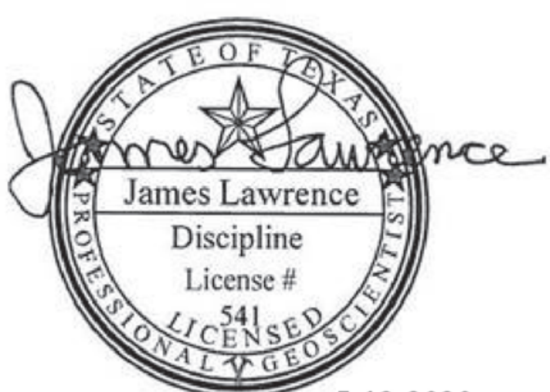

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Table III-4.8 Existing Piezometers Completion Data

Monitor Well No.	Drilled Depth (ft b.g.s)	Ground Surface Elevation (ft-msl)	Top of Pipe Elevation (ft-msl)	Screen		Filter Pack	
				Depth to Top (ft)	Depth to Base (ft)	Depth to Top (ft)	Depth to Base (ft)
PZ-1	39.5	551.7	555.12	19.19	39.19	16.00	39.47
PZ-3	45.0	541.2	544.21	24.53	44.53	21.5	44.76
PZ-8	75.0	550.3	553.39	54.47	74.47	52.70	74.70
PZ-9	40.0	535.3	539.44	18.28	38.28	15.90	38.48
PZ-18	56.0	534.8	537.80	25.18	45.18	22.80	45.50
PZ-20	73.0	564.7	567.77	44.00	64.00	42.00	64.00
PZ-33	55.0	539.2	542.49	34.63	54.63	33.00	54.90
PZ-41	60.0	534.6	538.04	28.58	48.58	24.00	48.77
PZ-43	75.0	548.9	551.31	28.20	48.20	24.00	48.45
PZ-47	57.4	532.5	536.16	10.00	30.00	8.00	30.00

Notes:
Ground-surface elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on as-built monitoring well and piezometer survey elevations. Top of casing elevations are to the nearest hundredth of a foot.
b.g.s indicates depth is measured from below ground surface.

Table III-4.9 Summary of Initial and Static Water Level Data

Boring/Well Number	Initial Water Level (ft-msl)	Static Water Level (ft-msl)	Date of Static Water Level Reading
B-1 (PZ-1)*	531.29	539.04	2/25/2020
B-3 (PZ-3)*	495.86 (dry)	510.65	2/25/2020
B-8 (PZ-8)*	476.30 (dry)	476.30 (dry)	2/25/2020
B-9 (PZ-9)*	510.05	501.45 (dry)	2/25/2020
B-18 (PZ-18)*	511.25	519.4	2/25/2020
B-20 (PZ-20)*	557.20	512.27	1/30/2020
B-33 (PZ-33)*	484.95 (dry)	484.95 (dry)	2/25/2020
B-41 (PZ-41)*	486.41 (dry)	486.41 (dry)	2/25/2020
B-43 (PZ-43)*	501.37 (dry)	500.86 (dry)	2/25/2020
B-47 (PZ-47)*	502.15 (dry)	502.18 (dry)	2/25/2020

* = Piezometer installed in bore hole.

Notes:

1. Initial water level information shown in this table was taken from the piezometers following installation.
2. PZ-1, PZ-3, PZ-9, and PZ-47 are piezometers in the west disposal area.
3. PZ-8, PZ-18, PZ-20, PZ-33, PZ-41, and PZ-43 are piezometers in the east disposal area.
4. PZ-1, PZ-3, PZ-9, PZ-20, PZ-41, and PZ-43 are screened in the weathered and unweathered shale-marl zones and across the interface.
5. PZ-8, PZ-18, PZ-33 are screened in the unweathered shale-marl zone, below the interface.
6. PZ-47 is screened in the weathered shale-mark zone, above the interface.

Table III-4.10 Summary of Vibrating Wire Piezometers Completion Data

VWP No.	Drilled Depth (ft b.g.s)	Ground Surface Elevation (ft-msl)	VWP Elevation (ft-msl)	VWP Depth (ft)	Bentonite Backfill Depth to Top (ft)	Filter Pack Depth to Top (ft)	Bentonite Seal Depth to Top (ft)
VWP-1	35.0	551.4	522.5	28.9	29.0	27.9	24.9
VWP-3	38.0	540.9	506.6	34.3	34.5	33.3	30.3
VWP-4	28.7	549.6	527.0	22.6	22.8	21.6	18.6
VWP-8	68.0	550.9	486.3	64.6	64.8	63.6	60.6
VWP-8D	160.0	551.0	400.0	151.0	--	150.0	147.0
VWP-9	35.0	535.3	506.9	28.4	28.5	27.3	24.3
VWP-9D	145.0	535.0	400.0	135.0	--	134.0	131.0
VWP-18	37.0	534.6	499.6	35.0	35.2	34.2	31.0
VWP-18D	145.0	535.0	400.0	135.0	--	134.0	131.0
VWP-19	53.0	562.1	511.0	51.1	51.3	50.3	47.0
VWP-20	56.5	564.6	510.1	54.5	54.7	53.7	51.0
VWP-25	32.0	533.8	505.0	28.8	29.0	27.8	24.8
VWP-26	24.8	530.5	506.0	24.5	--	23.5	20.5
VWP-27	30.0	546.7	520.0	26.7	27.0	25.7	23.0
VWP-30	40.0	544.0	506.0	38.0	38.1	37.0	34.0
VWP-33	48.0	538.6	494.8	43.8	44.0	42.8	39.8
VWP-33D	150.0	539.0	401.0	138.0	--	137.0	134.0
VWP-41	39.0	534.8	496.4	38.4	38.7	37.5	34.5
VWP-41D	145.0	535.0	402.0	133.0	--	132.0	129.0
VWP-43	40.0	549.5	511.5	38.0	38.3	37.0	34.0
VWP-43D	160.0	549.0	400.0	149.0	--	148.0	145.0
VWP-44	55.0	554.4	505.2	49.2	49.3	48.2	45.2
VWP-47	23.5	532.6	512.4	20.2	20.4	19.2	16.2
VWP-47D	142.0	532.0	400.0	132.0	--	131.0	128.0

Notes:
Ground-surface and VWP elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on piezometer survey elevations. b.g.s indicates depth is measured from below ground surface.

Table III-4.11 Summary of Vibrating Wire Piezometers Calculated Groundwater Elevations

VWP No.	Ground Surface Elevation (ft-msl)	VWP Elevation (ft-msl)	Temperature (°C)	Pressure (PSI)	Pressure Head (feet H_2O)	Calculated Groundwater Elevation (ft-msl)	Date of Reading
VWP-1	551.4	522.5	21.5	7.9	18.2	540.7	2/25/2020
VWP-3	540.9	506.6	21.5	2.5	6.0	512.6	2/25/2020
VWP-4	549.6	527.0	21.4	-0.1	-0.2	526.8 (dry)	2/25/2020
VWP-8	550.9	486.3	20.0	0.0	0.0	486.3 (dry)	2/25/2020
VWP-8D	551.0	400.0	21.8	43.5	100.64	500.6	2/25/2020
VWP-9	535.3	506.9	21.5	0.0	0.0	506.9 (dry)	2/25/2020
VWP-9D	535.0	400.0	22.5	51.2	118.4	518.4	2/25/2020
VWP-18	534.6	499.6	20.8	10.1	23.4	523.0	2/25/2020
VWP-18D	535.0	400.0	22.2	36.3	83.9	483.9	2/25/2020
VWP-19	562.1	511.0	21.6	-0.4	-1.0	510.0 (dry)	2/25/2020
VWP-20	564.6	510.1	21.7	0.0	0.0	510.1 (dry)	2/25/2020
VWP-25	533.8	505.0	19.7	0.0	0.0	505.0 (dry)	2/25/2020
VWP-26	530.5	506.0	20.5	-0.1	-0.3	505.7 (dry)	2/25/2020
VWP-27	546.7	520.0	21.4	-0.1	-0.3	519.7 (dry)	2/25/2020
VWP-30	544.0	506.0	20.2	1.5	3.4	509.4	2/25/2020
VWP-33	538.6	494.8	21.5	0.0	0.0	494.8 (dry)	2/25/2020
VWP-33D	539.0	401.0	22.1	3.1	7.1	408.1	2/25/2020
VWP-41	534.8	496.4	19.7	0.0	0.0	496.4 (dry)	2/25/2020
VWP-41D	535.0	402.0	21.3	8.8	20.3	422.4	2/25/2020
VWP-43	549.5	511.5	20.3	0.0	0.0	511.5 (dry)	2/25/2020
VWP-43D	549.0	400.0	21.8	36.0	83.3	483.3	2/25/2020
VWP-44	554.4	505.2	22.0	3.5	8.1	513.3	2/25/2020
VWP-47	532.6	512.4	20.5	0.0	0.0	512.4 (dry)	2/25/2020
VWP-47D	532.0	400.0	21.1	7.1	16.3	416.3	2/25/2020

Notes:
Ground-surface and VWP elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on piezometer survey elevations.

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Table III-4.12 Summary of Aquifer (Slug) Tests Performed by SCS Engineers

Piezometer Designation	Unit Tested	Slug Test Method	Hydraulic Conductivity (cm/sec)
PZA-1	II/III	Bouwer-Rice	Slug in: 2.03×10^{-8} cm/sec
			Slug out: 2.04×10^{-8} cm/sec
PZA-3	II/III	Bouwer-Rice	Slug in: 6.97×10^{-8} cm/sec
PZ-18	III	Bouwer-Rice	Slug in: 1.44×10^{-8} cm/sec
			Slug out: 2.36×10^{-8} cm/sec
PZ-20	II/III	Bouwer-Rice	Slug in: 2.05×10^{-8} cm/sec
Geometric Mean Hydraulic Conductivity = 2.42×10^{-8} cm/sec			
Arithmetic Mean Hydraulic Conductivity = 2.82×10^{-8} cm/sec			

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Table III-4.13 Estimated Ground Water Velocities

Location	Hydraulic Conductivity (k)* (cm/sec) (Geometric Mean)	Hydraulic Gradient (i)**	Average Effective Porosity (n)***	Velocities (v) ft/day	Velocity (v) ft/year
Entire Area (PZA-1, PZA-3, PZ-18, PZ-20)	2.42 x 10^{-8}	0.024	0.05	3.2 x 10^{-5}	0.012
Unit II (PZA-1, PZA-3, PZ-20)	2.77 x 10^{-8}	0.024	0.05	3.84 x 10^{-5}	0.014
West Disposal Area (PZA-1, PZA-3)	3.07 x 10^{-8}	0.024	0.05	3.84 x 10^{-5}	0.014
East Disposal Area (PZ-18, PZ-20)	1.91 x 10^{-8}	0.024	0.05	2.56 x 10^{-5}	0.009
PZA-3 (High)	6.97 x 10^{-8}	0.024	0.05	9.6 x 10^{-5}	0.035
PZ-18 (Low)	1.44 x 10^{-8}	0.024	0.05	1.92 x 10^{-5}	0.007

* Hydraulic conductivity estimated from slug test results.
** Gradient estimated from February 2020 potentiometric map (Figure III-4.17)
*** Typical porosity for shale (Driscoll, 1986)

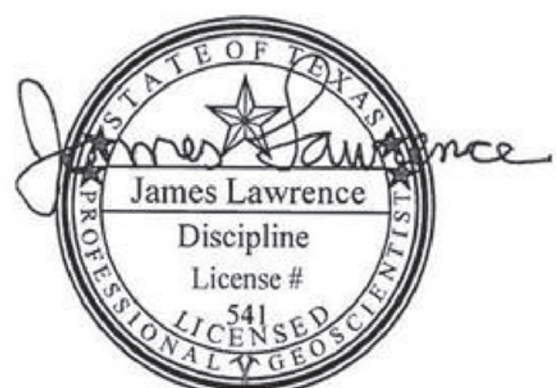

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Table III-4.14 Proposed Monitoring Well Information

Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P1-MW 1-A (D)	East	Prior to Landfill Operation	10601388.5'	3356636.7'	537.3	482	482-522	520
P1-MW 1-B (D)	East	Prior to Landfill Operation	10601388.5'	3356636.7'	537.3	400	400-440	520
P1-MW 2-A (D)	East	Prior to Landfill Operation	10600835.2'	3356820.8'	534.9	500	480-520	520
P1-MW 2-B (D)	East	Prior to Landfill Operation	10600835.2'	3356820.8'	534.9	400	400-440	520
P1-MW 3-A (D)	East	Waste < 1,000 feet	10600455.1'	3357167.6'	539.9	500	485-525	515
P1-MW 3-B (D)	East	Waste < 1,000 feet	10600455.1'	3357167.6'	539.9	400	400-440	515
P1-MW 4-A (D)	East	Waste < 1,000 feet	10599949.8'	3357049.5'	535.5	480	480-520	510
P1-MW 4-B (D)	East	Waste < 1,000 feet	10599949.8'	3357049.5'	535.5	400	400-440	500
P1-MW 5-A (D)	East	Waste < 1,000 feet	10599428.7'	3357289.6'	535.5	480	480-520	510
P1-MW 5-B (D)	East	Waste < 1,000 feet	10599428.7'	3357289.6'	535.5	400	400-440	480
P1-MW 6-A (D)	East	Waste < 1,000 feet	10598871.8'	3357451.8'	536.9	482	482-522	500
P1-MW 6-B (D)	East	Waste < 1,000 feet	10598871.8'	3357451.8'	536.9	400	400-440	440
P1-MW 7-A (D)	East	Waste < 1,000 feet	10598575.5'	3357780.2'	541.0	486	486-526	500
P1-MW 7-B (D)	East	Waste < 1,000 feet	10598575.5'	3357780.2'	541.0	400	400-440	410
P1-MW 8-A (D)	East	Waste < 1,000 feet	10598576.0'	3358302.8'	534.4	479	479-519	500
P1-MW 8-B (D)	East	Waste < 1,000 feet	10598576.0'	3358302.8'	534.4	400	400-440	410
P1-MW 9-A (D)	East	Waste < 1,000 feet	10599071.8'	3358618.2'	534.9	480	480-520	500
P1-MW 9-B (D)	East	Waste < 1,000 feet	10599071.8'	3358618.2'	534.9	400	400-440	420
P1-MW 10-A (D)	East	Waste < 1,000 feet	10599550.5'	3358887.5'	536.5	481	481-521	500
P1-MW 10-B (D)	East	Waste < 1,000 feet	10599550.5'	3358887.5'	536.5	400	400-440	430
P1-MW 11-A (D)	East	Waste < 1,000 feet	10599811.3'	3358835.5'	537.2	482	482-522	510

Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P1-MW 11-B (D)	East	Waste < 1,000 feet	10599811.3'	3358835.5'	537.2	400	400-440	460
P1-MW 12-A (D)	East	Waste < 1,000 feet	10599973.5'	3359272.3'	535.2	480	480-520	510
P1-MW 12-B (D)	East	Waste < 1,000 feet	10599973.5'	3359272.3'	535.2	400	400-440	480
P1-MW 13-A (D)	East	Waste < 1,000 feet	10600475.2'	3358969.8'	548.7	494	494-534	510
P1-MW 13-B (D)	East	Waste < 1,000 feet	10600475.2'	3358969.8'	548.7	400	400-440	480
P1-MW 14-A (D)	East	Waste < 1,000 feet	10600975.4'	3358654.1'	557.9	503	503-543	515
P1-MW 14-B (D)	East	Waste < 1,000 feet	10600975.4'	3358654.1'	557.9	400	400-440	480
P1-MW 15-A (D)	East	Waste < 1,000 feet	10601450.3'	3358350.5'	559.1	504	504-544	520
P1-MW 15-B (D)	East	Waste < 1,000 feet	10601450.3'	3358350.5'	559.1	400	400-440	500
P1-MW 16-A (D)	East	Prior to Landfill Operation	10601952.9'	3358044.6'	562.9	508	508-548	520
P1-MW 16-B (D)	East	Prior to Landfill Operation	10601952.9'	3358044.6'	562.9	400	400-440	520
P1-MW 17-A (D)	East	Prior to Landfill Operation	10602455.6'	3357728.7'	568.7	514	514-554	520
P1-MW 17-B (D)	East	Prior to Landfill Operation	10602455.6'	3357728.7'	568.7	400	400-440	520
P1-MW 18-A (U)	East	Prior to Landfill Operation	10602898.2'	3357210.8'	557.1	502	502-542	520
P1-MW 18-B (U)	East	Prior to Landfill Operation	10602898.2'	3357210.8'	557.1	400	400-440	520
P1-MW 19-A (U)	East	Prior to Landfill Operation	10602401.2'	3356897.4'	539.8	485	485-525	520
P1-MW 19-B (U)	East	Prior to Landfill Operation	10602401.2'	3356897.4'	539.8	400	400-440	520
P1-MW 20-A (U)	East	Prior to Landfill Operation	10601906.1'	3356610.0'	539.5	485	485-525	520
P1-MW 20-B (U)	East	Prior to Landfill Operation	10601906.1'	3356610.0'	539.5	400	400-440	520
P2-MW 1-A (U)	West	Waste < 1,000 feet	10601080.1'	3355911.8'	541.3	486	486-526	520

Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P2-MW 1-B (U)	West	Waste < 1,000 feet	10601080.1'	3355911.8'	541.3	400	400-440	520
P2-MW 2-A (U)	West	Waste < 1,000 feet	10600561.9'	3355105.9'	546.9	492	492-532	535
P2-MW 2-B (U)	West	Waste < 1,000 feet	10600561.9'	3355105.9'	546.9	400	400-440	535
P2-MW 3-A (U)	West	Waste < 1,000 feet	10600028.3'	3354261.3'	561.9	507	507-547	540
P2-MW 3-B (U)	West	Waste < 1,000 feet	10600028.3'	3354261.3'	561.9	400	400-440	540
P2-MW 4-A (D)	West	Waste < 1,000 feet	10599509.0'	3354533.4'	558.2	503	503-543	525
P2-MW 4-B (D)	West	Waste < 1,000 feet	10599509.0'	3354533.4'	558.2	400	400-440	525
P2-MW 5-A (D)	West	Waste < 1,000 feet	10599116.9'	3354318.4'	553.8	499	499-539	515
P2-MW 5-B (D)	West	Waste < 1,000 feet	10599116.9'	3354318.4'	553.8	400	400-440	515
P2-MW 6-A (D)	West	Waste < 1,000 feet	10598627.3'	3354628.1'	549.0	494	494-534	515
P2-MW 6-B (D)	West	Waste < 1,000 feet	10598627.3'	3354628.1'	549.0	400	400-440	515
P2-MW 7-A (D)	West	Waste < 1,000 feet	10598137.9'	3354937.1'	541.7	487	487-527	515
P2-MW 7-B (D)	West	Waste < 1,000 feet	10598137.9'	3354937.1'	541.7	400	400-440	515
P2-MW 8-A (D)	West	Waste < 1,000 feet	10597808.8'	3355366.0'	542.7	488	488-528	515
P2-MW 8-B (D)	West	Waste < 1,000 feet	10597808.8'	3355366.0'	542.7	400	400-440	515
P2-MW 9-A (D)	West	Waste < 1,000 feet	10598355.8'	3355575.5'	534.7	480	480-520	515
P2-MW 9-B (D)	West	Waste < 1,000 feet	10598355.8'	3355575.5'	534.7	400	400-440	500
P2-MW 10-A (D)	West	Waste < 1,000 feet	10598926.3'	3355714.8'	534.9	480	480-520	515
P2-MW 10-B (D)	West	Waste < 1,000 feet	10598926.3'	3355714.8'	534.9	400	400-440	500
P2-MW 11-A (D)	West	Waste < 1,000 feet	10599286.1'	3355952.6'	535.1	480	480-520	515
P2-MW 11-B (D)	West	Waste < 1,000 feet	10599286.1'	3355952.6'	535.1	400	400-440	440
P2-MW 12-A (D)	West	Waste < 1,000 feet	10599642.5'	3356227.9'	535.5	480	480-520	515
P2-MW 12-B (D)	West	Waste < 1,000 feet	10599642.5'	3356227.9'	535.5	400	400-440	440

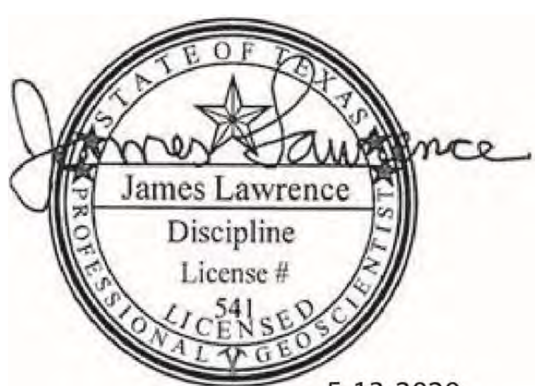
Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P2-MW 13-A (D)	West	Waste < 1,000 feet	10600060.5'	3356061.2'	535.3	480	480-520	515
P2-MW 13-B (D)	West	Waste < 1,000 feet	10600060.5'	3356061.2'	535.3	400	400-440	490
P2-MW 14-A (D)	West	Waste < 1,000 feet	10600549.7'	3356070.2'	536.9	482	482-522	515
P2-MW 14-B (D)	West	Waste < 1,000 feet	10600549.7'	3356070.2'	536.9	400	400-440	490

Notes:
Proposed shallow well bottom elevations are 55 feet below ground surface elevations. Proposed deep well bottom elevations will all be set at 400 ft-msl.

5-13-2020

APPENDIX III-4.A

SOIL RESOURCE REPORT



5-13-2020

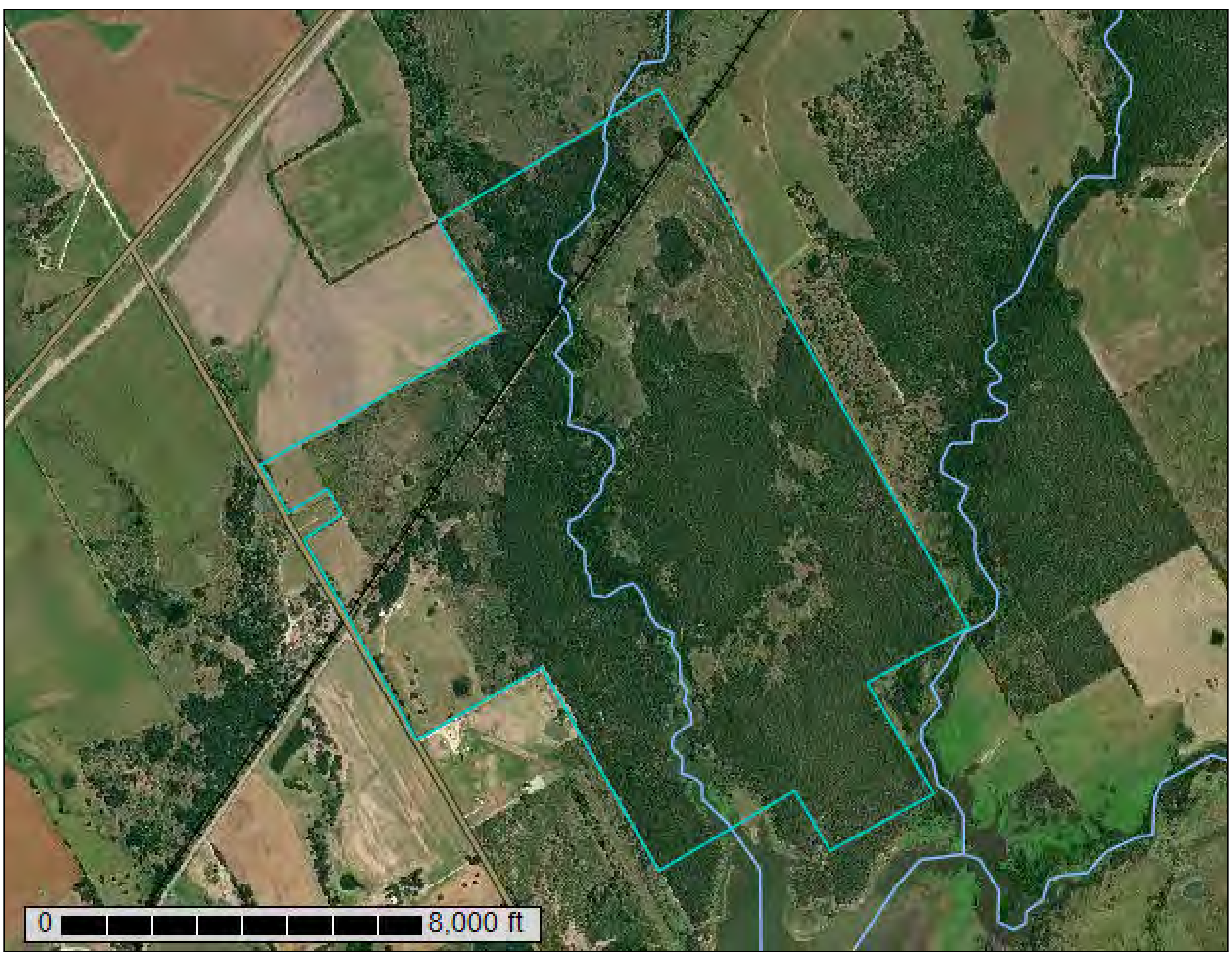
United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Hill County, Texas, Limestone County, Texas, and McLennan County, Texas

City of Waco Landfill - Site 50



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

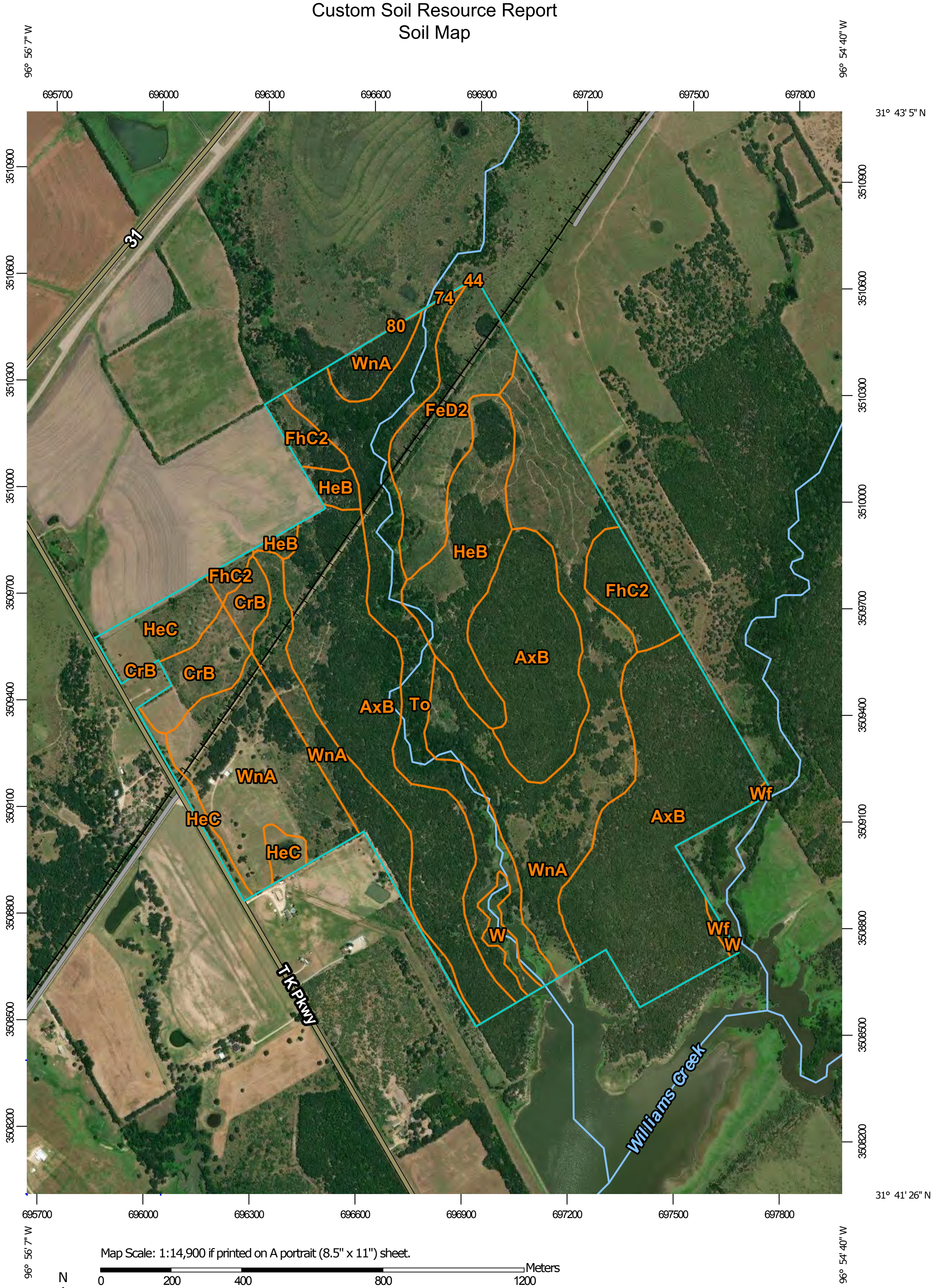
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:14,900 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hill County, Texas
Survey Area Data: Version 16, Sep 15, 2018

Soil Survey Area: Limestone County, Texas
Survey Area Data: Version 15, Sep 14, 2018

Soil Survey Area: McLennan County, Texas
Survey Area Data: Version 17, Sep 14, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 16, 2016—Nov 29, 2017

MAP LEGEND	MAP INFORMATION
	The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
44	Heiden clay, 5 to 8 percent slopes	0.0	0.0%
74	Tinn clay, 0 to 1 percent slopes, frequently flooded	0.1	0.0%
80	Wilson clay loam, 1 to 3 percent slopes	0.0	0.0%
Subtotals for Soil Survey Area		**0.2**	**0.0%**
Totals for Area of Interest		**527.7**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AxB	Axtell fine sandy loam, 1 to 3 percent slopes	182.8	34.6%
CrB	Crockett loam, 1 to 3 percent slopes	4.5	0.9%
FeD2	Ferris clay, 5 to 15 percent slopes, eroded	32.0	6.1%
FhC2	Ferris-Heiden complex, 2 to 5 percent slopes, eroded	19.6	3.7%
HeB	Heiden clay, 1 to 3 percent slopes	38.7	7.3%
To	Tinn clay, 0 to 1 percent slopes, frequently flooded	58.8	11.1%
W	Water	4.3	0.8%
Wf	Whitesboro loam, frequently flooded	1.2	0.2%
WnA	Wilson clay loam, 0 to 2 percent slopes	110.8	21.0%
Subtotals for Soil Survey Area		**452.7**	**85.8%**
Totals for Area of Interest		**527.7**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrB	Crockett loam, 3 to 5 percent slopes	12.0	2.3%
HeC	Heiden clay, 3 to 5 percent slopes	19.5	3.7%
WnA	Wilson clay loam, 0 to 2 percent slopes	43.3	8.2%
Subtotals for Soil Survey Area		**74.9**	**14.2%**
Totals for Area of Interest		**527.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Hill County, Texas

44—Heiden clay, 5 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2sshq
Elevation: 250 to 720 feet
Mean annual precipitation: 36 to 45 inches
Mean annual air temperature: 63 to 66 degrees F
Frost-free period: 245 to 278 days
Farmland classification: Not prime farmland

Map Unit Composition

Heiden and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Heiden

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Clayey residuum weathered from mudstone

Typical profile

A1 - 0 to 8 inches: clay
A2 - 8 to 22 inches: clay
Bss - 22 to 44 inches: clay
CBd - 44 to 80 inches: clay

Properties and qualities

Slope: 5 to 8 percent
Depth to restrictive feature: 40 to 65 inches to densic material
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Minor Components

Ferris, moderately eroded

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

Heiden, moderately eroded

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

74—Tinn clay, 0 to 1 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2vtgr
Elevation: 330 to 750 feet
Mean annual precipitation: 35 to 47 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 226 to 263 days
Farmland classification: Not prime farmland

Map Unit Composition

Tinn and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tinn

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Microfeatures of landform position: Circular gilgai
Down-slope shape: Linear
Across-slope shape: Concave

Parent material: Calcareous clayey alluvium

Typical profile

A - 0 to 17 inches: clay
Bss - 17 to 57 inches: clay
Bkssy - 57 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Clayey Bottomland (R086AY013TX)
Hydric soil rating: No

Minor Components

Whitesboro

Percent of map unit: 10 percent
Landform: Flood plains
Microfeatures of landform position: Circular gilgai
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Loamy Bottomland (R086AY012TX)
Hydric soil rating: No

Gladewater

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Clayey Bottomland (R086AY013TX)
Hydric soil rating: Yes

80—Wilson clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2wg9f
Elevation: 200 to 770 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 64 to 67 degrees F
Frost-free period: 243 to 262 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wilson and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wilson

Setting

Landform: Stream terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy and/or clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 7 inches: clay loam
Btss - 7 to 31 inches: clay
Btkss - 31 to 36 inches: clay
Btkssyg - 36 to 42 inches: clay
Btkyg - 42 to 80 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 15 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Minor Components

Burleson

Percent of map unit: 10 percent
Landform: Stream terraces, stream terraces
Landform position (three-dimensional): Tread
Microfeatures of landform position: Circular gilgai, circular gilgai
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Crockett

Percent of map unit: 5 percent
Landform: Ridges, stream terraces
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Limestone County, Texas

AxB—Axtell fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2shg6
Elevation: 200 to 790 feet
Mean annual precipitation: 33 to 47 inches
Mean annual air temperature: 65 to 67 degrees F
Frost-free period: 240 to 270 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Axtell and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Axtell

Setting

Landform: Stream terraces, stream terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Clayey alluvium of pleistocene age derived from mudstone

Typical profile

A - 0 to 10 inches: fine sandy loam
Btss - 10 to 18 inches: clay
Btk1 - 18 to 46 inches: clay
Btk2 - 46 to 80 inches: clay

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Claypan Savannah (R087AY003TX)
Hydric soil rating: No

Minor Components

Mabank

Percent of map unit: 7 percent
Landform: Stream terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Rader

Percent of map unit: 6 percent
Landform: Stream terraces, stream terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex, concave, linear
Ecological site: Sandy Loam (R087AY005TX)
Hydric soil rating: No

CrB—Crockett loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ssh6
Elevation: 280 to 860 feet
Mean annual precipitation: 34 to 43 inches
Mean annual air temperature: 63 to 67 degrees F
Frost-free period: 234 to 271 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Crockett and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crockett

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy residuum weathered from shale of cretaceous age

Typical profile

A - 0 to 8 inches: loam
Btss - 8 to 25 inches: clay
Btkss - 25 to 45 inches: clay
BCk - 45 to 53 inches: clay

Cdk - 53 to 72 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: 43 to 60 inches to densic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.03 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Minor Components

Normangee

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Wilson

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

FeD2—Ferris clay, 5 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: ddcz
Elevation: 400 to 1,000 feet

Mean annual precipitation: 28 to 42 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 230 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Ferris, eroded, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ferris, Eroded

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from calcareous shale in eagleford shale and taylor marl formations of cretaceous age

Typical profile

H1 - 0 to 4 inches: clay
H2 - 4 to 45 inches: clay
H3 - 45 to 80 inches: clay

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 40 to 60 inches to densic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Northern Eroded Blackland (R086AY008TX)
Hydric soil rating: No

FhC2—Ferris-Heiden complex, 2 to 5 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2sshj
Elevation: 400 to 720 feet
Mean annual precipitation: 42 to 44 inches
Mean annual air temperature: 63 to 66 degrees F
Frost-free period: 232 to 254 days
Farmland classification: Not prime farmland

Map Unit Composition

Ferris, eroded, and similar soils: 50 percent
Heiden, eroded, and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ferris, Eroded

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Clayey residuum weathered from mudstone

Typical profile

Ap - 0 to 10 inches: clay
Bkss1 - 10 to 30 inches: clay
Bkss2 - 30 to 45 inches: clay
Cdk - 45 to 60 inches: clay

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 39 to 60 inches to densic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

Description of Heiden, Eroded

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve, side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum weathered from mudstone

Typical profile

Ap - 0 to 5 inches: clay
A - 5 to 15 inches: clay
Bkss1 - 15 to 38 inches: clay
Bkss2 - 38 to 64 inches: clay
CBdk - 64 to 80 inches: clay

Properties and qualities

Slope: 2 to 4 percent
Depth to restrictive feature: 48 to 65 inches to densic material
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

Minor Components

Houston black

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve

Microfeatures of landform position: Linear gilgai
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Ferris, moderately eroded

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

HeB—Heiden clay, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2v1v9
Elevation: 290 to 1,020 feet
Mean annual precipitation: 33 to 45 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 224 to 278 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Heiden and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Heiden

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Microfeatures of landform position: Linear gilgai
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey residuum weathered from mudstone

Typical profile

Ap - 0 to 6 inches: clay
A - 6 to 18 inches: clay
Bkss - 18 to 58 inches: clay
CBdk - 58 to 70 inches: clay

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: 40 to 65 inches to densic material
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Minor Components

Houston black

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Microfeatures of landform position: Circular gilgai
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Ferris

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

To—Tinn clay, 0 to 1 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2vtgr
Elevation: 330 to 750 feet
Mean annual precipitation: 35 to 47 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 226 to 263 days
Farmland classification: Not prime farmland

Map Unit Composition

Tinn and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tinn

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Microfeatures of landform position: Circular gilgai
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Calcareous clayey alluvium

Typical profile

A - 0 to 17 inches: clay
Bss - 17 to 57 inches: clay
Bkssy - 57 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w

Hydrologic Soil Group: D
Ecological site: Clayey Bottomland (R086AY013TX)
Hydric soil rating: No

Minor Components

Whitesboro

Percent of map unit: 10 percent
Landform: Flood plains
Microfeatures of landform position: Circular gilgai
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Loamy Bottomland (R086AY012TX)
Hydric soil rating: No

Gladewater

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Clayey Bottomland (R086AY013TX)
Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Wf—Whitesboro loam, frequently flooded

Map Unit Setting

National map unit symbol: ddf9
Elevation: 170 to 570 feet
Mean annual precipitation: 34 to 40 inches
Mean annual air temperature: 63 to 70 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitesboro and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitesboro

Setting

Landform: Flood plains
Down-slope shape: Linear

Across-slope shape: Concave
Parent material: Loamy alluvium of holocene age drived from mixed sources

Typical profile
H1 - 0 to 26 inches: loam
H2 - 26 to 58 inches: clay loam
H3 - 58 to 80 inches: sandy clay loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B
Ecological site: Loamy Bottomland (R086AY012TX)
Hydric soil rating: No

Minor Components

Unnamed, hydric
Percent of map unit: 8 percent
Landform: Depressions
Hydric soil rating: Yes

Unnamed
Percent of map unit: 7 percent
Hydric soil rating: No

WnA—Wilson clay loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2wg9b
Elevation: 380 to 870 feet
Mean annual precipitation: 37 to 42 inches
Mean annual air temperature: 64 to 67 degrees F
Frost-free period: 250 to 255 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Wilson and similar soils: 85 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wilson

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy and/or clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 7 inches: clay loam
Btss - 7 to 31 inches: clay
Btkss - 31 to 36 inches: clay
Btkssyg - 36 to 42 inches: clay
Btkyg - 42 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 15 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Minor Components

Burleson

Percent of map unit: 10 percent
Landform: Stream terraces, stream terraces
Landform position (three-dimensional): Tread
Microfeatures of landform position: Circular gilgai, circular gilgai
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Crockett

Percent of map unit: 5 percent

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

McLennan County, Texas

CrB—Crockett loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2vv4y
Elevation: 380 to 610 feet
Mean annual precipitation: 35 to 37 inches
Mean annual air temperature: 65 to 67 degrees F
Frost-free period: 240 to 270 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Crockett and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crockett

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy residuum weathered from shale of cretaceous age

Typical profile

A - 0 to 8 inches: loam
Btss - 8 to 25 inches: clay
Btkss - 25 to 45 inches: clay
BCk - 45 to 53 inches: clay
Cdk - 53 to 72 inches: clay loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 43 to 60 inches to densic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.03 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Claypan Prairie (R086AY004TX)

Hydric soil rating: No

Minor Components

Heiden

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Wilson

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Microfeatures of landform position: Open depressions
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

HeC—Heiden clay, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2v1vc
Elevation: 260 to 890 feet
Mean annual precipitation: 33 to 42 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 233 to 260 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Heiden and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Heiden

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, interfluve
Microfeatures of landform position: Linear gilgai
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum weathered from mudstone

Typical profile

Ap - 0 to 6 inches: clay
Bkss1 - 6 to 18 inches: clay
Bkss2 - 18 to 58 inches: clay
CBdk - 58 to 80 inches: clay

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 40 to 65 inches to densic material
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Minor Components

Houston black

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Circular gilgai
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Ferris, moderately eroded

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Linear gilgai
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Eroded Blackland (R086AY009TX)
Hydric soil rating: No

WnA—Wilson clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2wg9b
Elevation: 380 to 870 feet
Mean annual precipitation: 37 to 42 inches
Mean annual air temperature: 64 to 67 degrees F
Frost-free period: 250 to 255 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wilson and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wilson

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy and/or clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 7 inches: clay loam
Btss - 7 to 31 inches: clay
Btkss - 31 to 36 inches: clay
Btkssyg - 36 to 42 inches: clay
Btkyg - 42 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 15 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

Minor Components

Burleson

Percent of map unit: 10 percent
Landform: Stream terraces, stream terraces
Landform position (three-dimensional): Tread
Microfeatures of landform position: Circular gilgai, circular gilgai
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Southern Blackland (R086AY011TX)
Hydric soil rating: No

Crockett

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Southern Claypan Prairie (R086AY004TX)
Hydric soil rating: No

References

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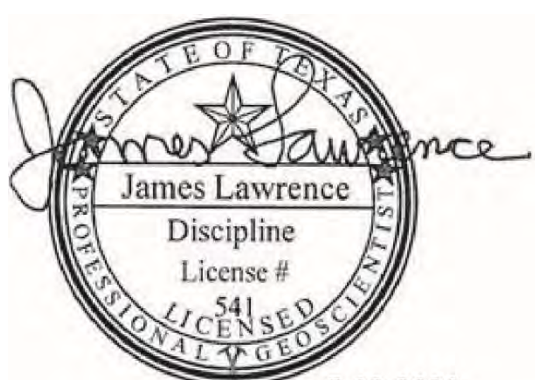
APPENDIX III-4.B

WELL SEARCH DATA



5-13-2020

ENVIRONMENTAL RESEARCH

ATLAS

Assessment, Compliance and Permitting Support

May 1, 2018

James Lawrence, P.G.
SCS Engineers
1901 Central Drive, Suite 550
Bedford, Texas 76021

Re: 500 Ft. Radial Water Well Search
Waco Site 50
Happy Swaner Lane
Limestone and McLennan Counties
Atlas Job #18-04-020

Mr. Lawrence:

Atlas Environmental Research has performed a water well search for the above referenced site using the records of the Texas Water Development Board (TWDB) and the Texas Commission on Environmental Quality (TCEQ). Included in this report you will find a complete well listing sorted by the different types of files in the state's water well system. You will also find a map delineating water wells within the area of review and copies of all available drillers logs.

Please do not hesitate to call me at (512) 339-4155 if you have any questions concerning this project or questions concerning Atlas' water well research protocol. Thank you for utilizing Atlas' research services to meet your environmental information needs. I look forward to being of service to you in the future.

Sincerely,

Scott Anderson
Research Consultant

Enclosures/SA/

ATLAS E. R., Inc.
8705 Shoal Creek Blvd., Suite 207 • Austin, Texas 78757
800.940.0977 • 512.339.4155 • FAX 512.339.4413

Atlas E.R. Water Well Search

Waco Site 50
Happy Swaner Lane
Limestone and McLennan Counties
Atlas Job #18-04-020

Atlas Environmental Research has located **0** water wells in the area of review.

Located Water Wells – 0

Plotted Water Wells – 0

Partially Numbered Water Wells – 0

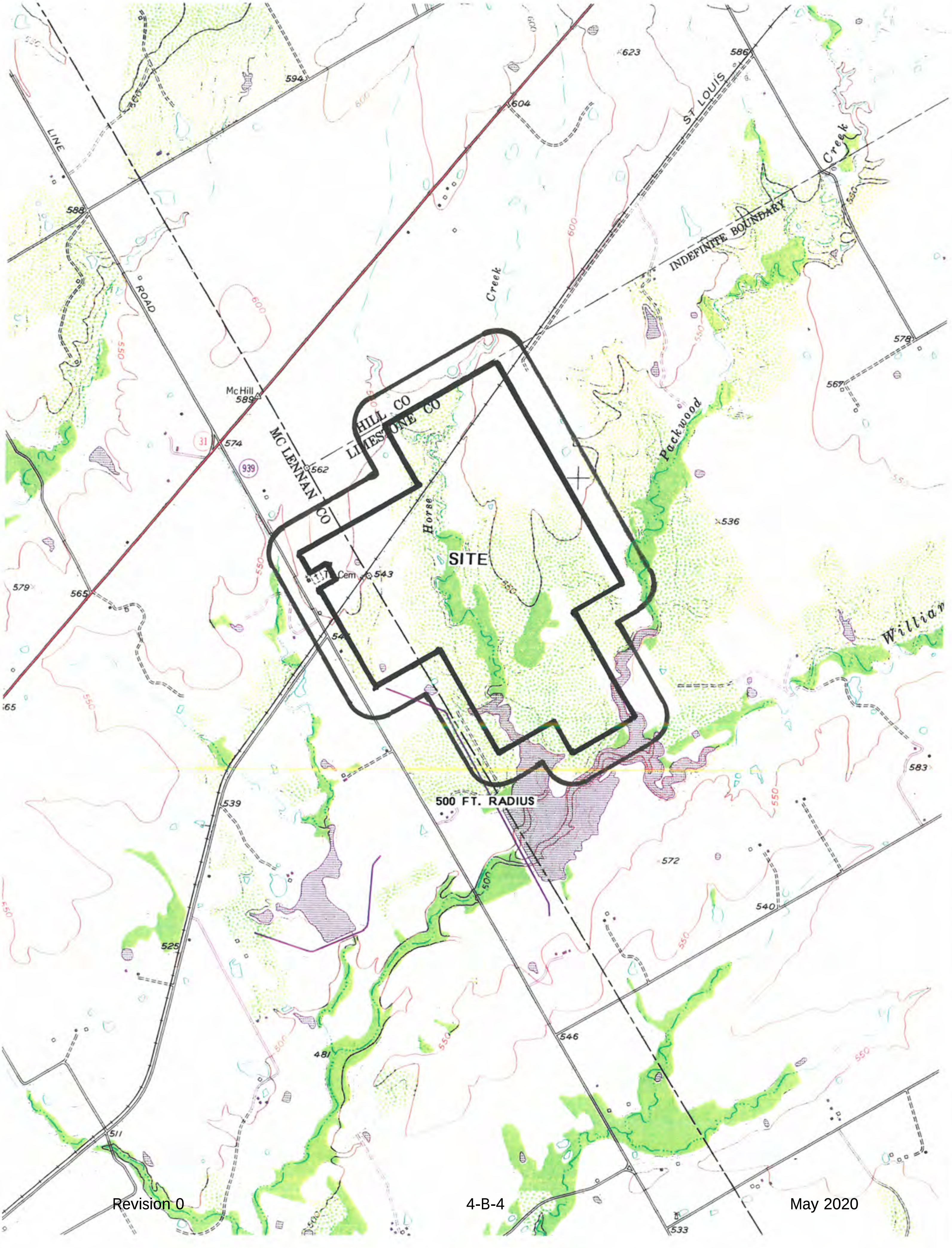
Unnumbered Water Wells – 0

Public Water Supply Wells – 0

These wells have been labeled on the attached map with the final portion of the state well number. This portion of the state well number has also been highlighted on the corresponding drillers log. The information for each USGS quadrangle utilized for the well location map is listed below.

Quadrangle	Date	Contours
Axtell, Texas	1956 (Photorevised 1978)	10 Feet

Quadrangle Scale: 1:24000; 1" = 2000'


SITE
500 FT. RADIUS
HILL CO
LIMESTONE CO
MC LENNAN CO
ST LOUIS
INDEFINITE BOUNDARY
Packwood
Creek
Horse
Creek
William
LINE
ROAD
Mc Hill
589
Cem
543
562
574
565
579
588
594
604
623
586
578
567
536
583
572
540
546
539
525
481
511
533

Assessment, Compliance and Permitting Support

May 1, 2018

James Lawrence, P.G.
SCS Engineers
1901 Central Drive, Suite 550
Bedford, Texas 76021

Re: One Mile Radial Water Well Search
Waco Site 50
Happy Swaner Lane
Limestone and McLennan Counties
Atlas Job #18-04-020

Mr. Lawrence:

Atlas Environmental Research has performed a water well search for the above referenced site using the records of the Texas Water Development Board (TWDB) and the Texas Commission on Environmental Quality (TCEQ). Included in this report you will find a complete well listing sorted by the different types of files in the state's water well system. You will also find a map delineating water wells within the area of review and copies of all available drillers logs.

Please do not hesitate to call me at (512) 339-4155 if you have any questions concerning this project or questions concerning Atlas' water well research protocol. Thank you for utilizing Atlas' research services to meet your environmental information needs. I look forward to being of service to you in the future.

Sincerely,

Scott Anderson

Scott Anderson
Research Consultant

Enclosures/SA/

ATLAS E. R., Inc.
8705 Shoal Creek Blvd., Suite 207 • Austin, Texas 78757
800.940.0977 • 512.339.4155 • FAX 512.339.4413

Atlas E.R. Water Well Search

Waco Site 50
Happy Swaner Lane
Limestone and McLennan Counties
Atlas Job #18-04-020

Atlas Environmental Research has located **2** water wells in the area of review.

Located Water Wells – 2
39-17-201
39-17-601

Plotted Water Wells – 0

Partially Numbered Water Wells – 0

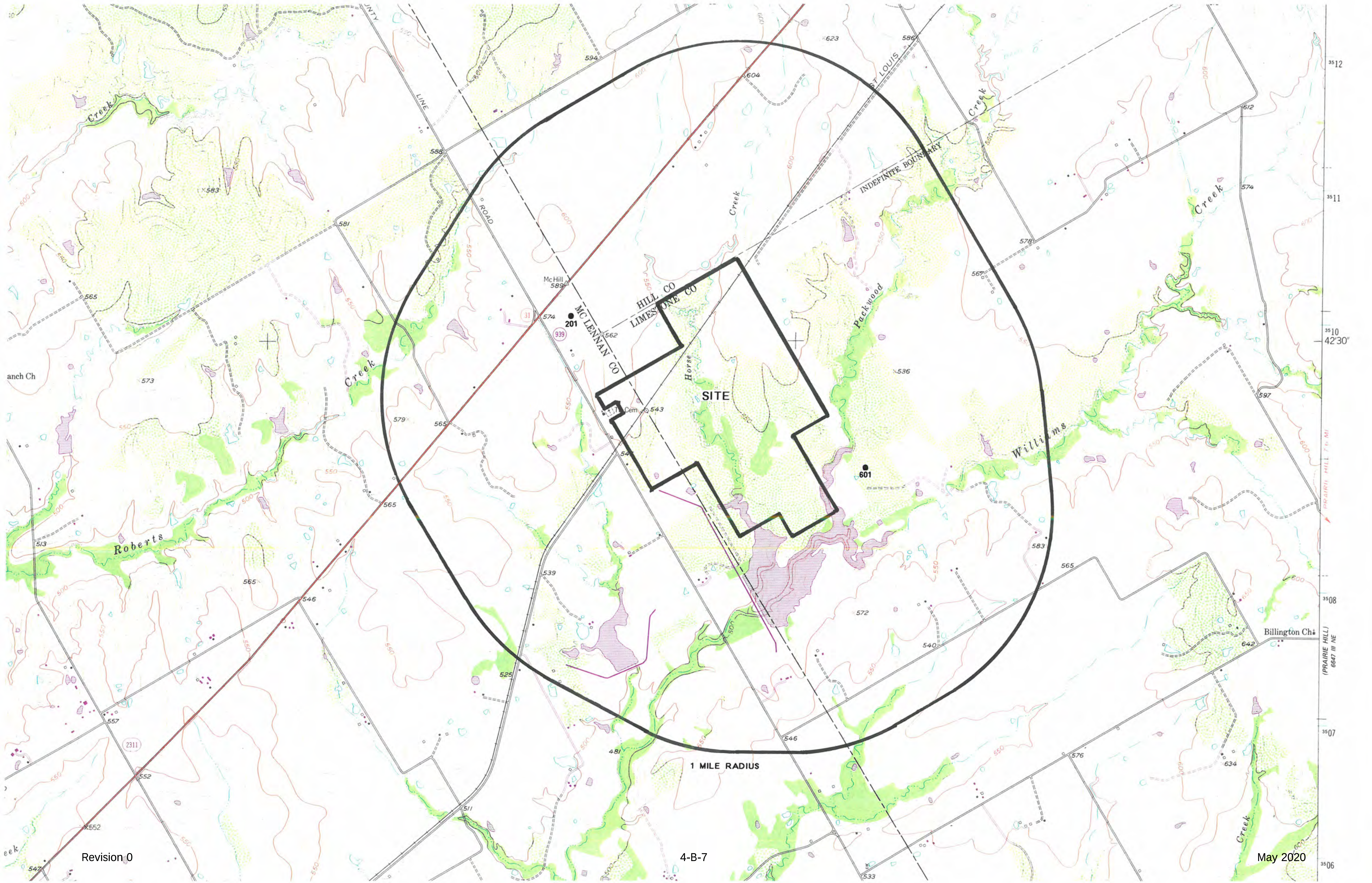
Unnumbered Water Wells – 0

Public Water Supply Wells – 0

These wells have been labeled on the attached map with the final portion of the state well number. This portion of the state well number has also been highlighted on the corresponding drillers log. The information for each USGS quadrangle utilized for the well location map is listed below.

Quadrangle	Date	Contours
Axtell, Texas	1956 (Photorevised 1978)	10 Feet

Quadrangle Scale: 1:24000; 1" = 2000'


SITE
1 MILE RADIUS
HILL CO
LIMESTONE CO
MC LENNAN CO
INDEFINITE BOUNDARY
Horse Creek
Packwood
Williams
Roberts Creek
Mc Hill
Billington Ch
201
601
(PRAIRIE HILL)
6647 III NE
42'30"

CROSS REFERENCE SHEET

Name or Subject CR-GWTD
McLENNAN

Located Well Data
ST 39-17-201

Date

Regarding Electric Log

SEE

Name or Subject GW-SC
ELECTRIC LOG FILE Q-29

TWDBS-M-3

Texas Water Development Board

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 39-17-201

groundwater division

GWDB Reports and Downloads | **Well Basic Details** | Scanned Documents

State Well Number	3917201
County	McLennan
River Basin	Brazos
Groundwater Management Area	8
Regional Water Planning Area	G - Brazos G
Groundwater Conservation District	Southern Trinity GCD
Latitude (decimal degrees)	31.709723
Latitude (degrees minutes seconds)	31° 42' 35" N
Longitude (decimal degrees)	-96.935278
Longitude (degrees minutes seconds)	096° 56' 07" W
Coordinate Source	+/- 1 Minute
Aquifer Code	NOT-APPL - Aquifer Code Is Not Applicable to this Well
Aquifer	Unassigned
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	560
Land Surface Elevation Method	Interpolated From Topo Map
Well Depth (feet below land surface)	2030
Well Depth Source	Another Government Agency
Drilling Start Date	
Drilling End Date	0/0/1951
Drilling Method	
Borehole Completion	

Well Type	Oil or Gas
Well Use	Unused
Water Level Observation	None
Water Quality Available	No
Pump	None
Pump Depth (feet below land surface)	
Power Type	
Annular Seal Method	
Surface Completion	
Owner	S. H. Riggs
Driller	Grindstaff No.1
Other Data Available	
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	
Previous State Well Number	
Reporting Agency	
Created Date	
Last Update Date	

Remarks	

Casing - No Data

Well Tests - No Data

Lithology - No Data

Annular Seal Range - No Data

Borehole - No Data

Plugged Back - No Data

Filter Pack - No Data

Packers - No Data

Water Level Measurements

No Data Available

Water Quality Analysis - No Data Available

GWDB DISCLAIMER: Except where noted, all of the information provided in the Texas Water Development Board (TWDB) Groundwater Database (http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp) is believed to be accurate and reliable; however, the TWDB assumes no responsibility for any errors appearing in rules or otherwise. Further, TWDB assumes no responsibility for the use of the information provided. PLEASE NOTE that users of these data are responsible for checking the accuracy, completeness, currency and/or suitability of all information themselves. TWDB makes no guarantees or warranties as to the accuracy, completeness, currency, or suitability of the information provided via the Groundwater Database (GWDB). TWDB specifically disclaims any and all liability for any claims or damages that may result from providing GWDB data or the information it contains. For additional information or answers to questions concerning the TWDB GWDB, contact the Groundwater Data Team at GroundwaterData@twdb.texas.gov.

CROSS REFERENCE SHEET

Name or Subject CR-GWTD LIMESTONE

Located Well Data
SD 39-17-601

Date

Regarding Electric Log

SEE

Name or Subject GW-SC ELECTRIC LOG FILE Q-143

TWDBS-M-3

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 39-17-601

GWDB Reports and Downloads | **Well Basic Details** | Scanned Documents

State Well Number	3917601
County	Limestone
River Basin	Brazos
Groundwater Management Area	8
Regional Water Planning Area	G - Brazos G
Groundwater Conservation District	
Latitude (decimal degrees)	31.700278
Latitude (degrees minutes seconds)	31° 42' 01" N
Longitude (decimal degrees)	-96.911389
Longitude (degrees minutes seconds)	096° 54' 41" W
Coordinate Source	+/- 1 Second
Aquifer Code	NOT-APPL - Aquifer Code Is Not Applicable to this Well
Aquifer	Unassigned
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	531
Land Surface Elevation Method	Interpolated From Topo Map
Well Depth (feet below land surface)	3187
Well Depth Source	Another Government Agency
Drilling Start Date	
Drilling End Date	0/0/1961
Drilling Method	
Borehole Completion	

Well Type	Oil or Gas
Well Use	
Water Level Observation	None
Water Quality Available	No
Pump	
Pump Depth (feet below land surface)	
Power Type	
Annular Seal Method	
Surface Completion	
Owner	Paul Collins No.1
Driller	Ralph Spence and Bill Hughes
Other Data Available	
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	
Previous State Well Number	
Reporting Agency	U.S. Geological Survey
Created Date	7/25/1996
Last Update Date	7/25/1996

Remarks	

Casing - No Data

Well Tests - No Data

Lithology - No Data

Annular Seal Range - No Data

Borehole - No Data ***Plugged Back - No Data***

Filter Pack - No Data ***Packers - No Data***

Water Level Measurements

No Data Available

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 39-17-601

Water Quality Analysis - No Data Available

ENVIRONMENTAL RESEARCH

ATLAS

Assessment, Compliance and Permitting Support

May 1, 2018

James Lawrence
SCS Engineers
1901 Central Drive, Suite 550
Bedford, Texas 76021

Re: Oil & Gas Well Search
Waco Site 50
Happy Swaner Lane
Limestone and McLennan Counties
Atlas Job #18-04-020

Mr. Lawrence:

Atlas Environmental Research has performed an oil & gas well search for the above referenced site using the records of the Texas Railroad Commission (TRC). The following is a well listing sorted by the status shown on the TRC's maps.

Producing Wells – 0 Locations

Plugged Wells – 3 Locations

Map ID: A
Map ID: B
Map ID: C

Canceled Permits – 0 Locations

Please call me at (512) 339-4155 if you have any questions concerning this project or questions concerning Atlas' oil & gas well research protocol. Thank you for utilizing Atlas' research services to meet your environmental information needs. I look forward to being of service to you in the future.

Sincerely,

Scott Anderson

Scott Anderson
Research Consultant

ATLAS E. R., Inc.
8705 Shoal Creek Blvd., Suite 207 • Austin, Texas 78757
800.940.0977 • 512.339.4155 • FAX 512.339.4413

B B B & C RR
A-149
A-95
109
J SINCLAIR
A-877
A-657
A-94
A-430
2B 30309
T N DUGGAN
A-1078
A-262
A-221
A-255
B M HUNTER
A
1A 3
30310 30312
B
B B B & C RR
1 80218
C SULLIVAN
A-508
A-162
C W LOVE
30580
A-320
J ALPERLADO
A-373
A-1062
A-151
C
T K
Cem
I H ROBERTS
W W BOREN
A-767
A-49
30589
A R VALDEZ
30756
A-54
W A SHELTON
A-1155
31°43'30"N
31°42'0"N
31°40'30"N

GIS Identify Results - Well Location Attributes

A

Number of identify results: 1

Result #1	
API	21730310
GIS WELL NUMBER	1A
GIS SYMBOL DESCRIPTION	Dry Hole
GIS LOCATION SOURCE	Commission`s hardcopy map
GIS LAT (NAD27)	31.720426
GIS LONG (NAD27)	-96.920970
GIS LAT (NAD83)	31.720589
GIS LONG (NAD83)	-96.921243

OPERATOR/WELLBORE	
WELLBORE STATUS	DRY
LAST PERMIT ISSUED	265676
LAST PERMIT OPERATOR NUMBER	089953
LAST PERMIT OPERATOR	BRAZOS PRODUCTION COMPANY INC.
LAST PERMIT LEASE NAME	HAWKINS, R. M. "A"
TOTAL DEPTH	0
SURFACE LOCATION	Land
ABSTRACT	373
SURVEY	B. M. HUNTER
BLOCK	
SECTION	
DISTANCE 1	5475
DIRECTION 1	NEL
DISTANCE 2	3475
DIRECTION 2	NWL
PLUGGING RECORD	
DATE PLUGGED	03/26/1985
PLUG DEPTH	769
PLUGGING OPERATOR	BRAZOS PROD. CO.
PLUGGED LEASE	HAWKINS

GIS Identify Results - Well Location Attributes

B

Number of identify results: 1

Result #1	
API	**21730312**
GIS WELL NUMBER	3
GIS SYMBOL DESCRIPTION	Dry Hole
GIS LOCATION SOURCE	Commission`s hardcopy map
GIS LAT (NAD27)	31.719254
GIS LONG (NAD27)	-96.921318
GIS LAT (NAD83)	31.719417
GIS LONG (NAD83)	-96.921592

OPERATOR/WELLBORE	
WELLBORE STATUS	DRY
LAST PERMIT ISSUED	271372
LAST PERMIT OPERATOR NUMBER	089953
LAST PERMIT OPERATOR	BRAZOS PRODUCTION COMPANY INC.
LAST PERMIT LEASE NAME	HAWKINS, R.M.
TOTAL DEPTH	0
SURFACE LOCATION	Land
ABSTRACT	373
SURVEY	B. M. HUNTER
BLOCK	
SECTION	
DISTANCE 1	3520
DIRECTION 1	NWL
DISTANCE 2	5475
DIRECTION 2	NEL
PLUGGING RECORD	
DATE PLUGGED	04/17/1985
PLUG DEPTH	575
PLUGGING OPERATOR	BRAZOS PROD. CO.
PLUGGED LEASE	HAWKINS

GIS Identify Results - Well Location Attributes

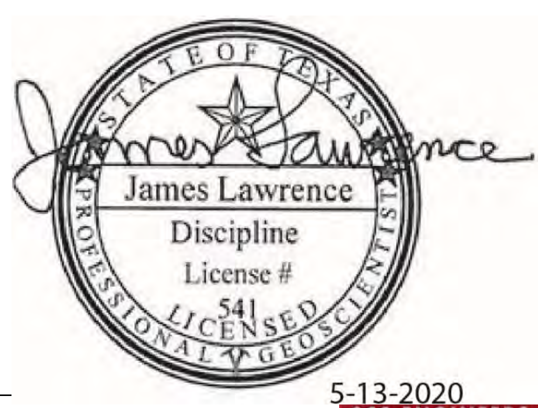
C

Number of identify results: 1

Result #1	
API	**293**
GIS WELL NUMBER	1
GIS SYMBOL DESCRIPTION	Dry Hole
GIS LOCATION SOURCE	Commission`s hardcopy map
GIS LAT (NAD27)	31.706381
GIS LONG (NAD27)	-96.912253
GIS LAT (NAD83)	31.706545
GIS LONG (NAD83)	-96.912525

APPENDIX III-4.C

SOIL BORING PLAN



5-13-2020

August 14, 2018 *Revised September 7, 2018 for minor hole relocations and one text revision*

SCS Project 16216088.00

Mr. Chance Goodin–Manager, Waste Permits Division
Texas Commission on Environmental Quality
12100 Park 35 Circle, MC-124
Building F
Austin, Texas 78753

Subject: Soil Boring Plan for a New Proposed Type I Municipal Solid Waste Landfill
McLennan and Limestone Counties, Texas

Dear Mr. Goodin:

SCS Engineers, on behalf of the City of Waco (The City), is herein submitting a Soil Boring Plan (SBP) for a new proposed Type I solid waste landfill (Landfill) in McLennan and Limestone Counties, Texas. As part of the permit application process for a new solid waste landfill, and as required in 30 TAC 330.63(e)(4), the following SBP is submitted for TCEQ review and approval. *This document has been revised from the August 14, 2018 original to incorporate minor changes in hole locations requested by TCEQ in a site meeting dated August 31, 2018. A text addition has also been made to reflect that a demonstration will be incorporated in the full permit application regarding constituent travel times addressed in 30 TAC 330.63(e)(4)(B).*

As described below, a total of 47 soil borings are proposed to characterize the 502.5-acre site for this permit application. Five of the soil borings are from a previous subsurface investigation at the site. Forty-two new soil borings are proposed. Piezometers will be installed to gather hydrogeologic data and sufficiently evaluate groundwater conditions on site.

PROPERTY LOCATION AND DESCRIPTION

The proposed Landfill property permitted area consists of approximately 502.5 acres. It is located about 16 miles northeast of the center of Waco, Texas on FM 939. (Figure 1).

REGIONAL GEOLOGY/HYDROGEOLOGY

Regional geology and stratigraphy is depicted in Table 1. Rocks exposed at the surface in McLennan and Limestone Counties generally consist of Taylor Group formations of Cretaceous marl, sand, and clay, as well as near-surface Tertiary/Quaternary sands, gravels and clay sediments deposited near and along stream channels (U.S. Department of Agriculture, *Soil Survey of McLennan County*, 1992; U.S. Department of Agriculture, *Soil Survey of Limestone County*, 1991).

The site location and detail are shown in Figures 1 and 2. The site topographic elevation ranges from about 570 feet msl (mean sea level) on the eastern side to about 540 feet msl on the western side. The site is directly underlain by the Wolfe City Formation. The Wolfe City Formation consists of Cretaceous period marl, sand, sandstone, and clay (Flawn, 1970). Surficial sediments above the Wolfe City consist of clayey and loamy alluvium, with some gravel observed in upland areas of the site. Table 1 shows stratigraphy in the site vicinity (Baker et al., 1990).

TABLE 1. Cretaceous Geologic and Hydrogeologic Units in McLennan County

System	Series	Group	Formation	Hydrogeologic Unit	Approximate Area Thickness (ft)
Site→ Cretaceous	Gulfian	Taylor	Pecan Gap Chalk	Not a named hydrogeologic unit	215
			Wolfe City	"	300
			Ozan	"	500-775
		Austin	Austin Chalk	"	30
		Eagle Ford	South Bosque Shale	"	120
			Lake Waco	"	75
		Woodbine	Pepper Shale	"	60
	Upper Comanche Series	Washita	Del Rio Clay	"	70-90
			Georgetown and Main Street Limestone	"	25-35
			Pawpaw and Weno Limestone	"	16-55
			Denton Clay, Fort Worth Limestone, and Duck Creek Limestone	"	53-76
		Fredericksburg	Edwards Limestone and Kiamichi Clay	"	20-77
			Comanche Peak Limestone	"	50-100
			Walnut Clay	"	125-175
	Lower Comanche Series	Trinity	Paluxy Sand	Upper Trinity Aquifer	<71
			Glen Rose	Middle Trinity Aquifer	200-375
			Travis Peak/Hensell Sand Member	Middle Trinity Aquifer	175
			Travis Peak/Pearsall Member	Middle Trinity Aquifer	85
			Travis Peak/Cow Creek Member	Middle Trinity Aquifer	130
			Travis Peak/Hammet Shale Member	Middle Trinity Aquifer	140
			Travis Peak/Sligo and Hosston Member	Lower Trinity Aquifer	1,680

PROPOSED SITE EXPLORATION

As previously mentioned, the proposed Landfill permit boundary encompasses approximately 502.5 acres. As described below, a total of 47 soil borings are proposed to characterize the site for this permit application. Five of the soil borings are from a previous subsurface investigation at the site. 42 new soil borings are proposed. Piezometers will be installed to gather hydrogeologic data and sufficiently evaluate groundwater conditions on site.

Table 2 lists the requirements for number of borings as listed in 30 TAC 330.63(e)(4)(B). For an area of 500 to 550 acres, 44 to 47 total soil borings are required, of which 22 to 24 must be 30 feet below the Elevation of Deepest Excavation (EDE) of 505 feet msl, the remaining borings must be five feet below the EDE of 505 feet msl.

Table 3 lists the number of borings at a depth of 5 or 30 feet below the EDE. Boring locations are shown in Figure 2. Tables 4 and 5 below tabulate the existing and proposed borings and depths below ground surface (bgs).

The proposed boring plan will meet the requirements of 30 TAC 330.63(e)(4)(B). Borings will allow identification of the uppermost water bearing zone, which based on existing site exploration is a shallow water table in the low-permeability Wolfe City sediments. This zone is the "uppermost monitorable water", i.e., it is the first occurrence of monitorable water beneath the Landfill footprint and is therefore the most appropriate horizon for monitoring the Landfill. The first perennial, State-designated aquifer below the site is the Trinity Aquifer, the upper boundary of which occurs at least 600 feet below the EDE (Baker et al., 1990). A test hole drilled to the first perennial aquifer beneath the site (i.e., the Trinity) will not be required because the depth to the aquifer is more than 300 feet below the EDE and it is estimated that the 600 feet of low-permeability sediments between the site and the Trinity Aquifer will for all practical purposes prevent migration to the Trinity Aquifer (this will be documented in the full permit application, see below). Note that 30 TAC 330.63(e)(4)(B) states (in part)

> *"Aquifers more than 300 feet below the lowest excavation and where the estimated travel times for constituents to the aquifer are in excess of 30 years plus the estimated life of the site need not be identified through borings."*

A demonstration will be prepared as a part of the permit application documenting that the "uppermost monitorable water" at the site is not hydraulically interconnected to the Trinity Aquifer due to a minimum of 600 feet of low-permeability sediments that exist between the base of the proposed Landfill and the Trinity Aquifer.

Figure 2 illustrates existing and proposed soil boring locations, which are tabulated in Tables 3, 4, and 5 below. All proposed drilling locations are subject to feasibility of drilling at that location, as controlled by areas of steep site topography, dense vegetation, or muddy conditions. If the location of a proposed soil boring deviates by more than 200 feet from the proposed location, TCEQ concurrence will be sought through a letter requesting a modification to the SBP.

Proposed new soil borings, listed in Table 5, will be continuously sampled from the ground surface to an elevation that meets the requirement of being 5 or 30 feet below EDE. Upon completion to total depth, water level depth will be checked prior to grouting from total depth to the ground surface. Any piezometer installation, abandonment, and plugging will be performed in accordance with 30 TAC §330.63(e)(4)(D), including applicable rules in Title 16 TAC Chapter 76, §76.72 and §76.104.

TABLE 2. TCEQ Regulatory Requirements (30 TAC 330.63(e)(4)(B))

Size of Area in Acres	Number of Borings	Min. No. of Borings 30 Feet below the Elev. of Deepest Excavation
5 or less	2-4	2
5-10	4-6	3
10-20	6-10	5
20-50	10-15	7
50-100	15-20	7-12
100-150	20-23	12-13
150-200	23-26	13-15
200-250	26-29	15-16
250-300	29-32	16-17
300-350	32-35	17-18
350-400	35-38	18-20
400-450	38-42	20-21
450-500	42-44	21-22
500-550	**44-47**	**22-24**
550-600	47-50	24-26
More than 600	Determined in consultation with the executive director	

TABLE 3. Soil Borings Summary

	Number of Borings 5 feet Below EDE	Number of Borings 30 feet Below EDE	Total Number of Borings
Existing Borings	2	3	5
Proposed Borings	21	21	42
Total	**23**	**24**	**47**

TABLE 4. Tabulation of Existing Soil Borings (See Figure 2)
EDE = 505 feet msl

Boring Number	Surface Elevation (ft msl)	Depth bgs (feet)	Bottom Elevation (ft msl)	Longitude	Latitude	5 Feet Below EDE	30 Feet Below EDE
B-1 (A-1)	551.7	82	469.7	96°55'59.14" W	31°42'16.87" N	No	Yes
B-2 (A-2)	549.8	55	494.8	96°55'51.13" W	31°42'04.71" N	Yes	No
B-3 (A-3)	541.1	72	469.1	96°55'43.82" W	31°41'54.30" N	No	Yes
B-4 (A-4)	550.0	101	449.0	96°55'44.66" W	31°42'12.76" N	No	Yes
B-5 (A-5)	541.4	47.75	493.6	96°55'35.17" W	31°42'24.40" N	Yes	No

Note – (A-1) reflects existing borehole

TABLE 5. Tabulation of Proposed Soil Borings (See Figure 2)
EDE = 505 feet msl

Boring Number	Surface Elevation (ft msl)	Depth bgs (feet)	Bottom Elevation (ft msl)	Longitude	Latitude	5 Feet Below EDE ?	30 Feet Below EDE ?
B-6	546.2	71.2	475	96°55'38.76" W	31° 42' 37.50" N	Yes	Yes
B-7	522.0	47.0	475	96°55'26.69" W	31° 42' 16.27" N	No	Yes
B-8	550.0	75.0	475	96°55'12.21" W	31° 42' 11.53" N	No	Yes
B-9	536.7	36.7	500	96°55'37.42" W	31° 42' 10.46" N	Yes	No
B-10	542.0	42.0	500	96°55'31.27" W	31° 42' 40.89" N	Yes	No
B-11	553.5	78.5	475	96°55'21.26" W	31° 42' 45.87" N	Yes	Yes
B-12	542.2	42.2	500	96°55'35.80" W	31° 42' 32.80" N	Yes	No
B-13	550.3	75.3	475	96°55'13.74" W	31° 42' 23.02" N	No	Yes
B-14	540.0	65.0	475	96°55'27.42" W	31° 42' 36.95" N	No	Yes
B-15	565.0	65	500	96°55'18.91" W	31° 42' 41.23" N	Yes	No
B-16	557.7	57.7	500	96°55'49.40" W	31° 42' 17.53" N	Yes	No
B-17	542.5	67.5	475	96°55'44.44" W	31° 42' 22.90" N	No	Yes
B-18	532.3	57.3	475	96°55'27.00" W	31° 42' 28.96" N	No	Yes
B-19	560.1	85.1	475	96°55'21.32" W	31° 42' 31.48" N	No	Yes
B-20	567.4	67.4	500	96°55'14.49" W	31° 42' 34.93" N	Yes	No
B-21	538.8	38.8	500	96°55'21.94" W	31° 42' 22.76" N	Yes	No
B-22	558.7	83.7	475	96°55'9.32" W	31° 42' 28.73" N	No	Yes
B-23	540.1	40.1	500	96°55'44.15" W	31° 42' 01.89" N	Yes	No
B-24	533.6	58.6	475	96°55'37.79" W	31° 42' 05.18" N	No	Yes
B-25	530.4	30.4	500	96°55'31.84"W	31° 42' 08.22" N	Yes	No
B-26	528.1	28.1	500	96°55'20.63"W	31° 42' 10.29" N	Yes	No

TABLE 5. Tabulation of Proposed Soil Borings (See Figure 2) (Continued)
EDE = 505 feet msl

Boring Number	Surface Elevation (ft msl)	Depth bgs (feet)	Bottom Elevation (ft msl)	Longitude	Latitude	5 Feet Below EDE ?	30 Feet Below EDE ?
B-27	549.8	49.8	500	96°55'7.56" W	31° 42' 20.70" N	Yes	No
B-28	530.0	55.0	475	96°55'25.77" W	31° 41' 59.98" N	No	Yes
B-29	540.9	40.9	500	96°55'5.45" W	31° 42' 10.40" N	Yes	No
B-30	543.8	43.8	500	96°55'13.67" W	31° 42' 05.60" N	Yes	No
B-31	535.8	60.8	475	96°55'36.34" W	31° 42' 16.20" N	No	Yes
B-32	524.0	24.0	500	96°55'22.49" W	31° 41' 52.18" N	Yes	No
B-33	540.1	40.1	500	96°55'14.49" W	31° 42' 00.02" N	Yes	No
B-34	538.8	38.8	500	96°55'7.47" W	31° 42' 04.37" N	Yes	No
B-35	550.1	50.1	500	96°55'14.95" W	31° 42' 17.03" N	Yes	No
B-36	520.1	45.1	475	96°55'21.25" W	31° 41' 44.45" N	No	Yes
B-37	525.7	50.7	475	96°55'9.75" W	31° 41' 54.45" N	No	Yes
B-38	530.6	55.6	475	96°55'2.11" W	31° 41' 58.73" N	No	Yes
B-39	520.1	45.1	475	96°55'4.12" W	31° 41' 47.19" N	No	Yes
B-40	520.0	20.0	500	96°54'55.18" W	31° 41' 49.01" N	Yes	No
B-41	534.6	59.6	475	96°54'58.94" W	31° 42' 10.80" N	No	Yes
B-42	522.3	22.3	500	96°55'2.27" W	31° 41' 52.71" N	Yes	No
B-43	523.6	48.6	475	96°55'01.00" W	31° 42' 20.59" N	No	Yes
B-44	551.2	76.2	475	96°55'51.63" W	31° 42' 08.74" N	Yes	Yes
B-45	547.7	47.7	500	96°55'24.97" W	31° 42' 32.26" N	Yes	No
B-46	560.1	60.1	500	96°55'14.42" W	31° 42' 29.45" N	Yes	No
B-47	530.1	55.1	475	96°55'28.39" W	31° 42' 04.16" N	No	Yes

B – indicates borehole location

TABLE 6. Proposed Boring Coordinates (See Figure 2)

Boring Number	Northing	Easting
B-1 (A-1)	10599904.81	3353867.3
B-2 (A-2)	10598697.55	3354595.81
B-3 (A-3)	10597665.32	3355259.69
B-4 (A-4)	10599528.02	3355130.33
B-5 (A-5)	10600728.27	3355913.87
B-6	10602041.85	3355562.957
B-7	10599929.57	3356670.828
B-8	10599489.18	3357935.817
B-9	10599314.37	3355762.305
B-10	10602404.05	3356199.158
B-11	10602933.53	3357047.997
B-12	10601574.98	3355833.068
B-13	10600645.61	3357768.091
B-14	10602016.3	3356543.767
B-15	10602471.11	3357265.269
B-16	10599996.76	3354706.007
B-17	10600519.55	3355568.959
B-18	10601210.43	3356604.769
B-19	10601479.99	3357087.392
B-20	10601846.53	3357666.418
B-21	10600597.63	3357060.87
B-22	10601234.03	3358132.028
B-23	10598431.01	3355207.682
B-24	10598780.11	3355746.691
B-25	10599102.89	3356251.059
B-26	10599457.29	3356929.036
B-27	10600427.67	3358308.895
B-28	10598286.72	3356800.71
B-29	10599392.97	3358523.03
B-30	10598886.39	3357828.13
B-31	10599896.96	3355837.802
B-32	10597864.54	3357077.273
B-33	10598320.64	3357774.619
B-34	10598778.59	3358367.308
B-35	10600037.42	3357682.178

TABLE 6. Proposed Boring Coordinates (See Figure 2) (Continued)

Boring Number	Northing	Easting
B-36	10596730.18	3357239. 121
B-37	10597770.64	3358201.19
B-38	10598223.17	3358847.638
B-39	10597052.31	3358709.871
B-40	10597259.85	3359476.221
B-41	10599450.64	3359083.912
B-42	10597484.34	3358523.734
B-43	10597783.63	3359150.691
B-44	10599103.09	3354540.616
B-45	10601549.1	3356769.826
B-46	10601293.23	3357689.447
B-47	10598701.96	3356561.531

CONCLUSION

We believe the existing site soil borings used in combination with the additional soil borings and piezometers will sufficiently characterize the site geology, hydrogeology, and engineering properties of the surface and subsurface strata at the site in accordance with 30 TAC 330.63(e)(4) and (5).

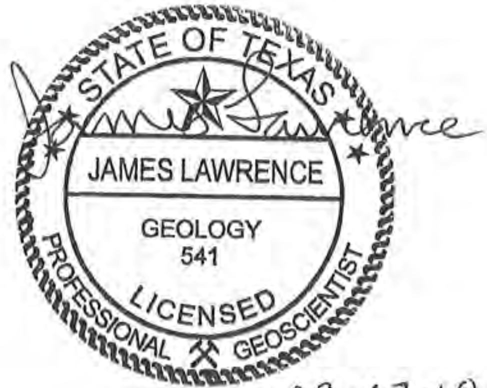
Please contact Jim Lawrence at (817) 358-6106 if you have comments or require additional information.

Sincerely,

James Lawrence

James Lawrence, P.G.
Manager, Groundwater Services
SCS ENGINEERS
TBPE Registration No. F-3407

Ryan Kuntz, P.E.
Project Director
SCS ENGINEERS



09-07-18

Attachments: Figure 1: Area Map
Figure 2: Soil Boring Plan

cc: Charles Dowdell, City of Waco
TCEQ Regional Office 9
Kevin D. Yard, P.E., BCEE

REFERENCES

Baker B., Duffin, G., Flores, R., and Lynch, T, *Evaluation of Water Resources in Part of Central Texas*,Texas Water Development Board Report 319, 1990.

Flawn, P. *Geologic Atlas of Texas—Waco Sheet.* Bureau of Economic Geology, The University of Texas at Austin. 1970.

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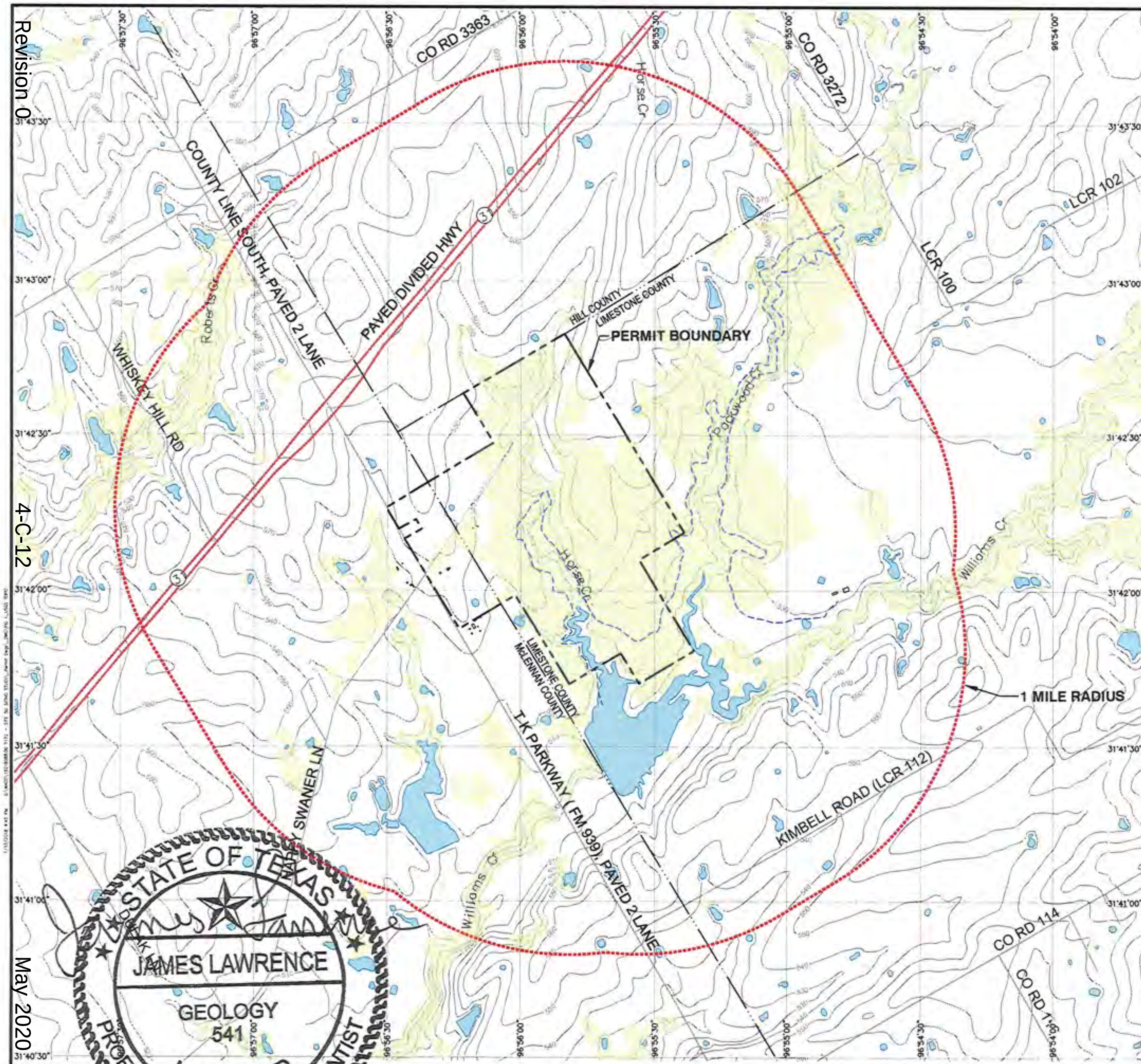
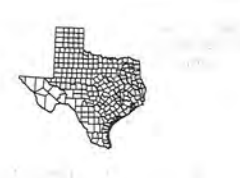
U.S. Department of Agriculture, *Soil Survey of McLennan County*, 1992





LEGEND

- PERMIT BOUNDARY
- 1 MILE RADIUS
- COUNTY LINE
- EXISTING CONTOURS (SEE NOTE 1)
- FLOOD PLAIN (SEE NOTE 2)
- 96°55'30" LATITUDE/LONGITUDE LINES

ROAD CLASSIFICATION

- Expressway
- Secondary Hwy
- Ramp
- Interstate Route
- Local Connector
- Local Road
- 4WD
- US Route
- State Route

WIND ROSE

CALM 2.81%
WIND ROSE REPRESENTS AVERAGE PERCENT OF TIME WIND BLOWS FROM EACH OF THE 16 COMPASS POINTS SHOWN.

SOURCE:
TNRCC-EPA
STATION TX03927
AVERAGE VALUES
PERIOD ANALYZED: 1984–1992

NOTE:

1. CONTOURS SHOWN ARE FROM THE 24K QUAD MAP FOR AXTELL, TEXAS (2016) PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. ALL KNOWN STRUCTURES AND INHABITABLE BUILDINGS WITHIN 500 FEET OF PERMIT BOUNDARY ARE SHOWN.

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

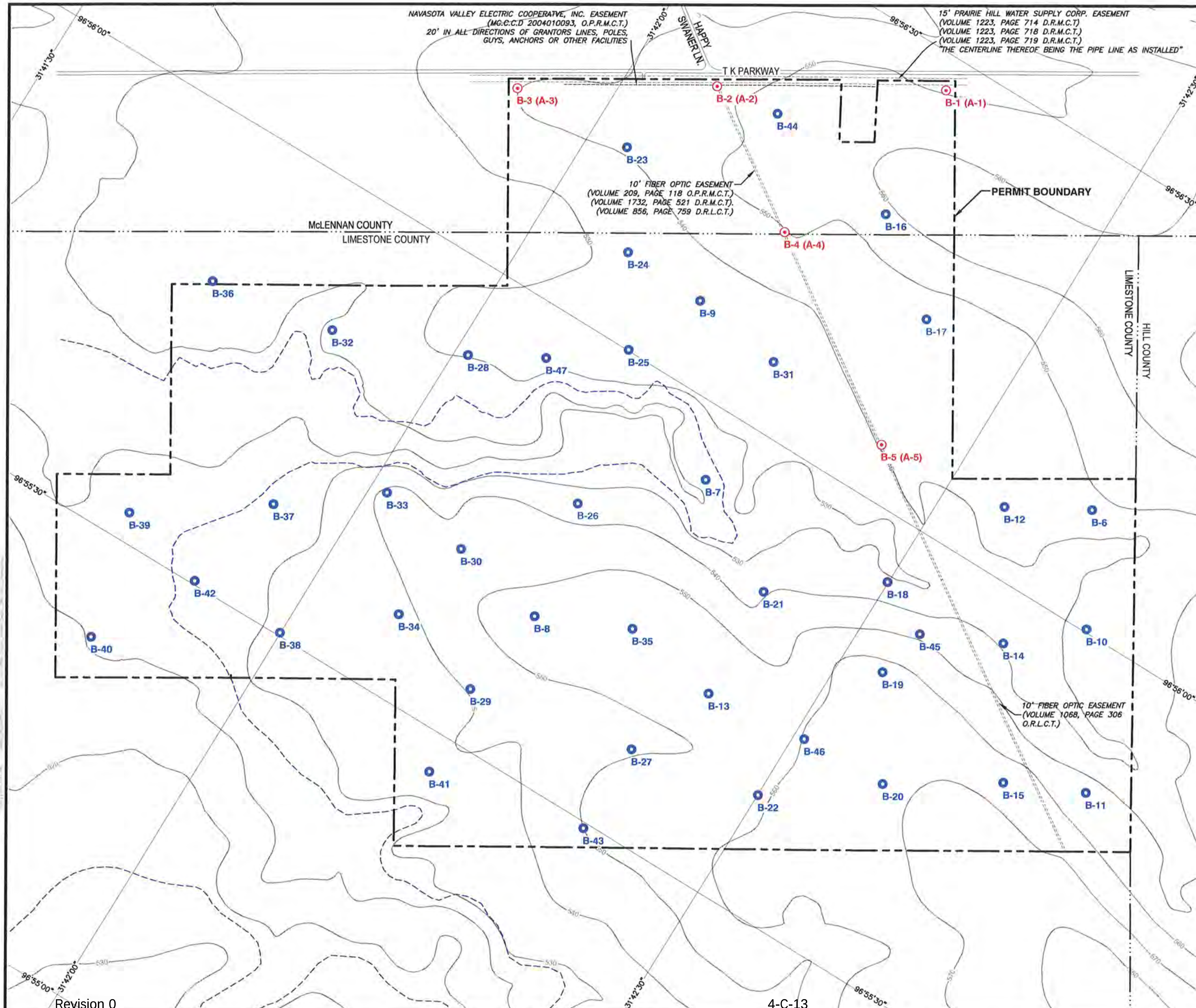
DRAWING TITLE: GENERAL TOPOGRAPHIC MAP
PROJECT TITLE: SITE 50
CLIENT: CITY OF WACO, 501 SHROEDER, WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

CADD FILE:
DATE: 05/2018
SCALE: AS SHOWN
FIGURE: 1

STATE OF TEXAS
JAMES LAWRENCE
GEOLOGY
541
LICENSED
PROFESSIONAL GEOSCIENTIST

09-07-18



0 300 600
SCALE IN FEET

LEGEND

- EXISTING CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- COUNTY LINE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 96°55'30" LATITUDE/LONGITUDE LINES
- B-5 EXISTING BORING LOCATION
- B-44 PROPOSED BORING LOCATION

NOTE:

1. CONTOURS SHOWN ARE FROM THE 24K QUAD MAP FOR AXTELL, TEXAS (2016) PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11.
3. A FLOWAGE EASEMENT EXISTS ON THE PROPERTY THAT IS UNDER THE JURISDICTION OF THE TECHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER (1) OF LEROY, TEXAS SUBJECT TO THE EASEMENT RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.

STATE OF TEXAS
James Lawrence
Discipline
License # 541
PROFESSIONAL GEOSCIENTIST
LICENSED

James Lawrence 8/14/18
Rev 9/7/18

FOR PERMITTING PURPOSES ONLY

DRAWING TITLE: BORING LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
501 SHROEDER
WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

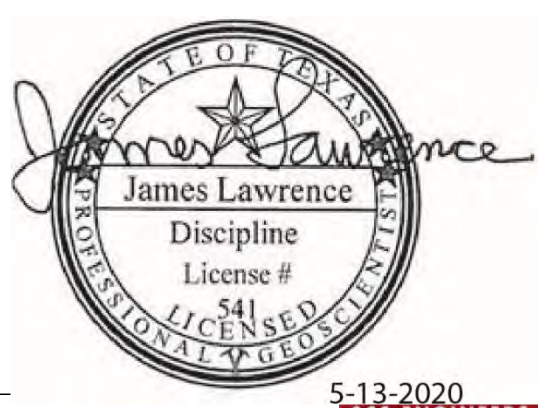
REV	DATE	DESCRIPTION	BY
△			
△			
△			
△			
△			
△			

PROJ. NO. 16216088.00
DSN. BY: JXL
DWN. BY: JLJ
CHK. BY: RRK
Q/A RVW BY: RRK
APP. BY: JXL

CADD FILE: FIG 2_BORING MAP
DATE: 08/2018
SCALE: AS SHOWN
FIGURE: 2

APPENDIX III-4.D

BORING LOGS



5-13-2020

SCS ENGINEERS

SCS Engineers
1901 Central Dr
Ste. 550
Bedford, TX 76021

PROJECT SYMBOL LEGEND

CLIENT City of Waco

PROJECT NAME City of Waco Landfill

PROJECT NUMBER 16216088.00

MSW-2400 **PROJECT LOCATION** Axtell, Texas

MATERIAL GRAPHICS

- CH: USCS High Plasticity Clay
- CL: USCS Low Plasticity Clay
- CL-ML: USCS Low Plasticity Silty Clay
- CLS: USCS Low Plasticity Sandy Clay
- FILL: Fill (made ground)
- GW-GM: USCS Well-graded Gravel with Silt
- LIMESTONE: Limestone
- MH: USCS Elastic Silt
- ML: USCS Silt
- NO CORE
- SC: USCS Clayey Sand
- SHALE: Shale
- SP: USCS Poorly-graded Sand
- SP-SC: USCS Poorly-graded Sand with Clay
- TOPSOIL: Topsoil

Sample Type

- SPT: Standard Penetration Test
- ST: Shelby Tube

NOTE: If no symbol for sample type is shown:
Sample Type = NXCB

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-1 (A-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/25/18 **COMPLETED** 1/26/18
GROUND ELEVATION 551.67 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elevation
0	ST1	75	PP = 3.5 tsf 0-16 feet logged from previous drilling in January 2018	SC	(SC) (From previous log drilled 1/25/2018)	2.0 / 549.7
	ST2	50	PP = 4.5+ tsf	CH	(CH) Clay, dark brown, hard, moist, calcareous Pebbles 2-4 ft	
5	ST3	50	PP = 4.5+ tsf		Color change to light brown at 6 ft	
	ST4	75	PP = 4.5+ tsf			
	ST5	80	PP = 4.5+ tsf		Color change to brown-grey at 8 ft	
10	ST6	85	PP = 4.5+ tsf MC = 31% LL = 83 PI = 58		Color change to reddish brown at 10 ft	12.0 / 539.7
	ST7	95	PP = 4.5+ tsf	CH	(CH) Clay, reddish brown, with gray sand, soft, moist	
15	ST8	95	PP = 4.5+ tsf MC = 30% LL = 89 PI = 63			16.0 / 535.7
	ST9	80	PP = 4.5+ tsf	CH	(CH) Clay, grey to brown, with silty sand lenses, hard, moist Fossil fragments 16-18 ft	
20	ST10	90	PP = 4.5+ tsf MC = 22% LL = 79 PI = 56			20.0 / 531.7
	ST11	50	PP = 4.5+ tsf	SC	(SC) Clayey sand, grey to dark grey, clay is reddish brown, soft, slightly saturated Quartz and calcite pebbles throughout	
	ST12	70	PP = 4.5+ tsf			24.0 / 527.7
25	ST13	80	PP = 4.5+ tsf	CH	(CH) Clay, mottled red/grey/brown, with sand lenses, hard, moist Sand lenses are saturated Calcite and quartz pebbles throughout	26.0 / 525.7
	ST14	70	PP = 4.5+ tsf	CH	(CH) Clay, reddish brown, with grey sand, soft, saturated	28.0 / 523.7
30	ST15	50	PP = 4.5+ tsf		Calcite and quartz throughout Unweathered shale begins at 28 ft Weathered / Unweathered	
		100	MC = 14% LL = 66 PI = 43		Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous Fossil fragments throughout Silty sand lenses throughout	
35						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 4/25/19 14:33 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

(Continued Next Page)

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-1 (A-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		100				Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous Fossil fragments throughout Silty sand lenses throughout *(continued)*
40		98	MC = 14% LL = 73 PI = 52			
45		35				
50		94				
55		81				
60		85	MC = 18% LL = 72 PI = 52			
65		100				
70		92				
75						

(Continued Next Page)

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

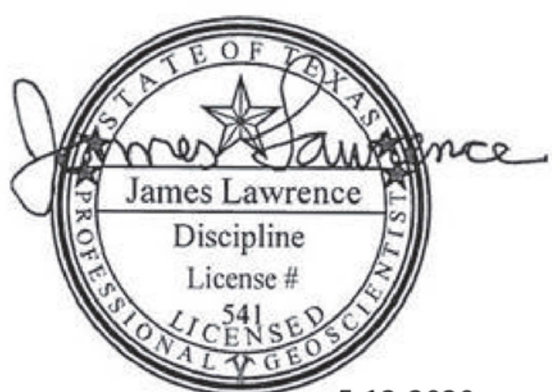
BORING NUMBER B-1 (A-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75		27				Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous Fossil fragments throughout Silty sand lenses throughout *(continued)*
80		100			82.0	469.7

Bottom of borehole at 82.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 4/25/19 14:33 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ



5-13-2020

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-1 (PZ-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/4/18 **COMPLETED** 10/4/18
GROUND ELEVATION 551.7 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 21.38 ft / Elev 530.32 ft

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						Silty Clay, dark brown, slightly moist to moist, soft	
2.0				CL-ML		(CL-ML) Silty Clay, red/orange to brown, slightly moist to moist, firm to stiff, with orange staining in joints (549.7)	
15.0		12	MC = 23% LL = 75 PI = 53 Fines = 93%			Silty Clay Shale, orange-brown mottled brown, slightly moist, stiff, non-calcareous, very weathered (536.7)	
20		90				Color change to orange-brown mottled tan to light gray and calcareous at 20 feet	
25		32	Weathered to Unweathered zone				
28.0						Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered (523.7) Slight orange staining in joints 30-39 feet.	
30		60					
35							

(Continued Next Page)

-
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-1 (PZ-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35		107	MC = 19% LL = 69 PI = 45 Fines = 97%		39.3	Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered Slight orange staining in joints 30-39 feet. *(continued)*	512.4

Bottom of borehole at 39.0 feet.

STATE OF TEXAS
James Lawrence
Discipline
License #
541
LICENSED
PROFESSIONAL GEOSCIENTIST

James Lawrence

5-13-2020

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-2 (A-2)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/22/18 **COMPLETED** 1/23/18
GROUND ELEVATION 549.78 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No water
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No water
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0	ST1	100		PP = 0 tsf	SC		(SC) Topsoil, dark brown, soft, dry	
2.0							No Recovery	547.8
4.0								545.8
5	SPT1	100	4-5-7 (12)		GW-GM		(GW-GM) Gravel, with dark brown silt, loose, moist	
5.5							2 inch limestone layer at 5.5 feet	544.3
	SPT2	100	6-8-11 (19)		CH		(CH) Clay, dark gray, hard, moist, calcareous	
	ST2	100		PP = 4.5+ tsf			Color change to mottled gray/brown at 6 feet	
10	ST3	100		PP = 4.5+ tsf MC = 20% LL = 71 PI = 51			Color change to brown at 8 feet Limestone pebbles 8-12 ft	
12.0	ST4	100		PP = 4.5+ tsf	CH		(CH) Clay, brown, with fine sand, hard, moist Color change to reddish brown at 14 feet	537.8
15	ST5	100		PP = 4.5+ tsf				
	ST6	100		PP = 4.5+ tsf MC = 18% LL = 69 PI = 48			Color change to brown at 16 feet Limestone pebbles 16-18 feet	
20	ST7	100		PP = 4.5+ tsf				
	ST8	100		PP = 4.5+ tsf				
22.0	ST9	100		PP = 4.5+ tsf	CH		(CH) Sandy Clay, brown/grey, hard, moist, calcareous	527.8
25	ST10	100		PP = 4.5+ tsf			Calcite and quartz throughout 24-26 ft	
	ST11	100		PP = 4.5+ tsf				
30	ST12	100		PP = 4.5+ tsf				
	ST13	100		PP = 4.5+ tsf MC = 21% LL = 74 PI = 52			Color change to brown at 32 feet	
35	ST14	100		PP = 4.5+ tsf				

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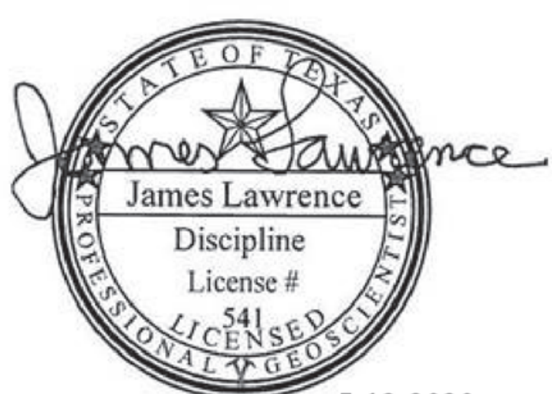
BORING NUMBER B-2 (A-2)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
35	ST15	100		PP = 4.5+ tsf	CH		Color change to dark brown at 36 feet Shale pieces throughout 36-38 feet	
	ST16	100		PP = 4.5+ tsf				
							38.0	511.8
	ST17	188		PP = 4.5+ tsf			Shale, dark grey, with limestone lenses throughout, hard, calcareous	
40		90						
45		100		MC = 13% LL = 56 PI = 36				
50		100						
55							55.0	494.8

Bottom of borehole at 55.0 feet.



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SCS ENGINEERS
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Telephone: 817-571-2288

BORING NUMBER B-3 (A-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/31/18 **COMPLETED** 1/31/18
GROUND ELEVATION 541.1 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0	ST1	50	PP = 4.5+ tsf		Topsoil
				2.0	539.1
	ST2	100	PP = 4.5+ tsf		Clay, brown/redbrown, with chalk layers, moist, hard Pebbles 2-4 ft
5	ST3	80	PP = 4.5+ tsf		
	ST4	90	PP = 4.5+ tsf		
				8.0	533.1
	ST5	100	PP = 4.5+ tsf		Clay, mottled red/gray/brown, with saturated fine sand layers, hard, moist Increasing hardness with depth
10	ST6	90	PP = 4.5+ tsf		
	ST7	100	PP = 4.5+ tsf		
15	ST8	100	PP = 4.5+ tsf		
	ST9	100	PP = 4.5+ tsf		
	ST10	80	PP = 4.5+ tsf		
20	ST11	100	PP = 4.5+ tsf		
	ST12	70	PP = 4.5+ tsf		
25					
	ST13	90	PP = 4.5+ tsf		Mineral deposits at 26 ft
	ST14	100	PP = 4.5+ tsf		
30	ST15	100	PP = 4.5+ tsf		Shale pieces at 30 ft
				32.0	Weathered 509.1
	ST16	100	PP = 4.5+ tsf		Sand, brown/gray, with minor clay and mineral deposit layers, saturated, soft
				34.0	507.1
35					No Recovery

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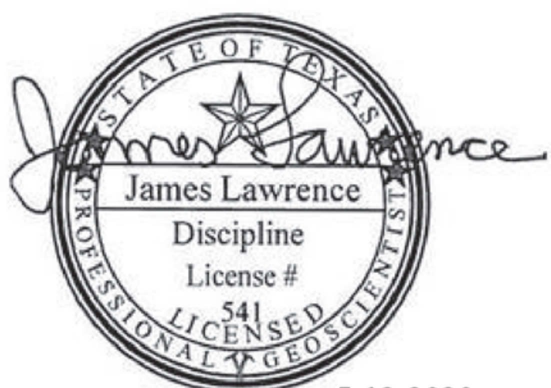
BORING NUMBER B-3 (A-3)

CLIENT City of Waco | **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 | **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
35					No Recovery *(continued)*
38.0					503.1
40	ST17	100	PP = 4.5+ tsf Weathered to unweathered zone		Shale, dark gray to black, hard, dry, calcareous, with limestone and fine sand layers up to 1/8" thick — Unweathered
		98			Very little sand 40-45 feet
45					Limestone layer 1/2 thick at 45 feet
		97			
50		100			
55		100			
60		98			
65					More sand layers 1/8" thick throughout at 65 feet
		98			
70					Fossil fragments 70-72 feet.
		100			
72.0					469.1

Bottom of borehole at 72.0 feet.



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WELL NUMBER B-3 (PZ-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 541.1 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						Blind Drill	
20.0		52		SP-SC		(SP-SC) Sand, brown, soft, moist to wet, with traces of clay, fine to medium grained (521.1)	
22.6						Silty Clay, dark brown, hard to stiff, moist (518.5)	
22.8				CL		(CL) Silty Clay, orange-brown mottled brown, hard, slightly moist, calcareous, with weathered shale (518.3)	
25		78	MC = 18% LL = 60 PI = 36 Fines = 93%				
27.0						Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered (514.1)	
30		74					
35						No mineral deposits 35-39 feet	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

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WELL NUMBER B-3 (PZ-3)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35		56	Weathered to Unweathered zone			Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered No mineral deposits 35-39 feet *(continued)*	
39.0						502.1	
40		70	MC = 16% LL = 63 PI = 43 Fines = 96%			Silty Clay Shale, dark gray, very hard, slightly moist to dry, calcareous, unweathered	
45.0						496.1	

Bottom of borehole at 45.0 feet.

STATE OF TEXAS
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5-13-2020

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/23/18 **COMPLETED** 1/23/18
GROUND ELEVATION 550.04 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING 48.77 ft / Elev 501.27 ft
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING 96.59 ft / Elev 453.45 ft
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elev.
0	ST1	75		PP = 0 tsf	SC	(SC) Topsoil/Fill material	2.0 / 548.0
	SPT1	75	2-3-5 (8)			Topsoil/Fill material, with dakr brown clay, soft, moist	4.0 / 546.0
5	ST2	50		PP = 4.5+ tsf	CH	(CH) Clay, dark brown, hard, moist, calcareous	
	ST3	75		PP = 4.5+ tsf		Color change to light brown at 8 feet	
	ST4	50		PP = 4.5+ tsf		Pebbles throughout 8-10 ft	
10	ST5	50		PP = 4.5+ tsf MC = 21% LL = 75 PI = 51			
	ST6	70		PP = 4.5+ tsf			
15	ST7	60		PP = 4.5+ tsf			
	ST8	80		PP = 4.5+ tsf		Color change to mottled brown/grey at 16 feet	
	ST9	75		PP = 4.5+ tsf		Sand lenses throughout 18-20 feet	
20	ST10	80		PP = 4.5+ tsf			
	ST11	80		PP = 4.5+ tsf MC = 21% LL = 74 PI = 53			
25	ST12	80		PP = 4.5+ tsf			
	ST13	80		PP = 4.5+ tsf			28.0 / 522.0
	ST14	50		PP = 4.5+ tsf Weathered to unweathered zone		Clayey shale, dark grey, fissile, calcareous	30.0 / 520.0
30	ST15	100		PP = 4.5+ tsf		Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout	
35		85		MC = 13% LL = 55 PI = 37			

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout *(continued)*
40		98					
45		98					
50		98		MC = 13% LL = 62 PI = 44			∇
55		98					
60		98					
65		97					
70		98					
75		98					

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout *(continued)*
80		100					
85		98					
90		99		MC = 14% LL = 74 PI = 53			
95		100					▼
100		99					101.0 449.0

Bottom of borehole at 101.0 feet.

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SCS ENGINEERS
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BORING NUMBER B-5 (A-5)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/25/18 **COMPLETED** 1/25/18
GROUND ELEVATION 541.38 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater, but muddy probe
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	SPT1	90	4-11-10 (21)		SC	2.0	(SC) Topsoil/ Fill Material No recovery 1.5-2 feet	539.4
	SPT2	60	4-7-8 (15)			4.0	Fill Material No recovery 3.5-4	537.4
5	SPT3	50	4-6-8 (14)			6.0	Fill material, dark brown, with clay, hard, moist No reocvery 5.5-6 feet	535.4
	ST1	60			CH		(CH) Clay, light brown, with fill material, hard, moist, calcareous Color change to mottled brown/grey at 8 feet	
10	ST2	40				10.0		531.4
	ST3	70			CH		(CH) Clay, mottled light brown/grey, with fine sand, hard, moist, calcareous	
	ST4	100		MC = 16% LL = 62 PI = 41			Color change to light reddish brown at 14 feet	
15	ST5	40						
	ST6	40				18.0		523.4
	ST7	60			CH		(CH) Clay, reddish brown, with grey sand, hard, moist, calcareous Calcite and Quartz throughout	
20	ST8	95						
	ST9	80		MC = 18% LL = 66 PI = 46				
25	ST10	60				26.0		515.4
	ST11	70		Weathered to unweathered zone			Shale, dark grey to black, with limestone lenses, hard, calcareous Silty sand lenses throughout	
	ST12	50					Fossil fragments 30-35 feet	
30		93		MC = 17% LL = 63 PI = 42				
35								

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BORING NUMBER B-5 (A-5)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		100					Shale, dark grey to black, with limestone lenses, hard, calcareous Silty sand lenses throughout
40		95					
45		100					
47.8							493.6
							Bottom of borehole at 47.8 feet.

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BORING NUMBER B-6

CLIENT	City of Waco	**PROJECT NAME**	City of Waco Landfill MSW-2400
PROJECT NUMBER	16216088.00	**PROJECT LOCATION**	Waco, Texas
DATE STARTED	10/25/18	**COMPLETED**	10/26/18
GROUND ELEVATION	545.55 ft	**HOLE SIZE**	8.25 inches
DRILLING CONTRACTOR	BEST Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Continuous Flight Auger	**AT TIME OF DRILLING**	--- No Groundwater
LOGGED BY	T. Derstine	**CHECKED BY**	J. Lawrence
AT END OF DRILLING	--- No Groundwater	**AFTER DRILLING**	--- No Groundwater
NOTES			

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–5.0		50		CL-ML		(CL-ML) Silty Clay, brown to reddish brown with orange-brown staining, soft to stiff, moist, with traces of gravel, organic	
5.0							540.6
5–10	ST1	50 / 45	PP = 4.5 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, slightly calcareous Chalk in fractures/joints 5-10 feet	
10–15	ST2	50 / 50	PP = 4.0 tsf			Silty lenses 10-15 feet	
15.0							530.6
15–20	ST3	38 / 66	PP = 4.5 tsf	CL		(CL) Silty Clay, orange-brown mottled brown-tan with some gray, hard, slightly moist, slightly calcareous, with weathered shale	
20–25	ST4	29 / 70	PP = 4.5+ tsf Weathered to Unweathered zone				
22.5							523.1
						Silty Shale, gray to dark gray, very hard, slightly moist, calcareous Orange-brown staining at 22.5-23.5 feet	
25–30	ST5	21 / 84	PP = 4.5+ tsf				
30–35	ST6	21 / 84	PP = 4.5+ tsf			Thin limestone layers in fractures at 30-50 feet	

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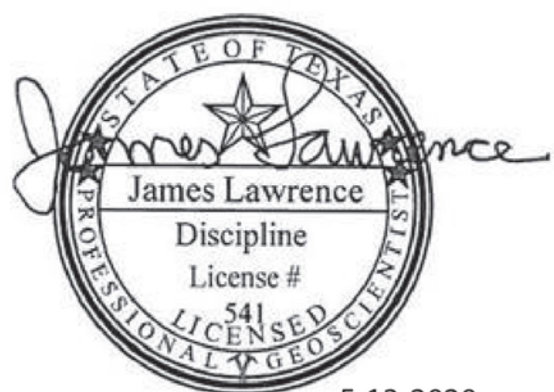
BORING NUMBER B-6

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Shale, gray to dark gray, very hard, slightly moist, calcareous
	ST7	17 98	PP = 4.5+ tsf			
40		80				
45	ST8	21 84	PP = 4.5+ tsf			
50		80				Shells at 50-51 feet
55	ST9	17 100	PP = 4.5+ tsf			
60		94				
65		80	PP = 4.5+ tsf			
70	ST10	29			70.7	474.9 Bottom of borehole at 70.7 feet.



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BORING NUMBER B-7

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/9/19 **COMPLETED** 1/9/19
GROUND ELEVATION 530.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 31.00 ft / Elev 499.50 ft

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–5		62		CL-ML		(CL-ML) Silty Clay, dark brown to olive brown, soft to hard, moist, with trace gravel
5.0–10.0		100		CL-ML		(CL-ML) Silty Clay, olive brown to brown with some orange-brown and gray mottling, firm to stiff, moist, with trace sub-angular gravel and pebbles (5.0 / 525.5)
10.0–19.0		50, 52		CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff, slightly moist to moist, calcareous (10.0 / 520.5)
19.0–24.0		60	Weathered to Unweathered zone			Shale Marl, dark gray with trace of orange-brown mottling, hard to stiff, slightly moist, with silty/limey lenses, calcareous Weathered to unweathered transition zone (19.0 / 511.5)
24.0–35		60, 86				Shale Marl, dark gray, hard, slightly moist, with silty/limey lenses and fossils, calcareous, unweathered (24.0 / 506.5) Very wet zones 31-32 feet

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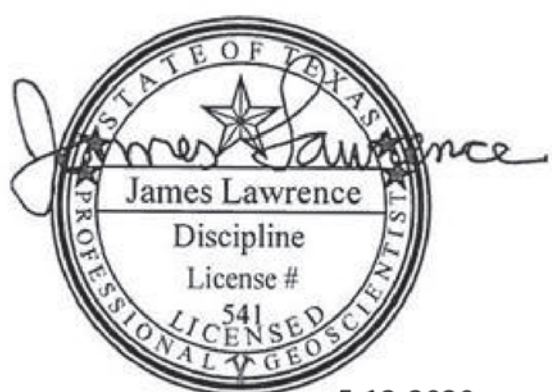
BORING NUMBER B-7

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35–40		60				Shale Marl, dark gray, hard, slightly moist, with silty/limey lenses and fossils, calcareous, unweathered
40–45		50				
45–50		80				
50–55		50				55.0 475.5

Bottom of borehole at 55.0 feet.



5-13-2020

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1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-8 (PZ-8)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/27/18 **COMPLETED** 11/28/18
GROUND ELEVATION 550.8 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	WELL DIAGRAM
0–1.5						Clayey Silt, dark brown, firm, moist, with roots and organics (1.5 / 549.3)	
1.5–5		100				(CL-ML) Silty Clay, gray to light gray, stiff to hard, moist to slightly moist, with white calcareous chalky material Trace of light gravel and orange-brown staining 6.5-10 feet	
5–10	ST1 / SPT1	38 / 100 / 100	11-20-23 (43)	PP = 4.0-4.5+ tsf	CL-ML	(10.0 / 540.8)	
10–15	ST2	50 / 63		PP = 3.5 tsf LL = 67 PI = 50 Fines = 85%	CL-ML	(CL-ML) Silty Clay, orange-brown stained gray and brown, stiff to hard, slighty moist, calcareous, with white chalky material and silty gray interbeds	
15–20	ST3 / SPT2	33 / 100 / 93	20-26-35 (61)	PP = 4.0-4.5 tsf		(20.0 / 530.8)	
20–25	ST4	21 / 56		PP = 4.5 tsf		Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous White chalky material and silty gray interbeds 20-25 feet	
25–30	ST5 / SPT3	29 / 100 / 64	18-29-43 (72)	PP = 4.5-4.5+ tsf			
30–35	ST6	21 / 67		PP = 4.5 tsf		Crystalline material in joints/bedding 35-43.8 feet	

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WELL NUMBER B-8 (PZ-8)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	ST7	21					Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous	
	SPT4	100	15-24-28 (52)					
		100		PP = 4.0-4.5+ tsf				
40	ST8	25		PP = 4.5+ tsf MC = 16% DD = 106 pcf LL = 58 PI = 38 Fines = 92%				
		68						
43.8							507.0	
				Weathered to Unweathered zone			Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, with silty/micaceous lenses and fossil remnants in interbeds, unweathered Orange-brown staining 47-55 feet	
45	ST9	17						
	SPT5	78	28-50					
		100		PP = 4.5+ tsf				
50	ST10	17		PP = 4.5+ tsf MC = 14% DD = 116 pcf LL = 58 PI = 37 Fines = 97%				
		70						
55	ST11 SPT6	17						
		93		PP = 4.5+ tsf				
60		100						
65	ST12	17						
		61		PP = 4.5+ tsf				
70		70						
75							75.0 / 475.8	

James Lawrence
STATE OF TEXAS
Discipline
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PROFESSIONAL GEOSCIENTIST
LICENSED
5-13-2020

Bottom of borehole at 75.0 feet.

SCS ENGINEERS

SCS Engineers
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Bedford, TX 76021

WELL NUMBER B-9 (PZ-9)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/9/18 **COMPLETED** 12/13/19
GROUND ELEVATION 535.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling; West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
∇ **AT TIME OF DRILLING** 25.10 ft / Elev 510.20 ft
LOGGED BY T. Derstine; A. Boudreaux **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0–5.0		92		CL-ML	(CL-ML) Silty Clay, dark brown to gray, stiff, slightly moist to moist, organic rich, with limestone fragments and shells Color change to gray at 2.5 feet
5.0					530.3
5.0–10.0	ST1	40 78	PP = 4.5+ tsf MC = 15% LL = 53 PI = 35 Fines = 75%	CL-ML	(CL-ML) Silty Clay, light gray/tan mottled orange-brown, hard, slightly moist, with minor sub-round gravel
10.0					525.3
10.0–15	ST2	36 44	PP = 4.5+ tsf		Silty Clay Shale, gray and orange-brown mottled yellow-brown, hard, slightly moist to dry, calcareous, with trace of gravel Chalk/limestone in joints 15-20 feet Color change to orange-brown mottled gray at 20 feet Limestone lenses in fractures 25-28.5 feet
15–20	ST3	24 57	PP = 4.5+ tsf		
20–25	ST4	24 57	PP = 4.5+ tsf MC = 20% DD = 105 pcf LL = 67 PI = 47 Fines = 91%		
25–30	ST5	20 67	PP = 4.5+ tsf Weathered to Unweathered zone		∇
28.5					506.8
28.5–35	ST6	20 67	PP = 4.5+ tsf		Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet

WELL DIAGRAM

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WELL NUMBER B-9 (PZ-9)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	ST7	16 87	PP = 4.5+ tsf MC = 15% DD = 116 pcf LL = 62 PI = 42 Fines = 89%			Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures	
40						40.0 — 495.3 40-45' no sample recovery	
45		100				45.0 — 490.3 Shale with minor, very fine sand. Dark gray, hard to very hard, damp to moist, well laminated	
50		100					
55		100	LL = 63 PI = 41 MC = 15% Fines = 99%				
60		100				Shale with minor, very fine sand. Dark gray, hard to very hard, damp to moist, laminated	
65		100					
70		100					
75							

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CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75		100	LL = 64 PI = 42 MC = 14% Fines = 93%			75-80' small fossils present	
80		100				Becoming harder with depth	
85		100					
90		100				Fewer laminations with depth	
95		100					
100		100					
105		100	LL = 73 PI = 51 MC = 15% Fines = 97%				
110		100				Shale with minor, very fine sand. Dark gray, very hard, moist, trace lamination	
115							

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WELL NUMBER B-9 (PZ-9)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115–120		100					
120–125		100				Becoming harder with depth	
125–130		100				Fewer laminations with depth	
130–135		100	LL = 74 PI = 49 MC = 16% Fines = 89%			Shale with minor, very fine sand. Dark gray, very hard, moist, scarce lamination	
135.0						400.3	

Bottom of borehole at 135.0 feet.

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James Lawrence

5-13-2020

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Telephone: 817-571-2288

BORING NUMBER B-10

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/13/18 **COMPLETED** 12/13/18
GROUND ELEVATION 548 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0 – 1.0					MH	(MH) Clayey Silt to Silty Clay, brown, soft to firm, moist, with roots and organics (1.0 / 547.0)
1.0 – 4.5		80			CL-ML	(CL-ML) Silty Clay, brown, stiff, moist, with traces of sub-rounded gravel and roots (4.5 / 543.5)
5	ST1	33 / 94	15-20-26 (46)	PP = 4.0-4.5 tsf	CL-ML	(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff, moist, with silty to very fine sand lenses and white chalky material
	SPT1	100				
10	ST2	33 / 71		PP = 4.5 tsf MC = 19% LL = 65 PI = 41 Fines = 90%		
15	ST3	21 / 100	20-30-37 (67)	PP = 4.0-4.5 tsf		
	SPT2	100				
20	ST4	21 / 56		PP = 4.0-4.5 tsf		
25	ST5	21 / 100	17-27-34 (61)	PP = 4.0-4.5 tsf MC = 15% DD = 108 pcf LL = 54 PI = 33 Fines = 94%		
	SPT3	100				
30	ST6	21 / 78		PP = 4.5 tsf		Crystalline pockets 30-34 feet (34.0 / 514.0)
35						

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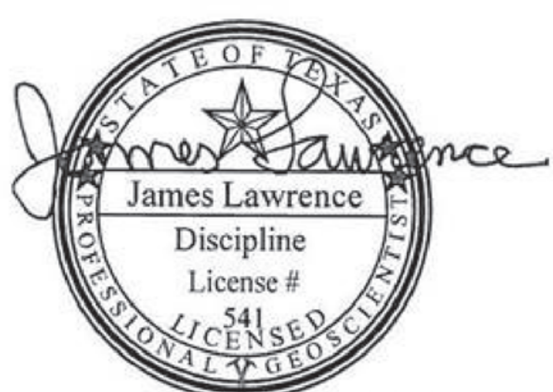
BORING NUMBER B-10

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	21 28	50	Weathered to Unweathered zone			36.0 Shale Marl, gray, hard, slightly moist, with occasional orange-brown staining and silty lenses, calcareous, weathered 512.0
	SPT4	100		PP = 4.5+ tsf			Transition zone *(continued)* Shale Marl, gray, hard, slightly moist, with fossil remnants and silty/limey lenses, calcareous, unweathered
40	ST8	17 87		PP = 4.5+ tsf MC = 14% LL = 59 PI = 39 Fines = 92%			
45	SPT5	17 95	34-50				
50		33					53.0 495.0

Bottom of borehole at 53.0 feet.



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BORING NUMBER B-11

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/5/18 **COMPLETED** 11/5/18
GROUND ELEVATION 553.5 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY A. Valerio **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0 – 1.0						Topsoil, dark brown (552.5)
1.0 – 5.0		95		CL		(CL) Clay, dark brown to orange-tan, medium firm, with some organic material (548.5)
5.0 – 10.0	ST1	100	PP = 0-4.5+ tsf	CL		(CL) Clay, orange brown, very soft to very hard, dry, with minor silt (543.5)
10.0 – 15.0	ST2	100	PP = 2.5-4.5+ tsf	CL		(CL) Clay, medium brown, firm to hard, dry, with minor orange silt
15.0 – 20.0	ST3	75	PP = 2.5-4.0 tsf			(533.5)
20.0 – 25.0	ST4	50	PP = 1.0-3.5 tsf MC = 21% DD = 95 pcf LL = 75 PI = 49 Fines = 89%	CL		(CL) Clay, medium to dark brown, firm to moderately firm, dry, with minor orange and gray silt (528.5)
25.0 – 30.0	ST5	93	PP = 0.5-4.5+ tsf Weathered to Unweathered zone	CL		(CL) Clay, dark gray, soft to very firm, dry, with minor orange silt (523.5)
30.0 – 35.0	ST6	75	PP = 4.0-4.5+ tsf	CL		(CL) Clay, very dark gray, very firm, with minor light gray silt and pebbles Sand/Silt parting at 33 feet (518.5)

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BORING NUMBER B-11

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	75	PP = 2.0-4.5+ tsf			(CL) Clay, very dark gray, medium firm to very firm, dry, with some very dark gray weathered shale Minor silty sand 40-45 feet
40		95				
45	ST8	95	PP = 3.5-4.5+ tsf MC = 13% DD = 120 pcf LL = 55 PI = 33 Fines = 86%			
50		75				Limey, white, calcareous, pebbles up to 1/2" at 54 feet Minor calcareous silt with few pebbles up to 1/8" at 58 feet
55	ST9	95	PP = 0.5-4.5 tsf	CL		
60		98				
65	ST10	95	PP = 1.0-4.5+ tsf			Minor limey pebbles <1/8" at 67 feet
70		99				Minor calcareous silt and pebbles <1/8" 70-75 feet
75						

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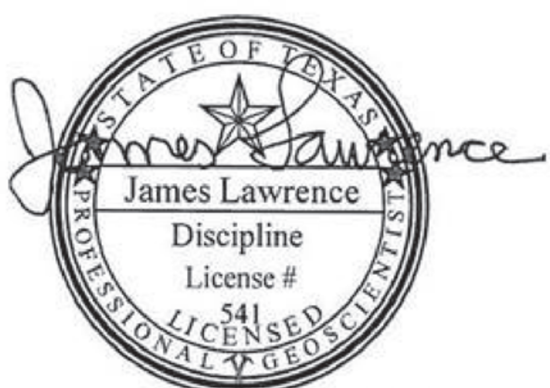
BORING NUMBER B-11

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						
		99		CL		
80						80.0 473.5

Bottom of borehole at 80.0 feet.



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BORING NUMBER B-12

CLIENT	City of Waco	**PROJECT NAME**	City of Waco Landfill MSW-2400
PROJECT NUMBER	16216088.00	**PROJECT LOCATION**	Waco, Texas
DATE STARTED	10/12/18	**COMPLETED**	10/12/18
GROUND ELEVATION	542.85 ft	**HOLE SIZE**	8.25 inches
DRILLING CONTRACTOR	BEST Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Continuous Flight Auger	**AT TIME OF DRILLING**	--- No Groundwater
LOGGED BY	T. Derstine	**CHECKED BY**	J. Lawrence
AT END OF DRILLING	--- No Groundwater	**AFTER DRILLING**	--- No Groundwater
NOTES			

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0–5		93		CL-ML		(CL-ML) Silty Clay, brown, soft to firm, slightly moist to moist Organic 0-5 feet Shell fragments 3-5 feet Minor amounts of small sub-rounded gravel 3-10 feet Mineral deposits in joints/bedding 5-10 feet	
5–10	ST1	38 / 68	PP = 4.5+ tsf				
10.0							532.9
10–15	ST2	29 / 50	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, with traces of roots/organics, calcareous Mineral desposits in fractures and traces of gravel 10-15 feet Very fine sandy lenses in fractures 15-20 feet	
15–20	ST3	21 / 50	PP = 4.5+ tsf				
20.0							522.9
20–25	ST4	21 / 60	PP = 4.5+ tsf	CL		(CL) Silty Clay, orange-brown mottled brown to light gray, hard, slightly moist, calcareous, with weathered shale Very fine sandy lenses 20-25 feet	
25–30	ST5	38 / 60	Weathered to Unweathered zone PP = 4.5+ tsf				
26.5						Silty Clay Shale, dark gray, moderately to very hard, slightly moist, calcareous Sandy lenses 26.5-30 feet Trace of shell fragments 30-35 feet	516.4
30–35	ST6	17 / 100	PP = 4.5+ tsf				

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Telephone: 817-571-2288

BORING NUMBER B-12

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
35						Silty Clay Shale, dark gray, moderately to very hard, slightly moist, calcareous Much softer and more calcareous 40-45 feet Very hard 45-48 feet	
	ST7	21 50	PP = 3.5-4.5+ tsf				
40		66					
45	ST8	100 25	PP = 4.5+ tsf			48.0	494.9

Bottom of borehole at 48.0 feet.

STATE OF TEXAS
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James Lawrence

5-13-2020

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BORING NUMBER B-13

CLIENT	City of Waco	**PROJECT NAME**	City of Waco Landfill MSW-2400
PROJECT NUMBER	16216088.00	**PROJECT LOCATION**	Waco, Texas
DATE STARTED	11/29/18 **COMPLETED** 12/4/18	**GROUND ELEVATION**	555.15 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR	BEST Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Continuous Flight Auger	**AT TIME OF DRILLING**	--- No Groundwater
LOGGED BY	T. Derstine **CHECKED BY** J. Lawrence	**AT END OF DRILLING**	--- No Groundwater
NOTES		**AFTER DRILLING**	--- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						0.5 Silt, brown, soft, slightly moist, organic 554.7
		56		CL-ML		(CL-ML) Silty Clay, brown to orange-brown stained brown and gray, firm, with traces of sub-rounded gravel and chalk
5	ST1 SPT1	100 / 76	PP = 3.5-4.0 tsf			5.0 (CL-ML) Silty Clay, orange-brown stained brown and gray, stiff to hard, slightly moist, calcareous, with silty lenses in interbeds, weathered 550.2 White chalky material 5-10 feet
10	ST2	100 / 45	PP = 3.5-4.5+ tsf			
15	ST3 SPT2	100 / 73	PP = 4.5+ tsf			
20	ST4	100 / 54	PP = 4.5+ tsf	CL-ML		
25	ST5 SPT3	100 / 80	PP = 4.5+ tsf			
30	ST6	100 / 100	PP = 4.5+ tsf			Weathered shale throughout 33-39.9 feet
35						

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BORING NUMBER B-13

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7 SPT4	100 / 100	PP = 4.5+ tsf MC = 20% DD = 109 pcf LL = 66 PI = 43 Fines = 94% Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, orange-brown stained brown and gray, stiff to hard, slightly moist, calcareous, with silty lenses in interbeds, weathered
40					39.9	515.3
	ST8	100 / 56	PP = 4.5+ tsf			Silty Clay Shale, gray, hard, slightly moist to moist, calcareous, unweathered Orange-brown staining in joints at 40-41 feet
45	ST9 SPT5	100 / 60	PP = 4.5+ tsf MC = 15% DD = 112 pcf LL = 51 PI = 33 Fines = 95%			Fossil/shell fragments 45-50 feet
50	ST10	100 / 60	PP = 4.5+ tsf			
55	ST11 SPT6	100 / 100	PP = 4.5+ tsf			
60		50				
65	ST12	100 / 43	PP = 4.5+ tsf			
70		40				
75						

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BORING NUMBER B-13

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75		60				Silty Clay Shale, gray, hard, slightly moist to moist, calcareous, unweathered
80						80.0 475.2

Bottom of borehole at 80.0 feet.

STATE OF TEXAS
James Lawrence
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PROFESSIONAL GEOSCIENTIST

5-13-2020

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

SCS ENGINEERS

1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-14

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/5/18 **COMPLETED** 11/6/18
GROUND ELEVATION 539.2 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–5		98		CL-ML		(CL-ML) Silty Clay, dark brown to brown, firm to stiff, moist to very moist, organic, with some small to medium sized sub-rounded gravel and chalk in fractures/joints
5–10	ST1	50 / 65	PP = 2.5-3.5 tsf			6.4 — 532.8 (CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff to hard, slightly moist, calcareous, weathered Fossil fragments and silty lenses in bedding 10-15 feet
10–15	ST2	58 / 66	PP = 4.5 tsf	CL-ML		
15–20	ST3	50 / 60	PP = 3.0-4.5 tsf MC = 19% DD = 104 pcf LL = 58 PI = 35 Fines = 65% Weathered to Unweathered zone			18.5 — 520.7 Silty Shale, gray, hard, slightly moist, calcareous, unweathered Fossil fragments in bedding 20-35 feet Silty lenses in bedding 18.5-45 feet
20–25	ST4	21 / 82	PP = 4.5+ tsf			
25–30	ST5	21 / 56	PP = 4.5+ tsf			
30–35		60				

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Telephone: 817-571-2288

BORING NUMBER B-14

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST6	17	PP = 4.5+ tsf MC = 15% LL = 58 PI = 39 Fines = 94%			Silty Shale, gray, hard, slightly moist, calcareous, unweathered Silty lenses in bedding 18.5-45 feet *(continued)*
		70				
40		64				
45	ST7	13	PP = 4.5+ tsf			
		58				
50		60				
55	ST8	21	PP = 4.5+ tsf			
		80				
60		60	PP = 4.5+ tsf			
65	ST9	21			65.0	474.2 Bottom of borehole at 65.0 feet.

STATE OF TEXAS
James Lawrence
Discipline
License #
541
LICENSED
PROFESSIONAL GEOSCIENTIST

5-13-2020

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BORING NUMBER B-15

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/26/18 **COMPLETED** 10/26/18
GROUND ELEVATION 563.35 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		96		CL-ML		(CL-ML) Silty Clay, dark brown to brown with orange-brown staining, firm to stiff, moist, with trace of white gravel, organics in top 1-2 feet
5	ST1	63 76	PP = 4.0-4.5+ tsf	CL-ML		5.0 558.4 (CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff to hard, slightly moist, with weathered shale
10	ST2	63 46	PP = 4.5+ tsf			10.0 553.4 Silty Shale, orange-brown mottled brown and gray, hard, slightly moist Silty lenses in interbeds 10-15 feet
15	ST3	75 83	PP = 4.5+ tsf			Crystalline lenses in interbeds 15-25 feet
20	ST4	75 89	PP = 4.5+ tsf			
25	ST5	75 72	PP = 4.5+ tsf			25.0 538.4 Silty Shale, brown and gray stained orange-brown, hard, slightly moist, with crystalline lenses in interbeds, weathered
30	ST6	83 100	Weathered to Unweathered zone PP = 4.5+ tsf			31.5 531.9 Silty Shale, gray, hard, slightly moist, calcareous
35						

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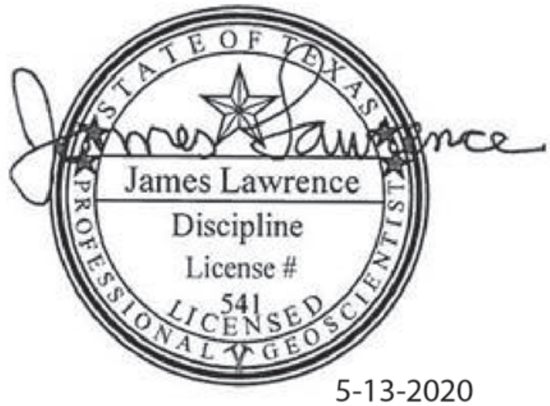
BORING NUMBER B-15

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	38 / 100	PP = 4.5+ tsf			Silty Shale, gray, hard, slightly moist, calcareous
40		84				
45	ST8	25 / 100	PP = 4.5+ tsf			Minor shell fragments 45-50 feet
50		100				
55	ST9	25 / 100	PP = 4.5+ tsf MC = 11% DD = 116 pcf LL = 57 PI = 37 Fines = 91%			
60		100				
65	ST10	29 / 100	PP = 4.5+ tsf			
70					70.0	493.4

Bottom of borehole at 70.0 feet.



SCS ENGINEERS

1901 Central Drive STE 550
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BORING NUMBER B-16

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/4/18 **COMPLETED** 10/4/18
GROUND ELEVATION 560.25 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING ---
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		80			CL		(CL) Clay, dark gray, slightly moist, hard, non-calcareous to slightly calcareous, with trace of sub-rounded small gravel Organic from 0-1.5 feet
4.0							556.3
5	ST1	25 50		PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, olive green/ mustard brown, slightly moist, hard, very calcareous Color change to yellow-brown at 6 feet with chalk/limestone in joints and trace of sub-rounded to angular gravel
10.0							550.3
10	ST2	54 50		PP = 4.5+ tsf MC = 19% DD = 105 pcf LL = 78 PI = 53 Fines = 91%			Shaley Clay, yellow to orange brown, slightly moist to dry, hard, calcareous, weathered Chalk/limestone intrusions 10-15 feet Tan to orange-brown at 15-20 feet
15	ST3	54 50		PP = 4.5+ tsf			
20	ST4	25 53		PP = 4.5+ tsf			Orange-brown mottled brown 20-25 feet
25	ST5	54 60		PP = 4.5+ tsf MC = 15% DD = 116 pcf LL = 60 PI = 38 Fines = 77%			
30	ST6	29 60		PP = 4.5+ tsf Weathered to			Orange-brown staining in joints 30-34.5 feet
35 / 35.0							525.3

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BORING NUMBER B-16

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35				Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
	ST7	33 / 60		PP = 4.5+ tsf			Orange-brown staining in joints 35-45 feet
40	ST8	29 / 60		PP = 4.5+ tsf			
45		50		PP = 4.5+ tsf			
50	ST9	25 / 60		PP = 4.5+ tsf MC = 17% DD = 115 pcf LL = 64 PI = 43 Fines = 94%			
55		69					Shells in interbeds 60 feet
60	SPT1	33	21-50				61.0 — 499.3

Bottom of borehole at 61.0 feet.

STATE OF TEXAS
James Lawrence
Discipline
License #
541
PROFESSIONAL GEOSCIENTIST
LICENSED

James Lawrence

5-13-2020

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BORING NUMBER B-17

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/8/18 **COMPLETED** 10/9/18
GROUND ELEVATION 546.75 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0.5						Limestone, white, hard, dry	546.3
0.5–5.0		40		CL		(CL) Clay, dark gray, slightly moist, hard, with sub-angular gravel <1/8-2"	541.8
5.0–15.0	ST1	40	PP = 4.5+ tsf	CL		(CL) Clay, yellow-brown mottled gray, slightly moist, hard	531.8
	ST2	80	PP = 4.5+ tsf				
15.0–31.0	ST3	60	PP = 4.5+ tsf MC = 19% DD = 106 pcf LL = 66 PI = 41 Fines = 91%	CL		(CL) Shaley Clay, tan to gray mottled orange, slightly moist to dry, hard, calcareous, weathered Color change to tan to brown mottled orange at 20 feet Mineral deposits in fractures 20-22 feet	515.8
	ST4	40	PP = 4.5+ tsf				
	ST5	40	PP = 4.5+ tsf LL = 67 PL = 23				
31.0–33.0	ST6	100	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, weathered	513.8
35							

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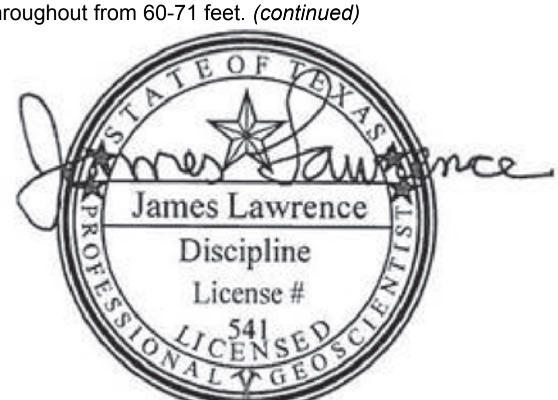
BORING NUMBER B-17

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
	ST7	60	PP = 4.5+ tsf			
40	ST8	60	PP = 4.5+ tsf			
45	ST9	60	PP = 4.5+ tsf MC = 15% DD = 120 pcf LL = 60 PI = 41 Fines = 83%			
50	ST10	100	PP = 4.5+ tsf			
55	ST11	100	PP = 4.5+ tsf			Limestone/chalk in fractures and joints 60-65 feet. Weathered zones throughout from 60-71 feet. *(continued)*
60	ST12	100	PP = 0-4.5+ tsf			
65		100	PP = 0-4.5+ tsf			
70	ST13				71.0	475.8



5-13-2020

Bottom of borehole at 71.0 feet.

SCS ENGINEERS
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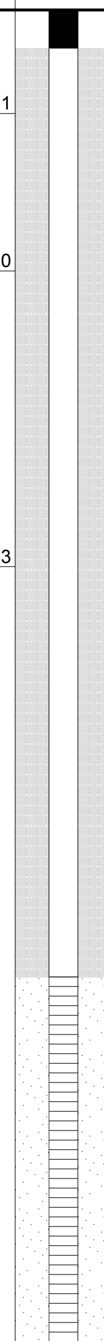
WELL NUMBER B-18 (PZ-18)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/30/18
GROUND ELEVATION 534.75 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		88		CL-ML		(CL-ML) Silty Clay Topsoil, dark brown, soft to firm, moist, organic	
2.7				CL-ML		532.1 (CL-ML) Silty Clay, brown, firm to stiff, moist, with traces of small to medium gravel and chalk in fractures/joints	
5	ST1	25 / 100	PP = 4.5+ tsf				
6.8				CL-ML		528.0 (CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, calcareous Silty lenses in bedding 10-14.5 feet	
10	ST2	25 / 77	PP = 4.5+ tsf MC = 19% DD = 105 pcf LL = 66 PI = 45 Fines = 92% Weathered to Unweathered zone				
14.5						520.3 Silty Shale, gray, hard, slightly moist, calcareous, unweathered Slight orange-brown staining 14.5-30 feet Trace of shells 30-56 feet	
15	ST3	17 / 93	PP = 4.5+ tsf				
20	ST4	21 / 78	PP = 4.5+ tsf				
25	ST5	25 / 80	PP = 4.5+ tsf				
30		70				Silty lenses in bedding 30-35 feet	
35							



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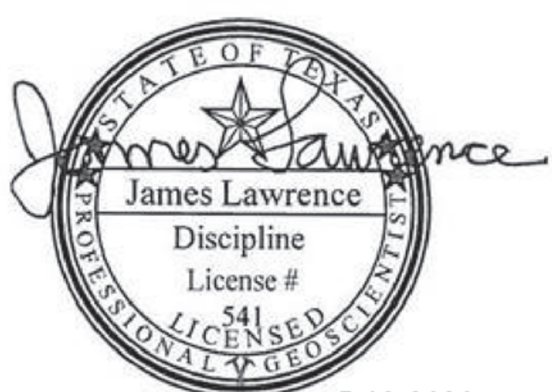
WELL NUMBER B-18 (PZ-18)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	ST6	21 80	PP = 4.5+ tsf			Silty Shale, gray, hard, slightly moist, calcareous, unweathered	
40		76					
45	ST7	21 76	PP = 4.5+ tsf MC = 13% DD = 109 pcf LL = 57 PI = 38 Fines = 90%				
50		80	PP = 4.5+ tsf				
55						56.0 ... 478.8	
	ST8	17				Bottom of borehole at 56.0 feet.	



5-13-2020

SCS ENGINEERS
1901 Central Drive STE 550
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BORING NUMBER B-19

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/30/18 **COMPLETED** 10/30/18
GROUND ELEVATION 562.05 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–4.0		100		CL-ML		(CL-ML) Silty Clay, dark brown, soft, moist, calcareous
4.0 (elev. 558.1)				CL-ML		(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous Chalk in fractures/joints 4-20 feet
5	ST1	100	PP = 4.5+ tsf			
10	ST2	50	PP = 0-4.5+ tsf LL = 60 PI = 38			
15	ST3	100	PP = 4.5+ tsf			Very weathered zones 15-20 feet
20	ST4	100	PP = 4.5+ tsf			
25	ST5	100	PP = 0-4.5+ tsf			
30	ST6	100	PP = 0-4.5+ tsf			
35						

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BORING NUMBER B-19

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
35	ST7	100	PP = 0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous	
40					40.0		522.1
	ST8	100	PP = 0-4.5+ tsf	CL		(CL) Clay, dark gray with orange to tan mottling, dry, hard, calcareous, with soft weathered shale zones	
45		100					
					49.0		513.1
50	ST9	100	PP = 4.5+ tsf MC = 14% DD = 117 pcf LL = 63 PI = 44 Fines = 91% Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, with chalk in joints/fractures, weathered	
					53.0		509.1
55		100				Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet	
60	ST10	100	PP = 0-4.5+ tsf				
65		100					
70	ST11	100	PP = 0-4.5+ tsf MC = 15% LL = 57 PI = 38 Fines = 95%				
75							

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BORING NUMBER B-19

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75		100				Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet *(continued)*
80	ST12	100	PP = 0-4.5+ tsf			
85	ST13	100	PP = 4.5+ tsf		87.0	475.1
						Bottom of borehole at 87.0 feet.

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5-13-2020

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1901 Central Drive STE 550
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WELL NUMBER B-20 (PZ-20)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/29/18
GROUND ELEVATION 564.1 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 7.90 ft / Elev 556.20 ft

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0–5		100		CL-ML		(CL-ML) Silty Clay, gray mottled tan, hard, dry, with <1/8" pebbles and chalk in fractures/joints, calcareous	
5.0						559.1	
5–10	ST1	60	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, tan/gray mottled orange, hard, dry, calcareous <1/8" pebbles 5-10 feet Chalk in joints/fractures 5-10 feet	
10–15	ST2	50	PP = 4.5+ tsf				
15–20	ST3	50	PP = 0 tsf			Very unconsolidated/weathered 15-35 feet	
20–25	ST4	50	PP = 0 tsf			Mineral deposits 24-25 feet	
25–30	ST5	50	PP = 0 tsf				
30–35	ST6	50	PP = 0 tsf				
35.0						529.1	

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Telephone: 817-571-2288

WELL NUMBER B-20 (PZ-20)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
35	ST7	100	PP = 4.5+ tsf	CL		(CL) Clay, dark gray with orange/tan mottling, hard, dry, calcareous, with weathered shale Mineral deposits in fractures 25-35 feet		
40	ST8	100	PP = 4.5+ tsf					
					43.0		521.1	
			Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, weathered		
45	ST9	100	PP = 4.5+ tsf MC = 13% DD = 116 pcf LL = 59 PI = 36 Fines = 95%					
					47.0		517.1	
						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Orange-brown oxidation staining 50-55 feet Chalk/limestone in fractures 50-55 feet		
50		100						
55	ST10	100	PP = 4.5+ tsf MC = 15% DD = 118 pcf LL = 58 PI = 37 Fines = 96%			No oxidation staining beginning at 57.5 feet		
60		100	PP = 4.5+ tsf					
65	ST11							
70								
					73.0		491.1	

Bottom of borehole at 73.0 feet.

5-13-2020

SCS ENGINEERS
1901 Central Drive STE 550
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Telephone: 817-571-2288

BORING NUMBER B-21

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/29/18
GROUND ELEVATION 538.75 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		66		CL-ML		(CL-ML) Silty Clay, dark brown to brown, firm, moist, organic, with traces of small gravel and shells
2.3						536.5
				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, hard, slightly moist, calcareous Shell fragments 2.3-15 feet Mineral deposits in fractures 5-10 feet
5	ST1	29 88	PP = 4.5+ tsf			
10	ST2	25 80	PP = 4.5+ tsf			
15	ST3	33 43	PP = 4.5+ tsf MC = 19% LL = 69 PI = 44 Fines = 97%			
20	ST4	29 56	PP = 4.5+ tsf Weathered to Unweathered zone			
24.9						513.9
25	ST5	21 89	PP = 4.5+ tsf			Silty Shale, gray, slightly moist to moist, hard, calcareous Orange-brown staining in fractures 24.9-35 feet Shell fragments 30-35 feet
30	ST6	21 100	PP = 4.5+ tsf MC = 15% DD = 118 pcf LL = 57 PI = 39 Fines = 94%			
35						

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BORING NUMBER B-21

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		90				Silty Shale, gray, slightly moist to moist, hard, calcareous Fossil remnants 35-45 feet
40	ST7	17 98	PP = 4.5+ tsf MC = 14% LL = 61 PI = 40 Fines = 88%			
45					45.0	493.8

Bottom of borehole at 45.0 feet.

STATE OF TEXAS
James Lawrence
Discipline
License #
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PROFESSIONAL GEOSCIENTIST

James Lawrence

5-13-2020

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BORING NUMBER B-22

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/18/18 **COMPLETED** 12/19/18
GROUND ELEVATION 555.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					MH	1.5	(MH) Clayey Silt, brown, soft, moist, with some subrounded gravel and roots 554.0
		46			CL-ML	4.9	(CL-ML) Silty Clay, brown, soft to firm, moist, with subrounded gravel and roots 550.6
5	ST1	33					(CL-ML) Silty Clay, brown-gray stained orange-brown, firm, moist, with white chalky material and silty micaceous lenses, calcareous
	SPT1	83 66	9-16-22 (38)	PP = 3.5-4.5 tsf			
10	ST2	38 61		PP = 4.0-4.5 tsf			Stiff to hard 10-34.7 feet No white chalky material 10-34.7 feet
15	ST3	50					
	SPT2	100 100	15-26-29 (55)	PP = 4.0 tsf			
20	ST4	17 48		PP = 4.0 tsf	CL-ML		
25	ST5	25					
	SPT3	100 86	18-24-35 (59)	PP = 4.0 tsf			Minor crystalline pockets 27-34.7 feet
30	ST6	29 70		PP = 4.5+ tsf MC = 20% LL = 74 PI = 47 Fines = 84%		34.7	520.8
35							

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BORING NUMBER B-22

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	25					Shale Marl, dark gray with orange-brown staining in joints, stiff to hard, slightly moist, with silty to very fine sand micaceous lenses and fossil remnants, calcareous
	SPT4	100 (77) 100	21-27-50 (77)	PP = 4.5+ tsf Weathered to Unweathered zone			Transition zone *(continued)*
38.5							517.0
							Shale Marl, dark gray, hard, slightly moist, with silty micaceous lenses and fossil remnants, calcareous, unweathered
40	ST8	21					
		100		PP = 4.5+ tsf			
45	ST9	17					
	SPT5	22	50	PP = 4.5+ tsf MC = 17% LL = 64 PI = 39 Fines = 92%			
		100					
50		100					
55	ST10	17					
		76		PP = 4.5+ tsf			
60		76					
65		90					
70		80					
75							

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BORING NUMBER B-22

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							
		80					Shale Marl, dark gray, hard, slightly moist, with silty micaceous lenses and fossil remnants, calcareous, unweathered *(continued)*
80						80.0	475.5

Bottom of borehole at 80.0 feet.

James Lawrence
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BORING NUMBER B-23

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/5/18 **COMPLETED** 10/5/18
GROUND ELEVATION 540.1 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING ---
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		94		CL-ML		(CL-ML) Silty Clay, dark gray, slightly moist to moist, stiff, with some gravel, non-calcareous Some fossil/shell fragments
5	ST1	28 49	PP = 3.0-4.0 tsf			Color change to orange/brown mottled tan/brown and slightly moist to dry with calcareous material in joints at 10 ft
10					10.0	530.1
10	ST2	36 49	PP = 2.0-2.75 tsf MC = 20% DD = 108 pcf LL = 73 PI = 52 Fines = 98%	CL-ML		(CL-ML) Silty Clay, orange-brown mottled tan and gray, stiff to hard, slightly moist to dry, calcareous Chalk in joints 10-20 feet
15	ST3	36 46	PP = 4.0-4.5+ tsf			Shells in bedding 15-20 feet
20	ST4	24 52	PP = 4.5+ tsf			
25	ST5	24 55	PP = 4.5+ tsf			
30	ST6	28 77	PP = 4.5+ tsf MC = 18% DD = 108 pcf LL = 74 PI = 51 Fines = 85%			Sandy lenses 30-38 feet
35						

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BORING NUMBER B-23

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	24 / 80	PP = 4.5+ tsf MC = 20% DD = 101 pcf LL = 77 PI = 55 Fines = 89% Weathered to Unweathered zone	CL-ML		38.0 — 502.1
40	ST8	12 / 96	PP = 4.5+ tsf MC = 15% LL = 70 PI = 50 Fines = 96%			Silty Clay Shale, dry, very hard, calcareous, unweathered, with sandy lenses in interbeds
45						45.0 — 495.1
	ST9	28				Bottom of borehole at 45.7 feet.

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BORING NUMBER B-24

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 533.62 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		100		CH		(CH) Clay, dark gray, hard, dry, non-calcareous, with sub-angular calcareous pebbles <1/8" Color change to light grayand slightly moist at 5 feet
5	ST1	80	PP = 3-4.5+ tsf MC = 15% DD = 112 pcf LL = 51 PI = 33 Fines = 73%			
7.0				CL-ML		526.6 (CL-ML) Silty Clay, orange-tan mottled gray, dry, hard, with chalk/limestone in joints and sand in fractures, slightly calcareous, weathered/crumbled Sub-angular calcareous pebbles 7-10 feet
10	ST2	40	PP = 3.0 tsf			
15	ST3	60	PP = 2.0-4.5+ tsf MC = 21% DD = 99 pcf LL = 74 PI = 52 Fines = 98%			
20	ST4	100	PP = 3.0-4.5+ tsf			
25.0	ST5	80	PP = 2.0 tsf MC = 19% DD = 103 pcf LL = 69 PI = 44 Fines = 89%	CL		508.6 (CL) Shaley Clay, dark gray with brown staining, soft, dry, calcareous, very weathered
30.0	ST6	80	PP = 4.5+ tsf Weathered to Unweathered zone			503.6 Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Intermittent weathered zones 35-59 feet
35						

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BORING NUMBER B-24

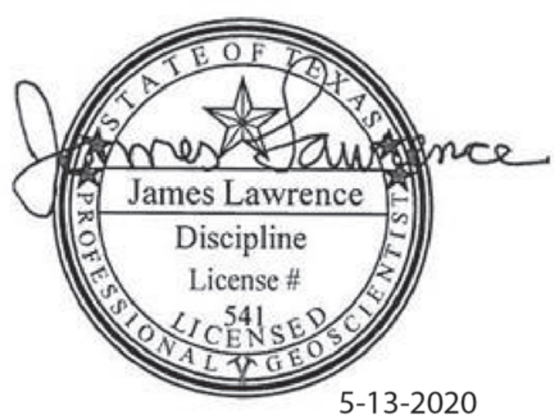
CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	80	PP = 4.5+ tsf			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 40-45 feet Intermittent weathered zones 35-59 feet Limestone lenses in fractures 50-59.2 feet
40	ST8	100	PP = 4.5+ tsf			
45	ST9	100	PP = 4.5+ tsf LL = 59 PI = 33			
50		80				
55	ST10	100	PP = 4.5+ tsf		59.2	474.4
	ST11					Bottom of borehole at 59.0 feet.



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BORING NUMBER B-25

CLIENT	City of Waco	**PROJECT NAME**	City of Waco Landfill MSW-2400
PROJECT NUMBER	16216088.00	**PROJECT LOCATION**	Waco, Texas
DATE STARTED	10/11/18	**COMPLETED**	10/11/18
GROUND ELEVATION	533.25 ft	**HOLE SIZE**	7.25 inches
DRILLING CONTRACTOR	West Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Continuous Flight Auger	**AT TIME OF DRILLING**	--- No Groundwater
LOGGED BY	V. Wooters	**CHECKED BY**	J. Lawrence
AT END OF DRILLING	--- No Groundwater	**AFTER DRILLING**	--- No Groundwater
NOTES			

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0–5		100		CL-ML		(CL-ML) Silty Clay, dark gray, soft to hard, slightly moist to dry, calcareous, with chalk in joints Color change to light gray 4-5 feet	
5.0							528.3
5–10	ST1	80	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange/gray/tan mottled, hard, slightly moist to dry, calcareous, with chalk in joints and sub-rounded pebbles 1/8"	
10–15	ST2	80	PP = 3.0-4.5+ tsf				
15–20	ST3	80	PP = 3.0-4.5+ tsf			No pebbles 15-20 feet Silty Sand lenses in fractures 15-23 feet	
20–25	ST4	100	PP = 1.0-3.0 tsf				
23.0							510.3
				CL		(CL) Shaley Clay, dark gray, medium hard to soft, dry, calcareous, weathered	
25.0							508.3
25–30	ST5	100	PP = 1.0-3.0 tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Intermittent weathered zones 25-33 feet	
30–33	ST6	100	PP = 1.0-3.0 tsf				
33.0							500.3

Bottom of borehole at 33.0 feet.

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BORING NUMBER B-26

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/18/18 **COMPLETED** 11/18/18
GROUND ELEVATION 530.45 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG (depth)	MATERIAL DESCRIPTION	Elev.
0						1.4	Top Soil, black, soft, moist, with roots and small gravel	529.1
		36			CL-ML	5.0	(CL-ML) Silty Clay, llight brown, hard, slightly moist, with small round to sub-rounded gravel up to 1/4", slightly calcareous	525.5
5	ST1	33		PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, tan to light brown mottled orange and gray, very hard, dry, slightly calcareous	
		83	14-25-35 (60)					
	SPT1	93						
10	ST2	35		PP = 4.5+ tsf		15.0	Orange staining 10-15 feet	515.5
		37						
15	ST3	35		PP = 3.0-4.5+ tsf	CL-ML	20.0	(CL-ML) Silty Clay, tan/brown with orange staining, hard to very hard, calcareous Color change to dark gray at 20 feet	510.5
		100	18-26-37 (63)					
	SPT2	75						
20	ST4	28		PP = 0.5-4.5+ tsf	CL-ML	26.0	(CL-ML) Silty Clay, dark gray to gray with orange staining, very soft to very hard, dry, slightly to moderately calcareous Transition zone into weathered shale	504.5
		51						
25	ST5	24		Weathered to Unweathered zone PP = 1.5-4.5+ tsf			Clay (Shale), dark gray, very soft to very hard, dry, with fossil remnants, slightly calcareous, unweathered Trace of orange staining 25-30 feet	
		33	28-50					
	SPT3	63						
30	ST6	26		PP = 2.5-4.0 tsf				
		47						
35								

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BORING NUMBER B-26

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
							36.0 494.5

Bottom of borehole at 36.0 feet.

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BORING NUMBER B-27

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/14/18 **COMPLETED** 11/14/18
GROUND ELEVATION 546.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0		90			MH	(MH) Clayey Silt, dark brown, soft to firm, very moist, organic
2.5					MH	544.2 (MH) Clayey Silt, brown, stiff to hard, moist to slightly moist, with white chalk and fossil fragments, calcareous
5	ST1	33				
		40		PP = 4.5+ tsf		
10	ST2	50			CL-ML	536.7 (CL-ML) Silty Clay, orange-brown mottled brown and gray, hard, slightly moist, calcareous
	SPT1	100 60	18-34-44 (78)	PP = 4.5+ tsf		
15	ST3	38				531.7 Silty Shale, orange-brown mottled brown and light gray, hard, slightly moist, calcareous, weathered
	SPT2	72 60	49-50	PP = 4.5+ tsf		White crystalline lenses in interbeds 17.7-21.4 feet
20	ST4	29				
	SPT3	78 93	25-36-50 (86)	PP = 4.5+ tsf		
25						Orange-brown and crystalline in interbeds 25-29 feet
	ST5	21	26-27-40 (67)	PP = 4.5+ tsf MC = 18% DD = 108 pcf LL = 68 PI = 47 Fines = 87%		
	SPT4	100 68				
29.0				Weathered to Unweathered zone		517.7 Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered
30	SS5	53 13	26-50			Orange-brown staining in joints/bedding 29-40 feet
	SPT6	80		PP = 4.5+ tsf		Occasional fossil fragments 33-38 feet
35						Fossil fragments 40.8-53 feet

Depth markers: 2.5, 10.0, 15.0, 29.0

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BORING NUMBER B-27

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		60					Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered Orange-brown staining in joints/bedding 29-40 feet Occasional fossil fragments 33-38 feet Fossil fragments 40.8-53 feet *(continued)*
40	ST7	17	50	PP = 4.5+ tsf MC = 15% DD = 118 pcf LL = 61 PI = 40 Fines = 97%			
	SPT6	33 100					
45		100					
50	ST8	17	50				
	SPT7	33 100		PP = 4.5+ tsf			
53.0							493.7

Bottom of borehole at 53.0 feet.

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BORING NUMBER B-28

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 529.6 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		98		CL-ML		(CL-ML) Silty Clay, gray, soft to firm, moist, organic, with traces of small to large gravel and chalk material
5	ST1	21 / 51	PP = 4.5+ tsf	CL-ML	5.0	(CL-ML) Silty Clay, orange-brown mottled gray and brown, very hard, slightly moist, with some weathered shale, weathered Chalky material interbedded 5-10 feet Sub-rounded, small to large gravel 5-6 feet Shell fragments 10-15 feet Crystalline/mineral deposits 15-25 feet (524.6)
10	ST2	54 / 64	PP = 4.5+ tsf			
15	ST3	33 / 100	PP = 4.5+ tsf			
20	ST4	25 / 100	PP = 4.5+ tsf			
25	ST5	29 / 100	PP = 4.5+ tsf Weathered to Unweathered zone		25.0	Silty Shale, orange-brown mottled brown and gray, very hard, slightly moist, with shell fragments, weathered (504.6)
					28.0	Silty Clay Shale, gray to dark gray, very hard, slightly moist to dry, calcareous, unweathered Mineral deposits 28-30 feet Shell fragments 30-35 feet Orange-brown staining 28-35 feet (501.6)
30	ST6	13 / 100	PP = 4.5+ tsf			
35						

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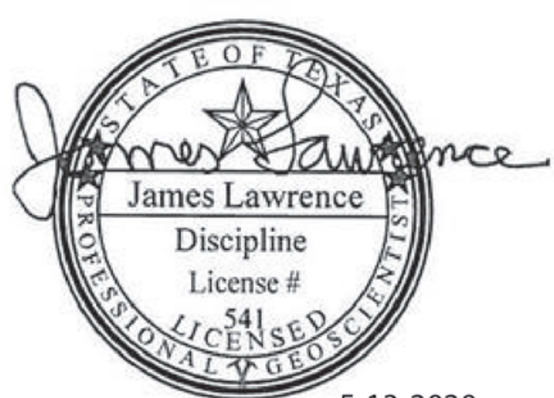
BORING NUMBER B-28

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	21 / 66	PP = 4.5+ tsf			Silty Clay Shale, gray to dark gray, very hard, slightly moist to dry, calcareous, unweathered Mineral deposits 28-30 feet Shell fragments 30-35 feet Orange-brown staining 28-35 feet *(continued)*
40		58				
45	ST8	21 / 71	PP = 4.5+ tsf			
50		66				
55						55.0 … 474.6

Bottom of borehole at 55.0 feet.



5-13-2020

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1901 Central Drive STE 550
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Telephone: 817-571-2288

BORING NUMBER B-29

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/16/18 **COMPLETED** 11/16/18
GROUND ELEVATION 540.25 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		73			MH		(MH) Clayey Silt, dark brown, soft, moist, with organics
						2.0	538.3
					CL-ML		(CL-ML) Silty Clay, brown to yellow-brown, hard to stiff, slightly moist to moist, with traces of sub-rounded gravel
5						5.0	535.3
	ST1	25 89	10-16-21 (37)		CL-ML		(CL-ML) Silty Clay (Weathered Shale/Marl), orange-brown stained gray and brown, hard to stiff, slightly moist, with white chalky material, calcareous, weathered Traces of gravel 5-15 feet
	SPT1	67		PP = 4.5+ tsf			
10	ST2	25					
		40		PP = 4.5+ tsf			
15	ST3	29 94	10-24-36 (60)				Black iron staining and limey lenses 15-25 feet
	SPT2	80		PP = 4.5+ tsf			
20	ST4	21					Color transitioning into mostly gray at 20 feet
		50		PP = 4.5+ tsf			
25						25.0	515.3
	SPT3	78 13	25-50	Weathered to Unweathered zone PP = 4.5+ tsf MC = 16% DD = 113 pcf LL = 60 PI = 39 Fines = 95%			Shale Marl, gray with some orange-brown staining, very hard, slightrly moist, calcareous, weathered Crystalline material in spots 25-26 feet
						26.5	513.8
	ST5	92					Silty Clay Shale Marl, gray with some orange-brown staining, very hard, slightrly moist, calcareous, weathered
30	ST6	13					Orange-brown limey/micaceous lenses 30-45 feet Fossil remnants 25-45 feet
		92		PP = 4.5+ tsf			
35							

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BORING NUMBER B-29

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	SPT4	28 8	50	PP = 4.5+ tsf MC = 11% DD = 114 pcf LL = 51 PI = 34 Fines = 90%			Silty Clay Shale Marl, gray with some orange-brown staining, very hard, slightrly moist, calcareous, weathered Orange-brown limey/micaceous lenses 30-45 feet Fossil remnants 25-45 feet *(continued)*
	ST7	72					
40		90					
45						45.0	495.3

Bottom of borehole at 45.0 feet.

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BORING NUMBER B-30

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/17/18 **COMPLETED** 11/18/18
GROUND ELEVATION 543.05 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elevation
0		86				Top Soil, dark brown to black, very soft, with organic material and silt	
2.0					CL-ML	(CL-ML) Silty Clay, gray, medium to very hard, slightly moist, with some round to sub-rounded pebles and chalky white material	541.1
5.0	ST1 SPT1	48 80 96	8-12-16 (28)	PP = 3.0-4.5+ tsf	CL-ML	(CL-ML) Silty Clay, gray mottled orange and brown, moderately hard, slightly moist, with some round to sub-rounded pebbles up to 1/2" and white chalky material, calcareous	538.1
10.0	ST2	35 53		PP = 2.0 tsf	CL-ML	(CL-ML) Silty Clay, orange-brown mottled gray and orange, medium soft, slightly moist, with white chalky material, calcareous Minor pebbles less than 1/8" 10-15 feet	533.1
15	ST3 SPT2	23 100 66	15-25-37 (62)	PP = 0-3.0 tsf MC = 18% DD = 115 pcf LL = 61 PI = 41 Fines = 90%		No pebbles or chalky white material 15-20 feet Turning gray 15-20 feet	
20	ST4	18 36		PP = 4.5+ tsf		Crystalline deposits and very hard 20-25 feet	
25.0	ST5 SPT3	19 100 58	18-31-39 (70)	PP = 2.0-4.5+ tsf	CL-ML	(CL-ML) Silty Clay, light brown/orange to gray, medium hard to very hard, dry, calcareous, weathered Red-brown staining along fractures, medium soft to hard, and crystalline deposits 30-35 feet	518.1
30	ST6	45 78		PP = 1.5-3.5 tsf MC = 18% LL = 62 PI = 41 Fines = 94%			
35							

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BORING NUMBER B-30

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	25 55	31-50		CL-ML		37.3 — 505.8
	SPT4	100		PP = 1.5-4.5+ tsf			Silty Clay Shale Marl, gray to dark gray, very hard, dry, with orange-brown staining, calcareous unweathered Less orange staining 40-45 feet
40	ST8	15					
		72		PP = 4.5+ tsf			
45	ST9	20 36	50	PP = 3.0-4.5 tsf			Some orange mottling and hard to very hard 45-48 feet
	SPT5	100					48.0 — 495.1

Bottom of borehole at 48.0 feet.

5-13-2020

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BORING NUMBER B-31

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/8/18 **COMPLETED** 10/9/18
GROUND ELEVATION 537.55 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–5		100		CL-ML		(CL-ML) Silty Clay, gray to dark gray, slightly moist to dry, stiff to hard, with trace of gravel, calcareous Organic rich 0-2 feet Color change to orange-brown mottled yellow-brown and chalk/limestone in joints 7.5-11.5 feet
5–10	ST1	84	PP = 4.5+ tsf			
11.5						526.1
10–15	ST2	85	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange/brown/gray mottled brown, hard, slightly moist to dry, calcareous, with traces of sub-rounded gravel
15–20	ST3	85	PP = 4.5+ tsf LL = 66 PI = 39			
20–25	ST4	64	PP = 4.0-4.5+ tsf			Shell fragments at 20 feet
25.0						512.6
25–30	ST5	80	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Orange-brown staining in fractures 25-30 feet
30–35	ST6	87	PP = 4.0 tsf MC = 18% DD = 103 pcf LL = 74 PI = 52 Fines = 90%			Limestone lenses in fractures 35-55 feet

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BORING NUMBER B-31

CLIENT City of Waco

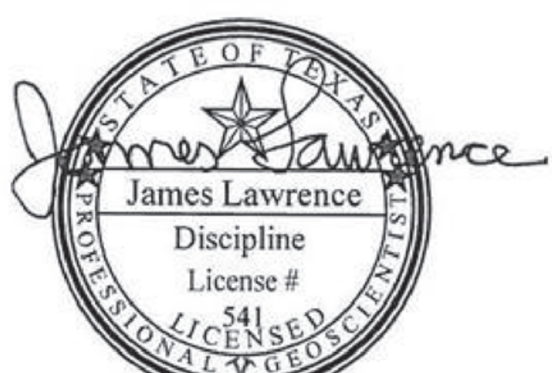
PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	53	PP = 4.5+ tsf			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 35-55 feet
40		90				
45	ST8	67	PP = 4.5+ tsf			
50		84				
55	ST9	89	PP = 4.5+ tsf MC = 14% LL = 60 PI = 37 Fines = 96%			
60		67			63.0	474.6

Bottom of borehole at 63.0 feet.



5-13-2020

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BORING NUMBER B-32

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/12/18
GROUND ELEVATION 526.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0 – 0.5		60		MH		(MH) Clayey Silt, brown, slightly moist to moist, soft to hard, organic (elev. 525.8)
0.5 – 5				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, slightly moist to dry, hard, calcareous, with weathered shale Traces of small sub-rounded gravel 2.5-5 feet Chalk in joints 5-10 feet
5 – 10	ST1	50 / 50	PP = 4.5+ tsf	CL-ML		
10 – 15	ST2	25 / 56	PP = 4.5+ tsf	CL-ML		
15 – 20	ST3	25 / 47	PP = 4.5+ tsf	CL-ML		
20 – 24.5	ST4	29 / 58	PP = 4.5+ tsf Weathered to Unweathered zone	CL-ML		(elev. 501.8 at 24.5)
24.5 – 29.0	ST5	25 / 68	PP = 4.5+ tsf			Silty Clay Shale, dark gray to gray, very hard, slightly moist, with orange-brown staining in joints, weathered (elev. 497.3 at 29.0)
29.0 – 32.0	ST6	100 / 25	PP = 4.5+ tsf			Silty Clay Shale, dark gray to gray, very hard, slightly moist, calcareous, with lighter colored material, unweathered (elev. 494.3 at 32.0)

Bottom of borehole at 32.0 feet.

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WELL NUMBER B-33 (PZ-33)

CLIENT City of Waco		**PROJECT NAME** City of Waco Landfill MSW-2400	
PROJECT NUMBER 16216088.00		**PROJECT LOCATION** Waco, Texas	
DATE STARTED 11/19/18	**COMPLETED** 11/20/18	**GROUND ELEVATION** 539.4 ft	**HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling		**GROUND WATER LEVELS:**	
DRILLING METHOD Continuous Flight Auger		**AT TIME OF DRILLING** --- No Groundwater	
LOGGED BY T. Derstine	**CHECKED BY** J. Lawrence	**AT END OF DRILLING** --- No Groundwater	
NOTES		**AFTER DRILLING** --- No Groundwater	

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elev.
0–1.5		60				Clayey Silt Topsoil, dark brown, soft to firm, moist, with roots and organics	1.5 / 537.9
1.5–15.0	ST1	33 / 89	13-29-37 (66)	PP = 4.5+ tsf	CL-ML	(CL-ML) Silty Clay, orange-brown mottled brown/tan, hard, moist to slightly moist, with white chalky material, calcareous Silty/micaceous interbeds 5-15 feet	15.0 / 524.4
	SPT1	100					
	ST2	33 / 67	22-50	PP = 4.5+ tsf			
	SPT2	43					
15.0–28.0	ST3	21 / 89		PP = 4.5+ tsf	CL-ML	(CL-ML) Silty Clay, orange-brown mottled brown and light gray, hard, slightly moist, with black iron staining, fossil remnants, and silty/micaceous interbeds, calcareous Weathered shale marl transition zone and mostly gray color at 25 feet	28.0 / 511.4
	ST4	21 / 49		PP = 4.5+ tsf			
	ST5	25 / 94	20-40-50 (90)	PP = 4.5+ tsf Weathered to Unweathered zone			
	SPT3	100					
28.0–30.0					CL-ML	(CL-ML) Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, unweathered Orange-brown staining at 28.2 and 29.7 feet	30.0 / 509.4
30.0–35	ST6	17 / 100		PP = 4.5+ tsf		Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered	

WELL DIAGRAM

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WELL NUMBER B-33 (PZ-33)

CLIENT City of Waco | **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 | **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	ST7	17 28	50				Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered *(continued)*	
	SPT4	100		PP = 4.5+ tsf				
40		74						
45	ST8	21 28	50					
	SPT5	90		PP = 4.5+ tsf				
50		76						
55							55.0 484.4	

Bottom of borehole at 55.0 feet.

STATE OF TEXAS
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BORING NUMBER B-34

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/17/18 **COMPLETED** 11/17/18
GROUND ELEVATION 535.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth	Elev.
0–2.0						Topsoil, dark brown to black, very soft, with roots, organic material, and silt	2.0	533.7
2.0–5.0		50			CL-ML	(CL-ML) Silty Clay, light brown mottled white, very hard, dry, with some chalky material, calcareous	5.0	530.7
5.0–10.0	ST1 SPT1	23 83 20	14-22-34 (56)	PP = 4.0-4.5+ tsf	CL-ML	(CL-ML) Silty Clay, brown-orange, very hard, dry to slightly moist, with some sub-round to round pebbles, calcareous	10.0	525.7
10.0–15.0	ST2	28 32		PP = 0.5-3.0 tsf MC = 14% LL = 57 PI = 38 Fines = 82%	CL-ML	(CL-ML) Silty Clay, light brown to white mottled gray, medium soft to medium hard, dry, with some orange staining and chalky white material, calcareous	15.0	520.7
15.0–20.0	ST3 SPT2	75 60 133	13-20-29 (49)	PP = 2.0-3.0 tsf	CL-ML	(CL-ML) Silty Clay, light brown to orange mottled gray, medium hard, dry, calcareous Less chalky white material throughout Transition zone	20.0	515.7
20.0–26.0	ST4	15 31		PP = 3.0-4.5+ tsf MC = 16% DD = 111 pcf LL = 63 PI = 43 Fines = 95%		Clayey Shale, gray with orange-brown staining, moderately hard to very hard, dry, calcareous, weathered	26.0	509.7
26.0–30.0	ST5 SPT3	15 33 100	24-50	Weathered to Unweathered zone PP = 4.5+ tsf		Clayey Shale, light gray with some orange-brown, very hard, dry, with some crystalline mineral deposits, calcareous	30.0	505.7
30.0–35	ST6	15 100		PP = 4.5+ tsf		Shale Marl, dark gray with very little orange staining, very hard, dry, with minor fossil fragments, slightly calcareous		

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BORING NUMBER B-34

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	15	50				Shale Marl, dark gray with very little orange staining, very hard, dry, with minor fossil fragments, slightly calcareous *(continued)*
		33					
	SPT4	92		PP = 4.5+ tsf			
40	ST8	100		PP = 4.5+ tsf			41.0 494.7
		50					Bottom of borehole at 41.0 feet.

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5-13-2020

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BORING NUMBER B-35

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/12/18 **COMPLETED** 12/12/18
GROUND ELEVATION 553.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0–2.0		100				Clayey Silt (top 0.5') to Silty Clay, brown, soft to firm, moist to very moist, with roots and organics (2.0 / 551.3)
2.0–5.5					CL-ML	(CL-ML) Silty Clay, brown, stiff, moist, with traces of sub-rounded gravel and roots (5.5 / 547.8)
5.5–10.0	ST1	33 78	15-18-18 (36)	PP = 4.5 tsf	CL-ML	(CL-ML) Silty Clay, orange-brown stained gray and brown, stiff, moist, weathered White chalky zone 6.5-7 feet Sandy zone (gray to brown) at 9 feet White chalky material 9-10 feet (10.0 / 543.3)
	SPT1	74				
10–15	ST2	38 85		PP = 4.5 tsf		Silty Clay Shale Marl, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, calcareous, weathered Traces of white gravel sized nodules 10-13.5 feet Gray silty lenses 15-34.8 feet
15–20	ST3	33 100	19-24-34 (58)	PP = 4.5 tsf		
	SPT2	85				
20–25	ST4	29 46		PP = 3.0-4.5 tsf		
25–30	ST5	21 117	21-36-40 (76)	PP = 4.5 tsf		
	SPT3	100				
30–35	ST6	21 56		PP = 4.5-4.5+ tsf Weathered to		(34.8 / 518.5)

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BORING NUMBER B-35

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	SPT4	28 13	50	Unweathered zone PP = 4.5+ tsf			Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered Orange-brown stained zone 37.5-38 feet
	ST7	90		PP = 4.5+ tsf			
40		76					Trace of fossil remnants and silty/limey lenses 40-59 feet *(continued)*
45	ST8	17 28	50	PP = 4.5+ tsf MC = 13% DD = 109 pcf LL = 54 PI = 33 Fines = 75%			
	SPT5	70					
50		73					
55		108					
59.0							494.3

Bottom of borehole at 59.0 feet.

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BORING NUMBER B-36

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/8/19 **COMPLETED** 1/9/19
GROUND ELEVATION 532.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0 – 0.5					MH	(MH) Clayey Silt, brown, soft, moist, with roots and organics (532.0)
0.5 – 5.0		100			CL-ML	(CL-ML) Silty Clay, brown grading to light gray, firm to stiff, moist, with organics in top layer and trace of subrounded gravel in bottom layer (527.5)
5.0 – 15.0	ST1	58			CL-ML	(CL-ML) Silty Clay, light gray, stiff, slightly moist to moist, with some orange-brown staining, white chalky material, and some gravel, calcareous
	SPT1	94 / 100	10-14-19 (33)	PP = 2.0 tsf		Color change to orange-brown mottled gray and brown at 7.5 feet
	ST2	50 / 100		PP = 4.5 tsf		(517.5)
15.0 – 34.0	ST3	29				Silty Clay Shale Marl, orange-brown stained gray and brown, stiff to hard, slightly moist, with very fine sandy laminate layers
	SPT2	94 / 71	15-24-31 (55)	PP = 4.0 tsf MC = 18% LL = 56 PI = 35 Fines = 91%		
	ST4	25 / 40		PP = 4.0 tsf		
	ST5	17				Crystalline material in joints at 25 feet
	SPT3	94 / 71	7-15-50 (65)	PP = 3.5 tsf		Color change to mostly dark gray at 27 feet
	ST6	25 / 68		PP = 4.5 tsf MC = 17% DD = 115 pcf LL = 64 PI = 39 Fines = 93% Weathered to Unweathered zone		(498.5)
34.0 – 35						

(Continued Next Page)

-
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Telephone: 817-571-2288

BORING NUMBER B-36

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	17	35-50	PP = 4.5 tsf			Shale Marl, dark gray, hard, slightly moist, calcareous, unweathered Occasional orange-brown staining 34-40 feet
	SPT4	50 54					
40	ST8	21		PP = 4.5 tsf			Silty/limey laminate layers 42-58 feet *(continued)*
		44					
45	ST9	25	33-50	PP = 4.5 tsf			
	SPT5	50 100					
50		100					
55	ST10	21 28	50	PP = 4.5 tsf			
	SPT6	60				58.0	474.5

Bottom of borehole at 58.0 feet.

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Telephone: 817-571-2288

BORING NUMBER B-37

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/6/18 **COMPLETED** 12/11/18
GROUND ELEVATION 526.9 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–1.0		86		ML		(ML) Silt, gray, soft, moist, with a trace of clay and roots/organics	525.9
1.0–5.0				CL-ML		(CL-ML) Silty Clay, light gray, firm to stiff, slightly moist to moist, with white chalky material in areas, trace of gravel, and roots	521.9
5.0–10.0		56		CL-ML		(CL-ML) Silty Clay, light gray to brown, stiff, slightly moist to moist, with white chalky areas and trace of sub-rounded gravel	516.9
10.0–11.0		90		CL-ML		(CL-ML) Sandy Silty Clay, light brown to tan, firm, slightly moist to moist, trace of gravel	515.9
11.0–23.5		90, 90		CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, hard, slightly moist to moist, with white chalky material in joints/bedding, calcareous, weathered	503.4
23.5–26.0						Shale Marl (Silty Clay), gray with trace of orange-brown staining, hard, slightly moist, calcareous, weathered	
26.0		98	Weathered to Unweathered zone			Transition zone	500.9
26.0–35		84				Shale Marl (Silty Clay), gray, hard, slightly moist, with fossil remnants, calcareous, unweathered	

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BORING NUMBER B-37

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
35–40		96				Shale Marl (Silty Clay), gray, hard, slightly moist, with fossil remnants, calcareous, unweathered *(continued)*
40–45		90				
45–50		100				
50–52		100				52.0 474.9

Bottom of borehole at 52.0 feet.

James Lawrence
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BORING NUMBER B-38

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/4/18 **COMPLETED** 12/5/18
GROUND ELEVATION 529.85 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	Depth	MATERIAL DESCRIPTION	Elev.
0					ML	0.7	(ML) Silt, brown, dry to slightly moist, soft	529.2
		66			CL-ML	5.0	(CL-ML) Silty Clay, dark brown to brown, firm to hard with depth, slightly moist to moist, with roots/organics and trace gravel	524.9
5	ST1	29						
		94	15-25-25 (50)					
	SPT1	63		PP = 2.0-3.5 tsf	CL-ML	10.0	(CL-ML) Silty Clay, light gray with orange-brown staining, slightly moist, firm to stiff, with white chalky material and trace sub-rounded gravel	519.9
10		36				17.0	Sandy Clay, brown, firm to stiff, slightly moist, with trace of white chalky spots and trace sub-rounded gravel at top, calcareous Fossil remnants 15-17 ft	512.9
15		22			CL-ML	20.0	(CL-ML) Silty Clay, brown, stiff, slightly moist, with trace of white chalky material and gravel, calcareous	509.9
20		40				27.0	Silty Clay Shale Marl, brown and gray, stiff, slightly moist to moist, with orange-brown staining and trace fossil remnants, calcareous, weathered	502.9
25		66		Weathered to Unweathered zone			Shale Marl (Silty Clay), gray, hard, slightly moist to moist, with fossil remnants, calcareous Orange-brown staining 28-28.2 feet	
30		48						
35								

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BORING NUMBER B-38

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35–40		54					Shale Marl (Silty Clay), gray, hard, slightly moist to moist, with fossil remnants, calcareous Light gray limey lenses 40-55 feet *(continued)*
40–45		66					
45–50		60					
50–55		44				55.0	474.9

Bottom of borehole at 55.0 feet.

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5-13-2020

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BORING NUMBER B-39

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Telephone: 817-571-2288

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/5/18 **COMPLETED** 12/6/18
GROUND ELEVATION 522.95 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0 – 0.6		84		ML		0.6 (ML) Silt, dark brown to brown, soft, moist, with a trace of clay and roots 522.4
0.6 – 8.6		100		CL-ML		(CL-ML) Silty Clay, brown to gray, firm to stiff, slightly moist to moist, with trace gravel, roots, fossil remnants, and white chalky material Color change to orange-brown mottled gray and brown at 5 feet Sandy from 5-7 feet
8.6 – 29.0		60 76 52 70		CL-ML		8.6 514.4 (CL-ML) Silty Clay, orange-brown mottled gray and brown, hard, slightly moist, with trace of white chalky material and gravel, calcareous
29.0 – 35		66				29.0 494.0 Shale Marl, mostly gray with orange-brown staining, hard, slightly moist, with trace chalky white material, fossil remnants, and limey lenses, calcareous Transition zone from weathered to unweathered

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

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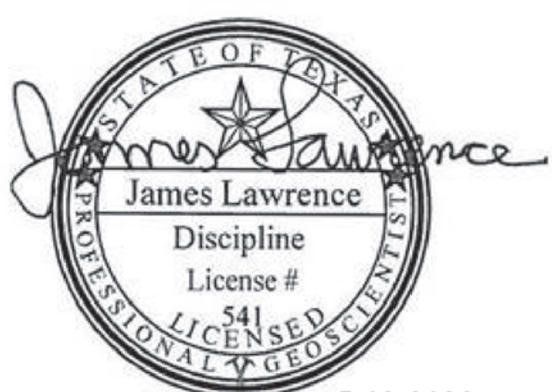
BORING NUMBER B-39

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		100	Weathered to Unweathered zone			Shale Marl, mostly gray with orange-brown staining, hard, slightly moist, with trace chalky white material, fossil remnants, and limey lenses, calcareous Transition zone from weathered to unweathered *(continued)*
38.0						485.0
						Shale Marl, gray, hard, slightly moist, with limey lenses, calcareous, unweathered
40		80				
45		100				
48.0						475.0

Bottom of borehole at 48.0 feet.



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BORING NUMBER B-40

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/5/18 **COMPLETED** 12/5/18
GROUND ELEVATION 522.8 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–5		40		CL-ML		(CL-ML) Silty Clay, brown, firm to stiff, slightly moist to moist, with trace sub-rounded gravel, fossil remnants, roots Sandy at 5 feet
5–10		100				7.0 — 515.8
				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff, slightly moist to moist, with white chalky material/gravel and fossil remnants, calcareous Crystalline pockets 10-19 feet
10–15		88				
15–20		76				19.0 — 503.8
20–25		54		CL-ML		(CL-ML) Silty Clay, gray with trace of orange-brown staining, hard, slightly moist, with fossil remnants, calcareous, unweathered Transition zone
25–28		100	Weathered to Unweathered zone			26.0 — 496.8
				CL-ML		(CL-ML) Shale Marl, gray, hard, slightly moist, with fossil remnants, calcareous, unweathered
28.0						28.0 — 494.8

Bottom of borehole at 28.0 feet.

STATE OF TEXAS
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WELL NUMBER B-41 (PZ-41)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/17/18 **COMPLETED** 12/18/18
GROUND ELEVATION 535 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0–5		72		CL-ML		(CL-ML) Silty Clay, dark brown to gray, soft to stiff, moist to very moist, with a trace of gravel and roots/organics	
5.0							530.0
5–10		44		CL-ML		(CL-ML) Silty Clay, gray grading to brown and orange-brown stained, stiff, moist, with trace of small to large sub-rounded gravel and white chalky material Color change to orange-brown stained brown at 10 feet	
10–15		34					
12.0							523.0
				CL-ML		(CL-ML) Silty Clay Shale Marl, orange-brown stained brown and gray, stiff to hard, moist, with white crystalline lenses in bedding, calcareous	
15–20		82					
20–25		44					
25–30		54					
29.0							506.0
						Shale Marl, dark gray with orange-brown stainining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet	
30–35		56					

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WELL NUMBER B-41 (PZ-41)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35–40		56				Shale Marl, dark gray with orange-brown staining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet *(continued)*	
40–45		100	Weathered to Unweathered zone			43.0 — 492.0 Shale Marl, gray to dark gray, hard, slightly moist, with lighter limey/silty lenses, fossil remnants, and crystalline areas, unweathered	
45–50		100					
50–55		100					
55–60		50				60.0 — 475.0	

Bottom of borehole at 60.0 feet.

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5-13-2020

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BORING NUMBER B-42

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/6/18 **COMPLETED** 12/6/18
GROUND ELEVATION 527 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0–0.5		100		ML		(ML) Silt, gray, soft, moist, with roots and organics	526.5
0.5–5.0				CL-ML		(CL-ML) Silty Clay, brown-gray, firm to stiff, moist, with a trace of gravel, roots, and white spots	522.0
5.0–10.0		72		CL-ML		(CL-ML) Silty Clay, gray, stiff, moist, with white chalky material and trace of sub-rounded gravel Orange-brown staining at 9-10 feet	517.0
10.0–15.0		86		CL-ML		(CL-ML) Silty Clay, gray and brown with orange-brown staining, stiff to hard, slightly moist to moist, with white chalky material/spots, weathered	512.0
15.0–31.0		80 (15–20), 84 (20–25), 80 (25–30)		CL-ML		(CL-ML) Silty Clay (Shale Marl), gray and brown with orange-brown staining, stiff to hard, slightly moist to moist, with white chalky material/spots, weathered More gray 28-30 feet (transition zone)	496.0
31.0–32.0		100 (30–32)	Weathered to Unweathered zone			Shale Marl, gray, hard, slightly moist, with white chalky material/specs, calcareous	495.0

Bottom of borehole at 32.0 feet.

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5-13-2020

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WELL NUMBER B-43 (PZ-43)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/15/18 **COMPLETED** 12/17/19
GROUND ELEVATION 548.86 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling; West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine; A. Boudreaux **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0 – 1.0					MH		(MH) Clayey Silt, dark brown, soft, very moist, with trace of gravel and organics (547.9)	
1.0 – 5.0		47			CL-ML		(CL-ML) Silty Clay, dark brown, hard, moist, with trace of gravel and organics (543.9)	
5.0 – 10.0	ST1	29 / 93	15-27-50 (77)	PP = 4.5 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, with white chalky material in interbeds, calcareous (538.9)	
	SPT1	67						
10.0 – 15	ST2	29		PP = 4.5 tsf MC = 18% DD = 111 pcf LL = 60 PI = 40 Fines = 95%	CL-ML		(CL-ML) Silty Clay (weathered shale/marl), orange-brown stained light gray and brown, stiff to hard, slightly moist, calcareous, weathered White chalky material in interbeds 10-16 feet Black iron staining in joints/interbeds 20-24 feet Weathered to unweathered transition at 25 feet	
		28						
15 – 20	ST3	25 / 93	21-39-50 (89)	PP = 4.5 tsf				
	SPT2	67						
20 – 25.0	ST4	25					(523.9)	
		80		PP = 4.5+ tsf				
25.0 – 30	ST5	17 / 72	26-50	PP = 4.5+ tsf MC = 16% DD = 117 pcf LL = 61 PI = 42 Fines = 94%	CL-ML		(CL-ML) Silty Clay, (shale/marl) gray with some orange-brown staining, hard, calcareous, with white fossil remnants	
	SPT3	70						
30 – 32.0	ST6	21		Weathered to Unweathered zone PP = 4.5+ tsf			(516.9)	
32.0 – 35		60						

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WELL NUMBER B-43 (PZ-43)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	ST7	19					Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered Occasional orange-brown staining and fossil remnants in beds 32-43 feet White crystalline material in bedding/joints at 35 feet Micaceous interbeds and traces of fossil remnants 45-70 feet	
		50						
40	ST8	17		PP = 4.5+ tsf				
		80						
45	ST9	21		PP = 4.5+ tsf MC = 16% DD = 108 pcf LL = 63 PI = 40 Fines = 95%				
	SPT4	28	50					
		70						
50		60						
55	ST10	17		PP = 4.5+ tsf				
	SPT5	22	50					
		43						
60		87						
65	ST11	17		PP = 4.5+ tsf				
		67						
70		83		PP = 4.5+ tsf LL = 60 PI = 40 MC = 15% Fines = 91%				
75							75.0 473.9	

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CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75		100					Shale with minor, very fine sand to silt. Dark gray, very hard, moist, laminated Few, small fossils	
80		100					Becoming harder with depth Fewer laminations with depth 80-85' very small mica flakes	
85		100					85-95' some fossils	
90		100						
95		85						
100		90						
105		100						
110		100					Large bivalve fossil @ 110' Shale with minor, very fine sand. Dark gray, very hard, moist, trace lamination	
115								

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WELL NUMBER B-43 (PZ-43)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115–120		100		LL = 68 PI = 46 MC = 12% Fines = 81%			Shale with minor, very fine sand to silt. Dark gray, very hard, moist, laminated Becoming harder with depth	
120–125		80						
125–130		75					Trace sands transitioning to no sands below 125'	
130–135		70					Scarce laminations	
135–140		95					Featureless	
140–145		100						
145–150		20		LL = 75 PI = 50 MC = 15% Fines = 99%			Shale. Dark gray, very hard, moist, no lamination 150.0 398.9	

Bottom of borehole at 150.0 feet.

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BORING NUMBER B-44

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 551.2 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–5		100		CL		(CL) Clay, dark brown to black, hard, moist, non-calcareous Calcareous 4-5 feet.
5					5.0	546.2
5–10	ST1	100	PP = 3.75-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous
10–15	ST2	80	PP = 4.5+ tsf MC = 20% DD = 108 pcf LL = 71 PI = 49 Fines = 91%			
15–20	ST3	80	PP = 4.5+ tsf			No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet
20–25	ST4	60	PP = 4.5+ tsf MC = 21% DD = 105 pcf LL = 79 PI = 55 Fines = 84%			
25–30	ST5	50	PP = 3.0-4.5+ tsf			
30–35	ST6	60	PP = 3.0-4.5+ tsf MC = 25% DD = 97 pcf LL = 72 PI = 51 Fines = 97%			

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:52 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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-
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-44

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	100	PP = 3.0-4.5+ tsf Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet *(continued)*
39.5						Shaley Clay, dark gray, hard, dry, slightly calcareous, weathered (511.7)
40	ST8	100	PP = 4.5+ tsf			
41.0						Silty Clay Shale, dark gray, hard, dry, calcareous, with limestone intrusions in fractures (510.2)
45	ST9	90	PP = 4.5+ tsf			
50	ST10	100	PP = 4.5+ tsf LL = 60 PI = 38			
55		100				No limestone intrusions in fractures 55-76 feet
60	ST11	100	PP = 4.5+ tsf			
65		100				Interbedded heavily weathered zones 65-76 feet
70	ST12	100	PP = 4.5+ tsf			
75						

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-
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Telephone: 817-571-2288

BORING NUMBER B-44

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75	ST13	100				76.0 — 475.2
						Bottom of borehole at 76.0 feet.

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STATE OF TEXAS
James Lawrence
Discipline
License #
541
LICENSED
PROFESSIONAL GEOSCIENTIST

5-13-2020

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-45

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/31/18 **COMPLETED** 10/31/18
GROUND ELEVATION 545.5 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		100		CL-ML		(CL-ML) Silty Clay, dark brown, medium hard, moist, slightly calcareous, organic
4.0						541.5
5	ST1	50	PP = 0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange/tan mottled gray hard, slightly moist to dry, slightly calcareous Very dry and weathered zones 5-26 feet
10	ST2	50	PP = 0-4.5+ tsf			
15	ST3	100	PP = 0-4.5+ tsf			
20	ST4	100	PP = 0-4.5+ tsf			
25	ST5	100	Weathered to Unweathered zone PP = 0-4.5+ tsf MC = 21% DD = 107 pcf LL = 66 PI = 46 Fines = 90%			
26.0				CL		519.5 (CL) Shaley Clay, dark gray with orange/tan mottling, dry, hard, calcareous, with weathered shale
28.0						517.5 Silty Clay Shale, dark gray, hard, dry, slightly calcareous, weathered
30	ST6	100	PP = 4.5+ tsf			
35						

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BORING NUMBER B-45

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35		100				Silty Clay Shale, dark gray, hard, dry, slightly calcareous, weathered *(continued)*
40	ST7	100	PP = 4.5+ tsf MC = 15% LL = 58 PI = 38 Fines = 92%			
45		100	PP = 4.5+ tsf			
50	ST8				51.0	494.5

Bottom of borehole at 51.0 feet.

STATE OF TEXAS
James Lawrence
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PROFESSIONAL GEOSCIENTIST

5-13-2020

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-46

CLIENT City of Waco		**PROJECT NAME** City of Waco Landfill MSW-2400	
PROJECT NUMBER 16216088.00		**PROJECT LOCATION** Waco, Texas	
DATE STARTED 11/1/18	**COMPLETED** 11/1/18	**GROUND ELEVATION** 559.25 ft	**HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling		**GROUND WATER LEVELS:**	
DRILLING METHOD Continuous Flight Auger		**AT TIME OF DRILLING** --- No Groundwater	
LOGGED BY T. Derstine	**CHECKED BY** J. Lawrence	**AT END OF DRILLING** --- No Groundwater	
NOTES		**AFTER DRILLING** --- No Groundwater	

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0				MH	1.0	(MH) Clayey Silt, brown, soft to firm, moist, organic, with a trace of gravel and white chalky material	558.3
		58		CL-ML	5.0	(CL-ML) Silty Clay, orange-brown mottled brown, stiff to hard, slightly moist, with some gravel	554.3
5	ST1	33 / 76	PP = 4.5+ tsf	CL-ML	10.0	(CL-ML) Silty Clay, orange-brown mottled brown, hard, slightly moist, calcareous, with chalk in joints and fossil fragments	549.3
10	ST2	29 / 100	PP = 4.5+ tsf			Silty Shale, orange-brown mottled brown and gray, hard, slightly moist, calcareous, weathered Chalk in joints 10-11.5 feet	
15	ST3	33 / 100	PP = 4.5+ tsf			Silty lenses and crystalline deposits in interbeds 15-35 feet	
20	ST4	33 / 56	PP = 4.5+ tsf				
25	ST5	33 / 71	PP = 3.0 tsf			More moist and softer 25-35 feet	
30	ST6	38 / 61	PP = 1.0-4.0 tsf				
35							

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Telephone: 817-571-2288

BORING NUMBER B-46

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7	33 71	PP = 3.0-4.5 tsf			
40	ST8	21 96	PP = 4.5+ tsf Weathered to Unweathered zone			40.0 — 519.3 Silty Shale, gray, hard, slightly moist, calcareous, with silty lenses in interbeds Traces of orange-brown staining 40-65 feet
45	ST9	21 96	PP = 4.5+ tsf MC = 13% DD = 110 pcf LL = 62 PL = 41 Fines = 94%			Shell/fossil fragments 45-65 feet
50		74				
55	ST10	25 95	PP = 4.5+ tsf			
60		80	PP = 4.5+ tsf			
65	ST11	17				65.4 — 493.9 Bottom of borehole at 65.4 feet.

5-13-2020

SCS ENGINEERS

1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-47 (PZ-47)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DATE STARTED 10/11/18 **COMPLETED** 10/12/18

GROUND ELEVATION 532.4 ft **HOLE SIZE** 7.25 inches

DRILLING CONTRACTOR West Drilling

GROUND WATER LEVELS:

DRILLING METHOD Continuous Flight Auger

AT TIME OF DRILLING --- No Groundwater

LOGGED BY V. Wooters **CHECKED BY** J. Lawrence

AT END OF DRILLING --- No Groundwater

NOTES

AFTER DRILLING --- No Groundwater

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	ELEV.
0 – 0.5				ML	(ML) Silt, dark brown, soft, moist	531.9
0.5 – 7.0		100		CL	(CL) Clay, light gray, hard, dry, calcareous, with chalk in fractures	525.4
5	ST1	100	PP = 4.5+ tsf			
7.0 – 27.0				CL-ML	(CL-ML) Silty Clay, orange-tan mottled gray, hard, dry, calcareous, with chalk in fractures/joints Trace of sub-angular gravel 1/8" at 7-10 feet	505.4
10	ST2	40	PP = 4.5+ tsf			
15	ST3	80	PP = 4.5+ tsf			
20	ST4	80	PP = 4.5+ tsf			
25	ST5	100	PP = 4.5+ tsf			
27.0 – 33.0				CL	(CL) Clay, gray with orange-brown mottling, hard, slighty moist to dry, calcareous, with weathered shale, weathered	499.4
30		80	Weathered to Unweathered zone			
33.0 – 35						

WELL DIAGRAM

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1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-47 (PZ-47)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE/NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35		100				Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 38-57 *(continued)*	
40		80					
45	ST6	80	PP = 4.5+ tsf				
50		80					
55	ST7	100	PP = 4.5+ tsf			57.0 ... 475.4	

Bottom of borehole at 57.0 feet.

STATE OF TEXAS
James Lawrence
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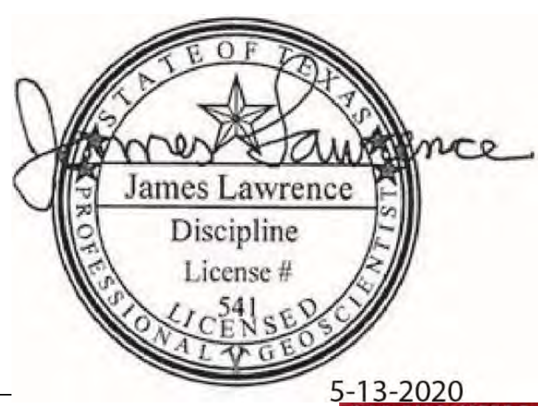
5-13-2020

APPENDIX III-4.E

STATE WELL REPORTS



5-13-2020

STATE OF TEXAS WELL REPORT for Tracking #508684

Owner: **The City of Waco**

Address: **401 Franklin Avenue**
Waco, TX 76701

Well Location: **intersection of Happy Swaner Ln &**
TK Pkwy 939
Axtell, TX 76701

Well County: **McLennan**

Owner Well #: **PZ-1**

Grid #: **39-17-5**

Latitude: **31° 42' 16.86" N**

Longitude: **096° 55' 59.13" W**

Elevation: **552 ft. above sea level**

Type of Work: **New Well**

Proposed Use: **PIEZOMETER**

Drilling Start Date: **10/4/2018** Drilling End Date: **10/4/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**39.47**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
16	**39.47**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**13**	**Cement 1 Bags/Sacks**
13	**16**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	Strata Depth (ft.)	Water Type
	No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. Bruce Milton** License Number: **4926**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**2**	**SILTY CLAY, drk. brown**
2	**15**	**SILTY CLAY, red/orange to brown**
15	**28**	**SILTY CLAY shale, orange-brown mottled brown**
28	**39.47**	**SILTY CLAY shale, gray to drk. gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**19.19**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**19.19**	**38.13**
2	**END CAP**	**New Plastic (PVC)**	**40**	**38.86**	**39.47**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508363

Owner:	**The City of Waco**	Owner Well #:	**PZ-3**
Address:	**401 Franklin Avenue** **Waco, TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln &** **TK Pkwy 939** **Axtell, TX 76701**	Latitude:	**31° 41' 54.3" N**
		Longitude:	**096° 55' 43.84" W**
Well County:	**McLennan**	Elevation:	**541 ft. above sea level**

Type of Work: **New Well** Proposed Use: **PIEZOMETER**

Drilling Start Date: **10/10/2018** Drilling End Date: **10/10/2018**

Borehole:

Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
8.25	**0**	**45**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
21.5	**45**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
0	**17.5**	**Cement 1 Bags/Sacks**
17.5	**21.5**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. BRUCE MILTON** License Number: **4926**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**2**	**Topsoil**
2	**8**	**CLAY, brown to red/brown**
8	**20**	**CLAY, mottled red/gray/brown**
20	**22.6**	**SAND, brown**
22.6	**22.8**	**SILTY CLAY, drk. brown**
22.8	**27**	**SILTY CLAY, orange-brown mottled brown**
27	**39**	**SILTY CLAY, shale, gray with orange-brown staining**
39	**45**	**SILTY CLAY, shale, drk. gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**24.53**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**24.53**	**44.53**
2	**END CAP**	**New Plastic (PVC)**	**40**	**44.53**	**44.76**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508360

Owner:	**The City of Waco**	Owner Well #:	**PZ-8**
Address:	**401 Franklin Avenue Waco , TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 11.59" N**
		Longitude:	**096° 55' 12.21" W**
Well County:	**Limestone**	Elevation:	**550 ft. above sea level**

Type of Work: **New Well** Proposed Use: **PIEZOMETER**

Drilling Start Date: **11/27/2018** Drilling End Date: **11/28/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**75**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
52.7	**75**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**48.7**	**Cement 2 Bags/Sacks**
48.7	**52.7**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. BRUCE MILTON** License Number: **4926**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1.5**	**CLAYEY SILT, drk. brown**
1.5	**10**	**SILTY CLAY, gray to lt. gray**
10	**20**	**SILTY CLAY, orange-brown**
20	**43.8**	**SILTY CLAY (weathered shale marl), orange-brown**
43.8	**75**	**SILTY CLAY Shale Marl, gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**54.47**
2	**Riser**	**New Plastic (PVC)**	**40 0.010**	**54.47**	**74.47**
2	**Bottom Cap**	**New Plastic (PVC)**	**40**	**74.47**	**74.7**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508367

Owner:	**The City of Waco**	Owner Well #:	**PZ-9**
Address:	**401 Franklin Avenue Waco, TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 10.46" N**
		Longitude:	**096° 55' 37.43" W**
Well County:	**Limestone**	Elevation:	**535 ft. above sea level**
Type of Work:	**New Well**	Proposed Use:	**PIEZOMETER**

Drilling Start Date: **10/9/2018** Drilling End Date: **10/10/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**40**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
15.9	**38.48**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**10.8**	**Cement 1 Bags/Sacks**
10.8	**15.9**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. BRUCE MILTON** License Number: **4926**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**5**	**SILTY CLAY, drk. brown to gray**
5	**10**	**SILTY CLAY, lt. gray/tan**
10	**28.5**	**SILTY CLAY shale gray and orange-brown**
28.5	**40**	**SILTY CLAY shale**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**18.28**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**18.28**	**38.28**
2	**END CAP**	**New Plastic (PVC)**	**40**	**38.28**	**38.48**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #509203

Owner:	**The City of Waco**	Owner Well #:	**PZ-18**
Address:	**401 Franklin Avenue Waco, TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 28.96" N**
		Longitude:	**096° 55' 26.98" W**
Well County:	**Limestone**	Elevation:	**535 ft. above sea level**
Type of Work:	**New Well**	Proposed Use:	**PIEZOMETER**

Drilling Start Date: **10/29/2018** Drilling End Date: **10/30/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**56**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
22.8	**56**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**19**	**Cement 1 Bags/Sacks**
19	**22.8**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. Bruce Milton**

License Number: **4926**

Comments: **Hole backfilled 56' - 45.5'**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**2.7**	**SANDY CLAY, topsoil, drk. brown**
2.7	**6.8**	**SILTY CLAY, lt. gray**
6.8	**14.5**	**SILTY CLAY, orange brown**
14.5	**30**	**SILTY SILT, gray**
30	**56**	**SILTY shale, gray**
56	**60**	**SILTY SILT, gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**25.18**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**25.18**	**44.13**
2	**END CAP**	**New Plastic (PVC)**	**40**	**44.13**	**45.5**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #500910

Owner:	**City of Waco**	Owner Well #:	**B-20**
Address:	**721 N. 4th Street** **Waco, TX 76701**	Grid #:	**39-17-2**
Well Location:	**Southeast corner of TK Pkwy and HWy 31** **Axtell, TX 76673**	Latitude:	**31° 42' 34.93" N**
		Longitude:	**096° 55' 14.49" W**
Well County:	**Limestone**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Piezometer**

Drilling Start Date: **10/29/2018** Drilling End Date: **10/29/2018**

Borehole:

Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
7.25	0	73

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Open Hole**

Annular Seal Data:

Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
0	3	Cement 2 Bags/Sacks
3	42	Bentonite 15 Bags/Sacks
42	64	Sand 10 Bags/Sacks
64	73	backfill cuttings

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

The driller did certify that while drilling, deepening or otherwise altering the above described well, injurious water or constituents was encountered and the landowner or person having the well drilled was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Ricardo Garcia** License Number: **54637**

Apprentice Name: **Joseph Garcia** Apprentice Number: **59885**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**7.5**	**Silty Clay gray**
7.5	**35**	**Silty Clay tan gray**
35	**47**	**Shaley Clay dark gray**
47	**73**	**Silty Clay Shale dark gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**3**	**44**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**44**	**64**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #509216

Owner:	**The City of Waco**	Owner Well #:	**PZ-33**
Address:	**401 Franklin Avenue Waco, TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 00" N**
		Longitude:	**096° 55' 14.54" W**
Well County:	**Limestone**	Elevation:	**539 ft. above sea level**

Type of Work: **New Well** Proposed Use: **PIEZOMETER**

Drilling Start Date: **11/19/2018** Drilling End Date: **11/20/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**55**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
33	**55**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**30**	**Cement 1 Bags/Sacks**
30	**33**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. Bruce Milton** License Number: **4926**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
1	**1.5**	**CLAYEY SILT topsoil**
1.5	**28**	**SILTY CLAY, brown to tan**
28	**55**	**SILTY CLAY, shale, gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**34.63**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**34.63**	**54.63**
2	**END CAP**	**New Plastic (PVC)**	**40**	**54.63**	**54.9**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508364

Owner:	**The City of Waco**	Owner Well #:	**PZ-41**
Address:	**401 Franklin Avenue Waco, TX 76701**	Grid #:	**39-17-6**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 10.8" N**
		Longitude:	**096° 54' 58.94" W**
Well County:	**Limestone**	Elevation:	**535 ft. above sea level**
Type of Work:	**New Well**	Proposed Use:	**PIEZOMETER**

Drilling Start Date: **12/17/2018** Drilling End Date: **12/18/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**60**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
24	**48.77**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**22**	**Cement 1 Bags/Sacks**
22	**24**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. BRUCE MILTON** License Number: **4926**

Comments: **Hole Backfilled from 60' - 48.77 with native material**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**5**	**SILTY CLAY, drk. brown to gray**
5	**12**	**SILTY CLAY, gray grading to brown and orange-brown**
12	**29**	**SILTY CLAY shale marl, orange-brown stained brown and gray**
29	**43**	**Shale Marl, drk. gray with orange-brown staining in joints**
43	**60**	**Shale Marl, gray to drk. gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

DIa (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**28.58**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**28.58**	**48.58**
2	**END CAP**	**New Plastic (PVC)**	**40**	**48.58**	**48.77**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508365

Owner:	**The City of Waco**	Owner Well #:	**PZ-43**
Address:	**401 Franklin Avenue Waco , TX 76701**	Grid #:	**39-17-5**
Well Location:	**intersection of Happy Swaner Ln & TK Pkwy 939 Axtell, TX 76701**	Latitude:	**31° 42' 20.55" N**
		Longitude:	**096° 55' 01.03" W**
Well County:	**Limestone**	Elevation:	**549 ft. above sea level**

Type of Work: **New Well** Proposed Use: **PIEZOMETER**

Drilling Start Date: **11/15/2018** Drilling End Date: **11/16/2018**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**75**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
24	**48.45**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**22**	**Cement 1 Bags/Sacks**
22	**24**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **L. BRUCE MILTON** License Number: **4926**

Comments: **Hole backfilled with native material from 75' - 48.45'**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1**	**CLAYEY SILT, drk. brown**
1	**5**	**SILTY CLAY, drk. brown**
5	**10**	**SILTY CLAY, orange-brown**
10	**25**	**SILTY CLAY (weathered shale/marl) orange-brown**
25	**32**	**SILTY CLAY (shale/marl) gray**
32	**75**	**SILTY shale marl, gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**28.2**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**28.2**	**48.2**
2	**END CAP**	**New Plastic (PVC)**	**40**	**48.2**	**48.45**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #500935

Owner:	**City of Waco**	Owner Well #:	**PZ-47**
Address:	**721 N. 4th Street Waco, TX 76701**	Grid #:	**39-17-5**
Well Location:	**Southeast corner of TK Pkwy and HWy 31 Axtell, TX 76673**	Latitude:	**31° 42' 02.16" N**
		Longitude:	**096° 55' 28.39" W**
Well County:	**Limestone**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Piezometer**

Drilling Start Date: **10/29/2018** Drilling End Date: **10/29/2018**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**57.4**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Open Hole**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**3.5**	**Cement 2 Bags/Sacks**
	3.5	**8**	**Bentonite 2 Bags/Sacks**
	8	**30**	**Sand 10 Bags/Sacks**
	30	**57**	**Bentonite 14 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	Strata Depth (ft.)	Water Type
	No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

The driller did certify that while drilling, deepening or otherwise altering the above described well, injurious water or constituents was encountered and the landowner or person having the well drilled was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Ricardo Garcia** License Number: **54637**

Apprentice Name: **Joseph Garcia** Apprentice Number: **59885**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	*Bottom (ft.)*	*Description*
0	**7**	**Clay light gray**
7	**27**	**Silty Clay tan gray**
27	**33**	**Shaley Clay gray**
33	**57.4**	**Silty Clay Shale dark gray**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	*Type*	*Material*	*Sch./Gage*	*Top (ft.)*	*Bottom (ft.)*
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**10**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**10**	**30**

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Texas Department of Licensing and Regulation
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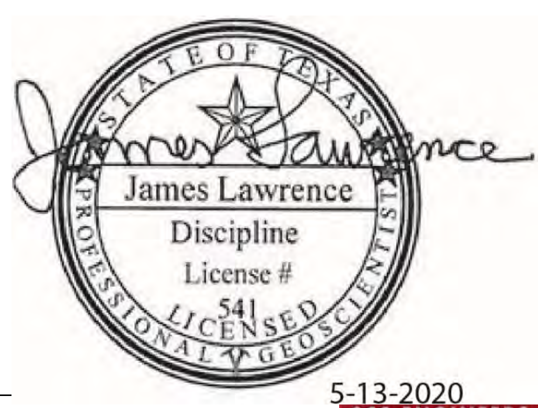
Austin, TX 78711
(512) 334-5540

APPENDIX III-4.F

GEOTECHNICAL INVESTIGATION REPORTS



5-13-2020

LANGERMAN FOSTER ENGINEERING COMPANY

Site 50

Summary of Laboratory Test Results

Boring Number	Sample Depth (ft)	LL(1)	PI(2)	% Passing on #200 Sieve	% Retained on #4 Sieve	MC(3)	USCS(4)	GSA(5)	Description
A-1	10 to 12	83	58	97	0	31	CH		FAT CLAY; tan and light gray
	12 to 14			93	0			✓	FAT CLAY; tan and light gray
	14 to 16	89	63	98	0	30	CH		FAT CLAY; tan and gray
	18 to 20	79	56	80	13	22	CH		FAT CLAY; reddish brown, with gravel and trace sand
	30 to 35	66	43	84	2	14	--		SHALE; dark gray, with sand lens
	40 to 45	73	52	91	0	14	--		SHALE; dark gray, calcareous
	60 to 65	72	52	90	1	18	--	✓	SHALE; dark gray
A-2	10 to 12	71	51	90	1	20	CH		FAT CLAY; tan and brown, calcareous
	16 to 18	69	48	82	0	18	CH	✓	FAT CLAY; tan and light gray, iron staining, with sand
	30 to 32	74	52	84	3	21	CH	✓	FAT CLAY; tan and gray, with sand
	45 to 50	56	36	91	0	13	--	✓	SHALE; dark gray
A-4	10 to 12	75	51	95	0	21	CH		FAT CLAY; tan and brown, calcareous
	22 to 24	74	53	94	1	21	CH	✓	FAT CLAY; tan and gray, iron staining
	31 to 36	55	37	91	0	13	--	✓	SHALE; dark gray
	46 to 51	62	44	97	0	13	--		SHALE; dark gray
	86 to 91	74	53	77	9	14	--		SHALE; dark gray, with sand lens
A-5	12 to 14	62	41	75	4	16	CH		FAT CLAY; tan and light gray, with sand
	22 to 24	66	46	76	8	18	CH	✓	FAT CLAY; tan, calcareous, with sand
	30 to 35	63	42	96	1	17	--		SHALE; dark gray

(1)Liquid Limit

(2)Plasticity Index

(3)Moisture Content

(4)Unified Soil Classification System

(5)Grain Size Analysis - Detailed Grain Size Analysis Results are recorded on the following pages. Gradation Curves are included.

LANGERMAN FOSTER ENGINEERING COMPANY

Site 50, Part 2, West

Summary of Laboratory Test Results

Boring Number	Sample Depth (ft)	LL(1)	PI(2)	% Fines*	% Sand**	% Gravel***	MC(3)	Dry Unit Weight (pcf)	Qu Strength (tsf)	USCS(4)	Description
B-1	15-20	75	53	93	5	2	23			CH	FAT CLAY; tan and brown, with iron stains
	35-38	69	45	97	3	0	19			CH	FAT CLAY; dark gray
B-3	25-30	60	36	93	7	0	18			CH	FAT CLAY; tan and light gray
	40-45	63	43	96	4	0	16			CH	FAT CLAY; dark gray
B-8	10-12										Bulk Sample, Proctor
B-9	5-7	53	35	75	23	2	15			CH	FAT CLAY; light gray, with sand
	20-22	67	47	91	6	3	20	105	12.32	CH	FAT CLAY; tan and light gray
	35-37	62	42	89	8	3	15	116		CH	FAT CLAY; dark gray
B-16	10-12	78	53	91	9	0	19	105		CH	FAT CLAY; tan and gray, with iron stains
	10-12										Bulk Sample, Proctor
	25-27	60	38	77	18	5	15	116	17.76	CH	FAT CLAY; tan, with sand
	50-52	64	43	94	6	0	17	115		CH	FAT CLAY; dark gray
B-17	15-17	66	41	91	9	0	19	106	8.09	CH	FAT CLAY; tan and light gray
	25-27										Sample sent to TRI, also receiving advanced geotechnical testing
	45-47	60	41	83	17	0	15	120	23.36	CH	FAT CLAY; gray, with sand
B-19	10-12										Bulk Sample, Proctor
B-23	10-12	73	52	98	2	0	20	108		CH	FAT CLAY; tan and light gray
	10-12										Bulk Sample, Proctor
	30-32	74	51	85	12	3	18	108		CH	FAT CLAY; tan and gray, with sand
	35-37	77	55	89	11	0	20	101	Not testable	CH	FAT CLAY; gray, with iron stains
	40-42	70	50	96	4	0	15			CH	FAT CLAY; dark gray
B-24	5-7	51	33	73	24	3	15	112	14.94	CH	FAT CLAY; light gray, with sand
	15-17	74	52	98	2	0	21	99	7.94	CH	FAT CLAY; tan and gray
	25-27	69	44	89	11	0	19	103		CH	FAT CLAY; brown and light gray
	45-47										Sample sent to TRI, also receiving advanced geotechnical testing
B-31	15-17										Sample sent to TRI, also receiving advanced geotechnical testing
	30-32	74	52	90	7	3	18	103	5.37	CH	FAT CLAY; dark gray
	55-57	60	37	96	3	1	14			CH	FAT CLAY; dark gray
B-44	10-12	71	49	91	6	3	20	108		CH	FAT CLAY; tan and light gray
	20-22	79	55	84	11	5	21	105		CH	FAT CLAY; tan, with sand
	30-32	72	51	97	3	0	25	97	4.44	CH	FAT CLAY; tan and light gray
	50-52										Sample sent to TRI, also receiving advanced geotechnical testing

(1)Liquid Limit
(2)Plasticity Index
(3)Moisture Content
(4)Unified Soil Classification System

* % Fines is defined as the fraction of the total sample passing the #200 Sieve
** % Sand is defined as the fraction of the total sample passing the #4 Sieve and retained on the #200 Sieve
*** % Gravel is defined as the fraction of the total sample retained on the #4 Sieve

12/24/2018

LANGERMAN FOSTER ENGINEERING COMPANY

Site 50, Part 2, East

Summary of Laboratory Test Results

Boring Number	Sample Depth (ft)	LL(1)	PI(2)	% Fines*	% Sand**	% Gravel***	MC(3)	Dry Unit Weight (pcf)	Qu Strength (tsf)	USCS(4)	Description
B-8	40-42	58	38	92	8	0	16	106	4.02	CH	SHALY FAT CLAY; tan, with iron stains
	50-52	58	37	97	2	1	14	116	Not testable	CH	SHALY FAT CLAY; dark gray
B-11	20-22	75	49	89	10	1	21	95		CH	FAT CLAY; tan and gray, with calcareous fragments
	45-47	55	33	86	14	0	13	120		CH	FAT CLAY; dark brown, with iron stains
B-13	35-37	66	43	94	6	0	20	109		CH	FAT CLAY; tan, with iron stains
	45-47	51	33	95	5	0	15	112	Not testable	CH	SHALY FAT CLAY; dark gray
B-14	15-17	58	35	65	30	5	19	104		CH	SANDY FAT CLAY; tan and gray, with iron stains
	35-37	58	39	94	5	1	15			CH	FAT CLAY; dark gray
B-15	55-57	57	37	91	7	2	11	116	1.61	CH	FAT CLAY; brown and dark gray
B-18	10-12	66	45	92	7	1	19	105	4.26	CH	FAT CLAY; tan and brown, with iron stains
	45-47	57	38	90	10	0	13	109	3.59	CH	FAT CLAY; dark gray, with iron stains
B-19	50-52	63	44	91	7	2	14	117		CH	SHALY FAT CLAY; tan and gray, with iron stains
	50-51	60	39	85			13				Sample sent to TRI, also receiving advanced geotechnical testing
	70-72	57	38	95	5	0	15	115	16.29	CH	SHALY FAT CLAY; gray and dark brown
B-20	45-47	59	36	95	5	0	13	116	18.68	CH	SHALY FAT CLAY; gray and dark brown
	55-57	58	37	96	3	1	15	118	16.82	CH	SHALY FAT CLAY; gray and dark brown
B-21	15-17	69	44	97	3	0	19			CH	FAT CLAY; tan and gray, with iron stains
	30-32						19	108	10.49	CH	SHALY FAT CLAY; dark brown
	30-32	57	39	94	6	0	15			CH	FAT CLAY; gray
	40-42	61	40	88	8	4	14			CH	SHALY FAT CLAY; gray
B-27	25-27	68	47	87	10	3	18	108		CH	FAT CLAY; tan and gray, with calcareous fragments
	40-42	61	40	97	3	0	15	118		CH	SHALY FAT CLAY; gray
B-29	25-27	60	39	95	4	1	16	113		CH	FAT CLAY; dark gray
	35-37	51	34	90	10	0	11	114		CH	FAT CLAY; dark gray
B-30	15-17	61	41	90	6	4	18	115		CH	FAT CLAY; tan, with iron stains
	30-32	62	41	94	6	0	18			CH	FAT CLAY; tan and gray, with a silty seam
B-34	10-12	57	38	82	17	1	14			CH	FAT CLAY; tan, with calcareous fragments
	20-22	63	43	95	5	0	16	111		CH	FAT CLAY; tan and gray, with calcareous fragments and iron stains
B-35	45-47	54	33	75	17	8	13	109		CH	SHALY FAT CLAY; gray, with sand
B-43	10-12	60	40	95	5	0	18	111	7.12	CH	FAT CLAY; tan, with iron stains
	25-27	61	42	94	5	1	16	117	Not testable	CH	FAT CLAY; tan, with calcareous fragments
	45-47	63	40	95	5	0	16	108		CH	SHALY FAT CLAY; gray
B-45	25-27	66	46	90	8	2	21	107	6.21	CH	FAT CLAY; brown and gray, with calcareous fragments and iron stains
	40-42	58	38	92	8	0	15			CH	SHALY FAT CLAY; gray
B-46	45-47	62	41	94	6	0	13	110	Not testable	CH	SHALY FAT CLAY; gray

(1) Liquid Limit
(2) Plasticity Index
(3) Moisture Content
(4) Unified Soil Classification System

* % Fines is defined as the fraction of the total sample passing the #200 Sieve
** % Sand is defined as the fraction of the total sample passing the #4 Sieve and retained on the #200 Sieve
*** % Gravel is defined as the fraction of the total sample retained on the #4 Sieve
"Not testable" indicates that the sample was fractured or otherwise compromised for quality strength tests

02/15/2019

LANGERMAN FOSTER ENGINEERING COMPANY

Site 50, Part 2, Data Set 4

Summary of Laboratory Test Results

Boring Number	Sample Depth (ft)	LL(1)	PI(2)	% Fines*	% Sand**	% Gravel***	MC(3)	Dry Unit Weight (pcf)	USCS(4)	Description
B-10	10-12	65	41	90	7	3	19		CH	FAT CLAY; tan and gray, with iron stains and limestone fragments
	25-27	54	33	94	6	0	15	108	CH	FAT CLAY; tan and brown, with iron stains and limestone fragments
	40-42	59	39	92	7	1	14		CH	FAT CLAY; dark brown
B-22	30-32	74	47	84	8	8	20		CH	FAT CLAY; tan and gray, with gravel and iron stains
	45-47	64	39	92	7	1	17		CH	FAT CLAY; dark brown, with iron stains
B-36	15-17	56	35	91	8	1	18		CH	FAT CLAY; tan and gray, with iron stains
	30-32	64	39	93	7	0	17	115	CH	FAT CLAY; tan and brown, with iron stains

(1)Liquid Limit
(2)Plasticity Index
(3)Moisture Content
(4)Unified Soil Classification System

* % Fines is defined as the fraction of the total sample passing the #200 Sieve
** % Sand is defined as the fraction of the total sample passing the #4 Sieve and retained on the #200 Sieve
*** % Gravel is defined as the fraction of the total sample retained on the #4 Sieve
"Not testable" indicates that the sample was fractured or otherwise compromised for quality strength tests

2/21/2019

LANGERMAN FOSTER ENGINEERING COMPANY

Site 50, Part 2, Data Set 4

Summary of Laboratory Test Results

Boring Number	Sample Depth (ft)	LL[(1)]	PI[(2)]	% Fines*	% Sand**	% Gravel***	MC[(3)]	Dry Unit Weight (pcf)	USCS[(4)]	Description
B-9	57	63	41	99	1	0	15	--	CH	SHALY FAT CLAY; gray
B-9	78	64	42	93	4	3	14	--	CH	SHALY FAT CLAY; gray
B-9	106	73	51	97	3	0	15	--	CH	SHALY FAT CLAY; gray
B-9	132	74	49	89	11	0	16	--	CH	SHALY FAT CLAY; gray
B-43	74	60	40	91	8	1	15	--	CH	SHALY FAT CLAY; gray
B-43	119	68	46	81	9	10	12	--	CH	SHALY FAT CLAY; gray, with gravel
B-43	146	75	50	99	1	0	15	--	CH	SHALY FAT CLAY; gray

(1) Liquid Limit
(2) Plasticity Index
(3) Moisture Content
(4) Unified Soil Classification System

* % Fines is defined as the fraction of the total sample passing the #200 Sieve
** % Sand is defined as the fraction of the total sample passing the #4 Sieve and retained on the #200 Sieve
*** % Gravel is defined as the fraction of the total sample retained on the #4 Sieve

3/5/2020

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-1
Top Depth	12'
Bottom Depth	14'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	100.00
19	3/4"	100.00
9.5	3/8"	100.00
4.75	4	100.00
2	10	96.42
0.85	20	95.28
0.425	40	94.74
0.25	60	94.49
0.15	100	94.41
0.075	200	93.44
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		

Maximum Particle Size
4.75 mm

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

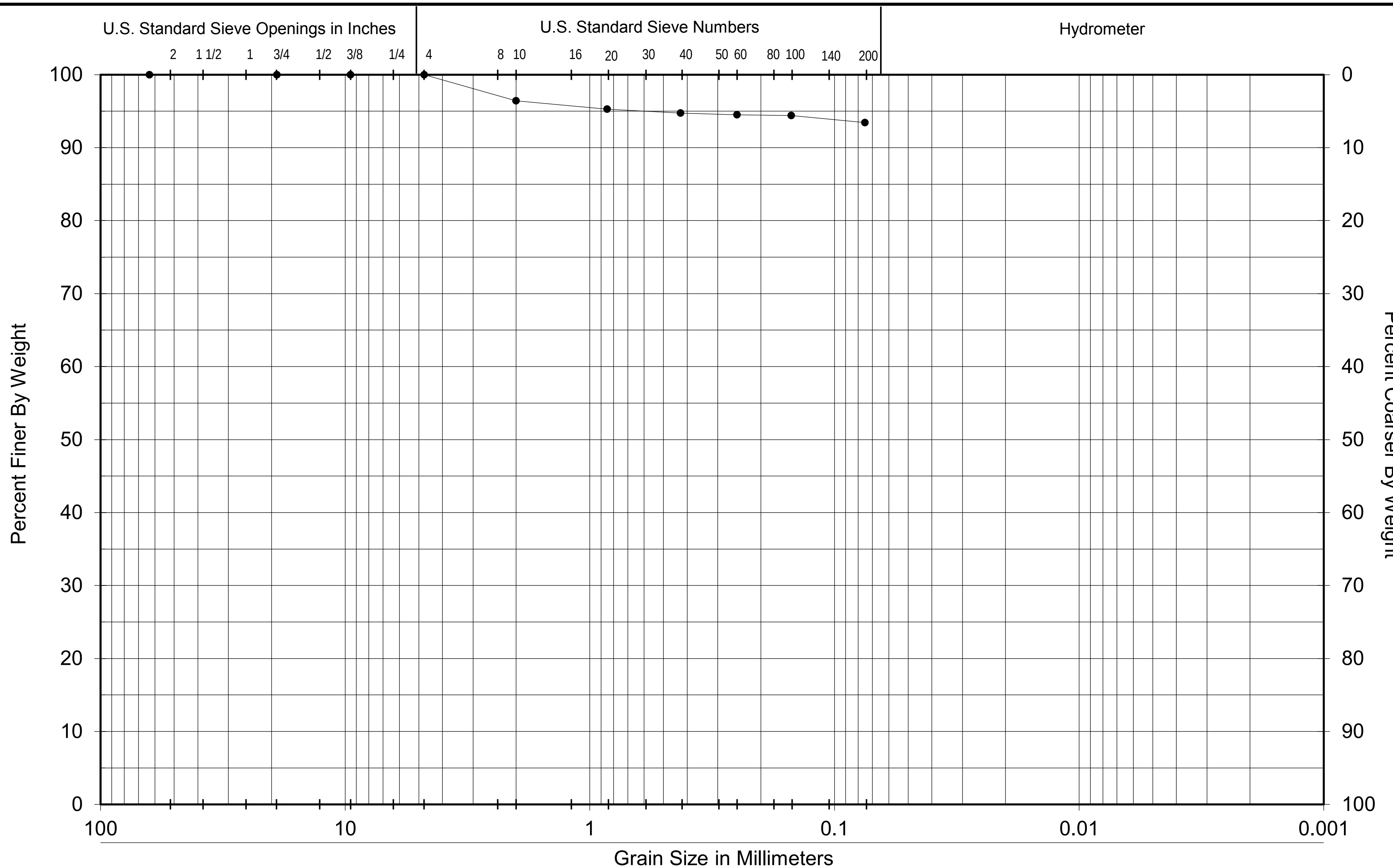
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	3.58
% Sand	0.075 - 2 mm	2.98
% Silt	0.002 - 0.075 mm	
% Clay	< 0.002 mm	

Hydrometer Type
151H

% Passing #10 96.42
% Passing #200 93.44
% Pass 2µ



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006

SCS Engineers/City of Waco

Site 50

Core ID A-1

Depth 12' to 14'

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-1
Top Depth	60'
Bottom Depth	65'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	
19	3/4"	
9.5	3/8"	
4.75	4	89.53
2	10	82.28
0.85	20	77.42
0.425	40	75.08
0.25	60	74.08
0.15	100	73.51
0.075	200	69.37
0.0414		60.96
0.0297		58.31
0.0189		56.98
0.0111		53.01
0.0079		50.36
0.0056		49.03
0.0029		38.43
0.0013		29.15
0.0006		21.20

Maximum Particle Size
not recorded

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

Dispersing Device
Apparatus A, ASTM D-422

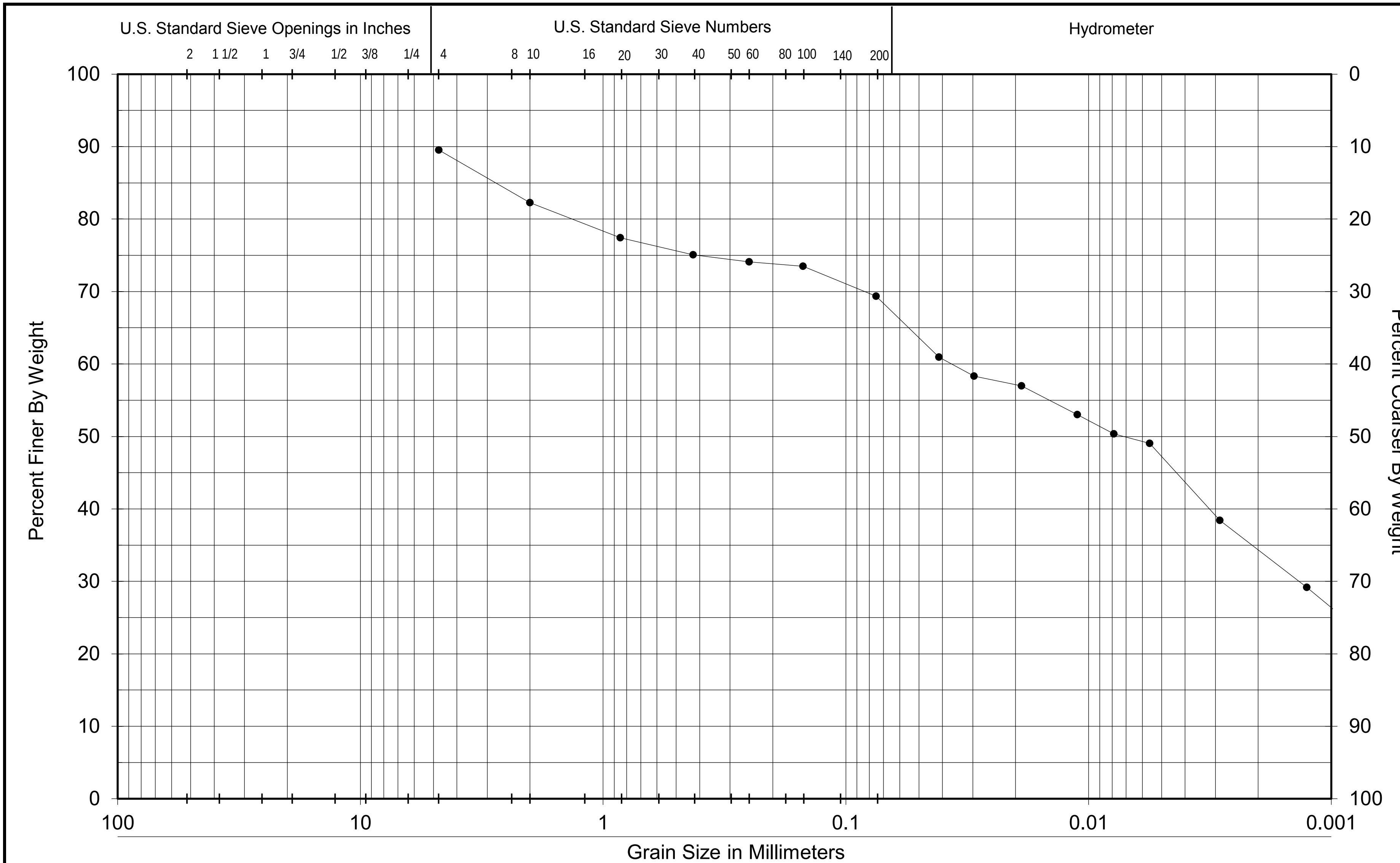
Dispersing Period
1 min

% Gravel	> 2 mm	17.72
% Sand	0.075 - 2 mm	12.91
% Silt	0.002 - 0.075 mm	37.72
% Clay	< 0.002 mm	31.64

Hydrometer Type
151H

% Passing #10	82.28
% Passing #200	69.37
% Pass 2µ	31.64

Comments:
A large piece of Shaly material did not disaggregate during the sieve analysis of this sample. It contributed to a disproportionate mass to be retained on the No. 4 sieve. The size and mass of the shale piece was not recorded. However, another sample from the same depth was wet sieved on the No. 200 sieve later. At that time, 90% of the sample passed the No. 200 sieve and 1% was retained on the No. 4 sieve.



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006

SCS Engineers/City of Waco

Site 50

Core ID A-1

Depth 60' to 65'

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-2
Top Depth	16'
Bottom Depth	18'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	100.00
19	3/4"	100.00
9.5	3/8"	100.00
4.75	4	100.00
2	10	91.44
0.85	20	87.21
0.425	40	85.55
0.25	60	84.91
0.15	100	84.59
0.075	200	82.20
0.0377		76.35
0.0271		73.72
0.0174		71.09
0.0102		67.14
0.0073		64.50
0.0052		61.87
0.0027		55.29
0.0012		47.39
0.0006		39.49

Maximum Particle Size
4.75 mm

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

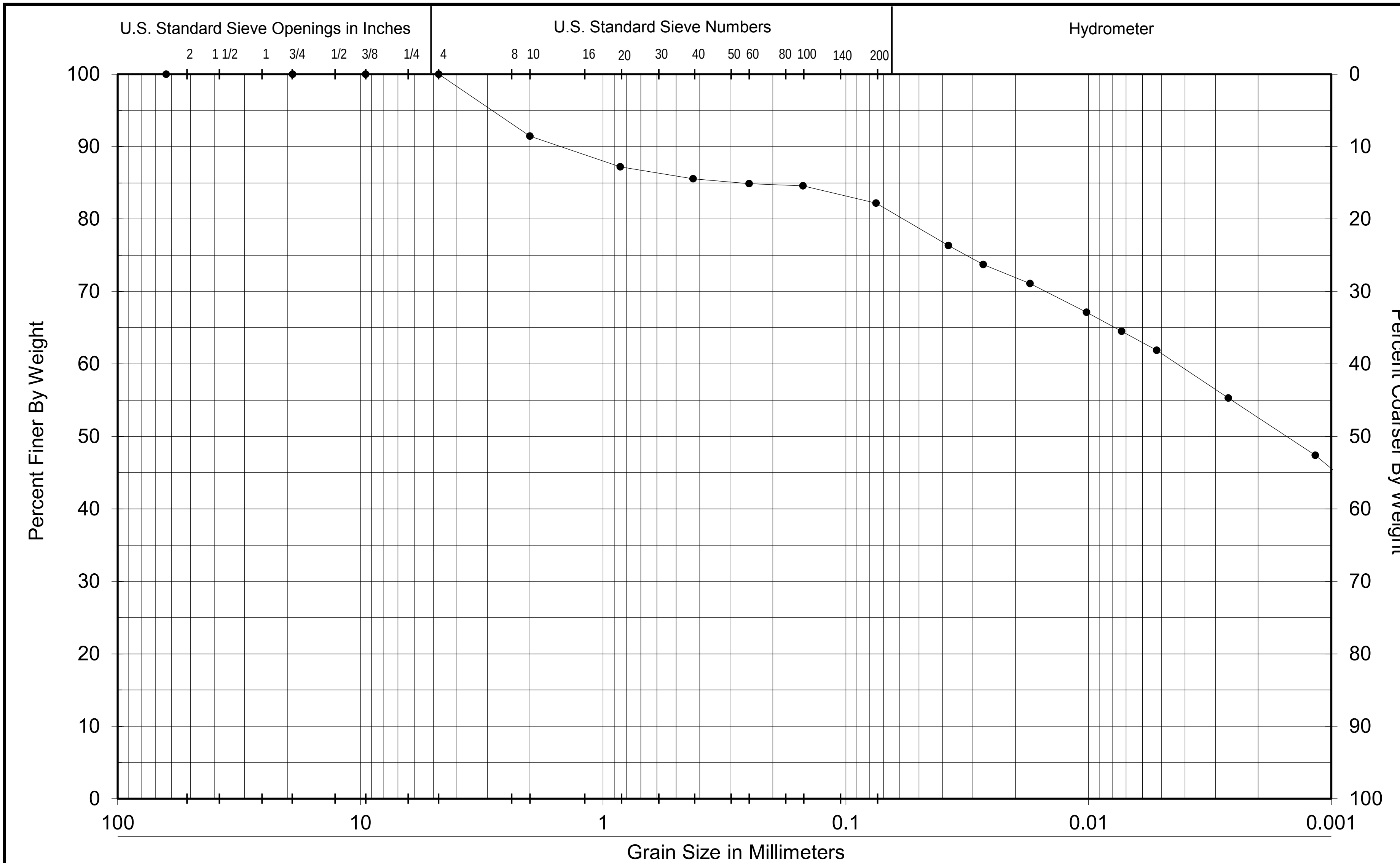
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	8.56
% Sand	0.075 - 2 mm	9.24
% Silt	0.002 - 0.075 mm	31.96
% Clay	< 0.002 mm	50.24

Hydrometer Type
151H

% Passing #10	91.44
% Passing #200	82.20
% Pass 2µ	50.24



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006

SCS Engineers/City of Waco

Site 50

Core ID A-2

Depth 16' to 18'

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-2
Top Depth	30'
Bottom Depth	32'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	
19	3/4"	
9.5	3/8"	
4.75	4	95.00
2	10	92.36
0.85	20	88.59
0.425	40	87.11
0.25	60	86.53
0.15	100	86.25
0.075	200	84.12
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		
0.0000		

Maximum Particle Size
not recorded

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

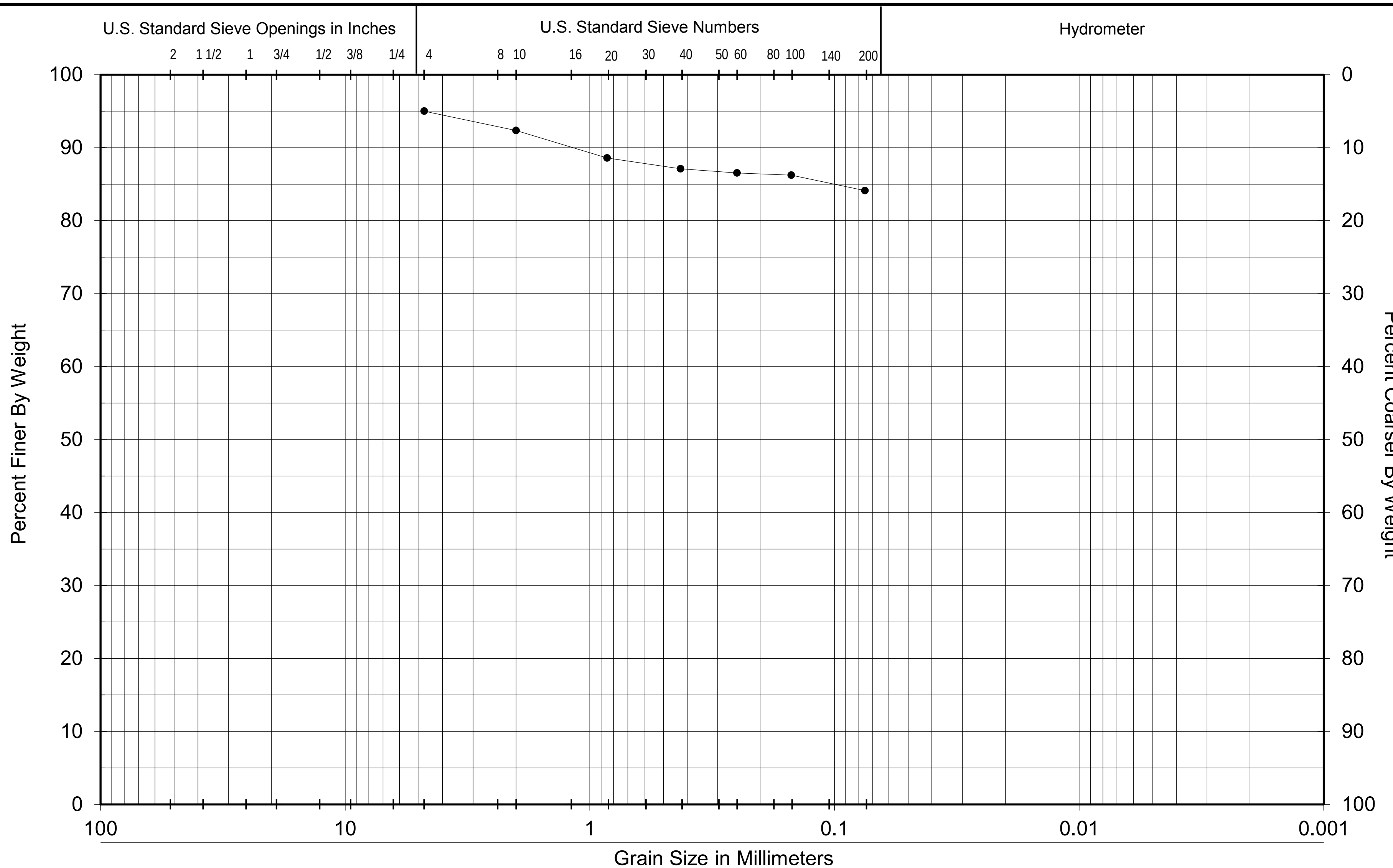
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	7.64
% Sand	0.075 - 2 mm	8.24
% Silt	0.002 - 0.075 mm	
% Clay	< 0.002 mm	

Hydrometer Type
151H

% Passing #10	92.36
% Passing #200	84.12
% Pass 2µ	



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006 Core ID A-2

SCS Engineers/City of Waco Depth 30' to 32'

Site 50

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-2
Top Depth	45'
Bottom Depth	50'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	100.00
19	3/4"	100.00
9.5	3/8"	100.00
4.75	4	100.00
2	10	98.95
0.85	20	94.95
0.425	40	93.35
0.25	60	92.86
0.15	100	92.65
0.075	200	90.73
0.0384		86.17
0.0280		80.02
0.0181		75.40
0.0106		70.78
0.0077		64.63
0.0055		63.09
0.0028		52.32
0.0012		36.93
0.0006		24.62

Maximum Particle Size
4.75 mm

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

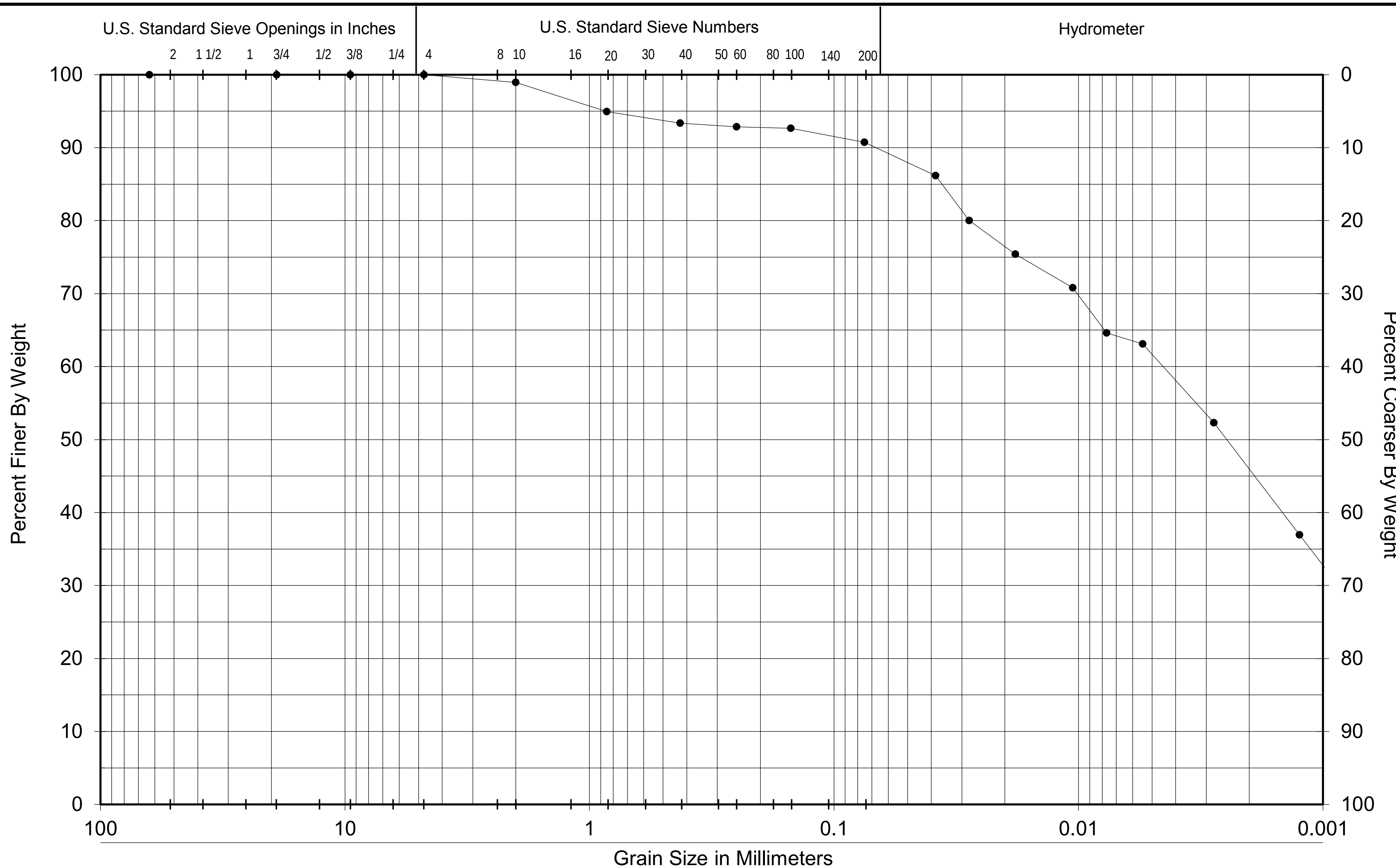
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	1.05
% Sand	0.075 - 2 mm	8.22
% Silt	0.002 - 0.075 mm	48.67
% Clay	< 0.002 mm	42.06

Hydrometer Type
151H

% Passing #10	98.95
% Passing #200	90.73
% Pass 2µ	42.06



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006

SCS Engineers/City of Waco

Site 50

Core ID A-2

Depth 45' to 50'

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-4
Top Depth	22'
Bottom Depth	24'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	
19	3/4"	
9.5	3/8"	
4.75	4	99.00
2	10	96.62
0.85	20	95.99
0.425	40	95.53
0.25	60	95.27
0.15	100	95.04
0.075	200	93.65
0.0373		91.35
0.0266		89.78
0.0169		88.20
0.0100		83.48
0.0072		80.33
0.0052		77.18
0.0026		69.30
0.0011		59.85
0.0006		50.40

Maximum Particle Size
not recorded

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

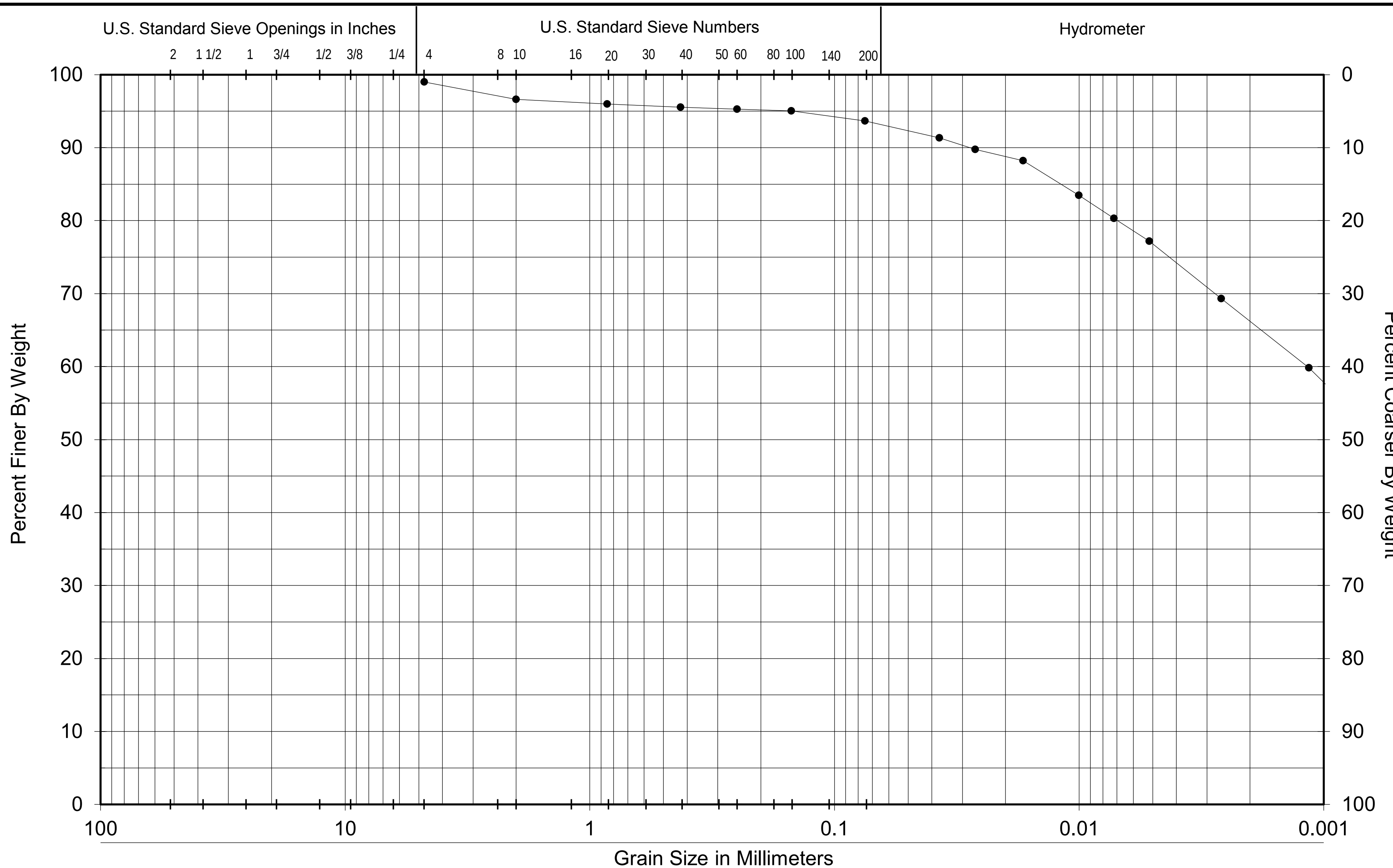
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	3.38
% Sand	0.075 - 2 mm	2.97
% Silt	0.002 - 0.075 mm	33.32
% Clay	< 0.002 mm	60.33

Hydrometer Type
151H

% Passing #10	96.62
% Passing #200	93.65
% Pass 2µ	60.33



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006 Core ID A-4

SCS Engineers/City of Waco Depth 22' to 24'

Site 50

LANGERMAN FOSTER
ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-4
Top Depth	31'
Bottom Depth	36'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	100.00
19	3/4"	100.00
9.5	3/8"	100.00
4.75	4	100.00
2	10	99.73
0.85	20	98.46
0.425	40	97.57
0.25	60	97.04
0.15	100	96.65
0.075	200	91.32
0.0434		58.91
0.0314		52.54
0.0203		46.17
0.0118		44.58
0.0084		41.39
0.0061		39.80
0.0030		35.03
0.0013		27.06
0.0007		20.70

Maximum Particle Size
4.75 mm

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

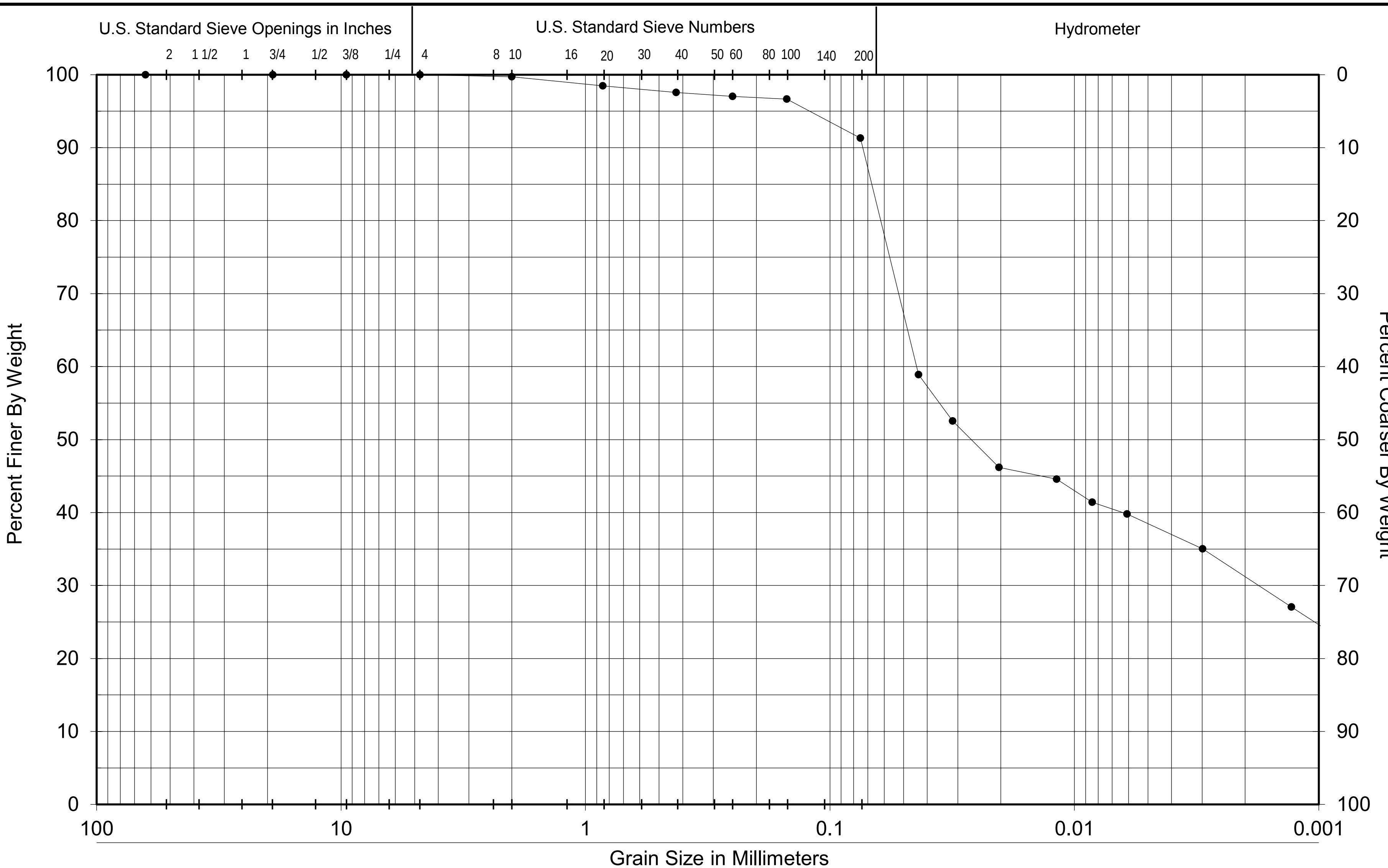
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	0.27
% Sand	0.075 - 2 mm	8.42
% Silt	0.002 - 0.075 mm	63.82
% Clay	< 0.002 mm	27.49

Hydrometer Type
151H

% Passing #10	99.73
% Passing #200	91.32
% Pass 2μ	27.49



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006 Core ID A-4

SCS Engineers/City of Waco Depth 31' to 36'

Site 50

LANGERMAN FOSTER ENGINEERING COMPANY

GRAIN SIZE DATA RESULTS

Job Number	W18-006
Client	SCS Engineers/City of Waco
Job Description	Site 50
Core ID	A-5
Top Depth	22'
Bottom Depth	24'

Grain Size Data

D (mm)	Sieve #	% Finer
63	2.5"	
19	3/4"	
9.5	3/8"	
4.75	4	91.00
2	10	90.38
0.85	20	86.70
0.425	40	84.81
0.25	60	83.99
0.15	100	83.31
0.075	200	75.81
0.0414		70.06
0.0299		65.29
0.0192		62.10
0.0111		60.51
0.0080		57.33
0.0057		55.73
0.0029		47.77
0.0012		38.22
0.0007		11.15

Maximum Particle Size
not recorded

Dispersing Agent
(NaPO3)6 @ 40 g/L

Soak Time in Dispersing Agent
24 hrs

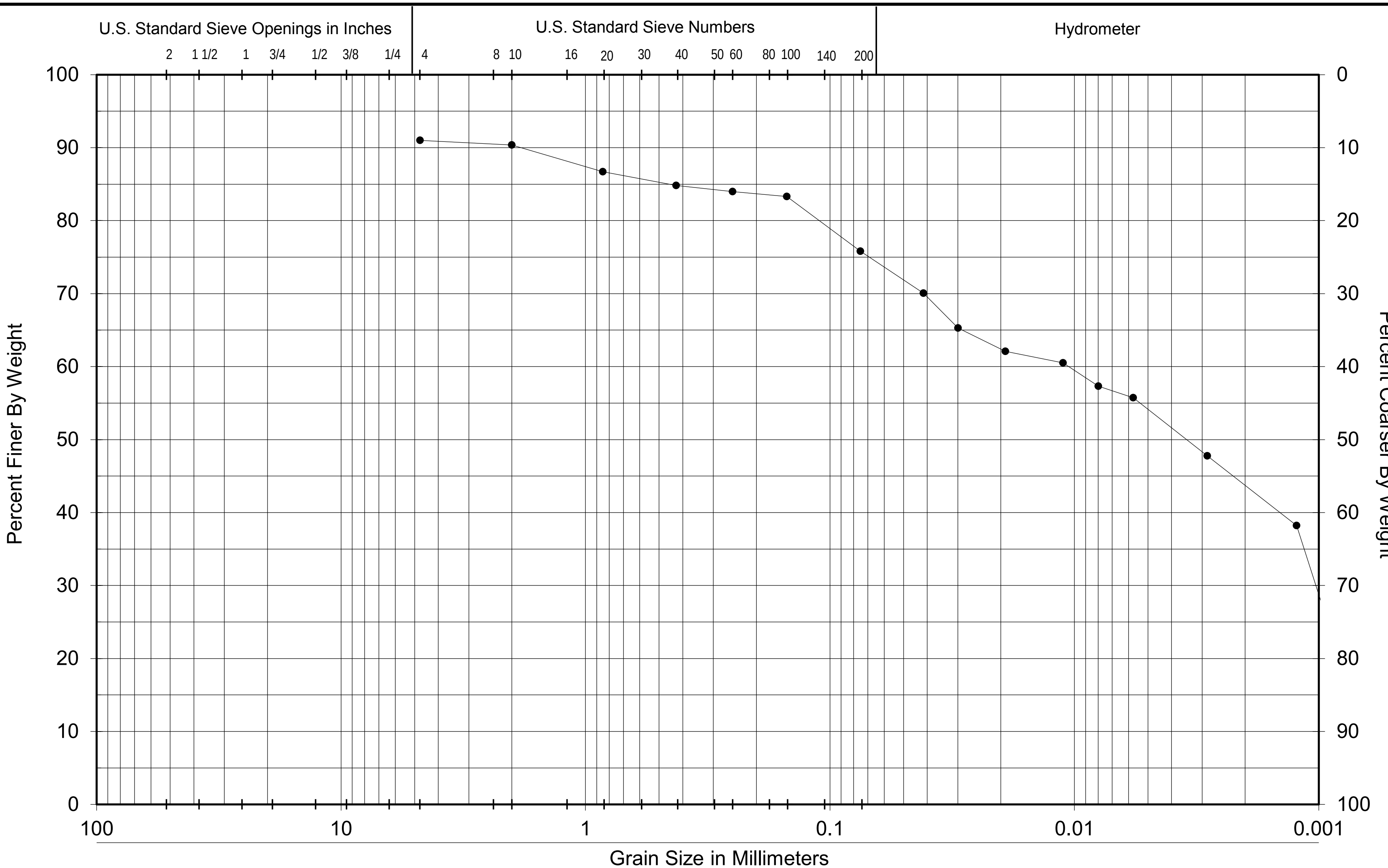
Dispersing Device
Apparatus A, ASTM D-422

Dispersing Period
1 min

% Gravel	> 2 mm	9.62
% Sand	0.075 - 2 mm	14.57
% Silt	0.002 - 0.075 mm	51.48
% Clay	< 0.002 mm	24.33

Hydrometer Type
151H

% Passing #10	90.38
% Passing #200	75.81
% Pass 2µ	24.33



LANGERMAN FOSTER ENGINEERING COMPANY

GRADATION CURVE

W18-006

Core ID A-5

SCS Engineers/City of Waco

Depth 22' to 24'

Site 50

LANGERMAN FOSTER
ENGINEERING COMPANY

2000 South 15th Street, Waco, Texas 76706
Ph: 254/235-1048 www.LFEctx.com

MOISTURE DENSITY REPORT

To: SCS

Project No.: W18-068

Project: Site 50

Date: 12/28/2018
Lab ID No.: 9162

Material Description: Gray and Reddish-Brown Fat Clay
B-16, 10.0' - 12.0'

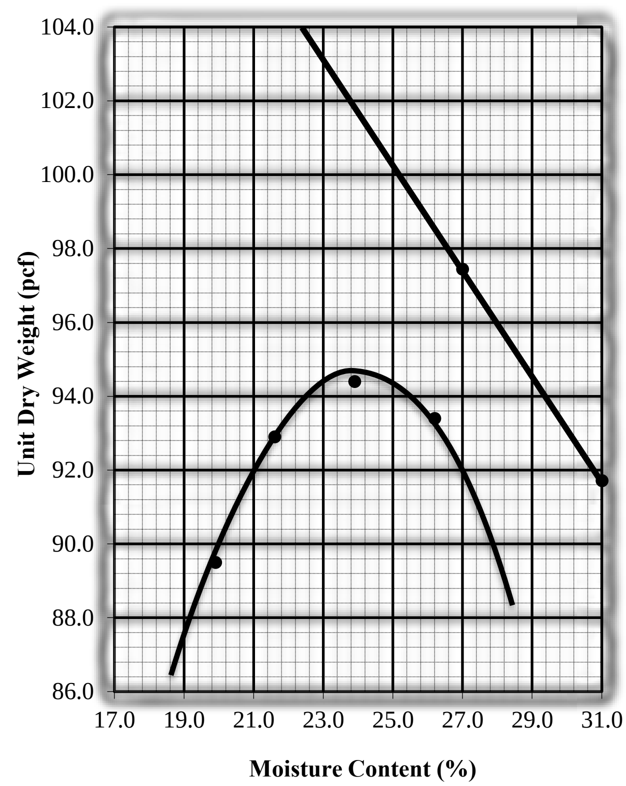
Sampled By: SCS

Test Performed By: PR

Test Method: ASTM D 698, Method A

Estimated Spec. Gravity: 2.70

Moisture (%)	Unit Dry Wgt. lbs/cu ft
19.9	89.5
21.6	92.9
23.9	94.4
26.2	93.4



Atterberg Limit
(ASTMD 4318-98 Wet Method)

Liquid Limit:	83
Plasticity Index:	58
Passing #200 Sieve (%):	94

Optimum Moisture (%): 23.8
Maximum Density (PCF): 94.8

LANGERMAN FOSTER
ENGINEERING COMPANY

MOISTURE DENSITY REPORT

2000 South 15th Street, Waco, Texas 76706
Ph: 254/235-1048 www.LFEctx.com

To: SCS

Project No.: W18-068

Project: Site 50

Date: 12/28/2018
Lab ID No.: 9163

Material Description: Tan and Greenish-Gray Fat Clay
B-23, 10.0' - 12.0'

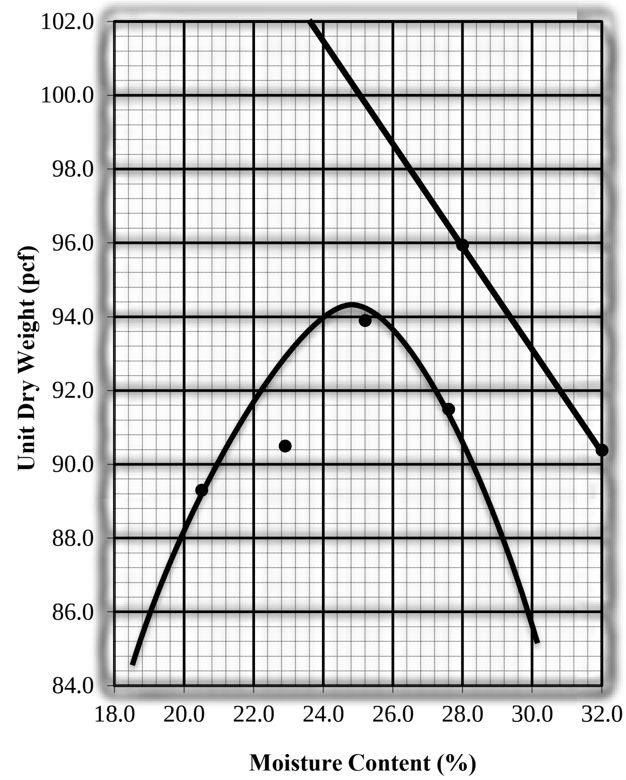
Sampled By: SCS

Test Performed By: PR

Test Method: ASTM D 698, Method A

Estimated Spec. Gravity: 2.70

Moisture (%)	Unit Dry Wgt. lbs/cu ft
20.5	89.3
22.9	90.5
25.2	93.9
27.6	91.5



Atterberg Limit
(ASTMD 4318-98 Wet Method)

Liquid Limit: 70
Plasticity Index: 50
Passing #200 Sieve (%): 95

Optimum Moisture (%): 24.9
Maximum Density (PCF): 94.4

LANGERMAN FOSTER
ENGINEERING COMPANY

MOISTURE DENSITY REPORT

2000 South 15th Street, Waco, Texas 76706
Ph: 254/235-1048 www.LFEctx.com

To: SCS

Project No.: W18-068

Project: Site 50

Date: 12/28/2018
Lab ID No.: 9164

Material Description: Gray Fat Clay with Sand
B-8, 10.0' - 12.0'

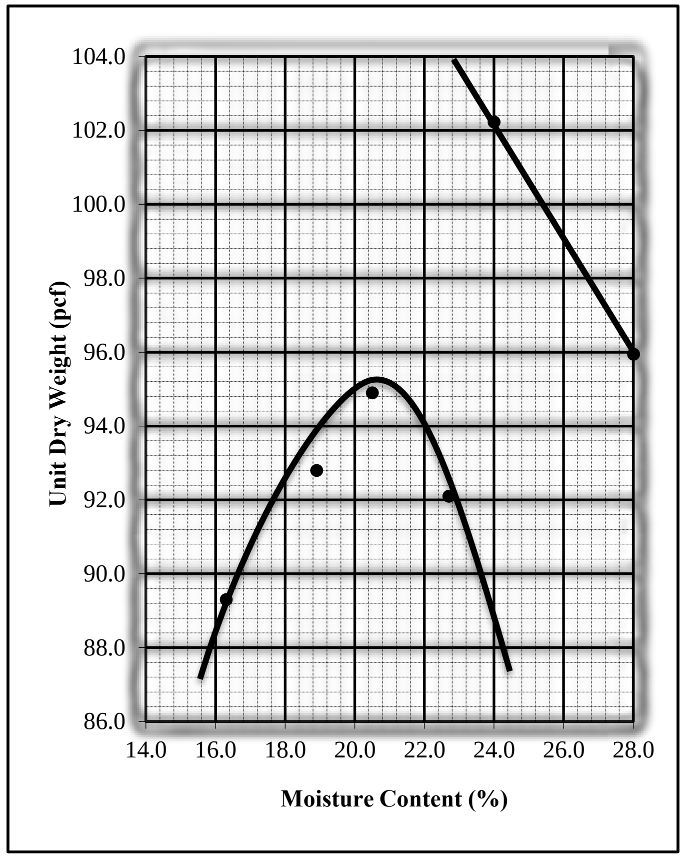
Sampled By: SCS

Test Performed By: PR

Test Method: ASTM D 698, Method A

Estimated Spec. Gravity: 2.70

Moisture (%)	Unit Dry Wgt. lbs/cu ft
16.3	89.3
18.9	92.8
20.5	94.9
22.7	92.1



Atterberg Limit
(ASTMD 4318-98 Wet Method)

Liquid Limit: 67
Plasticity Index: 50
Passing #200 Sieve (%): 85

Optimum Moisture (%): 20.6
Maximum Density (PCF): 95.3

LANGERMAN FOSTER
ENGINEERING COMPANY

2000 South 15th Street, Waco, Texas 76706
Ph: 254/235-1048 www.LFEctx.com

MOISTURE DENSITY REPORT

To: SCS

Project No.: W18-068

Project: Site 50

Date: 12/28/2018
Lab ID No.: 9165

Material Description: Gray Fat Clay
B-19, 10.0' - 12.0'

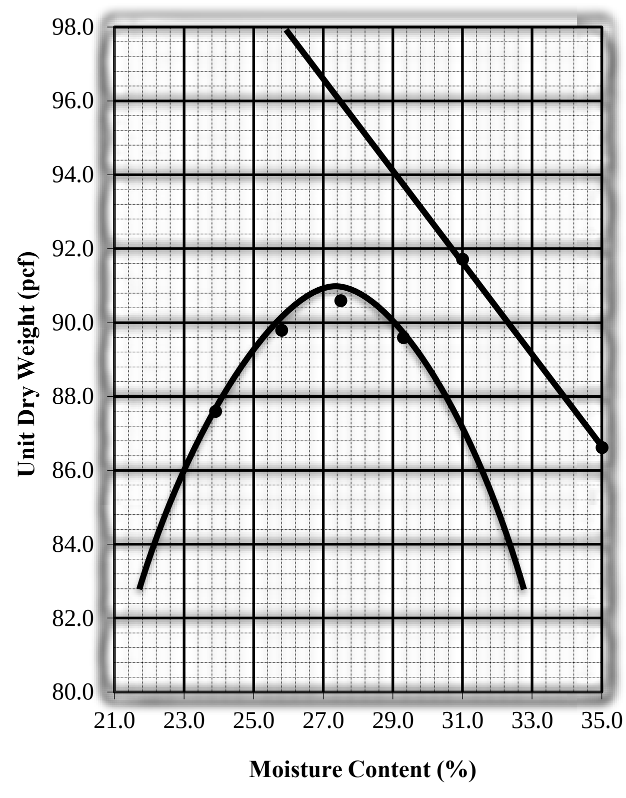
Sampled By: SCS

Test Performed By: PR

Test Method: ASTM D 698, Method A

Estimated Spec. Gravity: 2.70

Moisture (%)	Unit Dry Wgt. lbs/cu ft
23.9	87.6
25.8	89.8
27.5	90.6
29.3	89.6



Atterberg Limit
(ASTMD 4318-98 Wet Method)

Liquid Limit:	83
Plasticity Index:	59
Passing #200 Sieve (%):	92

Optimum Moisture (%): 27.2
Maximum Density (PCF): 90.9

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

February 8, 2019
TEAM Project No. 192022
Report No. 1

SCS Engineers
1901 Central Drive
Suite 550
Bedford, Texas 76021

Attn: Ms. Basak Gulec, P.E.

Re: Geotechnical Laboratory Testing
Waco Landfill

Dear Ms. Gulec:

Submitted here is our report of laboratory testing services completed on four (4) bulk soil samples received at our materials testing laboratory in Arlington, Texas on January 31, 2019 for the above referenced project.

The samples were tested for Proctor (ASTM D-698A), Grain Size Analysis (ASTM D-422), Atterberg Limits (ASTM D-4318), and Permeability (USACE EM 1110-2-1906, Appendix VII). The results of those tests are presented on the attached proctor curves and laboratory permeability worksheets.

We appreciate the opportunity to be of assistance to you with this project. Should you have any questions, or if we may be of further assistance, please call.

Sincerely,
TEAM Consultants, Inc.

Jason Young

Jason Young, GIT
Staff Geologist

4087 Shilling Way Dallas, TX 75237 (214) 331-4395 Fax (214) 331-4458
3101 Pleasant Valley, Suite 101 Arlington, TX 76015 (817) 467-5500 Fax (817) 468-9920

SUMMARY OF LABORATORY TEST RESULTS

SCS Engineers, Waco Landfill

		Grain Size Analysis (ASTM D-422)					Atterberg Limits (ASTM D-4318)		Moisture/Density Relationship (ASTM D-698)		Permeability Test (EM 1110-2-1906)		
Sample Identification	Unified Classification System (ASTM D-2487)	Fraction Passing Sieve 1"	#4	#10	#40	#200	Liquid Limit	Plasticity Index	Optimum Moisture (%)	Max Unit Weight (PCF)	Moisture Content (%)	Dry Density (pcf)	Falling Head Permeability K (cm/sec)
B-8 10-12'	CH	100	99.5	98.5	97.8	86.1	70	44	23.6	97.9	**23.5**	**92.9**	**2.23E-08**
B-16 10-12'	CH	100	99.7	99.0	98.2	90.6	71	45	24.0	97.6	**23.9**	**92.6**	**1.94E-08**
B-19 10-12'	CH	100	99.3	98.9	98.3	93.0	81	53	26.6	93.9	**26.5**	**88.9**	**2.05E-08**
B-23 10-12'	CH	100	99.4	98.3	96.7	91.6	77	49	25.1	96.0	**25.0**	**91.2**	**2.69E-08**

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Arlington, Texas 76015
Phone: (817) 467-5500
Fax: (817) 468-9920

To: SCS Engineers
Project: Waco Landfill

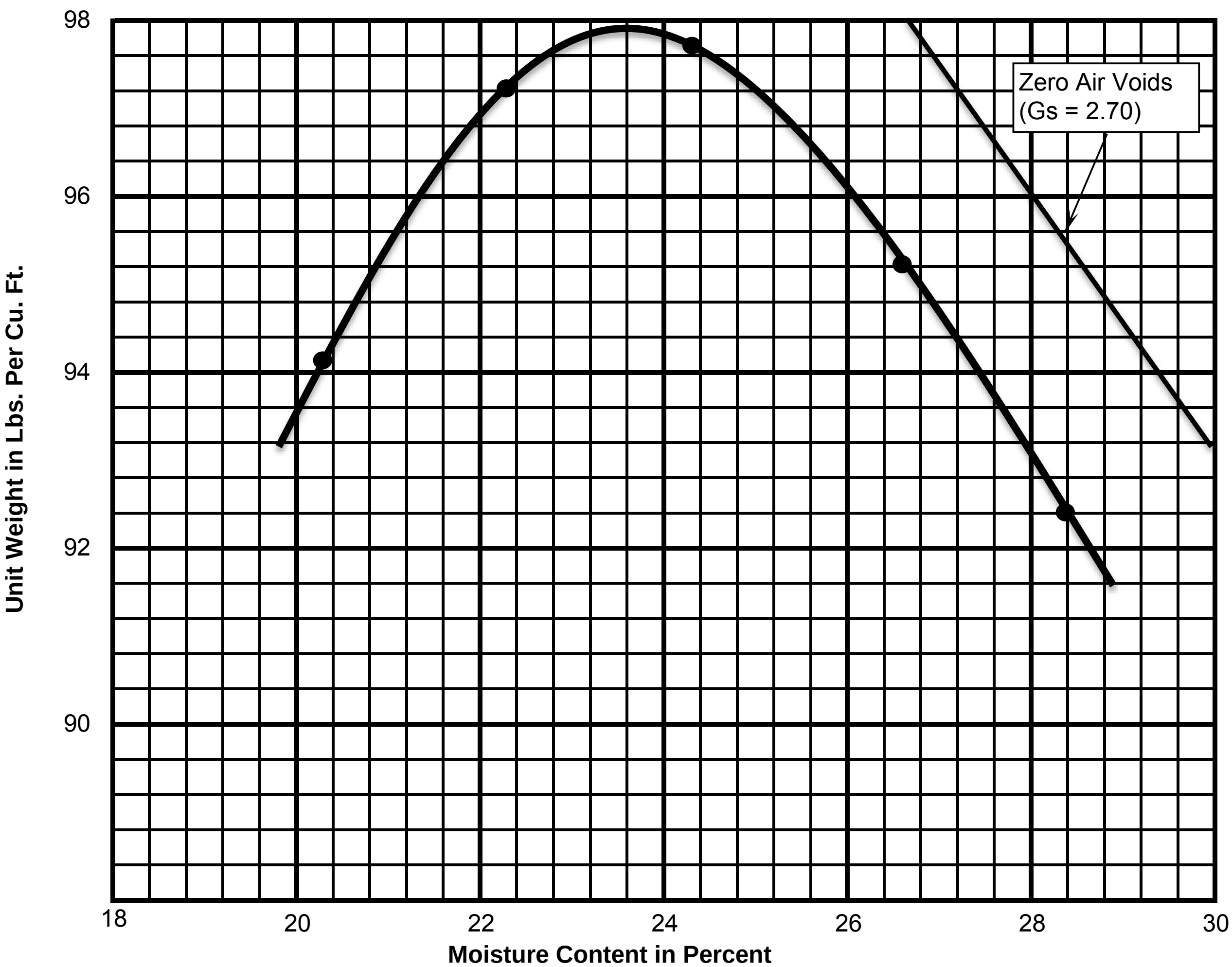
Job No.: 192022

Date: 2/4/19

Sample: B-8 10-12'
Proctor No. 848
Description: Tan and light gray fat clay (CH)

Test Method: ASTM-D-698
Mold: 1/30 cu. ft.
Hammer: 5.5#
Drop: 12"
Blows: 25
Layers: 3

Liquid Limit: 70
Plasticity Index: 44
Optimum Moisture: 23.6 **%**
Max. Unit Dry Weight: 97.9 **Lbs./Cu. Ft.**
% Passing No. 200 Sieve: 86.1 **%**



OPTIMUM MOISTURE TEST

TEAM Consultants, Inc.

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Fax: (817) 468-9920

To: SCS Engineers
Project: Waco Landfill

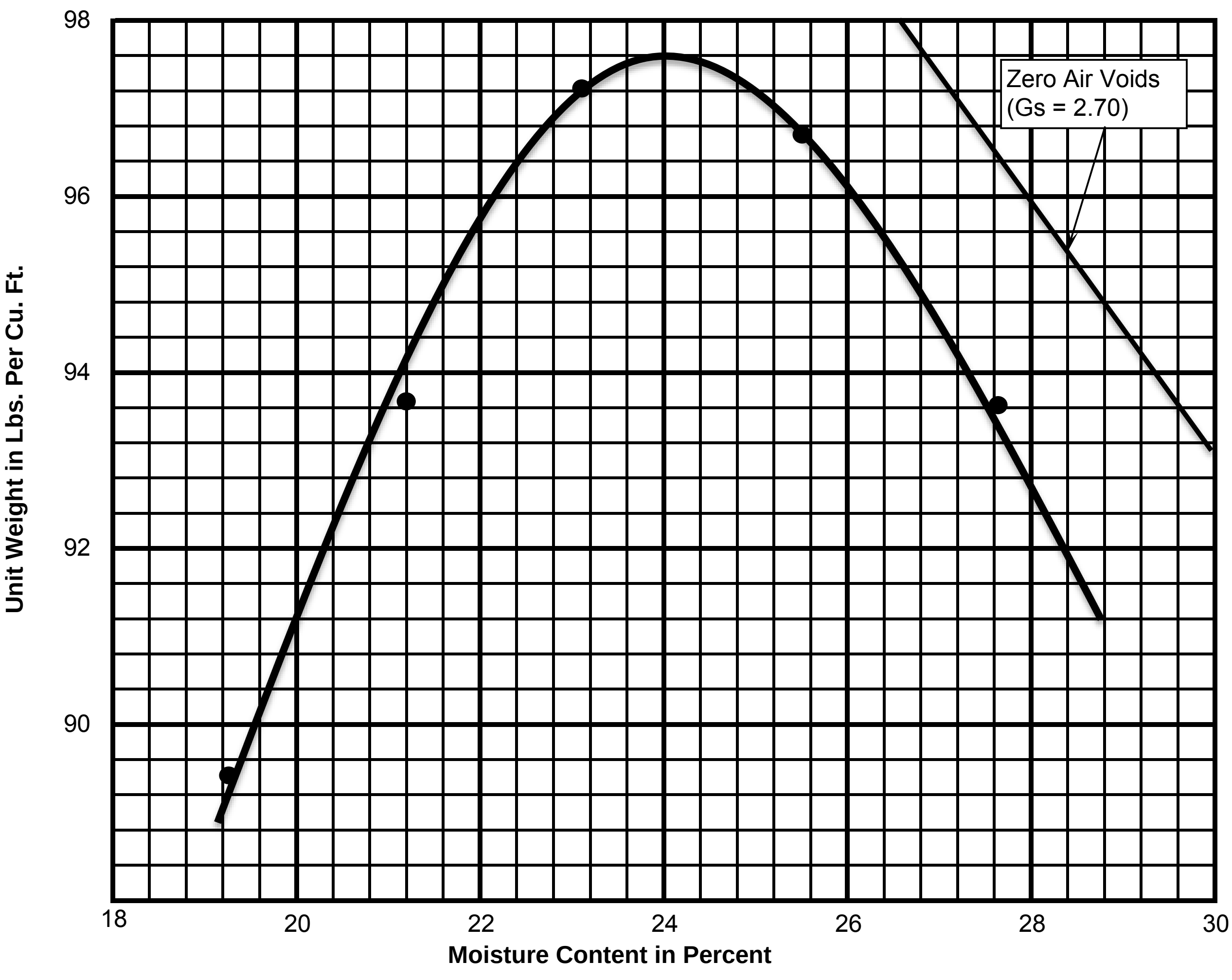
Job No.: 192022

Date: 2/4/19

Sample: B-16 10-12'
Proctor No. 849
Description: Tan and light gray fat clay (CH)

Test Method: ASTM-D-698
Mold: 1/30 cu. ft.
Hammer: 5.5#
Drop: 12"
Blows: 25
Layers: 3

Liquid Limit: 71
Plasticity Index: 45
Optimum Moisture: 24.0 **%**
Max. Unit Dry Weight: 97.6 **Lbs./Cu. Ft.**
% Passing No. 200 Sieve: 90.6 **%**



OPTIMUM MOISTURE TEST

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Arlington, Texas 76015
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Fax: (817) 468-9920

To: SCS Engineers
Project: Waco Landfill

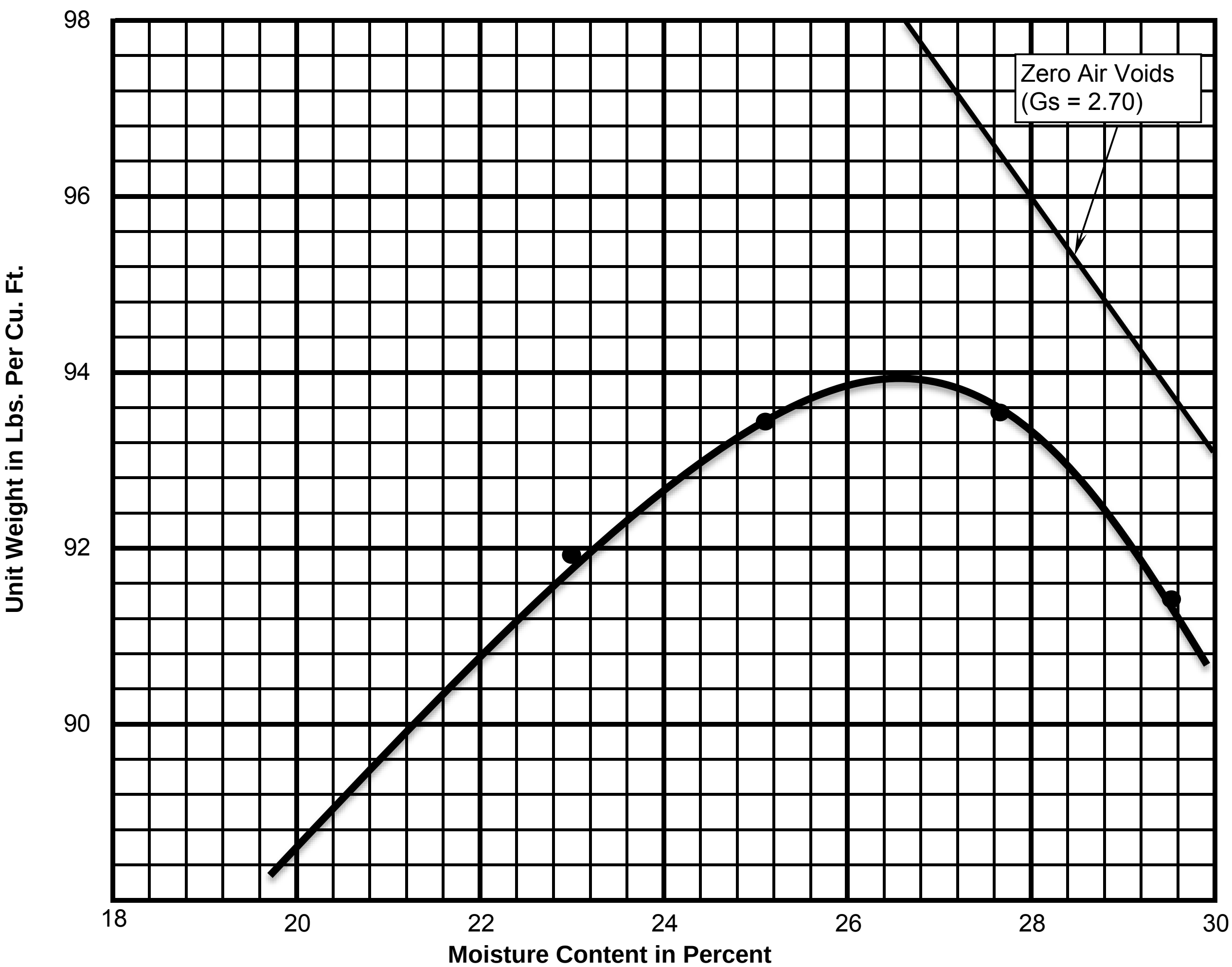
Job No.: 192022

Date: 2/4/19

Sample: B-19 10-12'
Proctor No. 850
Description: Tan and light gray fat clay (CH)

Test Method: ASTM-D-698
Mold: 1/30 cu. ft.
Hammer: 5.5#
Drop: 12"
Blows: 25
Layers: 3

Liquid Limit: 81
Plasticity Index: 53
Optimum Moisture: 26.6 **%**
Max. Unit Dry Weight: 93.9 **Lbs./Cu. Ft.**
% Passing No. 200 Sieve: 93.0 **%**



OPTIMUM MOISTURE TEST

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Arlington, Texas 76015
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Fax: (817) 468-9920

To: SCS Engineers
Project: Waco Landfill

Job No.: 192022

Date: 2/4/19

Sample: B-23 10-12'
Proctor No. 851
Description: Tan and light gray fat clay (CH)

Test Method: ASTM-D-698
Mold: 1/30 cu. ft.
Hammer: 5.5#
Drop: 12"
Blows: 25
Layers: 3

Liquid Limit: 77
Plasticity Index: 49
Optimum Moisture: 25.1 **%**
Max. Unit Dry Weight: 96.0 **Lbs./Cu. Ft.**
% Passing No. 200 Sieve: 91.6 **%**

OPTIMUM MOISTURE TEST

TEAM Consultants, Inc.

PERMEABILITY TEST

(EM 1110-2-1906 30 NOV 70)

Project: SCS Waco Landfill   Project No.: 192022   Date: 2/6/2019

Sample No: B-8 10-12'   Date Sampled: n/a

Material Description: Tan and light gray fat clay (CH)

SAMPLE MEASUREMENTS			MOISTURE CONTENT		
Wet weight sample+ring:	320.6	g	Tare No.:	664	
Ring weight:	211.4	g	Wet weight+tare:	186.3	g
Wet weight of sample:	109.2	g	Dry weight+tare:	171.0	g
Diameter:	6.35	cm	Tare weight:	105.9	g
Area:	31.67	cm^2	Dry weight of sample:	65.1	g
Thickness:	1.877	cm	Weight of moisture:	15.3	g
Unit dry weight:	92.9	pcf	Percent moisture:	23.5	%

PERMEABILITY DATA

Date & Time	Elapsed Time (t) sec	Burrette Readings (H_0) cm	Burrette Readings (H_1) cm	Permeability (k) Single	Permeability (k) Cumulative
2/7/19 06:45 AM		44.6			
2/7/19 07:30 AM	2,700		44.1	2.05E-08	
2/7/19 09:30 AM	7,200		43.0	1.72E-08	
2/7/19 11:55 AM	8,700		41.4	2.14E-08	
2/7/19 02:40 PM	9,900		39.2	2.71E-08	
	28,500				2.23E-08

Tube No.: 2

Area of Tube: 0.0829 cm^2

Confining Load: 0.625 tsf

$$K = \left[\frac{axL}{Axt}\right] x \ln\left[\frac{H_0}{H_1}\right] x R_T$$

K = 2.23E-08 cm/sec

Remarks: A temperature correction factor (R_T) of 1.00 is used as this test was performed within a laboratory environment maintained at or slightly above 68°F.

Tested by: Jason Young

Computed by: Jason Young

Checked by: James Hutt

PERMEABILITY TEST

(EM 1110-2-1906 30 NOV 70)

Project: SCS Waco Landfill   Project No.: 192022   Date: 2/6/2019

Sample No: B-16 10-12'   Date Sampled: n/a

Material Description: Tan and light gray fat clay (CH)

SAMPLE MEASUREMENTS			MOISTURE CONTENT		
Wet weight sample+ring:	320.6	g	Tare No.:	470	
Ring weight:	211.4	g	Wet weight+tare:	270.4	g
Wet weight of sample:	109.2	g	Dry weight+tare:	246.6	g
Diameter:	6.35	cm	Tare weight:	146.9	g
Area:	31.67	cm^2	Dry weight of sample:	99.7	g
Thickness:	1.877	cm	Weight of moisture:	23.8	g
Unit dry weight:	92.6	pcf	Percent moisture:	23.9	%

PERMEABILITY DATA

Date & Time	Elapsed Time (t) sec	Burrette Readings (H_0) cm	(H_1) cm	Permeability (k) Single	Cumulative
2/7/19 07:30 AM		47.9			
2/7/19 09:30 AM	7,200		46.7	1.73E-08	
2/7/19 11:55 AM	8,700		45.1	1.97E-08	
2/7/19 02:40 PM	9,900		43.0	2.37E-08	
2/7/19 05:15 PM	9,300		41.7	1.62E-08	
	35,100				1.94E-08

Tube No.: 3

Area of Tube: 0.0829 cm^2

Confining Load: 0.625 tsf

$$K = \left[\frac{axL}{Axt}\right] x \ln\left[\frac{H_0}{H_1}\right] x R_T$$

K = 1.94E-08 cm/sec

Remarks: A temperature correction factor (R_T) of 1.00 is used as this test was performed within a laboratory environment maintained at or slightly above 68°F.

Tested by: Jason Young

Computed by: Jason Young

Checked by: James Hutt

PERMEABILITY TEST

(EM 1110-2-1906 30 NOV 70)

Project: SCS Waco Landfill Project No.: 192022 Date: 2/6/2019

Sample No: B-19 10-12' Date Sampled: n/a

Material Description: Tan and light gray fat clay (CH)

SAMPLE MEASUREMENTS			MOISTURE CONTENT		
Wet weight sample+ring:	318.5	g	Tare No.:	691	
Ring weight:	211.4	g	Wet weight+tare:	236.2	g
Wet weight of sample:	107.1	g	Dry weight+tare:	215.2	g
Diameter:	6.35	cm	Tare weight:	136.0	g
Area:	31.67	cm^2	Dry weight of sample:	79.2	g
Thickness:	1.877	cm	Weight of moisture:	21.0	g
Unit dry weight:	88.9	pcf	Percent moisture:	26.5	%

PERMEABILITY DATA

Date & Time		Elapsed Time (t) sec	Burrette Readings (H_0) cm	(H_1) cm	Permeability (k) Single	Cumulative
2/7/19	06:45 AM		44.5			
2/7/19	07:30 AM	2,700		44.0	2.06E-08	
2/7/19	09:30 AM	7,200		42.6	2.21E-08	
2/7/19	11:55 AM	8,700		41.1	2.02E-08	
2/7/19	02:40 PM	9,900		39.5	1.97E-08	
		28,500				2.05E-08

Tube No.: 4

Area of Tube: 0.0829 cm^2

Confining Load: 0.625 tsf

$$K = \left[\frac{axL}{Axt}\right] x\ln\left[\frac{H_0}{H_1}\right] xR_T$$

K = 2.05E-08 cm/sec

Remarks: A temperature correction factor (R_T) of 1.00 is used as this test was performed within a laboratory environment maintained at or slightly above 68^{o}F.

Tested by: Jason Young

Computed by: Jason Young

Checked by: James Hutt

PERMEABILITY TEST

(EM 1110-2-1906 30 NOV 70)

Project: SCS Waco Landfill   Project No.: 192022   Date: 2/6/2019

Sample No: B-23 10-12'   Date Sampled: n/a

Material Description: Tan and light gray fat clay (CH)

SAMPLE MEASUREMENTS			MOISTURE CONTENT		
Wet weight sample+ring:	319.9	g	Tare No.:	678	
Ring weight:	211.4	g	Wet weight+tare:	237.7	g
Wet weight of sample:	108.5	g	Dry weight+tare:	215.6	g
Diameter:	6.35	cm	Tare weight:	127.1	g
Area:	31.67	cm^2	Dry weight of sample:	88.5	g
Thickness:	1.877	cm	Weight of moisture:	22.1	g
Unit dry weight:	91.2	pcf	Percent moisture:	25.0	%

PERMEABILITY DATA

Date & Time	Elapsed Time (t) sec	Burrette Readings (H_0) cm	Burrette Readings (H_1) cm	Permeability (k) Single	Permeability (k) Cumulative
2/7/19 06:45 AM		46.4			
2/7/19 07:30 AM	2,700		45.8	2.37E-08	
2/7/19 09:30 AM	7,200		44.1	2.58E-08	
2/7/19 11:55 AM	8,700		41.8	3.03E-08	
2/7/19 02:40 PM	9,900		39.7	2.56E-08	
	28,500				2.69E-08

Tube No.: 5

Area of Tube: 0.0829 cm^2

Confining Load: 0.625 tsf

$$K = \left[\frac{axL}{Axt}\right] x \ln\left[\frac{H_0}{H_1}\right] x R_T$$

K = 2.69E-08 cm/sec

Remarks: A temperature correction factor (R_T) of 1.00 is used as this test was performed within a laboratory environment maintained at or slightly above 68°F.

Tested by: Jason Young

Computed by: Jason Young

Checked by: James Hutt

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	20.0	50.0	100.0	-
Initial Specimen Properties				
Avg. Diameter (in)	1.47	1.49	1.51	-
Avg. Height (in)	3.16	3.03	2.90	-
Avg. Water Content (%)	18.2	-	-	-
Bulk Density (pcf)	115.9	117.8	120.5	-
Dry Density (pcf)	98.0	-	-	-
Saturation (%)	67.4	-	-	-
Void Ratio, n	0.74	0.71	0.67	-
Total Back-Pressure (psi)	79.1	79.1	79.1	-
B-Value, End of Saturation	0.97	-	-	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.74	0.71	0.67	-

Shear / Post-Shear				
Rate of Strain (%/hr)	0.50	0.50	0.50	-
Avg. Water Content (%)	-	-	22.4	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	-	2.4	1.8	1.6	-
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	-	4.0	14.4	35.5	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	-	42.1	82.8	124.6	-
Pore Water Pressure, Δu_f (psi)	-	-	-	-	15.9	35.3	64.3	-
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	-	46.1	97.2	160.1	-
Secant Friction Angle (degrees)	-	-	-	-	57.2	47.8	39.6	-
Effective Friction Angle (degrees)	-				34.0			
Effective Cohesion (psi)	-				10.0			

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio. The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio are presented in tabular form on the first page of the report. There are alternate interpretations to this failure criterion including but not limited to peak principal stress difference and strain compatibility.

Jeffrey A. Kuhn , Ph.D., P.E., 1/2/2019
Analysis & Quality Review/Date

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

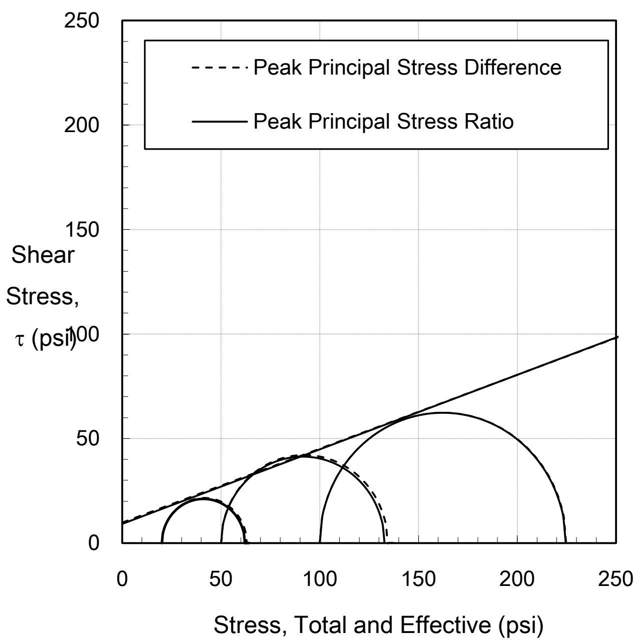
TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	19.5	19.6
Cohesion (psi)	c_R	9.7	9.1

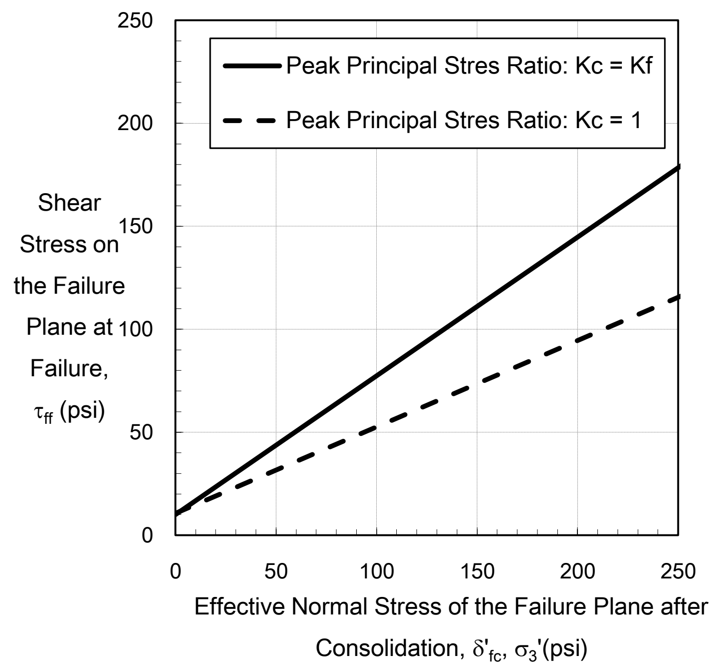
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	33.9	34.0
Effective Cohesion (psi)	c'	10.1	10.0

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	22.5	22.8
Cohesion (psi)	$\psi_{Kc=1}$	11.4	10.7

R / "Total Stress" Envelope



Three-Stage Rapid Drawdown Envelopes



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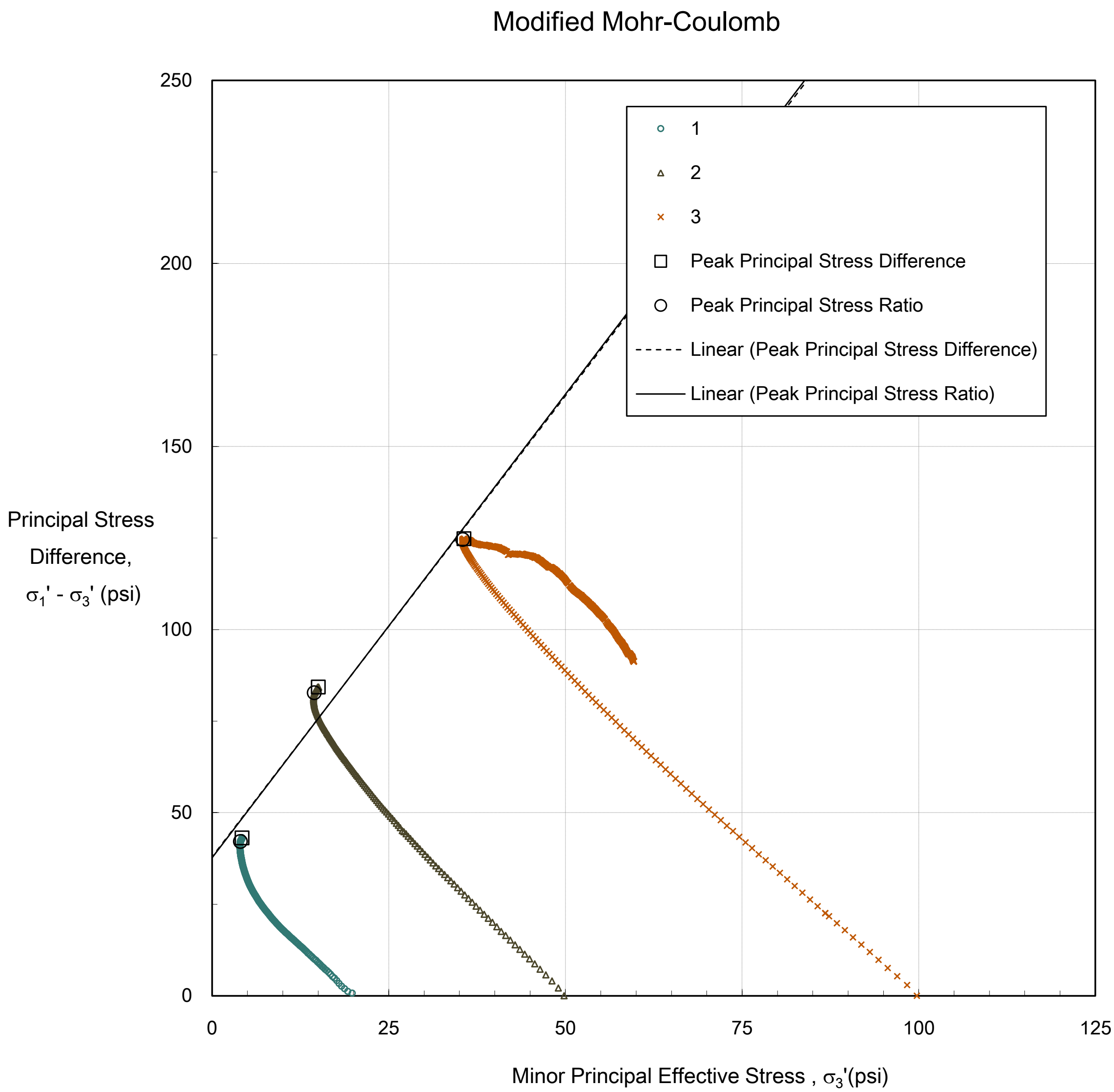
Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

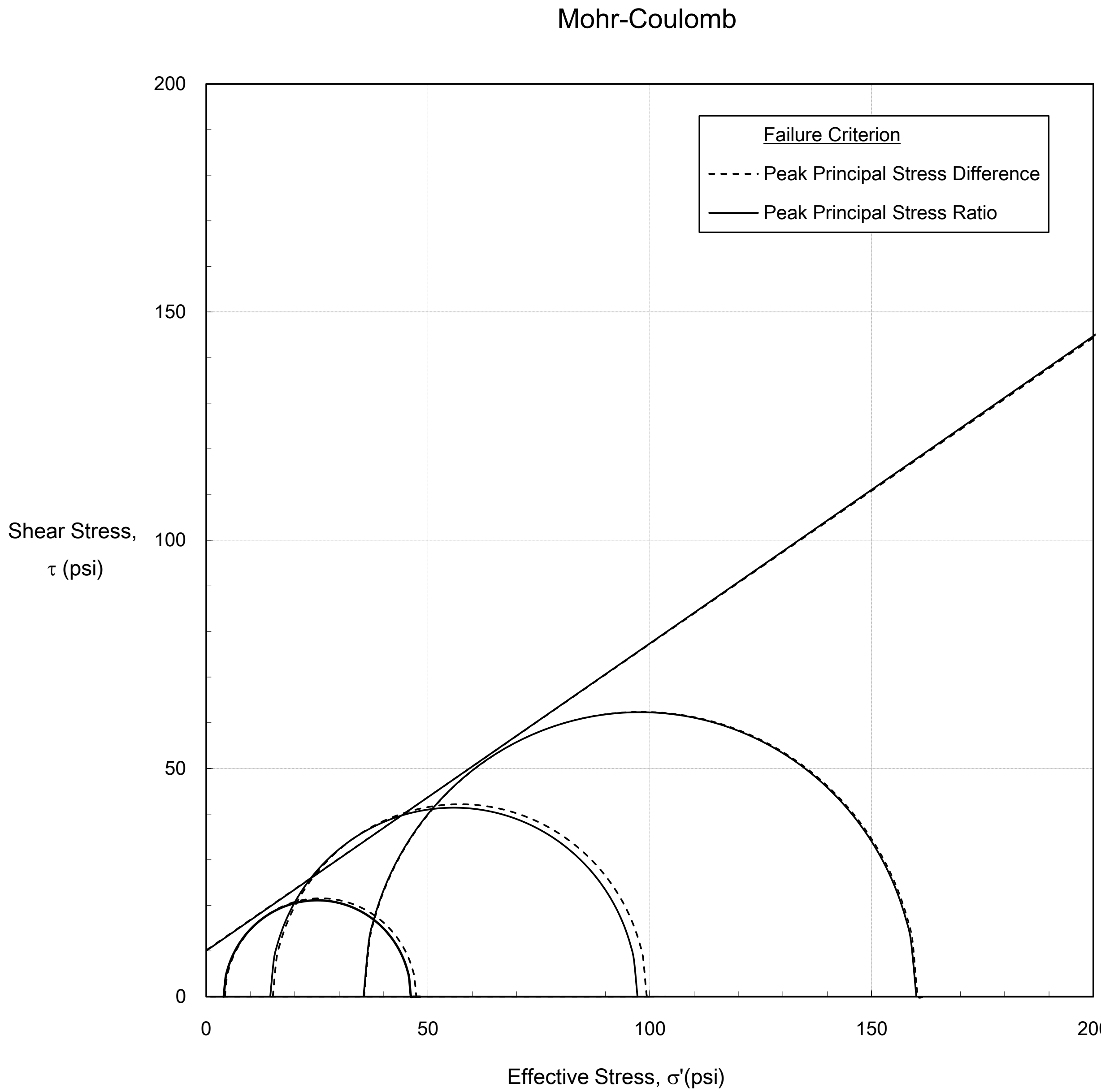


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	34.0
Effective Cohesion (psi)	-	10.0

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

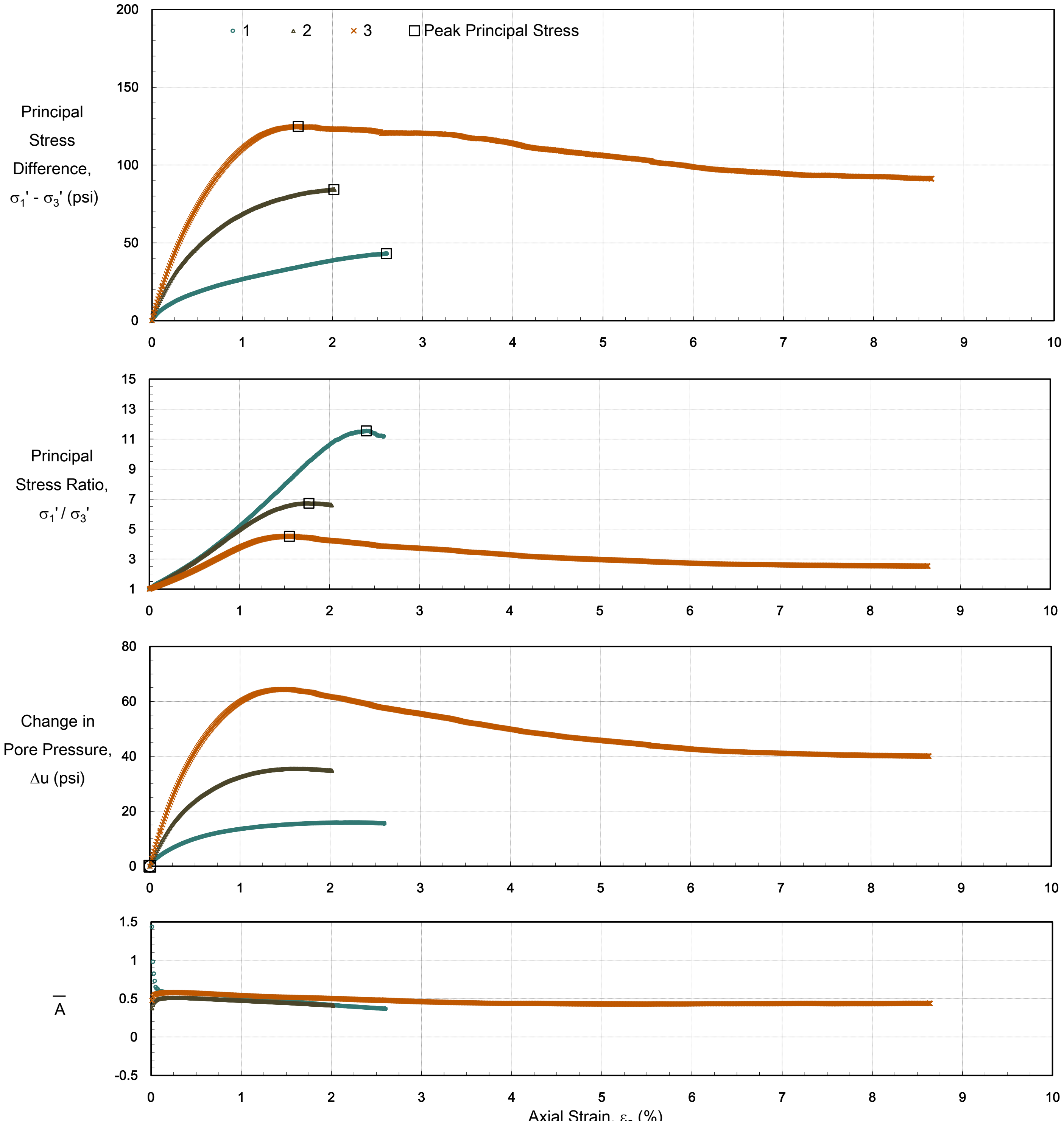


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	34.0
Effective Cohesion (psi)	-	10.0

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

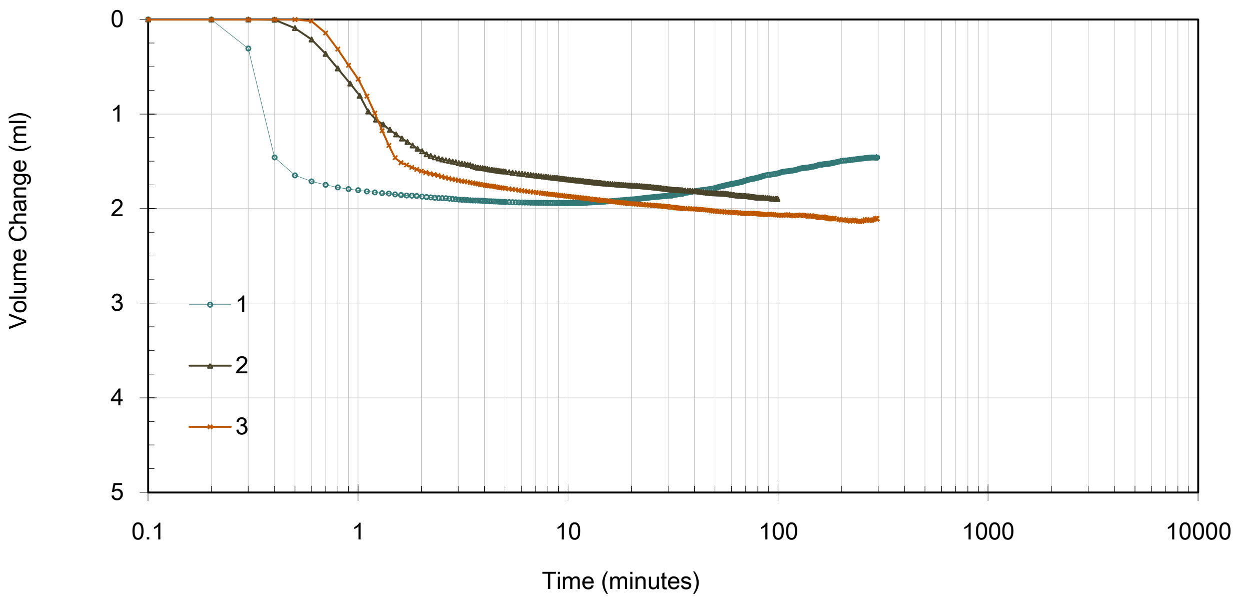


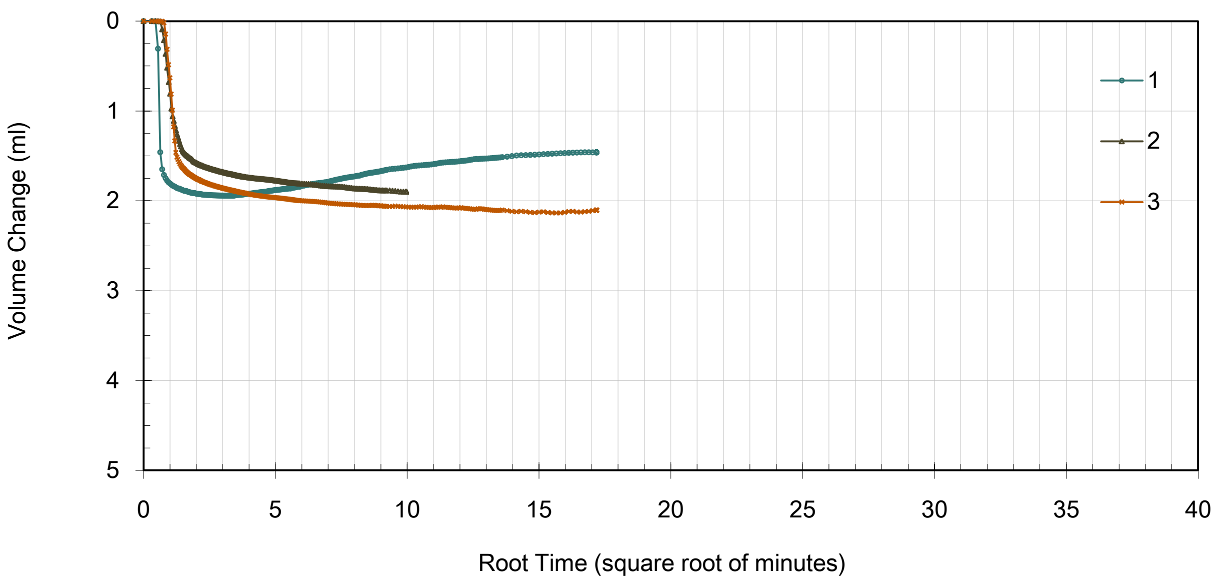
Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-24 (45-46)

TRI Log #: 43240.1
Test Method: ASTM D4767 Mod

Consolidation





Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

TRI Log #: 43240.2
Test Method: ASTM D4767

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	20.0	-	100.0	-
Initial Specimen Properties				
Avg. Diameter (in)	1.45	-	1.39	-
Avg. Height (in)	3.22	-	3.32	-
Avg. Water Content (%)	18.5	-	18.5	-
Bulk Density (pcf)	124.8	-	132.2	-
Dry Density (pcf)	105.3	-	111.6	-
Saturation (%)	81.8	-	95.9	-
Void Ratio, n	0.62	-	0.53	-
Total Back-Pressure (psi)	80.0		37.6	-
B-Value, End of Saturation	0.96	-	0.95	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.62	-	0.53	-

Shear / Post-Shear				
Rate of Strain (%/hr)	1.00	-	0.25	-
Avg. Water Content (%)	23.4	-	22.5	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	14.8	-	6.2	-	2.2	-	4.7	-
Minor Effective Stress (psi), $\sigma_3'_f$	18.0	-	88.0	-	10.3	-	83.4	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	33.8	-	144.5	-	23.2	-	141.8	-
Pore Water Pressure, Δu_f (psi)	2.1	-	12.1	-	9.7	-	16.6	-
Major Effective Stress (psi), $\sigma_1'_f$	51.8	-	232.5	-	33.5	-	225.2	-
Secant Friction Angle (degrees)	28.9	-	26.8	-	32.0	-	27.4	-
Effective Friction Angle (degrees)	26.2				26.6			
Effective Cohesion (psi)	1.6				2.0			

Note: The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

Jeffrey A. Kuhn , Ph.D., P.E., 1/2/2019
Analysis & Quality Review/Date

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

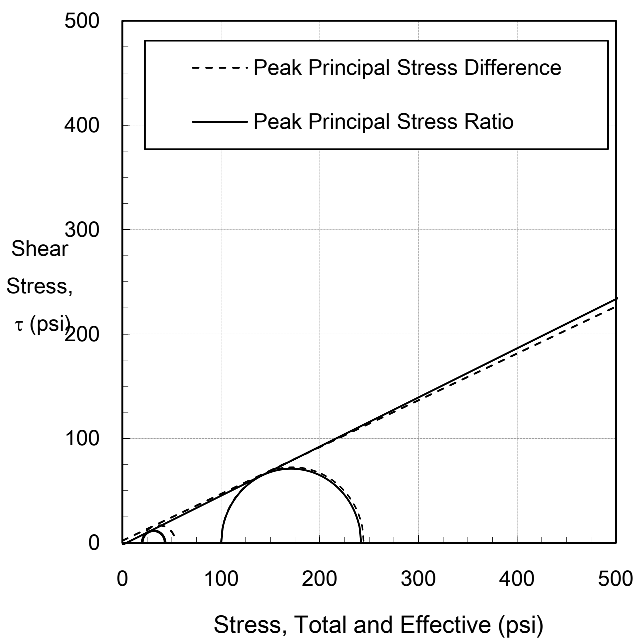
TRI Log #: 43240.2
Test Method: ASTM D4767

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	24.1	25.2
Cohesion (psi)	c_R	2.0	-2.0

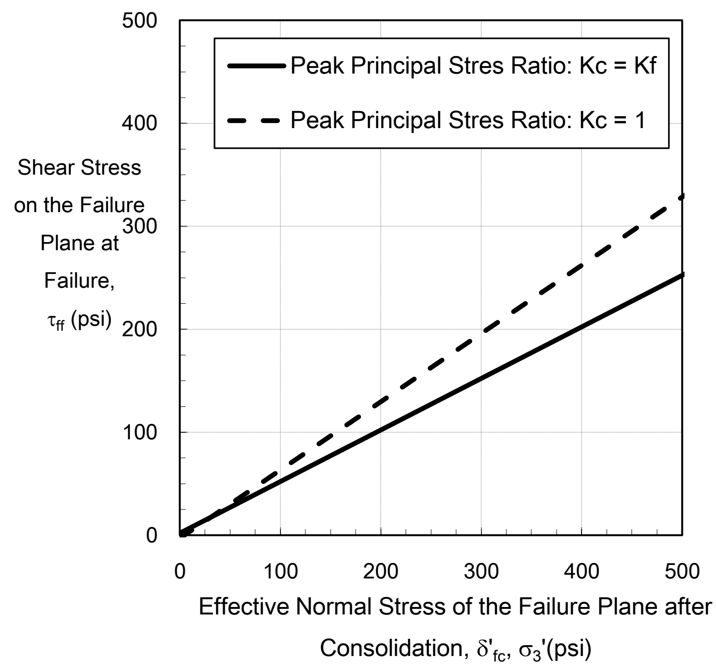
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	26.2	26.6
Effective Cohesion (psi)	c'	1.6	2.0

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	31.8	33.5
Cohesion (psi)	$\psi_{Kc=1}$	2.8	-2.9

R / "Total Stress" Envelope



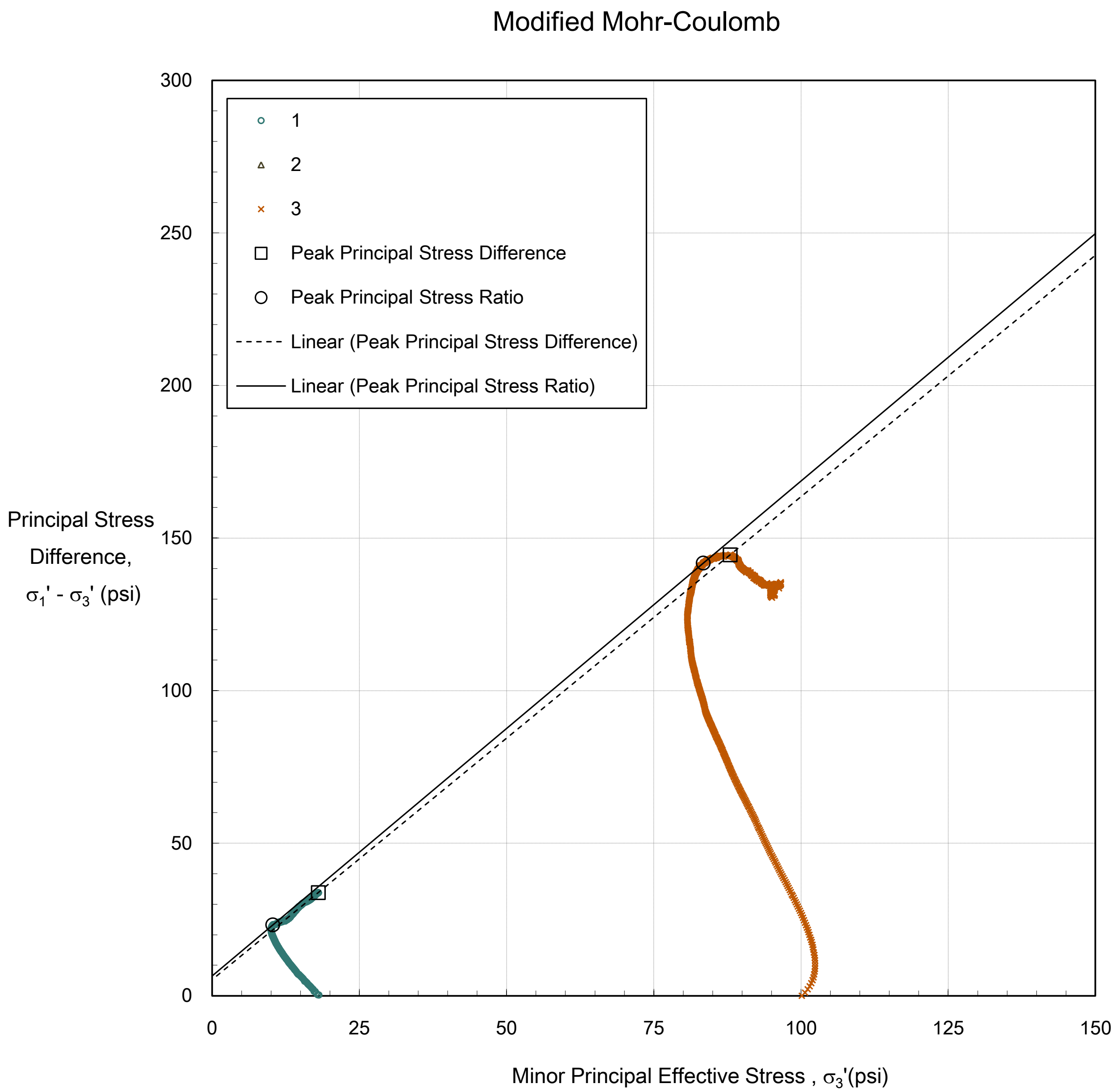
Three-Stage Rapid Drawdown Envelopes



Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

TRI Log #: 43240.2
Test Method: ASTM D4767

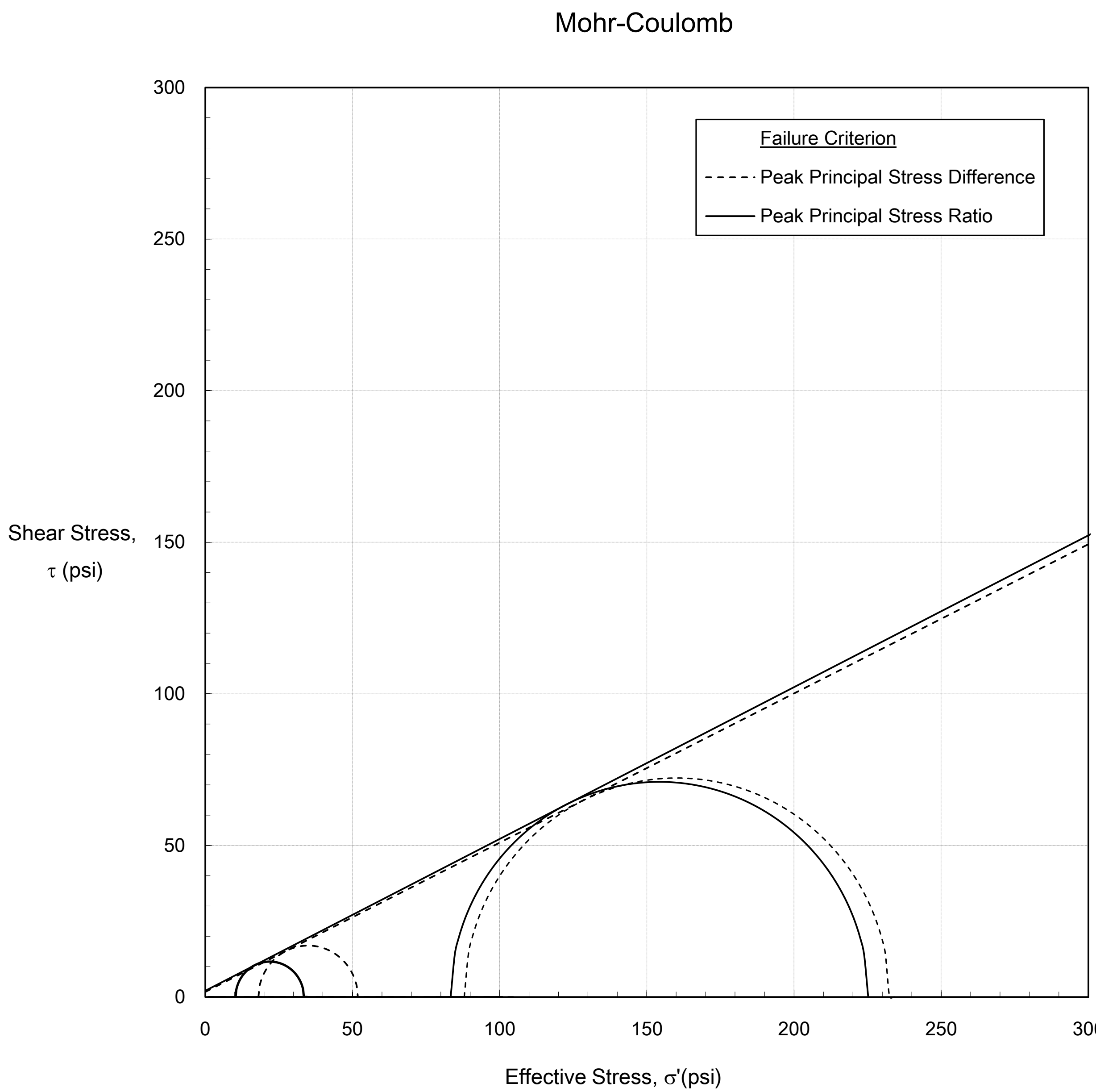


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	26.2	26.6
Effective Cohesion (psi)	1.6	2.0

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

TRI Log #: 43240.2
Test Method: ASTM D4767



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	26.2	26.6
Effective Cohesion (psi)	1.6	2.0

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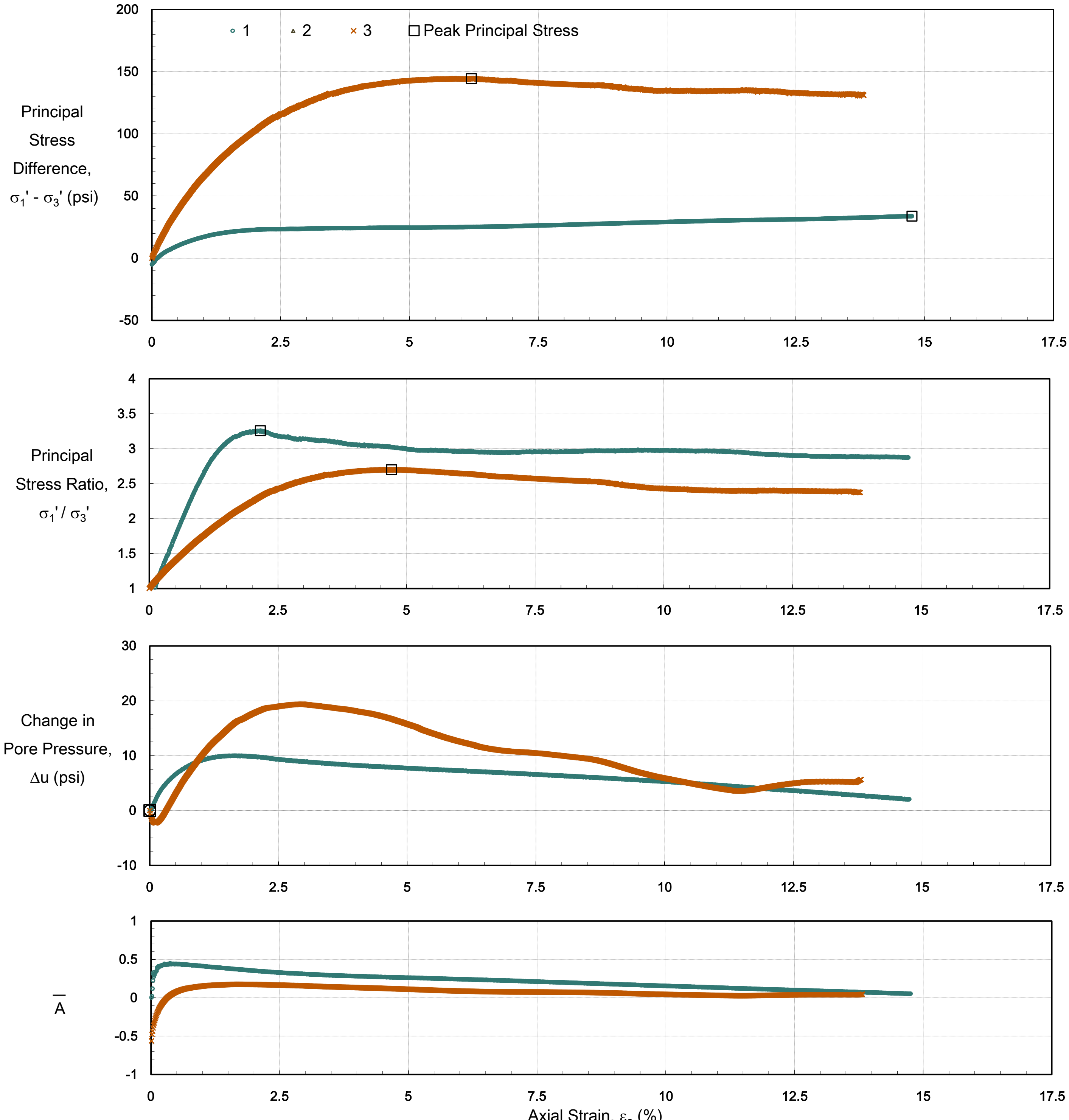
Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

TRI Log #: 43240.2
Test Method: ASTM D4767

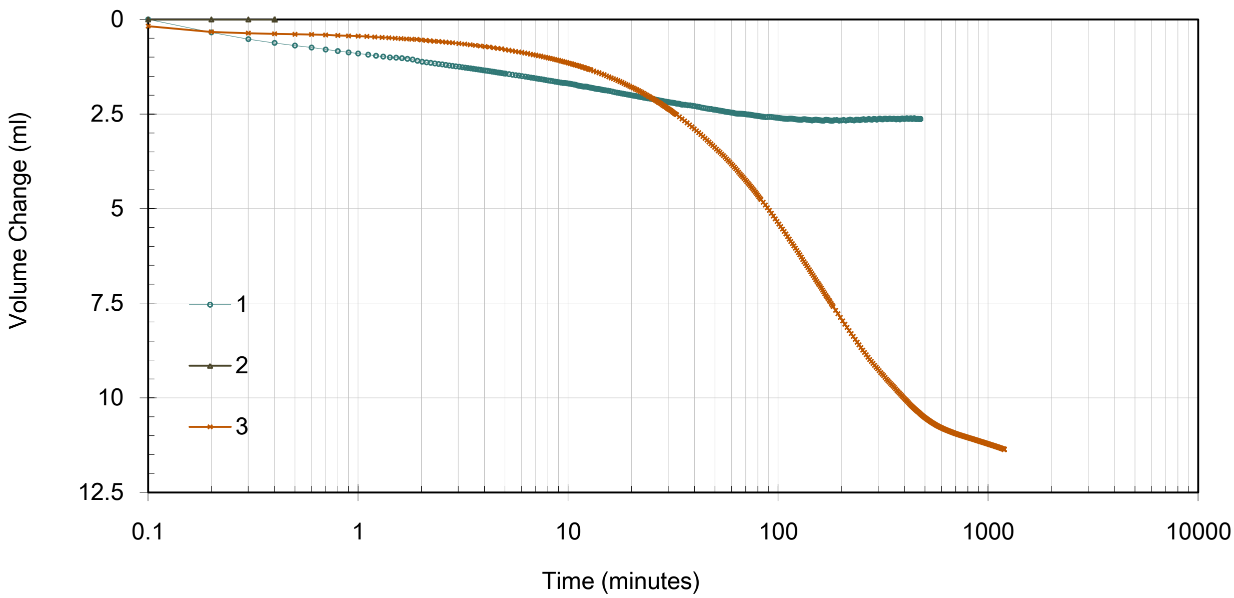


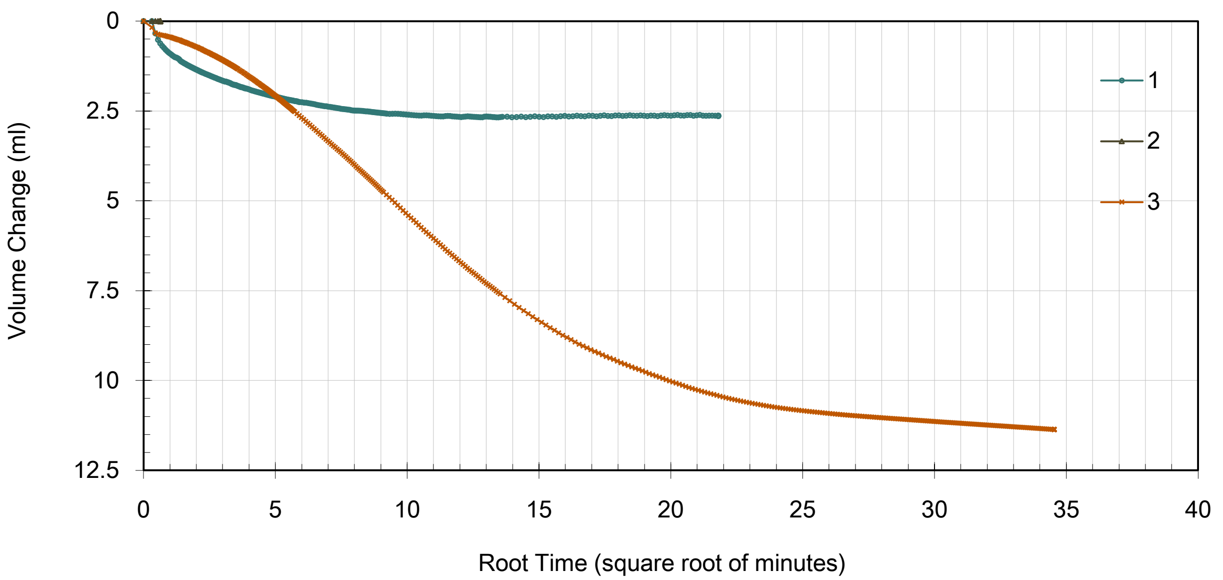
Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-17 (25-26)

TRI Log #: 43240.2
Test Method: ASTM D4767

Consolidation





Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-31 (15-15.9)

TRI Log #: 43240.3
Test Method: ASTM D4767

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	20.0	-	100.0	-
Initial Specimen Properties				
Avg. Diameter (in)	1.41	-	1.45	-
Avg. Height (in)	2.94	-	3.24	-
Avg. Water Content (%)	19.2	-	24.9	-
Bulk Density (pcf)	140.5	-	119.9	-
Dry Density (pcf)	117.8	-	96.0	-
Saturation (%)	117.7	-	87.8	-
Void Ratio, n	0.45	-	0.77	-
Total Back-Pressure (psi)	79.1	-	79.6	-
B-Value, End of Saturation	0.99	-	0.95	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.44	-	0.77	-

Shear / Post-Shear				
Rate of Strain (%/hr)	0.50	-	0.50	-
Avg. Water Content (%)	26.8	-	24.9	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	16.7	-	2.4	-	11.9	-	2.3	-
Minor Effective Stress (psi), $\sigma_3'_f$	9.6	-	47.6	-	9.2	-	47.6	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	32.4	-	91.3	-	31.4	-	91.3	-
Pore Water Pressure, Δu_f (psi)	9.2	-	52.6	-	9.6	-	52.7	-
Major Effective Stress (psi), $\sigma_1'_f$	42.0	-	138.9	-	40.6	-	138.8	-
Secant Friction Angle (degrees)	38.9	-	29.3	-	39.0	-	29.3	-
Effective Friction Angle (degrees)	25.9				26.0			
Effective Cohesion (psi)	5.5				5.3			

Note: The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

Jeffrey A. Kuhn , Ph.D., P.E., 1/2/2019
Analysis & Quality Review/Date

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-31 (15-15.9)

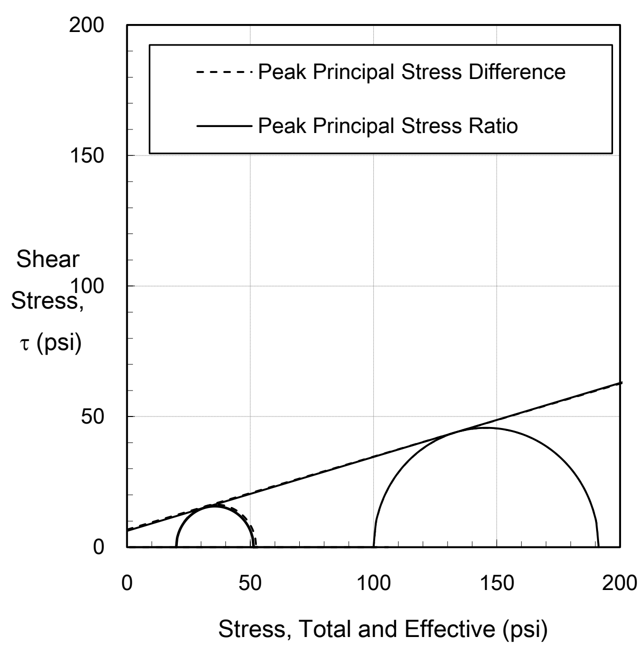
TRI Log #: 43240.3
Test Method: ASTM D4767

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	15.6	15.8
Cohesion (psi)	c_R	6.7	6.2

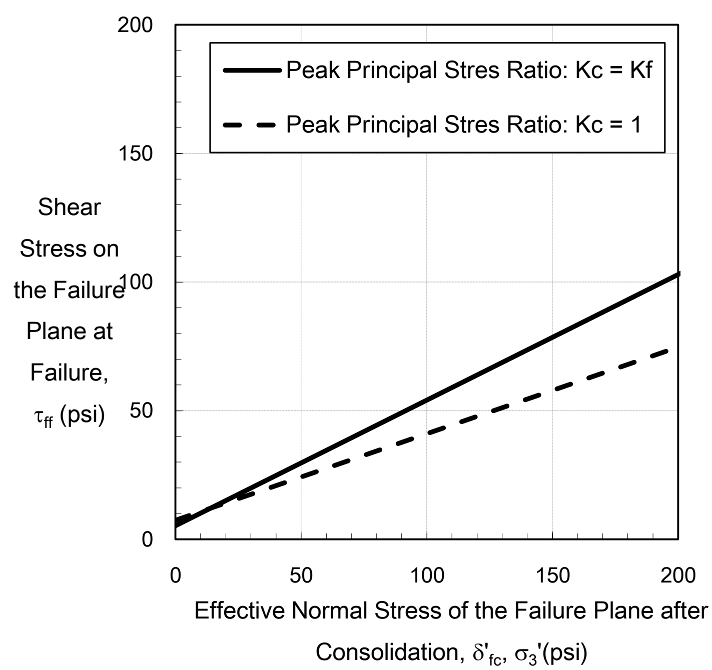
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	25.9	26.0
Effective Cohesion (psi)	c'	5.5	5.3

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	18.3	18.6
Cohesion (psi)	$\psi_{Kc=1}$	8.0	7.4

R / "Total Stress" Envelope



Three-Stage Rapid Drawdown Envelopes



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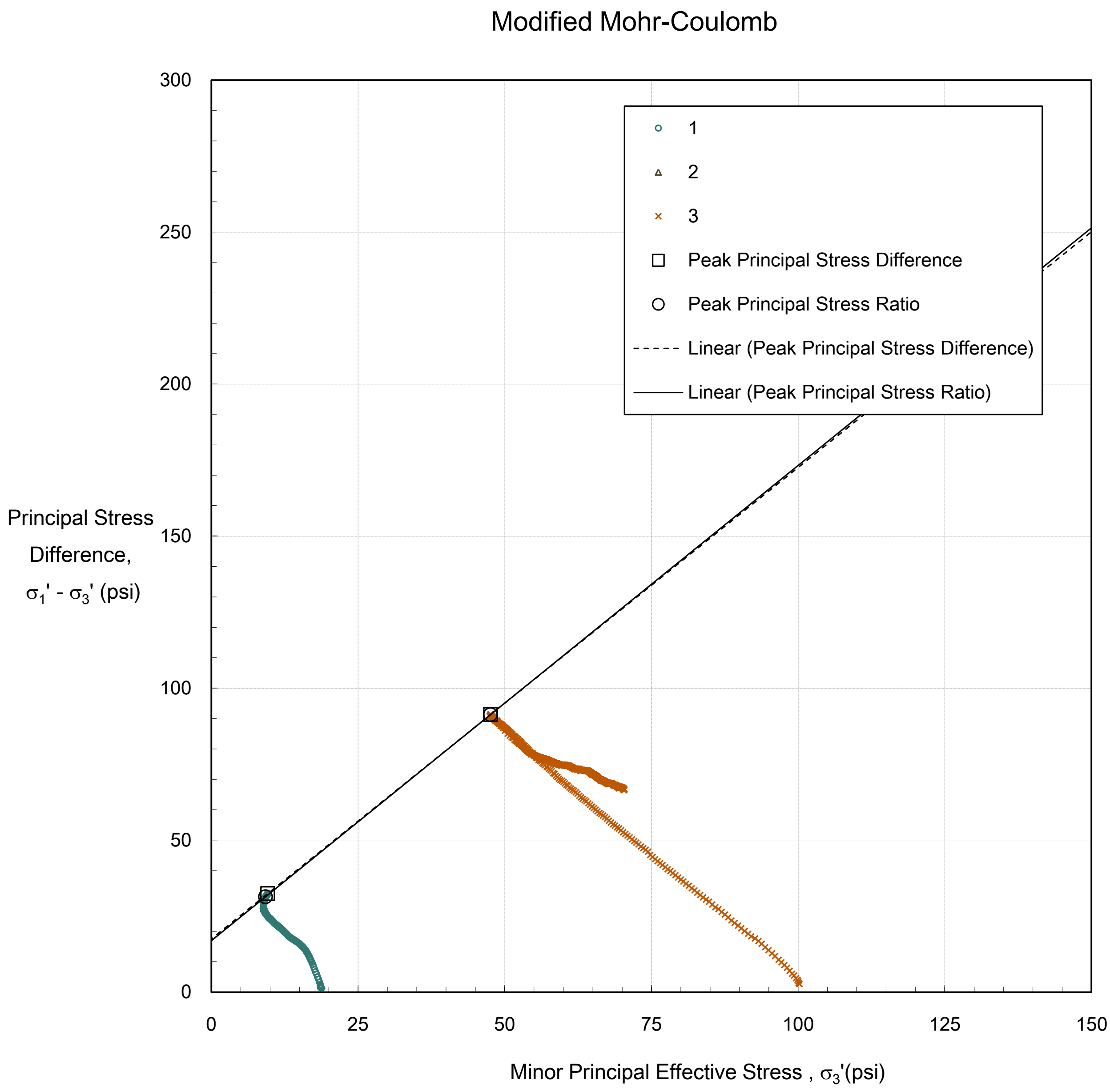
Consolidated-Undrained Triaxial Compression

Client:	Langerman Foster Engineering	TRI Log #:	43240.3
Project:	Site 50 Part 2	Test Method:	ASTM D4767
Sample:	B-31 (15-15.9)		



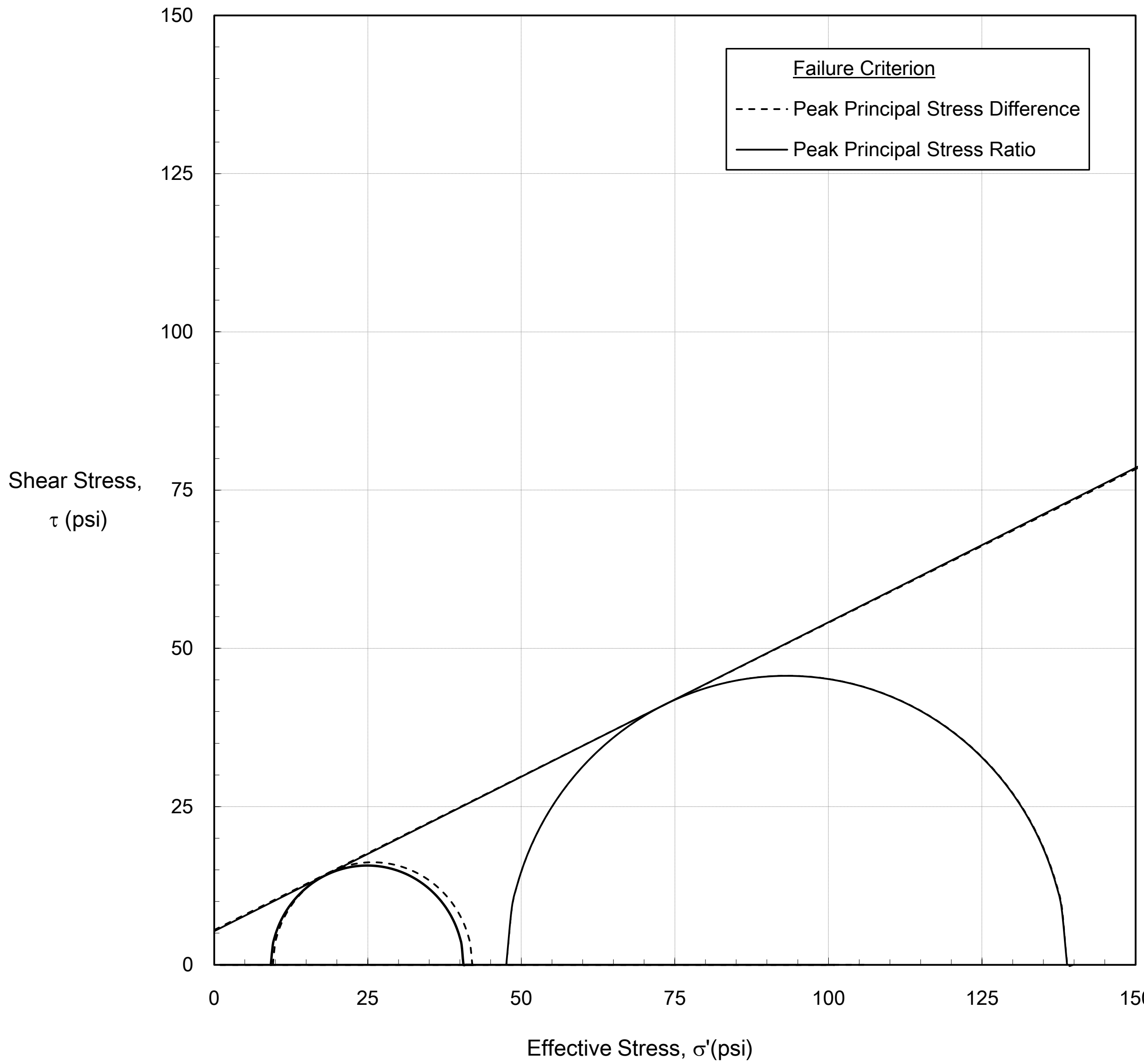
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	25.9	26.0
Effective Cohesion (psi)	5.5	5.3

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-31 (15-15.9)

TRI Log #: 43240.3
Test Method: ASTM D4767

Mohr-Coulomb

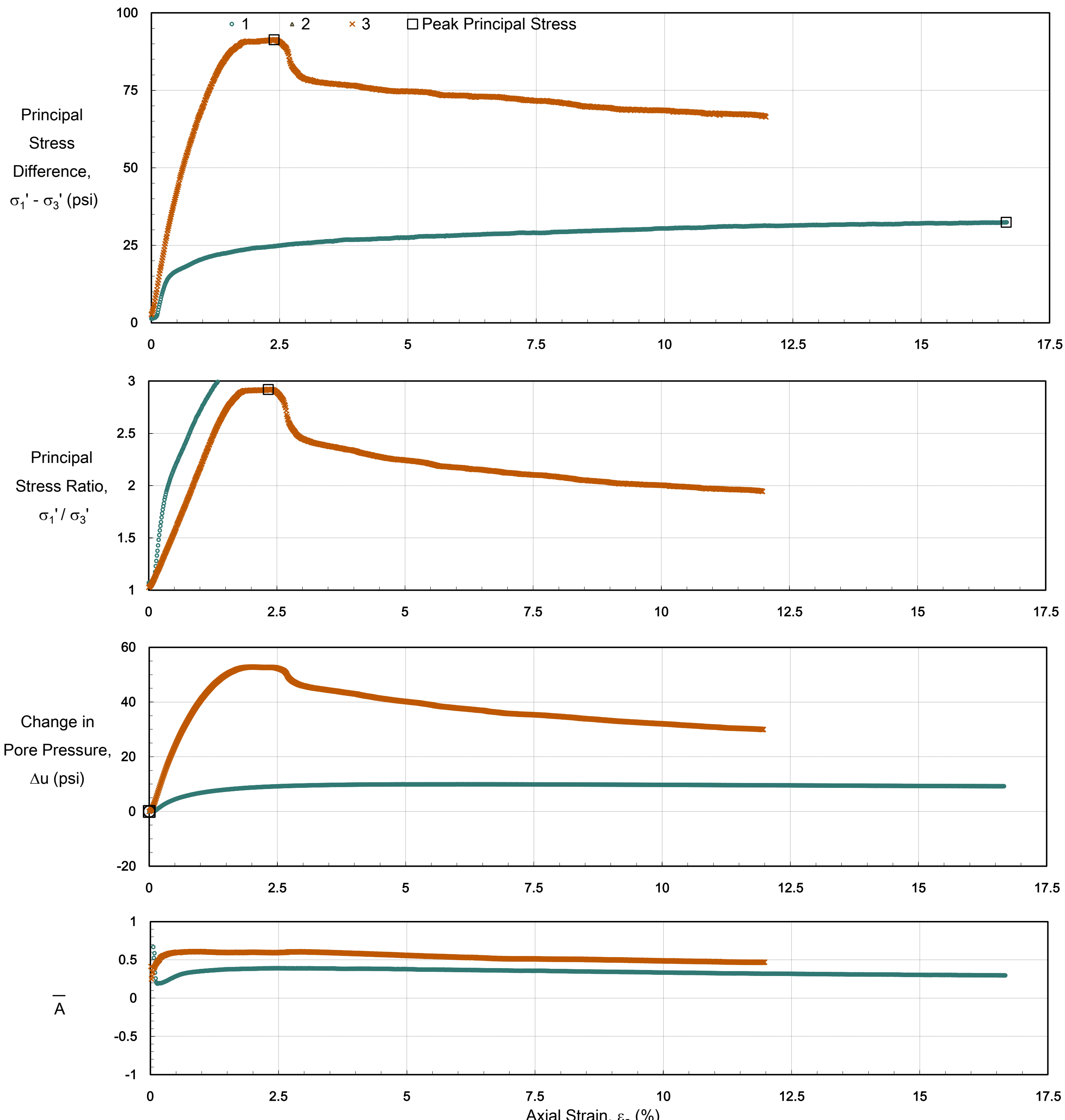


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	25.9	26.0
Effective Cohesion (psi)	5.5	5.3

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-31 (15-15.9)

TRI Log #: 43240.3
Test Method: ASTM D4767

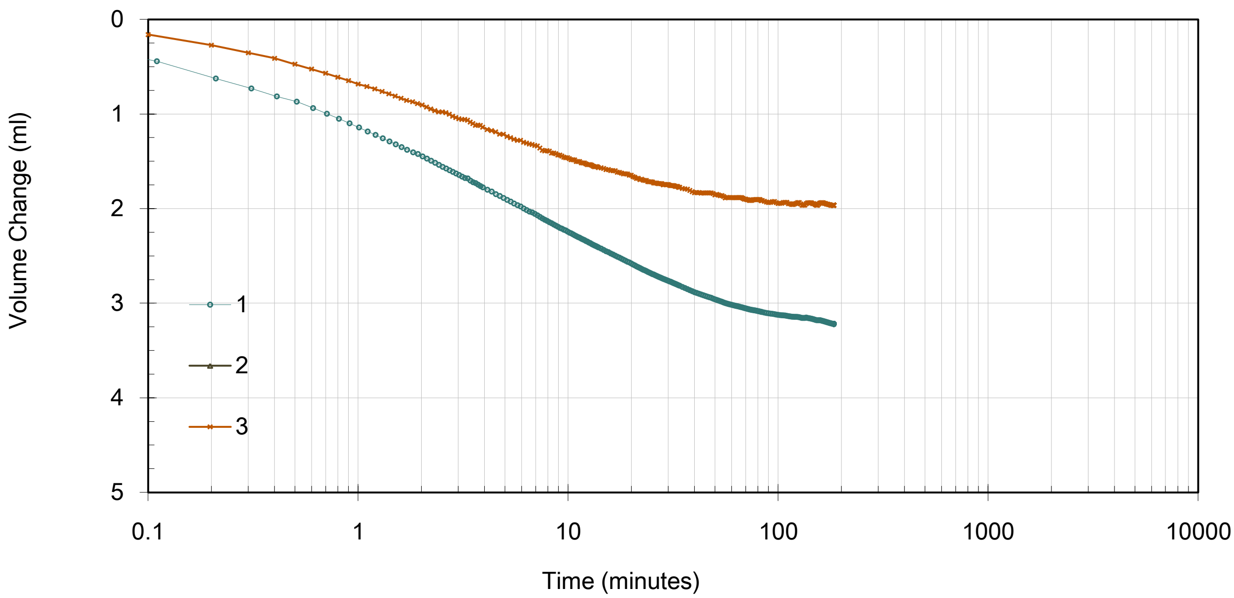


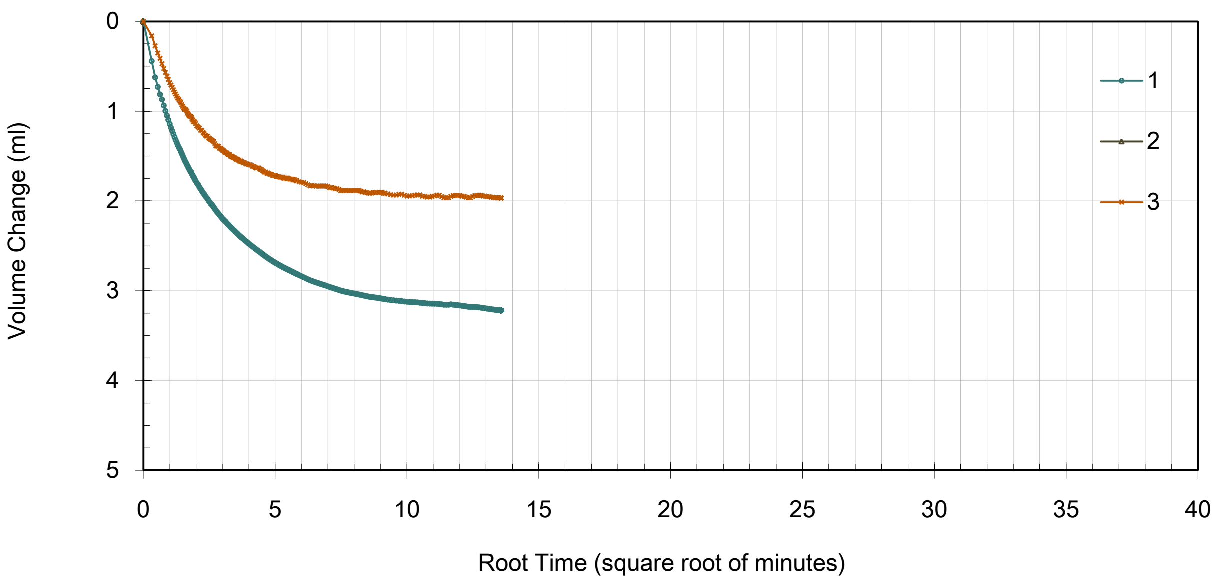
Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-31 (15-15.9)

TRI Log #: 43240.3
Test Method: ASTM D4767

Consolidation





Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-44 (50-51.5)

TRI Log #: 43240.4
Test Method: ASTM D4767

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	20.0	-	100.0	-
Initial Specimen Properties				
Avg. Diameter (in)	1.53	-	1.43	-
Avg. Height (in)	3.28	-	3.31	-
Avg. Water Content (%)	18.3	-	15.3	-
Bulk Density (pcf)	123.9	-	140.5	-
Dry Density (pcf)	104.7	-	121.8	-
Saturation (%)	79.7	-	105.2	-
Void Ratio, n	0.63	-	0.40	-
Total Back-Pressure (psi)	79.3	-	83.8	-
B-Value, End of Saturation	0.98	-	0.99	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.63	-	0.40	-

Shear / Post-Shear				
Rate of Strain (%/hr)	0.50	-	0.50	-
Avg. Water Content (%)	22.5	-	19.9	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	14.3	-	11.6	-	3.3	-	7.2	-
Minor Effective Stress (psi), $\sigma_3'_f$	25.3	-	76.5	-	18.8	-	72.9	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	26.8	-	78.2	-	23.3	-	76.4	-
Pore Water Pressure, Δu_f (psi)	-5.4	-	23.7	-	1.1	-	27.4	-
Major Effective Stress (psi), $\sigma_1'_f$	52.1	-	154.7	-	42.1	-	149.3	-
Secant Friction Angle (degrees)	20.2	-	19.8	-	22.5	-	20.1	-
Effective Friction Angle (degrees)	19.6				19.2			
Effective Cohesion (psi)	0.5				1.7			

Note: The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

Jeffrey A. Kuhn , Ph.D., P.E., 1/2/2019
Analysis & Quality Review/Date

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-44 (50-51.5)

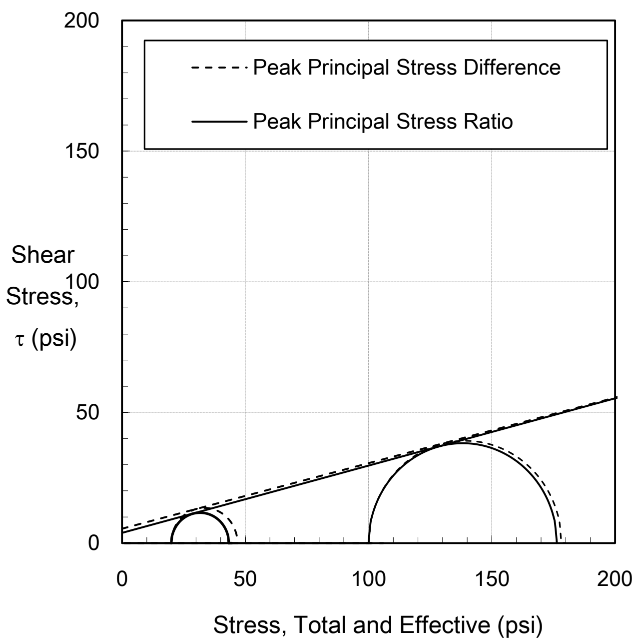
TRI Log #: 43240.4
Test Method: ASTM D4767

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	14.1	14.4
Cohesion (psi)	c_R	5.4	3.9

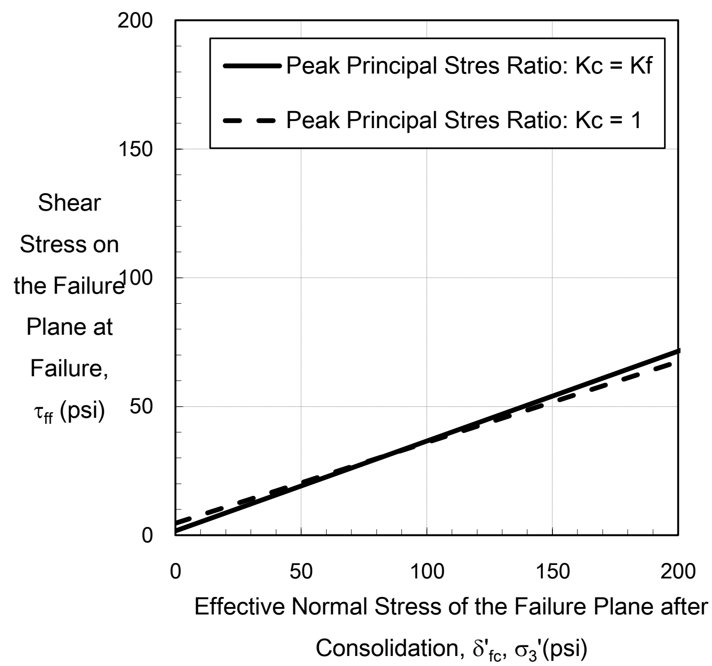
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	19.6	19.2
Effective Cohesion (psi)	c'	0.5	1.7

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	16.9	17.4
Cohesion (psi)	$\psi_{Kc=1}$	6.6	4.7

R / "Total Stress" Envelope



Three-Stage Rapid Drawdown Envelopes



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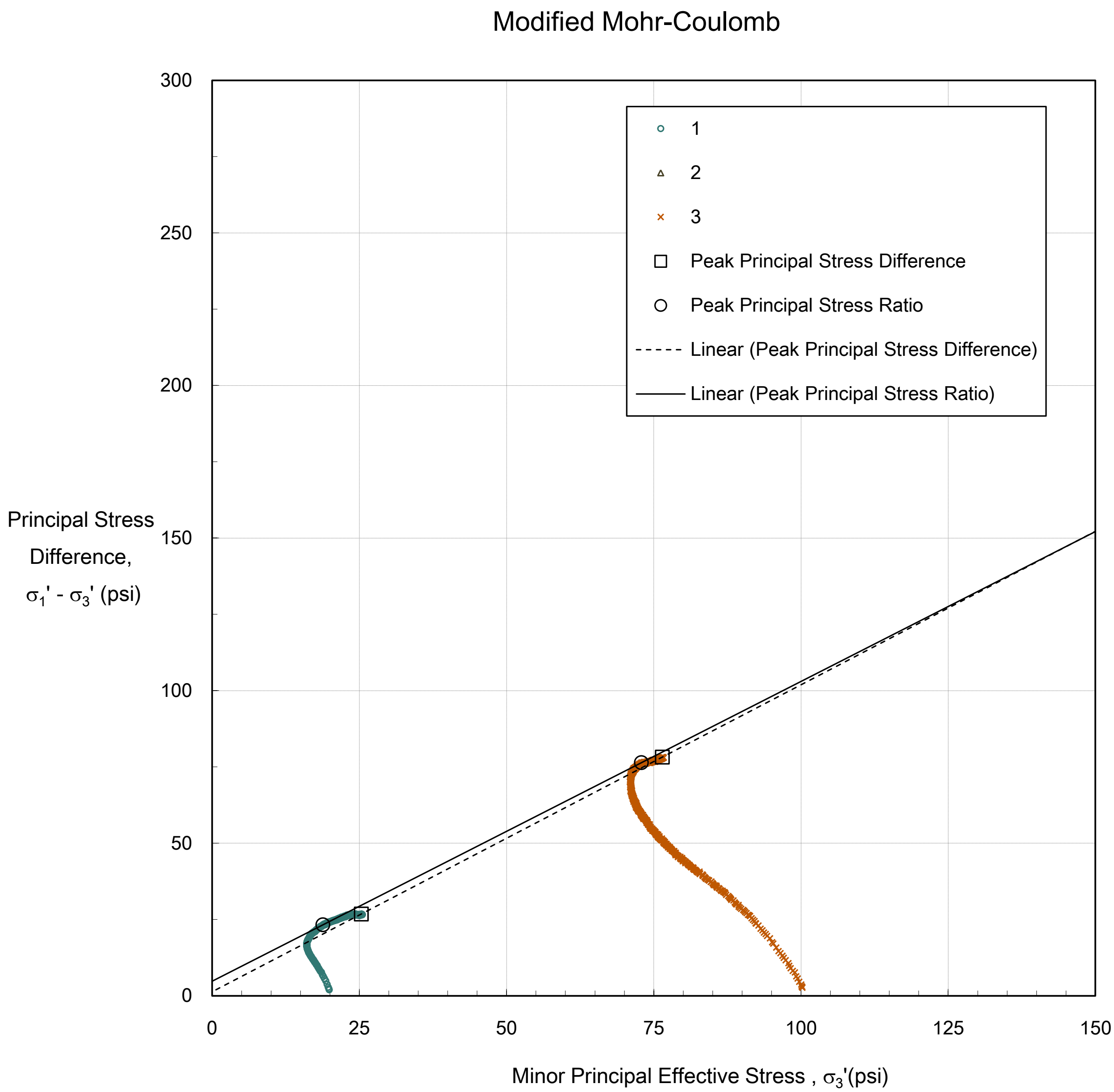
Consolidated-Undrained Triaxial Compression

Client:	Langerman Foster Engineering	TRI Log #:	43240.4
Project:	Site 50 Part 2	Test Method:	ASTM D4767
Sample:	B-44 (50-51.5)		



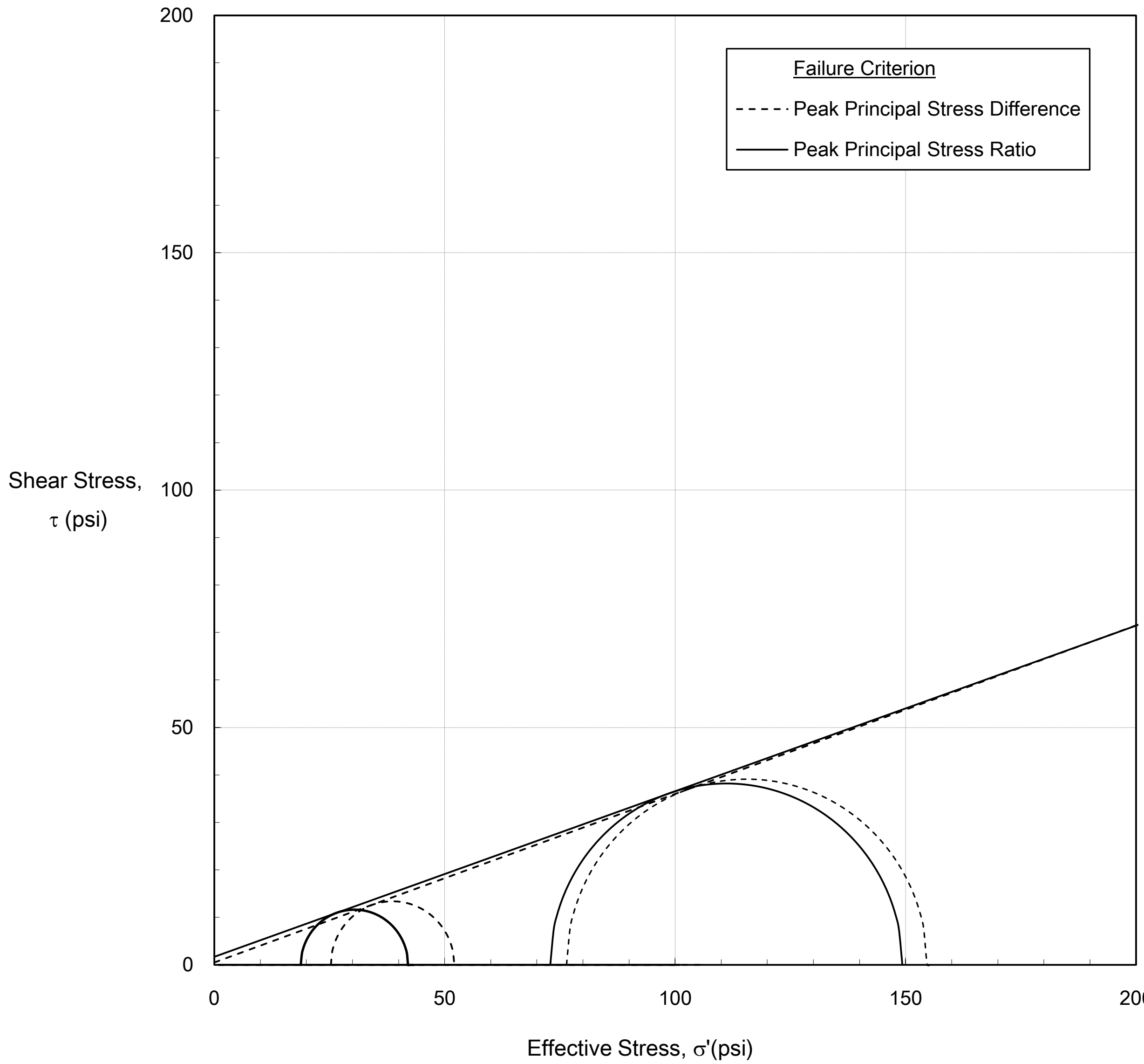
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	19.6	19.2
Effective Cohesion (psi)	0.5	1.7

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-44 (50-51.5)

TRI Log #: 43240.4
Test Method: ASTM D4767

Mohr-Coulomb

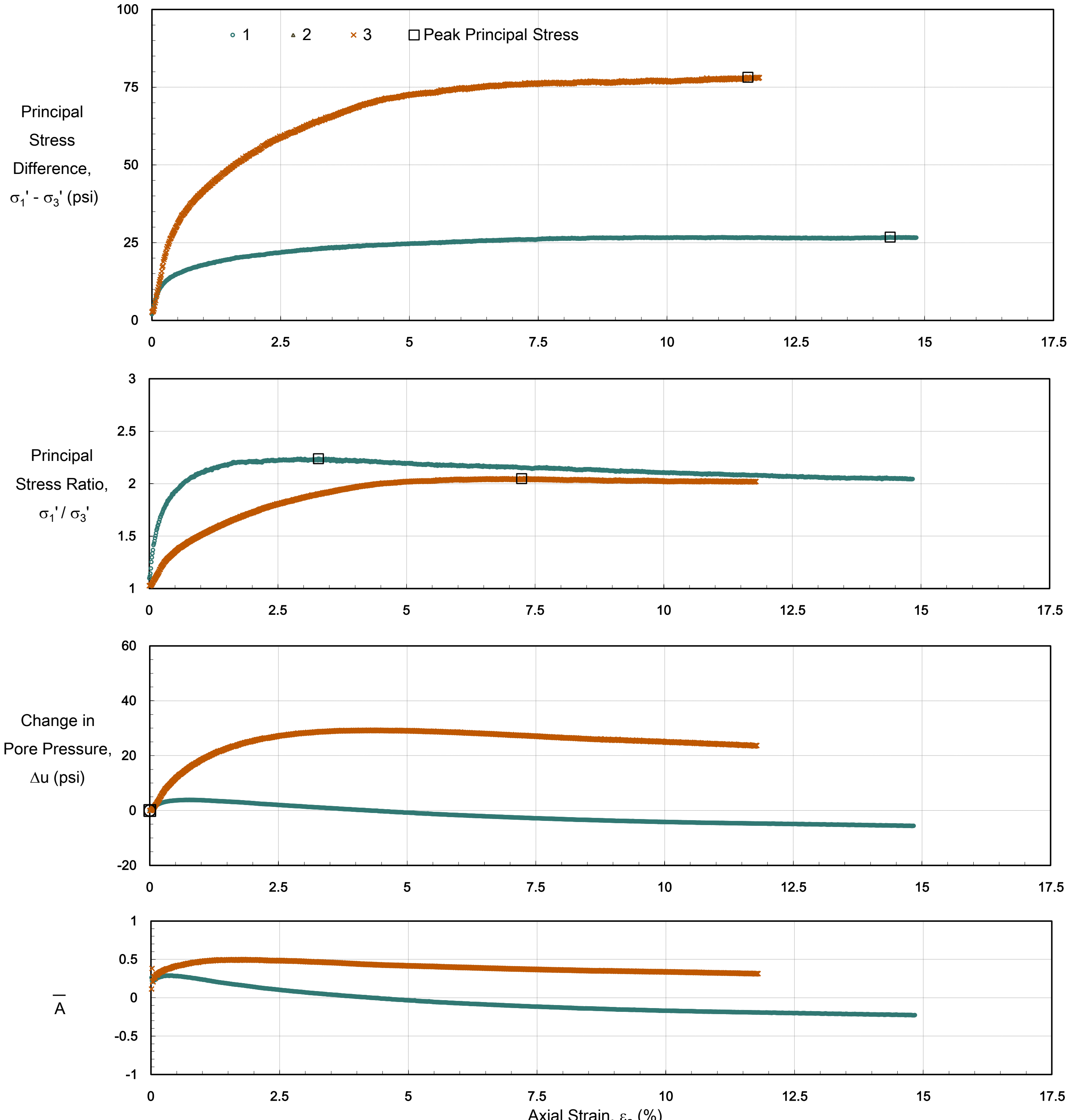


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	19.6	19.2
Effective Cohesion (psi)	0.5	1.7

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-44 (50-51.5)

TRI Log #: 43240.4
Test Method: ASTM D4767

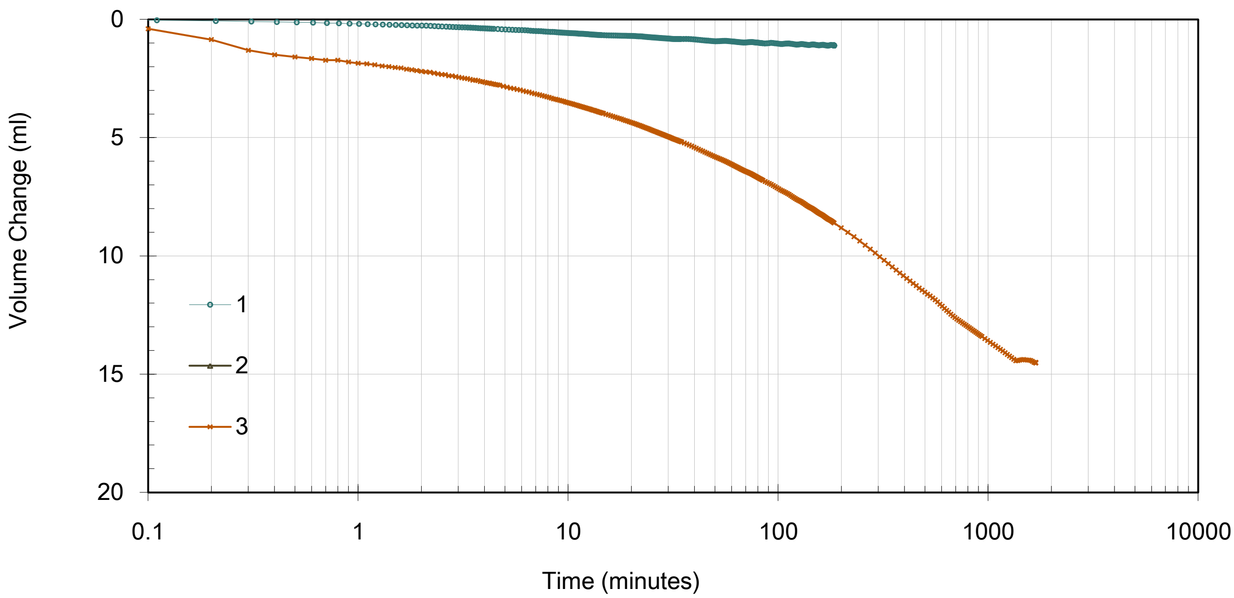


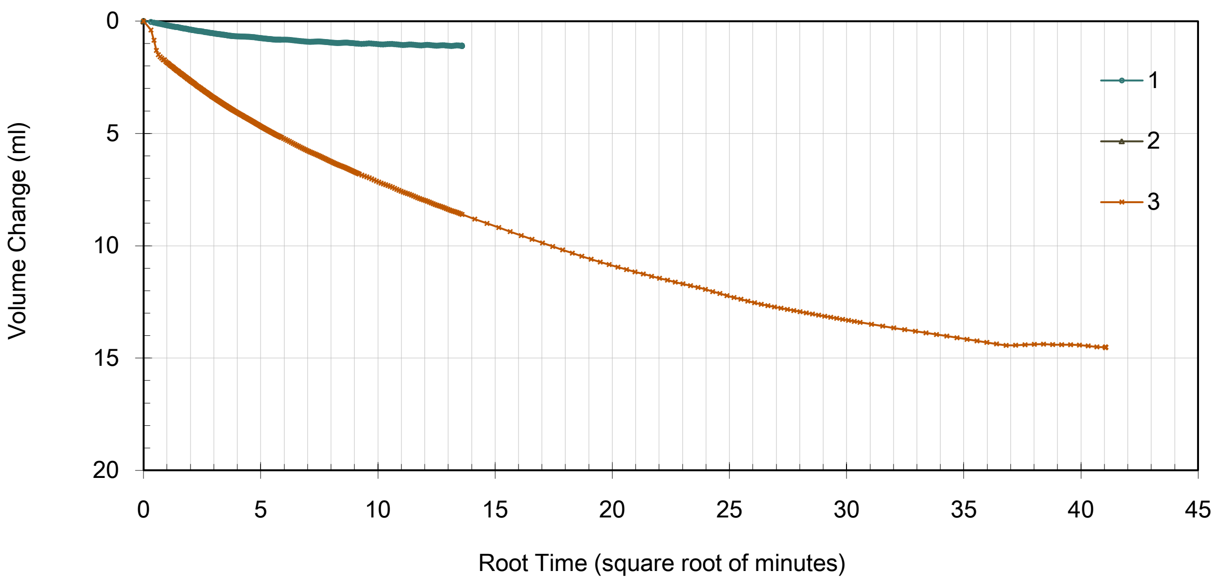
Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-44 (50-51.5)

TRI Log #: 43240.4
Test Method: ASTM D4767

Consolidation





Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-19(50-51)

TRI Log #: 44112.1
Test Method: ASTM D4767

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	20.0	-	100.0	-
Initial Specimen Properties				
Avg. Diameter (in)	1.47	-	1.53	-
Avg. Height (in)	3.31	-	3.27	-
Avg. Water Content (%)	14.3	-	15.3	-
Bulk Density (pcf)	131.1	-	125.0	-
Dry Density (pcf)	114.7	-	108.5	-
Saturation (%)	80.6	-	73.0	-
Void Ratio, n	0.49	-	0.57	-
Total Back-Pressure (psi)	79.5	-	80.5	-
B-Value, End of Saturation	0.98	-	0.98	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.49	-	0.57	-

Shear / Post-Shear				
Rate of Strain (%/hr)	1.00	-	1.00	-
Avg. Water Content (%)	20.7	-	18.4	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	12.8	-	5.0	-	3.7	-	3.4	-
Minor Effective Stress (psi), $\sigma_3'_f$	16.9	-	59.7	-	10.3	-	54.7	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	45.9	-	104.6	-	37.3	-	101.8	-
Pore Water Pressure, Δu_f (psi)	3.4	-	40.4	-	9.8	-	45.3	-
Major Effective Stress (psi), $\sigma_1'_f$	62.8	-	164.3	-	47.6	-	156.5	-
Secant Friction Angle (degrees)	35.2	-	27.8	-	40.0	-	28.8	-
Effective Friction Angle (degrees)	24.0				24.9			
Effective Cohesion (psi)	7.4				7.1			

Note: The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

Jeffrey A. Kuhn , Ph.D., P.E., 2/1/2019
Analysis & Quality Review/Date

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-19(50-51)

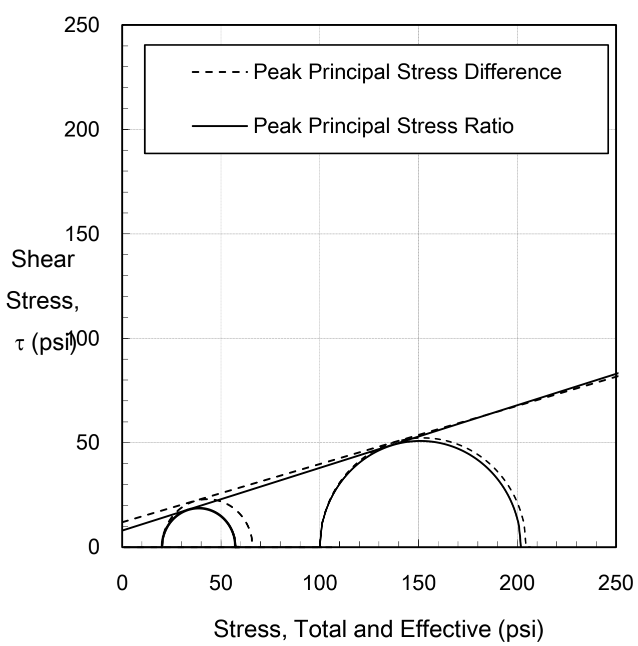
TRI Log #: 44112.1
Test Method: ASTM D4767

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	15.6	16.7
Cohesion (psi)	c_R	11.9	7.9

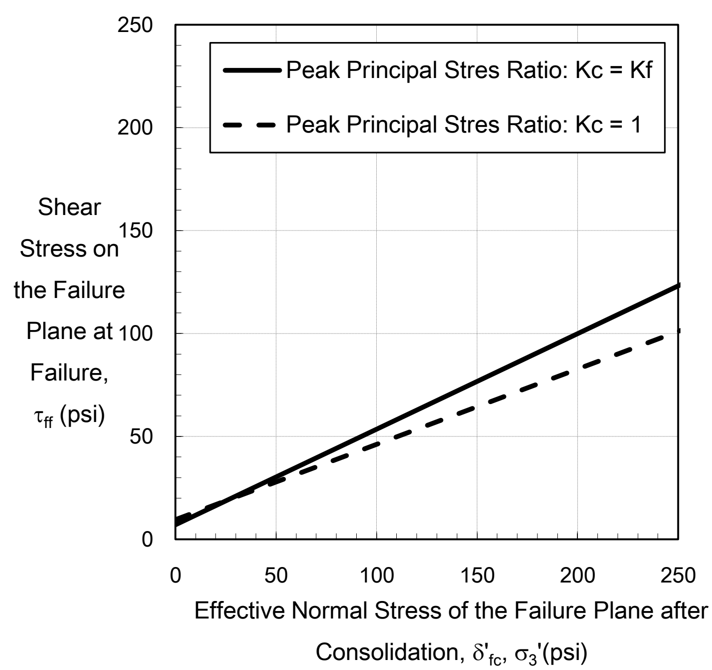
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	24.0	24.9
Effective Cohesion (psi)	c'	7.4	7.1

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	18.5	20.1
Cohesion (psi)	$\psi_{Kc=1}$	14.3	9.6

R / "Total Stress" Envelope



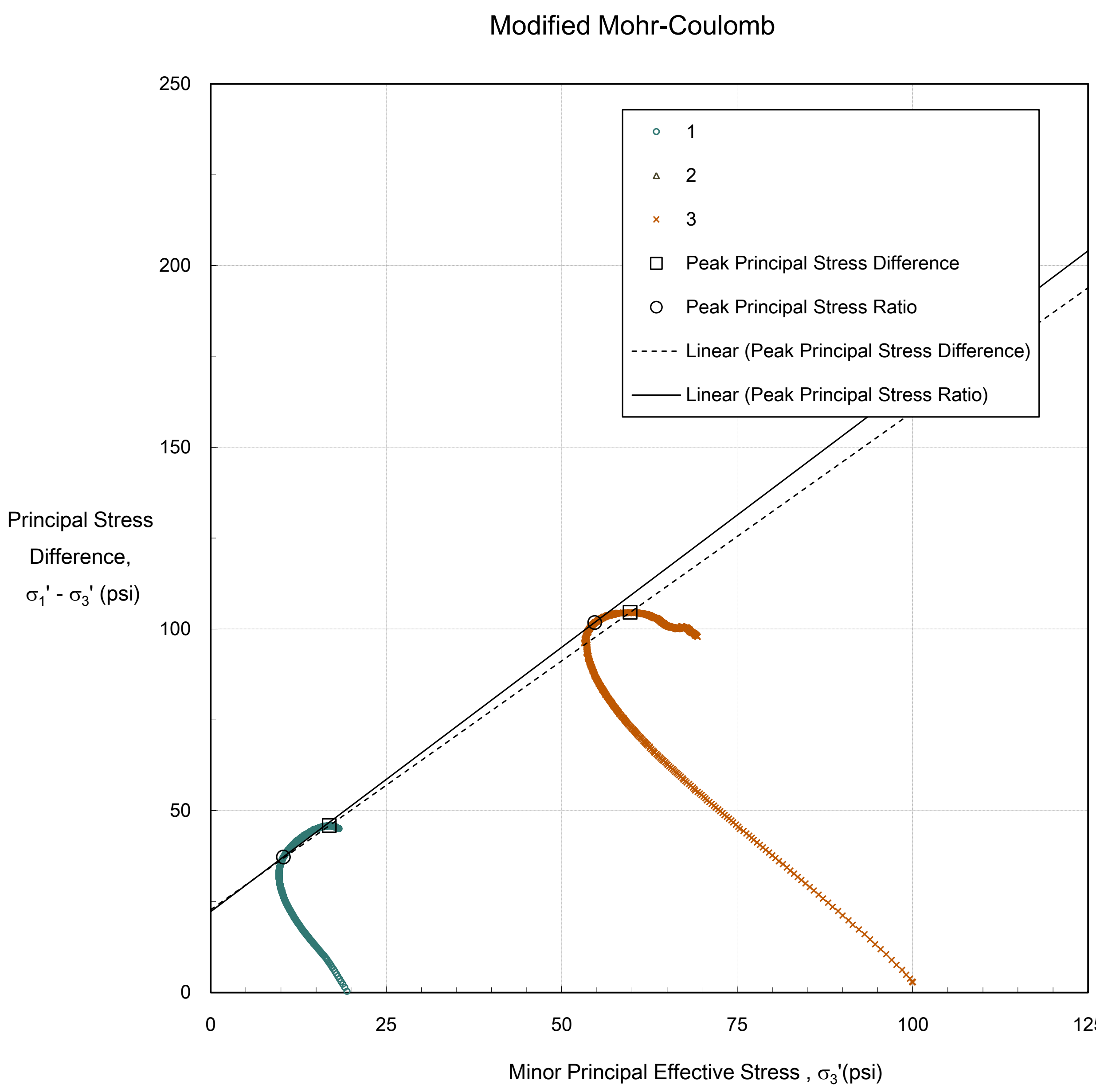
Three-Stage Rapid Drawdown Envelopes



Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-19(50-51)

TRI Log #: 44112.1
Test Method: ASTM D4767

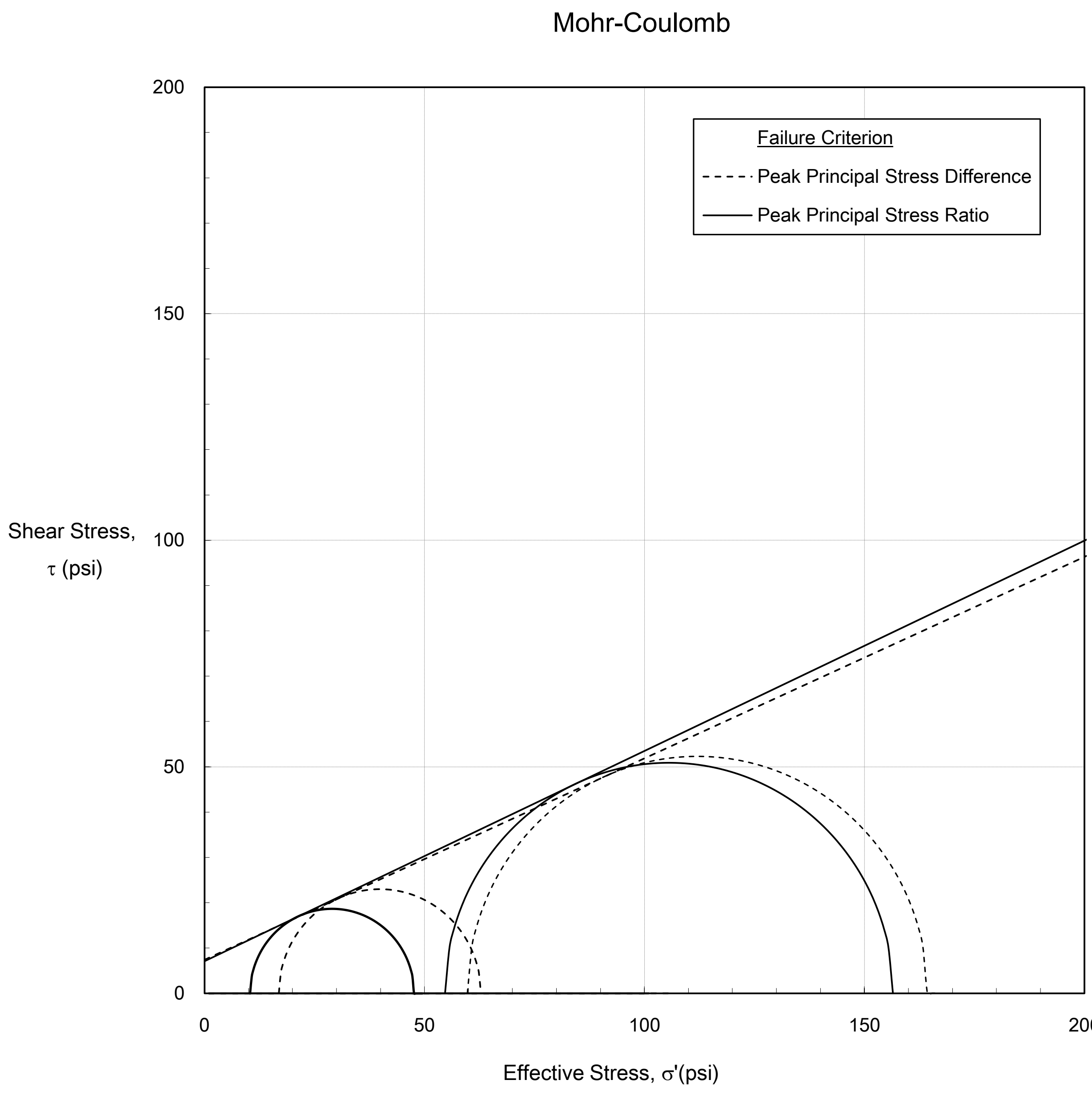


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	24.0	24.9
Effective Cohesion (psi)	7.4	7.1

Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-19(50-51)

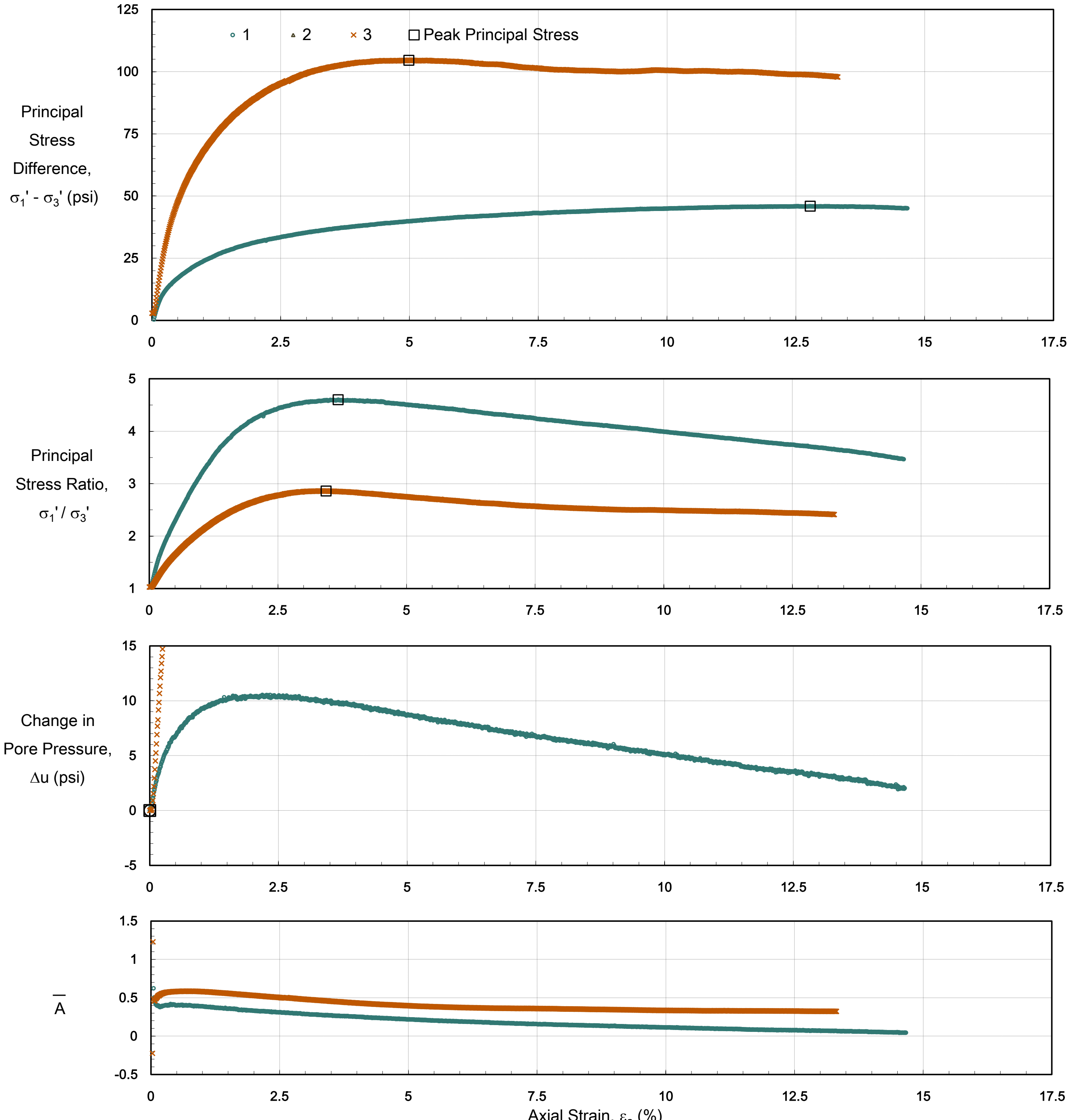
TRI Log #: 44112.1
Test Method: ASTM D4767



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	24.0	24.9
Effective Cohesion (psi)	7.4	7.1

Consolidated-Undrained Triaxial Compression

Client:	Langerman Foster Engineering	TRI Log #:	44112.1
Project:	Site 50 Part 2	Test Method:	ASTM D4767
Sample:	B-19(50-51)		

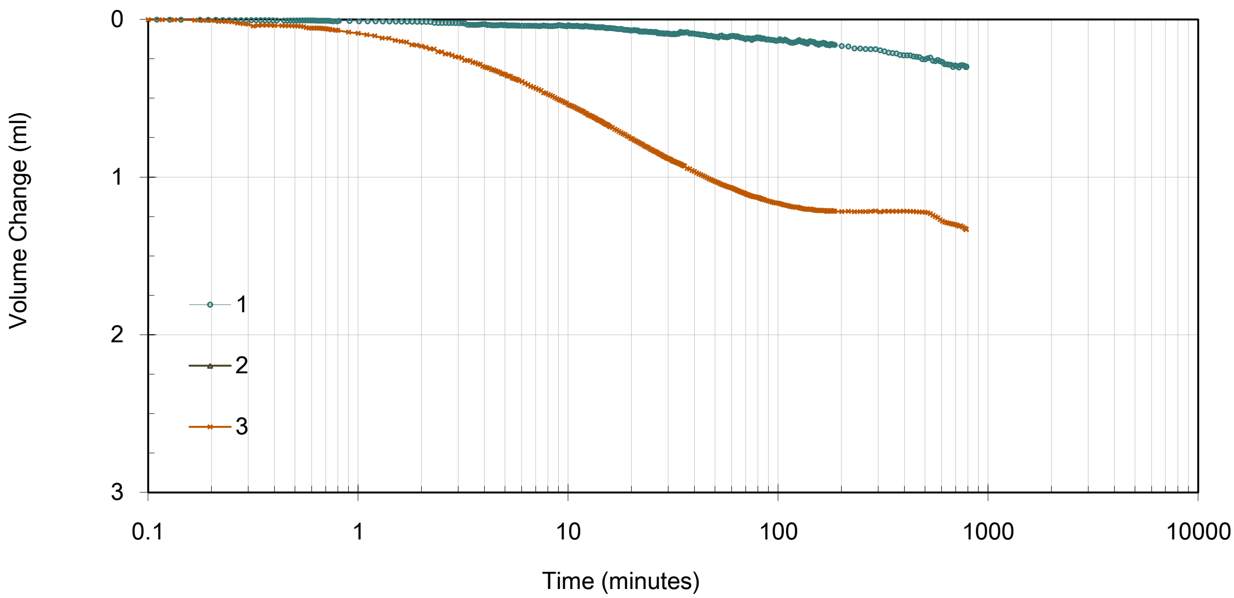


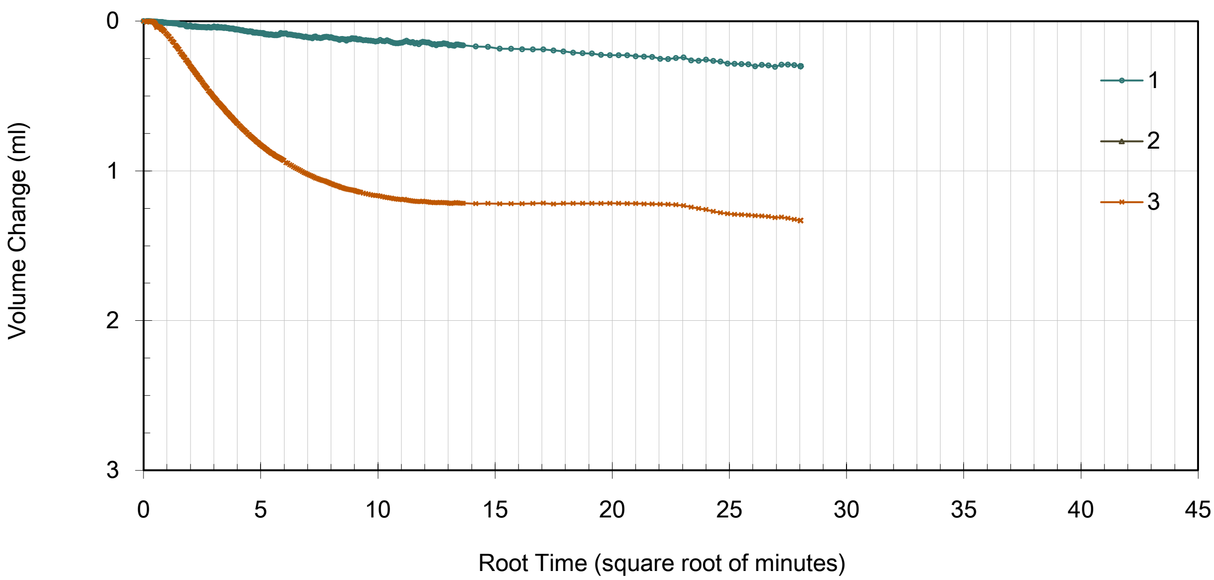
Consolidated-Undrained Triaxial Compression

Client: Langerman Foster Engineering
Project: Site 50 Part 2
Sample: B-19(50-51)

TRI Log #: 44112.1
Test Method: ASTM D4767

Consolidation





Client: Langerman Foster Engineering

TRI Log #: 43240

Project: Site 50 Part 2

Jeffrey A. Kuhn, Ph.D., P.E., 1/2/2019

Quality Review/Date

COC Line #	Sample Identification	Atterberg Limits		
		Liquid Limit	Plastic Limit	Plasticity Index
-	Test Method	ASTM D4318, Method A : Multipoint		
1	B-24 (45-46)	59	26	33
2	B-17 (25-26)	67	23	44
3	B-31 (15-15.9)	66	27	39
4	B-44 (50-51.5)	60	25	35

Note: NL = No Liquid Limit; NP = No Plastic Limit

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Client: Langerman Foster Engineering

TRI Log #: 44112

Project: Site 50 Part 2

Jeffrey A. Kuhn, Ph.D., P.E., 2/1/2019

Quality Review/Date

COC Line #	Sample Identification	Fines (%)	Moisture Content (%)	Atterberg Limits		
				Liquid Limit	Plastic Limit	Plasticity Index
-	Test Method	ASTM D1140	ASTM D2216	ASTM D4318, Method A : Multipoint		
1	B-19(50-51)	85.2	13.3	60	21	39

Note: NL = No Liquid Limit; NP = No Plastic Limit

APPENDIX III-4.G

VIBRATING WIRE PIEZOMETER MANUAL AND CALIBRATION FORMS

STATE OF TEXAS
James Lawrence
Discipline
License #
541
LICENSED
PROFESSIONAL GEOSCIENTIST

5-13-2020

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Email: geokon@geokon.com
http://www.geokon.com

Instruction Manual

Model 4500 series

Vibrating Wire Piezometer

(Doc Rev MM, 04/30/2019)

Warranty Statement

Geokon warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by Geokon, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of Geokon's control. Components which wear or which are damaged by misuse are not warranted. This includes fuses and batteries.

Geokon manufactures scientific instruments whose misuse is potentially dangerous. The instruments are intended to be installed and used only by qualified personnel. There are no warranties except as stated herein. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and of fitness for a particular purpose. Geokon is not responsible for any damages or losses caused to other equipment, whether direct, indirect, incidental, special or consequential which the purchaser may experience as a result of the installation or use of the product. The buyer's sole remedy for any breach of this agreement by Geokon or any breach of any warranty by Geokon shall not exceed the purchase price paid by the purchaser to Geokon for the unit or units, or equipment directly affected by such breach. Under no circumstances will Geokon reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

Every precaution for accuracy has been taken in the preparation of manuals and/or software, however, Geokon neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages or losses that result from the use of the products in accordance with the information contained in the manual or software.

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FIGURES

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EQUATIONS

1. THEORY OF OPERATION

Geokon model 4500 Vibrating Wire Piezometers are intended primarily for long-term measurements of fluid depths and pore pressures in standpipes, boreholes, embankments, pipelines, and pressure vessels. Several different models are available to suit a variety of Geotechnical applications. Calibration data is supplied with each piezometer.

All Geokon vibrating wire piezometers utilize a sensitive stainless steel diaphragm (with the exception of model 4500C, which employs bellows) to which a vibrating wire element is connected. During use, changing pressures on the diaphragm cause it to deflect. This deflection is measured as a change in tension and frequency of vibration of the vibrating wire element. The square of the vibration frequency is directly proportional to the pressure applied to the diaphragm. A filter is used to keep out solid particles and prevent damage to the sensitive diaphragm. Standard filters are 50-micron stainless steel. High air entry value filters are available upon request.

Two coils, one with a magnet insert, the other with a pole piece insert, are installed near the vibrating wire. In use, a pulse of varying frequency (swept frequency) is applied to these coils, causing the wire to vibrate primarily at its resonant frequency. When the excitation ends, the wire continues to vibrate. During vibration, a sinusoidal signal is induced in the coils and transmitted to the readout box where it is conditioned and displayed.

Portable readout units are available to provide the excitation, signal conditioning, and readout of the instrument. Datalogger systems, which allow remote, unattended data collection of multiple sensors, are also available. Contact Geokon for additional information.

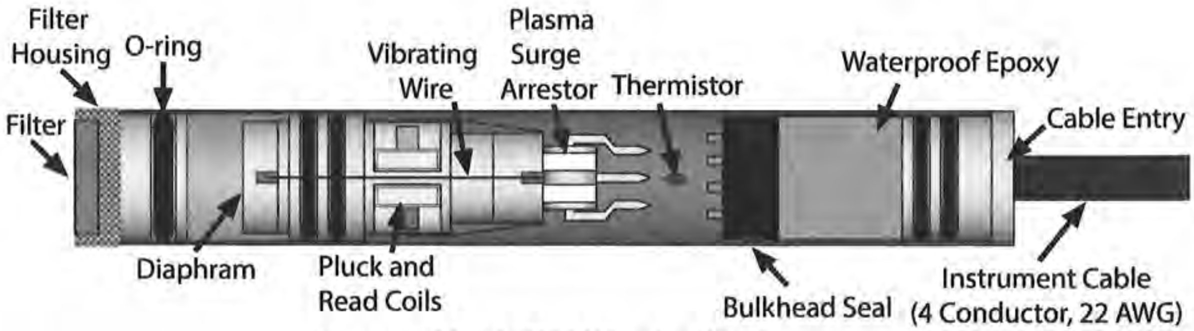


Figure 1 - Model 4500S Vibrating Wire Piezometer

All exposed components are made of corrosion resistant stainless steel. If proper installation techniques are used, the device should have an unlimited life.

In salt water, it may be necessary to use special materials for the diaphragm and housing. The 4500TI series piezometers are constructed from titanium and are specifically designed to be used in this type of environment.

2. QUICK START INSTRUCTIONS

For those familiar with Geotechnical instrumentation and its installation, the following quick start instructions may be used. For more detailed instructions see Section 3.

1) Prior to installation, allow the piezometer to come to thermal equilibrium for a minimum of 15 minutes. (Alternatively, if the instrument is attached to a readout box, wait until the piezometer reading has stabilized.)

2) Record the piezometer reading, barometric pressure, and temperature while the piezometer is experiencing zero (atmospheric) pressure. This is what is known as the "initial zero" reading.

3) Verify that the initial zero reading for the piezometer is compatible with the factory supplied zero reading on the calibration report.

4) Carefully measure and mark the cable where it will lie at the top of the borehole, well, or standpipe, once the piezometer has reached the desired depth. (The piezo diaphragm lies 3/4 of an inch above the tip of the piezometer.)

5) Saturate the piezometer filter. (See Section 3.1) **Warning! Do not allow the piezometer to freeze once the filter stone has been saturated!**

6) For installation in standpipes or wells, see Section 4.1, for boreholes Section 4.2, and for fills and embankments Section 4.3.

3. PRIOR TO INSTALLATION

3.1 Saturating Filter Tips

Warning! Do not allow the piezometer to freeze once the filter stone has been saturated! See Section 4.8 for information about protecting the piezometer from freezing.

Most filter tips can be removed for saturation and then reassembled. To maintain saturation, the unit should be kept underwater until installation. If the piezometer is used in a standpipe where it will be raised and lowered frequently, the filter housing may loosen over time, and a permanent filter assembly may be required. The removable filter may be fixed permanently by prick punching the piezometer tube approximately 1/16" to 1/8" behind the filter assembly joint.

Salts in the water can be deposited into the filter stone causing it to become clogged if it is allowed to dry out completely. Filter stones may be replaced with screens for standpipe installations. Screens available from Geokon are less likely than standard filters to collect salt and become clogged.

3.1.1 Saturating Low Air Entry (Standard) Filters

For accurate results, total saturation of the filter is necessary. As the piezometer is lowered into the water, water is forced into the filter, compressing the air in the space between the filter stone and the pressure sensitive diaphragm. After a period, this air will dissolve into the water, filling the filter and the space above it entirely with water.

To speed up the saturation process, remove the filter from the piezometer by carefully twisting and pulling on the filter housing assembly (or unscrewing the point of the piezometer for model 4500DP). Hold the piezometer with the filter facing up and fill the space above the diaphragm with water. Slowly replace the filter housing, allowing the water to squeeze through the filter stone as it is installed. For piezometers with a range of less than 10 psi, take readings with a readout box while reinstalling the filter housing to ensure the piezometer is not overranged.

3.1.2 Saturating High Air Entry Ceramic Filters

Because of the high air entry characteristics of the ceramic filter, de-airing is particularly important. Different air entry values require different saturation procedures.

3.1.2.1 One Bar Filters

1) Remove the filter from the piezometer by carefully twisting and pulling on the filter housing assembly.

2) Boil the filter assembly in de-aired water.

3) Reassemble the piezometer under the surface of a container of de-aired water. Use a readout box while installing the filter to monitor the diaphragm pressure. If the piezometer begins to overrange, allow the pressure to dissipate before pushing further.

4) Be sure that no air is trapped in the transducer cavity.

3.1.2.2 Two Bar and Higher Filters

The proper procedure for de-airing and saturating these filters is somewhat complex; therefore, it is recommended that saturation be done at the factory by Geokon. If saturation must be done in the field, carefully follow the instructions below:

1) Place the assembled piezometer, filter down, in a vacuum chamber that has an inlet port at the bottom for de-aired water.

2) Close off the water inlet and evacuate the chamber. The transducer should be monitored while the chamber is being evacuated.

3) When maximum vacuum has been achieved, allow de-aired water to enter the chamber until it reaches an elevation a few inches above the piezometer filter.
4) Close off the inlet port.

5) Release the vacuum.

6) Observe the transducer output. It may take up to 24 hours for the filter to completely saturate and the pressure to rise to zero.

7) After saturation, the transducer should be kept in a container of de-aired water until installation. If de-aired at the factory a special cap is applied to the piezometer to maintain saturation.

3.1.3 Saturating Model 4500C Filter Tips

WARNING! The filter housing is not removable on the 4500C. Any attempt to remove the filter stone or the housing will destroy the transducer!

If the pressure to be measured is less than 5 psi the filter stone must be saturated. A hand operated vacuum pump and short length of half inch surgical tubing is required. Hand pumps and tubing are available from the factory. (A hand pump that has been used successfully is the MityvacII® by Lincoln Industries Corp. of St. Louis, MO.)

The saturation procedure is as follows:

1) Attach the tube to the transducer as shown in Figure 2.

2) Fill the tubing with approximately two inches (five centimeters) of water.

3) Attach the other end of the tube to the hand vacuum pump.

4) While holding the transducer so that the water rests on the filter, but does not enter the pump, squeeze the hand pump to initiate a vacuum inside the tubing. This will draw the air out of the filter and the area behind it, replacing it with water. A vacuum of 20 to 25" Hg. (50 to 65 cm Hg.) is enough for proper air evacuation.

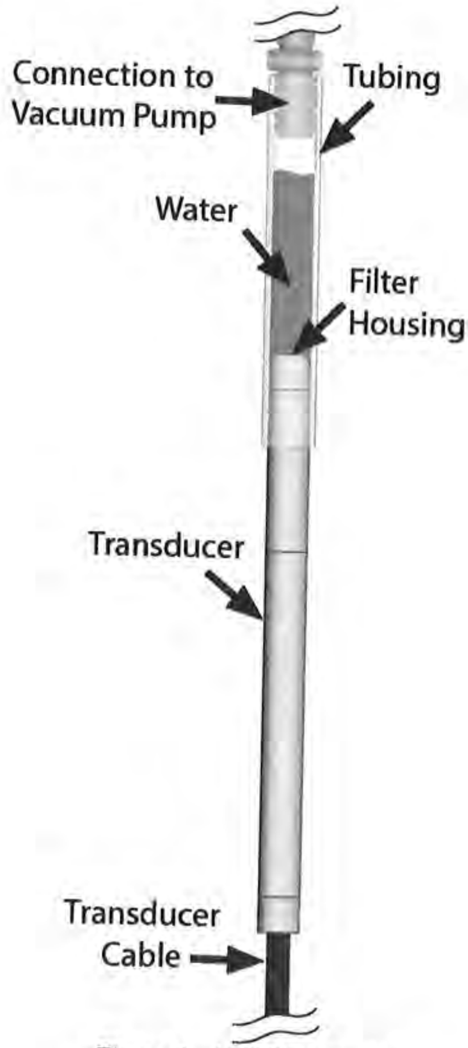


Figure 2 - 4500C Saturation

3.2 Establishing an Initial Zero Reading

Vibrating Wire Piezometers differ from other types of pressure sensors in that they indicate a reading when no pressure is exerted on the sensor. **It is imperative that an accurate initial zero reading be obtained for each piezometer, as this reading will be used for all subsequent data reduction.**

Generally, the initial zero reading is obtained by reading the instrument prior to installation. There are several different ways of taking an initial zero reading. The essential element in all methods is that the piezometer needs to thermally stabilize in a constant temperature environment while the pressure on the piezometer is barometric only. Because of the way the piezometer is constructed, it usually takes 15 to 20 minutes for the temperature of all the different elements to equalize.

A question may arise as to what to do with the filter stone while taking zero readings. If a standard stainless steel filter is being used, it will not matter if the filter stone is saturated or not. However, if the piezometer is equipped with a ceramic high air entry filter stone, then it must be saturated while taking the zero readings.

It will be necessary to measure the barometric pressure only if the piezometer is unvented and it will be installed in a location that is subject to barometric pressure changes that would require correction, such as in an open well. A piezometer sealed in place at depth could be recording pressures in groundwater that is not hydraulically connected to the atmosphere, for which barometric pressure compensation would be inappropriate. See Section 6.3 for more information on Barometric corrections.

Calibration data is supplied with each gauge, a factory zero reading taken at a specific temperature and absolute barometric pressure is included. (See Appendix E for a sample calibration report.) Zero readings at the site should coincide with the factory readings within 50 digits, after barometric and temperature corrections are made. Barometric pressures change with elevation at a rate of approximately 3.45 kPa (½ psi) per 300 meters (1,000 ft.). The factory elevation is +580 feet. All stated barometric readings represent absolute pressure uncorrected for height above sea level. A thermistor is included inside the body of the piezometer for the measurement of temperature.

NOTE REGARDING THE 4500C: The construction of this very slender vibrating wire transducer requires a miniaturization of the internal parts, which consequently are somewhat delicate. **Handle the transducer with care during the installation procedure.** Despite taking every precaution to ensure that the transducer arrives unharmed, it is possible for the zero to shift during shipment due to rough handling. However, tests have shown that though the zero may shift, the calibration factors do not change. Therefore, it is doubly important that an initial no load zero reading be taken prior to installation.

3.2.1 Recommended Method for Establishing an Initial Zero Reading

1) Saturate the filter stone per Section 3.1. **Warning! Do not allow the piezometer to freeze once the filter stone has been saturated!**

2) Replace the filter stone.

3) Hang the piezometer in the borehole at a point just above the water.

4) Wait until the piezometer reading has stopped changing.

5) Take the zero and temperature readings.

3.2.2 Alternative Method One

1) Place the piezometer under water in a bucket.

2) Allow 15 to 20 minutes for the temperature of the unit to stabilize.

3) Use the instrument cable to lift the piezometer out of the water. Do not handle the piezometer housing; body heat from the hands could cause temperature transients.

4) Immediately take a zero and temperature reading.

3.2.3 Alternative Method Two

1) Allow 15 to 20 minutes for the temperature of the unit to stabilize.

2) Lift the piezometer into the air by the cable only. Do not handle the piezometer housing; body heat from the hand could cause temperature transients.

3) Take a zero and temperature reading.

(If this method is chosen, be sure that the piezometer is protected from sunlight or sudden changes of temperature. Wrapping it in some insulating material is recommended.)

3.2.4 Alternative Method Three

1) Lower the piezometer to a known depth marked on the piezometer cable. (The diaphragm inside the piezometer is located approximately 3/4" (15 mm) from the tip.)

2) Use a dip meter to accurately measure the depth to the water surface.

3) After temperature stabilization, read the piezometer pressure.

4) Using the factory calibration constants and a knowledge of the pressure of the water column above the piezometer (height times density), calculate the equivalent zero pressure reading if linear regression is used, or the factor C if the second order polynomial is used.

3.3 Checking the Piezometer Performance

If a rough check of the piezometer performance is needed, the following procedure is recommended:

1) Lower the piezometer to a point near the bottom of a water-filled borehole, or below the surface of a body of water.

2) Allow 15 to 20 minutes for the piezometer to come to thermal equilibrium.

3) Using a readout box, record the reading at the current depth.

4) Raise the piezometer by a measured increment.

5) Record the reading on the readout box at the new depth.

6) Using the factory calibration factor, calculate the change in water depth.

7) Compare the calculated change in depth with the measured depth increment. The two values should be roughly the same.

Alternative method using a dip meter:

1) Lower the piezometer tip to a measured depth below the water surface.

2) Allow 15 to 20 minutes for the piezometer to come to thermal equilibrium.

3) Using a readout box, record the reading at that level.

4) Calculate the elevation of the water surface using the given calibration factor.

5) Compare the calculated elevation to the elevation measured using the dip meter.

A couple of things that can affect this checking procedure:

- If the density of the water is not one gram/cubic centimeter.

- If the water is saline or turbid.

- The water level inside the borehole may vary during the test. This is due to the displacement of water caused by the cable as it is raised and lowered in the borehole. The smaller the borehole is, the greater the displacement will be. For example, a Model 4500S-50KPA piezometer lowered 50 feet below the water column in a one-inch (0.875-inch ID) standpipe *will displace the water level by more than four feet.*

4. INSTALLATION

4.1 Installation in Standpipes or Wells

1) Saturate the filter stone and establish an initial zero reading by following the steps outlined in Section 3.1 and Section 3.2. (**Warning! Do not allow the piezometer to freeze once the filter stone has been saturated!)**

2) Mark the cable where the top of the well or standpipe will reside once the piezometer has reached the desired depth. (The piezometer diaphragm is located 3/4 of an inch above the tip of the piezometer.)

3) Lower the piezometer into the standpipe/well.

4) Be sure the cable is securely fastened to prevent the piezometer from sliding further into the well and causing an error in the readings.

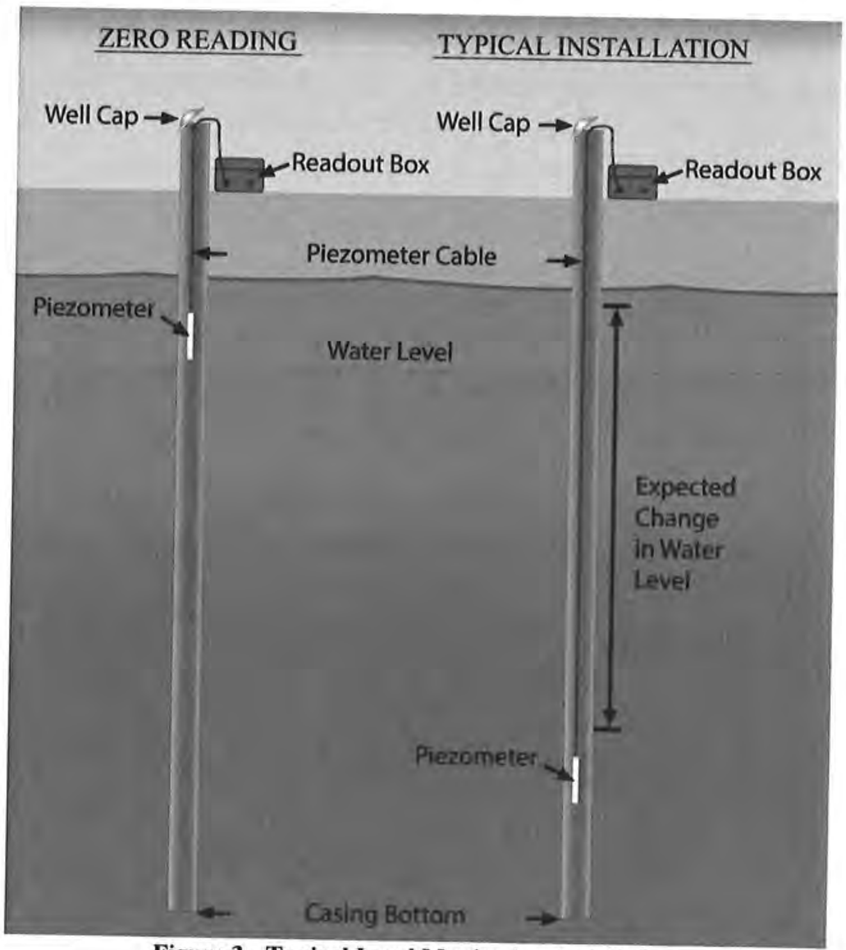


Figure 3 - Typical Level Monitoring Installation

It is not recommended that piezometers be installed in wells or standpipes where an electrical pump or cable is nearby. Electrical interference from these sources can cause unstable readings. If unavoidable, it is recommended that the piezometer be placed inside a piece of steel pipe. In situations where packers are used in standpipes, special care should be taken to avoid cutting the cable jacket with the packer, as this could introduce a possible pressure leak in the cable.

4.2 Installation in Boreholes

Geokon piezometers can be installed in cased or uncased boreholes, in either single or multiple piezometer configurations. If pore pressures in a particular zone are to be monitored, careful attention must be paid to the borehole sealing technique.

The borehole should extend 6 to 12 inches below the proposed piezometer location. Boreholes should be drilled without using drilling mud, or by using a material that degrades rapidly with time, such as Revert™. Wash the borehole clean of drill cuttings. Backfill the borehole with clean fine sand to a point six inches below the desired piezometer tip location. The piezometer can then be lowered into position. (Preferably, the piezometer will be encapsulated in a canvas bag containing clean, saturated sand.) While holding the instrument in position, (a mark on the cable is helpful) fill the borehole with clean fine sand to a point six inches above the piezometer.

Three different methods of isolating the zone to be monitored are detailed below.

Installation A:

Immediately above the area filled with clean fine sand, known as the "collection zone", the borehole should be sealed by an impermeable bentonite cement grout mix, or with alternating layers of bentonite and sand backfill, tamped in place for approximately one foot, followed by common backfill. (See Figure 4.)

If multiple piezometers are to be used in a single hole, the bentonite and sand should be tamped in place below and above the upper piezometers, as well as at interval between the piezometer zones. When using tamping tools special care should be taken to ensure that the piezometer cable jackets are not cut during installation, as this could introduce a possible pressure leak in the cable.

Installation B:

The borehole is filled from the "collection zone" upwards with an impermeable bentonite grout. (See Figure 4.)

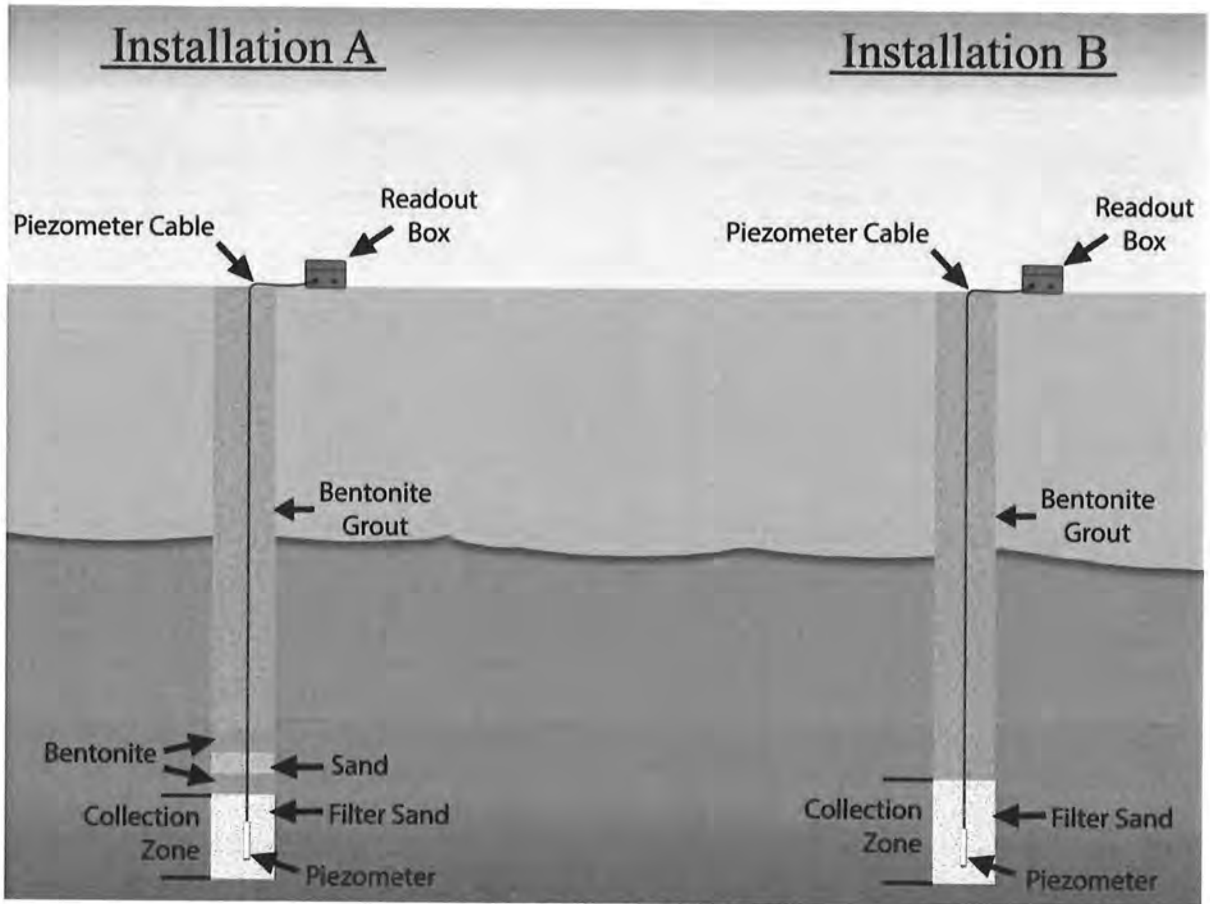


Figure 4 - Typical Borehole Installations

Installation C:

It should be noted that since the vibrating wire piezometer is essentially a no flow instrument, collection zones of appreciable size are not required. The piezometer can be placed directly in contact with most materials, provided that the fines are not able to migrate through the filter. The latest thinking is that it is not necessary to provide sand zones and that the piezometer can be grouted directly into the borehole using a bentonite cement grout only. However, good results have been obtained by placing the piezometer inside a canvas bag filled with sand before grouting.

The general rule for installing piezometers in this way is to use a bentonite grout that mimics the strength of the surrounding soil. The emphasis should be on controlling the water to cement ratio. This is accomplished by *mixing the cement with the water first.* The most effective way of mixing the two substances is to use a drill rig pump to circulate the mix in a 50 to 200-gallon barrel or tub.

Any kind of bentonite powder combined with Type I or Type II Portland cement can be used to make drilling mud. The exact amount of bentonite needed will vary somewhat. Table 1 shows two possible mixes for strengths of 50 psi and 4 psi.

	50 PSI Grout for Medium to Hard Soils		4 PSI Grout for Soft Soils	
	Amount	**Ratio by Weight**	**Amount**	**Ratio by Weight**
Water	30 gallons	2.5	75 gallons	6.6
Portland Cement	94 lb. (one sack)	1	94 lb. (one sack)	1
Bentonite	25 lb. (as required)	0.3	39 lb. (as required)	0.4
Note:	The 28-day compressive strength of this mix is about 50 psi, similar to very stiff to hard clay. The modulus is about 10,000 psi		The 28-day strength of this mix is about 4 psi, similar to very soft clay.	

Table 1 - Cement/Bentonite/Water ratios

Add the measured amount of clean water to the barrel then gradually add the cement in the correct weight ratio. Slowly add the bentonite powder so that clumps do not form. Keep adding bentonite until the watery mix turns to an oily/slimy consistency. Let the grout thicken for 5 to 10 minutes. Add more bentonite as required until it is a smooth, thick cream, similar to pancake batter. It is now as heavy as it is feasible to pump.

When pumping grout (unless the tremie pipe is to be left in place,) withdraw the tremie pipe after each batch, by an amount corresponding to the grout level in the borehole.

CAUTION! If the grout is pumped into the hole, rather than tremie piped, there is a danger that the piezometer will be overranged and damaged. Pumping directly into the bottom of the borehole should be avoided. It is good practice to read the piezometer while pumping.

For more details on grouting, refer to "Piezometers in Fully Grouted Boreholes" by Mikkelson and Green, FMGM proceedings Oslo 2003. Copies are available from Geokon.

4.3 Installation in Fills and Embankments

Geokon piezometers are normally supplied with direct burial cable suitable for placement in fills such as highway embankments and dams, both in the core and in the surrounding materials.

For installations in non-cohesive fill materials, the piezometer may be placed directly in the fill, or, if large aggregate sizes are present, in a saturated sand pocket in the fill. If installed in large aggregate, additional measures may be necessary to protect the cable from damage.

In fills such as impervious dam cores, where subatmospheric pore water pressure may need to be measured, (as opposed to the pore air pressure,) a ceramic tip with a high air entry value is often used. This type of filter should be carefully placed in direct contact with the compacted fill material. (See Figure 5).

Cables are normally installed inside shallow trenches with the fill material consisting of smaller size aggregate. This fill is carefully hand compacted around the cable. Bentonite plugs are placed at regular intervals to prevent migration of water along the cable path. In high traffic areas and in materials that exhibit pronounced "weaving", heavy-duty armored cable should be used.

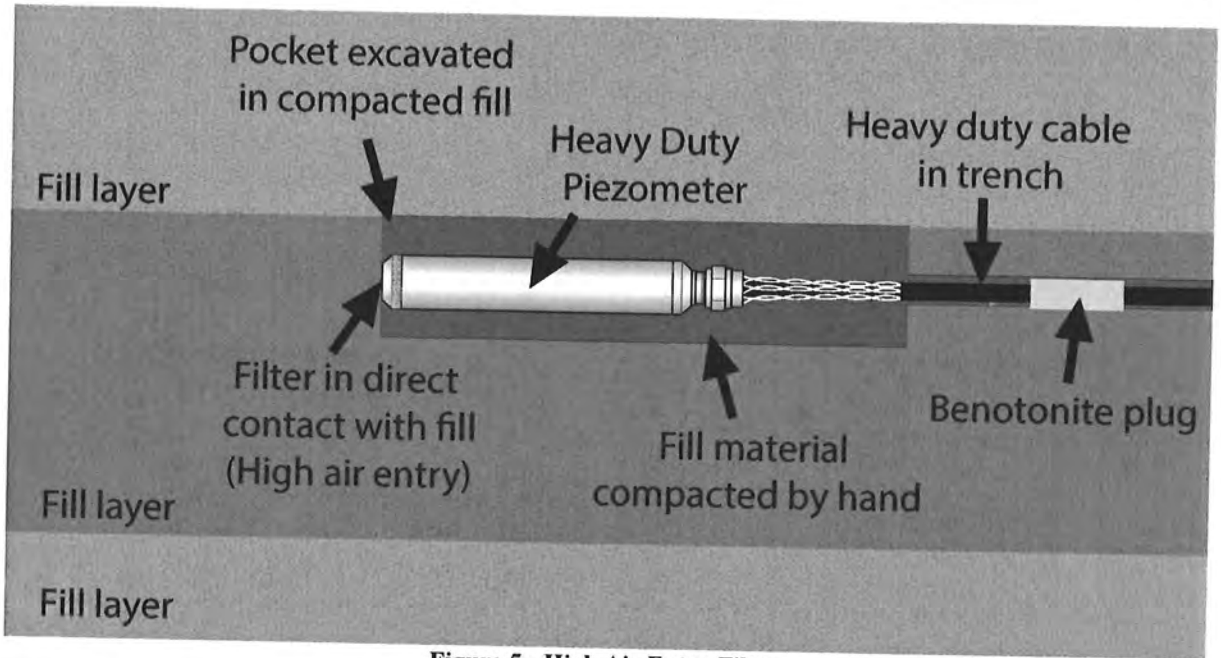


Figure 5 - High Air Entry Filter

In partially saturated fills (if only the pore air pressure is to be measured,) the standard tip is satisfactory. It should be noted that the standard coarse tip (low air entry) measures the air pressure when there is a difference between the pore air pressure and the pore water pressure. The difference between these two pressures is due to the capillary suction in the soil. The consensus is that the difference is normally of no consequence to embankment stability.

The coarse tip filter is suitable for most routine measurements. Both the installation shown in Figure 5 and the installation shown in Figure 6 may be used with the standard piezometer filter.

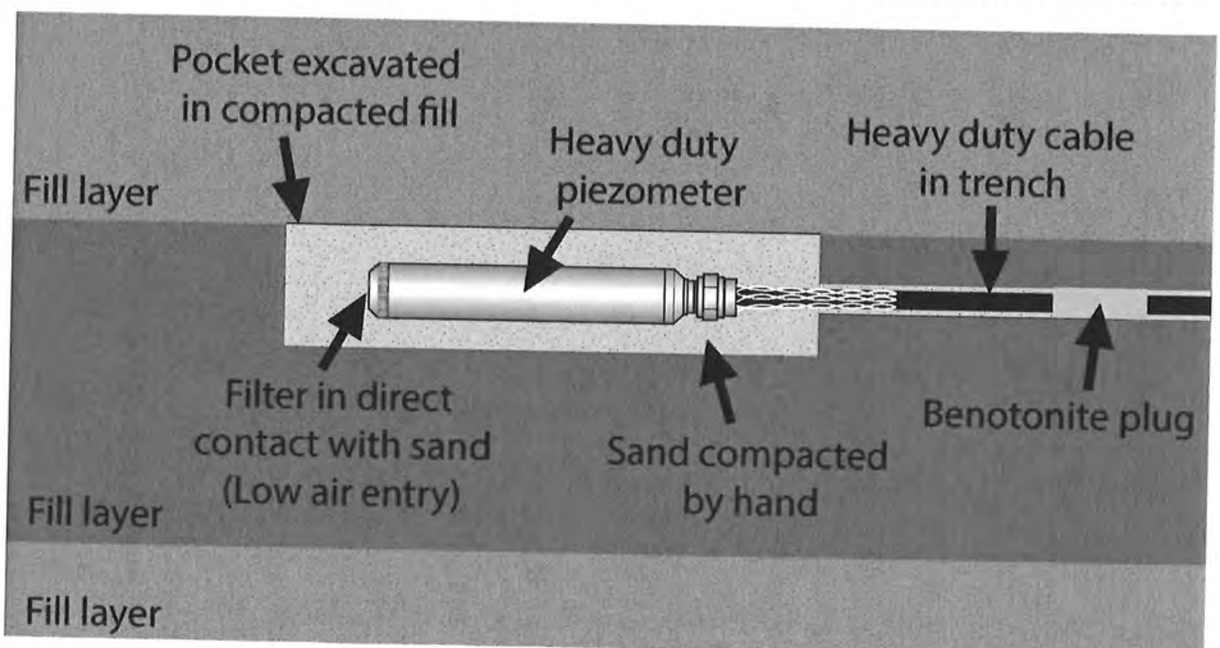


Figure 6 - Low Air Entry Filters ONLY

4.4 Installation by Pushing or Driving into Soft Soils

The Model 4500DP piezometer is designed to be pushed into soft soils. In soft soils, it can be difficult to keep a borehole open. The 4500DP may eliminate the need for a borehole altogether. The unit is connected directly to the drill rod (AW, EW, or other) and pressed into the ground, either by hand or by means of the hydraulics on the rig. (See Figure 7.) The units can also be driven into the soil, but there is a possibility that the driving forces may shift the zero reading.

The ground conditions need to be relatively soft for the 4500DP to be effective. Soft soils (like clays or silts) with SPT blow counts under 10 are ideal. In stiffer soils, it is possible to drill a hole and then push the 4500DP only a few feet below the bottom of the hole, but if the soil is too stiff, the sensor may overrange or break.

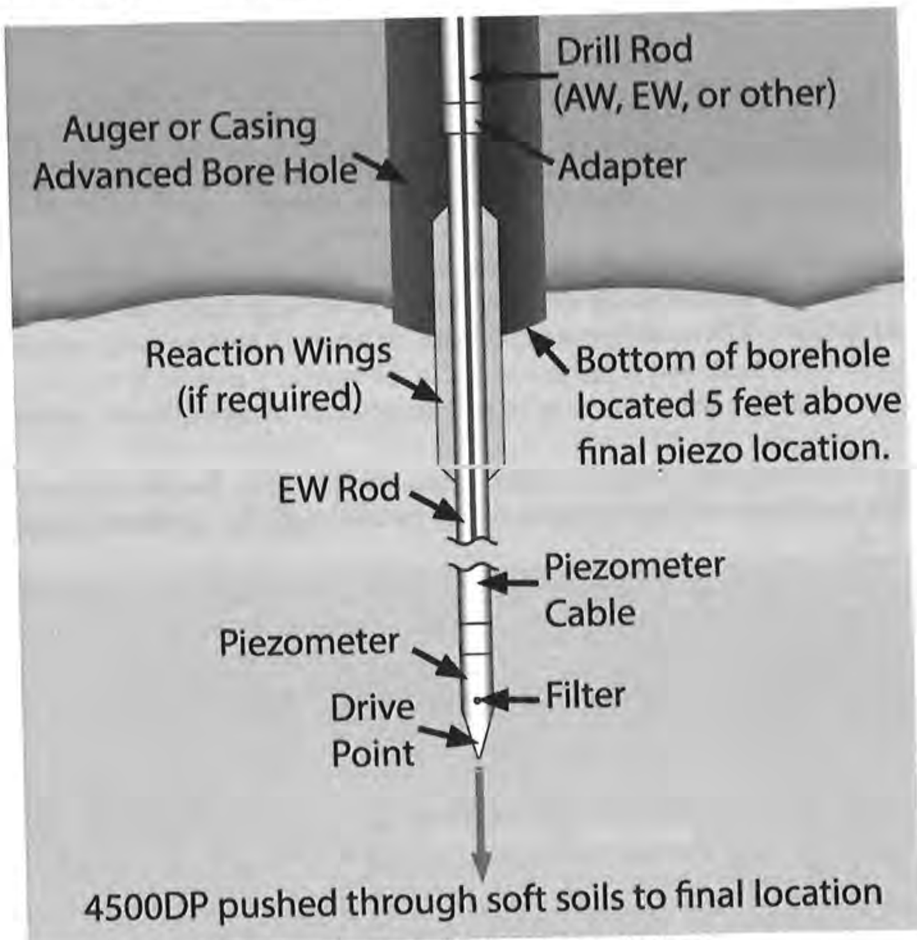


Figure 7 - Typical Soft Soils Installation

The piezometer should be connected to a readout box and monitored during the installation process. If pressures reach or exceed the calibrated range, the installation should be stopped. Allow the pressure to dissipate before continuing.

The drill rod can be left in place or it can be removed. If it is to be removed, a special five-foot section of EW (or AW) rod with reaction wings and a left-hand thread are attached directly to the piezometer tip. This section is detached from the rest of the drill string by rotating the string clockwise. The reaction wings prevent the EW rod from turning. A LH/RH adapter is available from Geokon. This adapter is retrieved along with the drill string.

4.5 Model 4500H and Model 4500HH Transducer

When connecting the Model 4500H transducer to external fittings, the fitting should be tightened into the 1/4-18 NPT female port by placing a wrench on the flats provided on the transducer housing. Avoid tightening onto a closed system; the process of tightening the fittings could overrange and permanently damage the transducer. If in doubt, attach the gauge leads to a readout box and take readings while tightening. For an easier and more positive connection to the transducer, PTFE (plumber's) tape on the threads is recommended. The maximum pressure for the 4500H is 3 MPa.

Geokon's Model 4500HH is designed for high-pressure environments. This model uses a 7/16-20, 60-degree, female, medium pressure fitting. The maximum pressure for the 4500HH is 75 MPa.

CAUTION! All high-pressure sensors are potentially dangerous. Care must be taken not to overrange them beyond their calibrated range. Sensors are tested to 150% of their range to provide a factor of safety.

4.6 Splicing and Junction Boxes

Because the vibrating wire output signal is a frequency rather than a current or voltage, variations in cable resistance have little effect on gauge readings. Therefore, splicing of cables has no effect, and in some cases may in fact be beneficial. For example, if multiple piezometers are installed in a borehole, and the distance from the borehole to the terminal box or datalogger is great, a splice (or junction box) could be made to connect the individual cables to a single multi-conductor cable. (See Figure 8.) This multi-conductor cable would then be run to the readout station. For these types of installations, it is recommended that the piezometer be supplied with enough cable to reach the installation depth, plus extra cable to pass through drilling equipment (rods, casing, etc.).

Cable used for making splices should be a high-quality twisted pair type, with 100% shielding and an integral shield drain wire. **When splicing, it is very important that the shield drain wires be spliced together.** Splice kits recommended by Geokon incorporate casts that are placed around the splice and then filled with epoxy to waterproof the connections. When properly made, this type of splice is equal or superior to the cable in strength and electrical properties. Contact Geokon for splicing materials and additional cable splicing instructions.

Junction boxes and terminal boxes are available from Geokon for all types of applications. In addition, portable readouts and dataloggers are also available. Contact Geokon for specific application information.

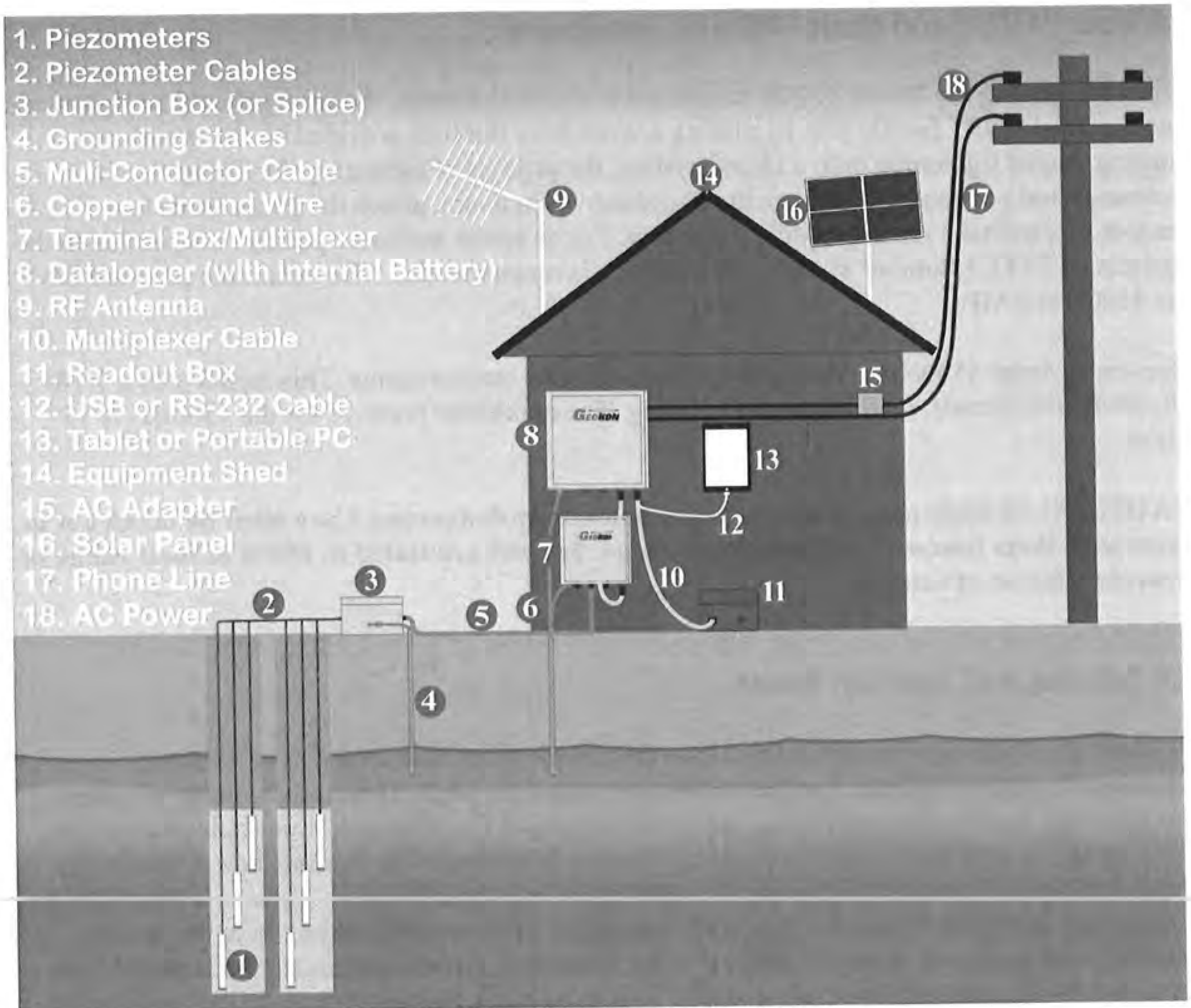


Figure 8 - Typical Multi-Piezometer Installation

4.7 Lightning Protection

In exposed locations, it is vital that the piezometer be protected against lightning strikes. A tripolar plasma surge arrestor, which protects against voltage spikes across the input leads, is built into the body of the piezometer. (See Figure 1.)

Additional lightning protection measures available include:

- Placing a Lightning Arrestor Board (LAB-3), in line with the cable, as close as possible to the installed piezometer. (See Figure 9.) These units utilize surge arrestors and transzorbs to further protect the piezometer. This is the recommended method of lightning protection.

- Terminal boxes available from Geokon can be ordered with lightning protection built in. The terminal board used to make the gauge connections has provision for the installation of plasma surge arrestors. Lightning Arrestor Boards (LAB-3) can also be incorporated into the terminal box. The terminal box must be connected to an earth ground for these levels of protection to be effective.

- If the instruments will be read manually with a portable readout (no terminal box), a simple way to help protect against lightning damage is to connect the cable leads to a good earth ground when not in use. This will help shunt transients induced in the cable to ground, away from the instrument.

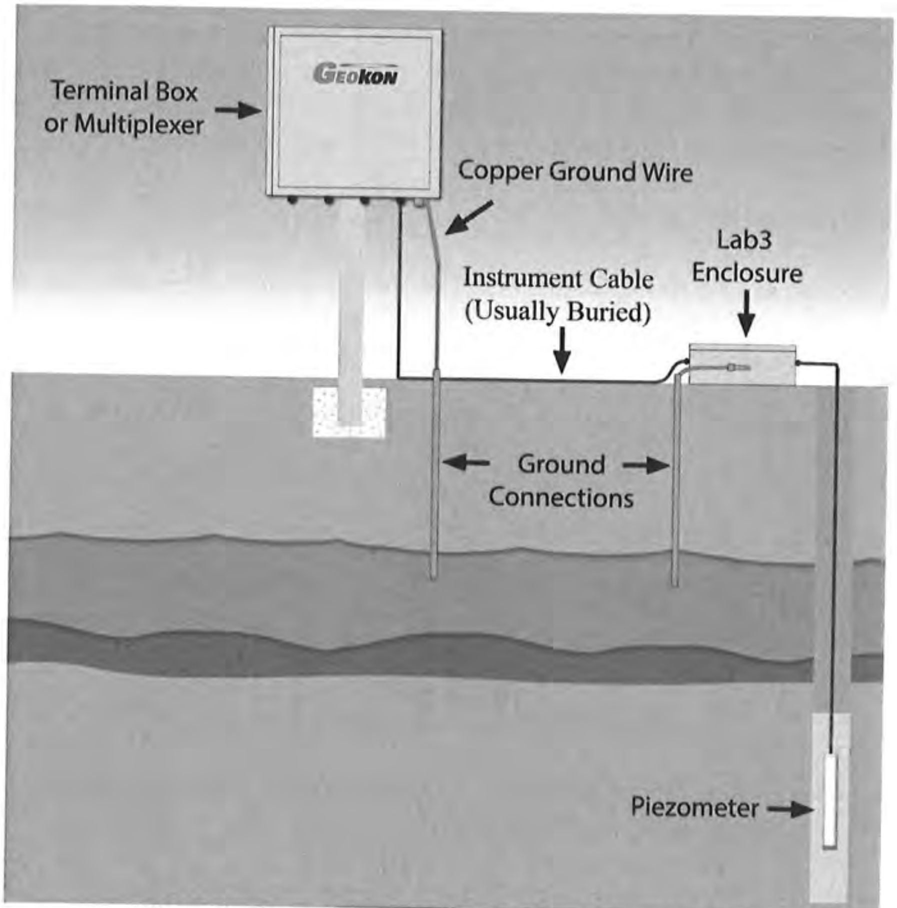


Figure 9 - Recommended Lightning Protection Scheme

4.8 Freezing Protection

If the water around the piezometer freezes this could damage the piezometer diaphragm causing a large shift in the zero pressure reading. If the piezometer is to be used in locations that are subject to freezing, Geokon can provide a special modification that will protect the piezometer diaphragm.

5. TAKING READINGS

5.1 GK-404 Readout Box

The Model GK-404 Vibrating Wire Readout is a portable, low-power, handheld unit that can run continuously for more than 20 hours on two AA batteries. It is designed for the readout of all Geokon vibrating wire gauges and transducers; and is capable of displaying the reading in either digits, frequency (Hz), period (μs), or microstrain (με). The GK-404 also displays the temperature of the transducer (embedded thermistor) with a resolution of 0.1 °C.

5.1.1 Operating the GK-404

Before use, attach the flying leads to the GK-404 by aligning the red circle on the silver Lemo connector of the flying leads with the red line on the top of the GK-404 (Figure 10). Insert the Lemo connector into the GK-404 until it locks into place.

Figure 10 - Lemo Connector to GK-404

Connect each of the clips on the leads to the matching colors of the sensor conductors, with blue representing the shield (bare).

To turn the GK-404 on, press the "ON/OFF" button on the front panel of the unit. The initial startup screen will be displayed. After approximately one second, the GK-404 will start taking readings and display them based on the settings of the POS and MODE buttons.

The unit display (from left to right) is as follows:

- The current Position: Set by the **POS** button. Displayed as a letter A through F.
- The current Reading: Set by the **MODE** button. Displayed as a numeric value followed by the unit of measure.
- Temperature reading of the attached gauge in degrees Celsius.

Use the **POS** button to select position **B** and the **MODE** button to select **Dg** (digits). (Other functions can be selected as described in the GK-404 Manual.)

The GK-404 will continue to take measurements and display readings until the unit is turned off, either manually, or if enabled, by the Auto-Off timer.

If no reading displays or the reading is unstable, see Section 7 for troubleshooting. For further information, consult the GK-404 manual.

5.2 GK-405 Readout Box

The GK-405 Vibrating Wire Readout is made up of two components: The Readout Unit, consisting of a Windows Mobile handheld PC running the GK-405 Vibrating Wire Readout Application; and the GK-405 Remote Module, which is housed in a weatherproof enclosure and connects to the vibrating wire gauge to be measured. The two components communicate wirelessly. The Readout Unit can operate from the cradle of the Remote Module, or, if more convenient, can be removed and operated up to 20 meters from the Remote Module.

5.2.1 Connecting Sensors with a 10-pin Bulkhead

Align the grooves on the sensor connector (male), with the appropriate connector on the readout (female connector labeled senor or load cell). Push the connector into place, and then twist the outer ring of the male connector until it locks into place.

5.2.2 Connecting Sensors with Bare Leads

Attach the GK-403-2 flying leads to the bare leads of a Geokon vibrating wire sensor by connecting each of the clips on the leads to the matching colors of the sensor conductors, with blue representing the shield (bare).

5.2.3 Operating the GK-405

Press the button labeled "POWER ON". A blue light will begin blinking, signifying that the Remote Module is waiting to connect to the handheld unit.
Launch the GK-405 VWRA program on the handheld PC by tapping on "Start", then "Programs", then the GK-405 VWRA icon. After a few seconds, the blue light on the Remote Module should stop flashing and remain lit, indicating that the remote module has successfully paired with the handheld PC. The Live Readings Window will be displayed on the handheld PC. Figure 11 shows a typical vibrating wire piezometer output in digits and thermistor output in degrees Celsius.

If the no reading displays or the reading is unstable, see Section 7 for troubleshooting suggestions. For further information, consult the GK-405 Instruction Manual.

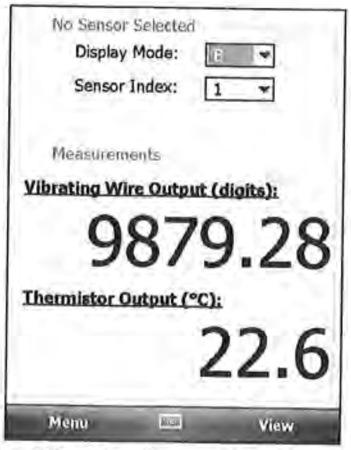


Figure 11 - Live Readings – Raw Readings

5.3 GK-403 Readout Box (Obsolete Model)

The GK-403 can store gauge readings as well as apply calibration factors to convert readings to engineering units. The following instructions explain taking gauge measurements using Modes "B" and "F".

5.3.1 Connecting Sensors with a 10-pin Bulkhead

Align the grooves on the sensor connector (male), with the appropriate connector on the readout (female connector labeled senor or load cell). Push the connector into place, and then twist the outer ring of the male connector until it locks into place.

5.3.2 Connecting Sensors with Bare Leads

Attach the GK-403-2 flying leads to the bare leads of a Geokon vibrating wire sensor by connecting each of the clips on the leads to the matching colors of the sensor conductors, with blue representing the shield (bare).

5.3.3 Operating the GK-403

1) Turn the display selector to position "B" (or "F").
2) Turn the unit on.
3) The readout will display the vibrating wire output in digits (see Equation 1 in Section 6). The last digit may change one or two digits while reading.
4) The thermistor reading will be displayed above the gauge reading in degrees centigrade.
5) Press the "Store" button to record the value displayed.

If the no reading displays or the reading is unstable, see Section 7 for troubleshooting suggestions. The unit will automatically turn off after approximately two minutes to conserve power. Consult the GK-403 Instruction Manual for additional information.

5.4 Measuring Temperatures

All vibrating wire piezometers are equipped with a thermistor, which gives a varying resistance output as the temperature changes. The white and green leads of the instrument cable are normally connected to the internal thermistor. Geokon readout boxes will read the thermistor and display the temperature in degrees C. (High temperature versions use a different thermistor, which must be read using an ohmmeter.)

To read temperatures using an ohmmeter:

1) Connect an ohmmeter to the green and white thermistor leads coming from the piezometer. Since the resistance changes with temperature are large, the effect of cable resistance is usually insignificant. For long cables a correction can be applied, equal to approximately 14.7 Ω per one thousand feet (48.5Ω per km). Multiply this factor by two to account for both directions.
2) Look up the temperature for the measured resistance in Appendix B, Table 7. For high temperature models, use Appendix C, Table 8.

6. DATA REDUCTION

6.1 Pressure Calculation

The digits displayed by the Geokon Models GK-403, GK-404, and GK-405 Readout Boxes on channel B are based on the equation:

$$\text{Digits} = \left(\frac{1}{\text{Period}}\right)^2 \times 10^{-3} \text{ or Digits} = \frac{\text{Hz}^2}{1000}$$

Equation 1 - Digits Calculation

Note that in the above equation, the period is in seconds; Geokon readout boxes display microseconds. For example, a piezometer reading of 8000 digits corresponds to a period of 354 μs and a frequency of 2828 Hz.

Digits are directly proportional to the applied pressure, as can be seen by the following equation:

$$\text{Pressure} =$$

$$(\text{Current Reading} - \text{Initial Zero Reading}) \times \text{Linear Calibration Factor}$$

Or

$$P = (R_1 - R_0) \times G$$

Equation 2 - Convert Digits to Pressure

Since the linearity of most sensors is within ±0.2% F.S., the errors associated with nonlinearity are of minor consequence. However, for those situations requiring the highest degree of accuracy, it may be desirable to use a second order polynomial to get a better fit of the data points. The use of a second order polynomial is explained in Appendix D.

The instrument's calibration report (a typical example of which is shown in Appendix E,) shows the data from which the linear gauge factor and the second order polynomial coefficients are derived. Columns on the right show the size of the error incurred by assuming a linear coefficient and the improvement that can be expected by going to a second order polynomial. In many cases, the difference is minor. The calibration report gives the pressure in certain engineering units. These can be converted to other engineering units using the multiplication factors shown in Table 2.

From → To ↓	psi	"H_2O	'H_2O	mm H_20	m H_20	"HG	mm HG	atm	mbar	bar	kPa	MPa
psi	1	.036127	.43275	.0014223	1.4223	.49116	.019337	14.696	.014503	14.5039	.14503	145.03
"H_2O	27.730	1	12	.039372	39.372	13.596	.53525	406.78	.40147	401.47	4.0147	4016.1
'H_2O	2.3108	.08333	1	.003281	3.281	1.133	.044604	33.8983	.033456	33.4558	.3346	334.6
mm H_20	704.32	25.399	304.788	1	1000	345.32	13.595	10332	10.197	10197	101.97	101970
m H_20	.70432	.025399	.304788	.001	1	.34532	.013595	10.332	.010197	10.197	.10197	101.97
"HG	2.036	.073552	.882624	.0028959	2.8959	1	.03937	29.920	.029529	29.529	.2953	295.3
mm HG	51.706	1.8683	22.4196	.073558	73.558	25.4	1	760	.75008	750.08	7.5008	7500.8
atm	.06805	.002458	.029499	.0000968	.0968	.03342	.001315	1	.000986	.98692	.009869	9.869
mbar	68.947	2.4908	29.8896	.098068	98.068	33.863	1.3332	1013.2	1	1000	10	10000
bar	.068947	.002490	.029889	.0000981	.098068	.033863	.001333	1.0132	.001	1	.01	10
kPa	6.8947	.24908	2.98896	.0098068	9.8068	3.3863	.13332	101.320	.1	100	1	1000
MPa	.006895	.000249	.002988	.0000098	.009807	.003386	.000133	.101320	.0001	.1	.001	1

Table 2 - Engineering Units Multiplication Factors

(Note: Due to changes in specific gravity with temperature, the factors for mercury and water in the above table are approximate.)

6.2 Temperature Correction

The materials used in the construction of Geokon's vibrating wire piezometers have been carefully selected to minimize thermal effects; however, most units still have a slight temperature coefficient. Consult the calibration report supplied with the instrument to obtain the coefficient for the individual piezometer.

Since piezometers are normally installed in a tranquil and constant temperature environment, corrections are normally not required. If this is not the case for the selected installation, corrections can be made using the internal thermistor for temperature measurement. See Section 5.4 for instructions regarding obtaining the piezometer temperature.

The temperature correction equation is as follows:

$$\text{Temperature Correction} =$$

$$(\text{Current Temperature} - \text{Initial Zero Temperature}) \times \text{Thermal Factor}$$

Or

$$P_T = (T_1 - T_0) \times K$$

Equation 3 - Temperature Correction

The calculated correction would then be added to the pressure calculated using Equation 2. If the engineering units were converted, remember to apply the same conversion to the calculated temperature correction.

For example, if the initial temperature was 22 °C, and the current temperature is 15 °C, and the thermal factor (K on the calibration report,) is +0.1319 kPa per °C rise. The temperature correction is +0.1319(15-22) = -0.92 kPa. Refer to the calibration report provided with the instrument for the thermal factor.

6.3 Barometric Correction (required only on unvented transducers)

Since the standard piezometer is hermetically sealed, it responds to changes in atmospheric pressure. Corrections may be necessary, particularly for the sensitive, low-pressure models. For example, a barometric pressure change from 29 to 31 inches of mercury would result in approximately one PSI of error (or ≈2.3 feet if monitoring water level in a well). It is advisable to read and record the barometric pressure every time the piezometer is read. Having an onsite barometer also allows the monitoring of barometric changes to judge what extent they may be affecting the reading. A separate pressure transducer (piezometer), kept out of the water, may also be used for this purpose.

The barometric correction equation is as follows:

$$\text{Barometric Correction} =$$

$$(\text{Current Barometer - Initial Zero Barometer}) \times \text{Conversion Factor}$$

Or

$$P_B = (S_1 - S_0) \times F$$

Equation 4 - Barometric Correction

The calculated barometric correction is subtracted from the pressure calculated using Equation 2. If the engineering units were converted, remember to apply the same conversion to the calculated barometric correction.

Barometric pressure is usually recorded in inches of mercury. The conversion factor for inches of mercury to PSI is 0.491, and from inches of mercury to kPa is 3.386. Table 2 in Section 6.1 lists other common conversion factors.

The user should be cautioned that this correction scheme assumes ideal conditions. In reality, conditions are not always ideal. For example, if the well is sealed, barometric effects at the piezometer level may be minimal or attenuated from the actual changes at the surface. Thus, errors may result from applying a correction that is not required. In these cases, Geokon recommends independently recording the barometric pressure changes and correlating them with the observed pressure changes to arrive at a correction factor.

An alternative to making barometric corrections is to use piezometers that are vented to the atmosphere (see Section 6.4). However, vented piezometers only make sense if the piezo is in an open well or standpipe and the user is only interested in the water level. If the piezo is buried it is not certain that the full effect of the barometric change will be felt immediately at the instrument and is more likely to be attenuated and delayed, in which case a vented piezo would automatically apply a correction that is too large and too soon.

Equation 5 shows the pressure calculation with temperature and barometric correction applied.

$$P_{\text{corrected}} = (R_1 - R_0)G + (T_1 - T_0)K - (S_1 - S_0)F$$

Equation 5 - Corrected Pressure Calculation

6.4 Model 4500SV, Vented Piezometers

Figure 12 - Vented Piezometers

The Model 4500SV vented piezometer is designed to eliminate the effect of barometric pressure changes on water level measurements in wells, reservoirs, and boreholes that are connected directly to the atmosphere. They are not to be used where pore water pressures are being measured.

The space inside the transducer is not hermetically sealed and evacuated, as it is in the standard 4500 model piezometer, instead, it is connected via a tube (integral within the cable) to the atmosphere. A chamber containing desiccant capsules is attached to the outer end of this tube to prevent moisture from entering the transducer cavity. Vented piezometers require more maintenance then unvented types, since there is always the danger that moisture may find its way inside the transducer and ruin it.

Installation of the piezometer is accomplished simply by lowering it to the desired level in the well, reservoir, or borehole. The piezometer can be placed inside a canvas bag filled with sand, if so desired.

The desiccant capsule chamber needs to be positioned in some kind of housing to keep it dry. Geokon can provide suitable housings on request.

To keep the desiccant fresh during storage and transportation, the end of the desiccant chamber is closed off by means of a seal screw before being shipped from the factory. **THIS SEAL SCREW MUST BE REMOVED BEFORE THE PIEZOMETER IS PUT INTO SERVICE!**

The desiccant capsules are blue when fresh. They will gradually turn pink as they absorb moisture. When they have turned light pink in color, they should be replaced. Contact Geokon for replacement capsules.

6.5 Environmental Factors

Since the purpose of the piezometer installation is to monitor site conditions, factors that may affect these conditions should always be observed and recorded. Seemingly minor effects may have a real influence on the behavior of the structure being monitored and may give an early indication of potential problems. Some of these factors include, but are not limited to, blasting, rainfall, tidal levels, traffic, temperature and barometric changes, weather conditions, changes in personnel, nearby construction activities, excavation and fill level sequences, seasonal changes, etc.

7. TROUBLESHOOTING

Maintenance and troubleshooting of vibrating wire piezometers is confined to periodic checks of cable connections and maintenance of terminals. The transducers themselves are sealed and are not user serviceable. **Gauges should not be opened in the field.**

Should difficulties arise, consult the following list of problems and possible solutions. For additional troubleshooting and support, contact Geokon.

Symptom: Thermistor resistance is too high

- ✓ It is likely that there is an open circuit. Check all connections, terminals, and plugs. If a cut is located in the cable, splice according to instructions in Section 4.6.

Symptom: Thermistor resistance is too low

- ✓ It is likely that there is a short. Check all connections, terminals, and plugs. If a short is located in the cable, splice according to instructions in Section 4.6.
- ✓ Water may have penetrated the interior of the piezometer. There is no remedial action.

Symptom: Piezometer reading unstable

- ✓ Make sure the shield drain wire is connected to the blue clip on the flying leads. (Green for the GK-401.)
- ✓ Isolate the readout from the ground by placing it on a piece of wood or another insulator.
- ✓ Check for sources of nearby electrical noise such as motors, generators, antennas, or electrical cables. Move the piezometer cable away from these sources if possible. Contact the factory for available filtering and shielding equipment.
- ✓ The Piezometer may have been damaged by overranging or shock. Inspect the diaphragm and housing for damage.
- ✓ The body of the Piezometer may be shorted to the shield. Check the resistance between the shield drain wire and the Piezometer housing. If the resistance is very low, the gauge conductors may be shorted.

Symptom: Piezometer fails to give a reading

- ✓ Check the readout with another gauge to ensure it is functioning properly.
- ✓ The Piezometer may have been overranged or shocked. Inspect the diaphragm and housing for damage.
- ✓ Check the resistance of the cable by connecting an ohmmeter to the sensor leads. Table 3 shows the expected resistance for the various wire combinations; Table 4 is provided for the customer to fill in the actual resistance found. Cable resistance is approximately 14.7Ω per 1000 feet (48.5Ω per km). Multiply this factor by two to account for both directions.
  If the resistance is very high or infinite, the cable is probably broken or cut. If the resistance is very low, the gauge conductors may be shorted. If a cut or a short is located in the cable, splice according to instructions in Section 4.6.

Vibrating Wire Sensor Lead Grid - SAMPLE VALUES					
	Red	Black	White	Green	Shield
Red	N/A	**≅180Ω**	infinite	infinite	infinite
Black	**≅180Ω**	N/A	infinite	infinite	infinite
White	infinite	infinite	N/A	**3000Ω at 25°C**	infinite
Green	infinite	infinite	**3000Ω at 25°C**	N/A	infinite
Shield	infinite	infinite	infinite	infinite	N/A

Table 3 - Sample Resistance

Vibrating Wire Sensor Lead Grid - SENSOR NAME/## :					
	Red	Black	White	Green	Shield
Red					
Black					
White					
Green					
Shield					

Table 4 - Resistance Work Sheet

APPENDIX A. SPECIFICATIONS

A.1 4500 Series Specifications

Model	4500S	4500AL[1]	4500AR	4500B	4500C	4500DP	4580
Available Ranges[2] (psi)	0-50 0-100 0-150 0-250 0-500 0-750 0-1000 0-1500 0-3000 0-5000 0-10000 0-15000	0-10 0-25		0-50 0-100 0-250	0-50 0-100 0-250	0-10 0-25 0-50 0-150 0-250 0-500 0-750 0-1000 0-1500 0-3000 0-5000 0-10000	0-1 0-5
Resolution	0.025% F.S.	0.025% F.S.	0.025% F.S.	0.025% F.S.	0.05% F.S.	0.025% F.S.	0.01% F.S.
Linearity[3]	< 0.5% F.S.						
Accuracy[4]	0.1% F.S.						
Overrange	1.5 × Rated Pressure						
Thermal Coefficient	<0.025% F.S./°C	<0.1% F.S./°C	<0.05% F.S./°C	<0.025% F.S./°C	<0.05% F.S./°C	<0.025% F.S./°C	<0.025% F.S./°C
Temperature Range	-20 °C to + 80 °C						
Frequency Range	1400-3500 Hz						
OD	.75" 19.05 mm	1" 25.40 mm	.75" 19.05 mm	.687" 17.45 mm	.437" 11.10 mm	1.3" 33.3 mm	1.5" 38.10 mm
Length	5.25" 133 mm	5.25" 133 mm	10" 254 mm	5.25" 133 mm	6.5" 165 mm	7.36" 187 mm	6.5" 165 mm

Table 5 - Vibrating Wire Piezometer Specifications

Notes:
Accuracy of Geokon test apparatus: 0.1%
Contact Geokon for specific application information.
[1] Accuracy of test apparatus: 0.05%
[2] Other ranges available upon request.
[3] 0.1% F.S. linearity available upon request.
[4] Derived using second order polynomial.

A.2 Thermistor (See Appendix B. also)

Range: -80 to +150 °C
Accuracy: ±0.5 °C

A.3 Standard Piezometer Wiring

Pin	Function	Wire Color
A	Vibrating Wire Gauge +	Red
B	Vibrating Wire Gauge -	Black
C	Thermistor	White
D	Thermistor	Green
E	Cable Shield	Shield
F-K	Not Used	

Table 6 - Standard Piezometer Wiring

APPENDIX B. THERMISTOR TEMPERATURE DERIVATION

Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3
Resistance to Temperature Equation:

$$T = \frac{1}{A + B(\mathrm{LnR}) + C(\mathrm{LnR})^3} - 273.15\ ^\circ\mathrm{C}$$

Equation 6 - Resistance to Temperature

Where;

T = Temperature in °C.

LnR = Natural Log of Thermistor Resistance

A = 1.4051×10^{-3}

B = 2.369×10^{-4}

C = 1.019×10^{-7}

Note: Coefficients calculated over the –50 to +150° C. span.

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	**3000**	**25**	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Table 7 - Thermistor Resistance Versus Temperature

APPENDIX C. HIGH TEMPERATURE THERMISTOR LINEARIZATION

Resistance to Temperature Equation for *US Sensor 103JL1A*:

$$T=\frac{1}{A+B(LnR)+C(LnR)^3+D(LnR)^5}-273.15\ °C$$

Equation 7 - High Temperature Resistance to Temperature

Where;
T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance.
$A = 1.127670 \times 10^{-3}$
$B = 2.344442 \times 10^{-4}$
$C = 8.476921 \times 10^{-8}$
$D = 1.175122 \times 10^{-11}$
Note: Coefficients optimized for a curve "J" Thermistor over the temperature range of 0°C to +250°C.

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
32,650	0	7,402	32	2,157	64	763.5	96	316.6	128	148.4	160	76.5	192	42.8	224
31,029	1	7,098	33	2,083	65	741.2	97	308.7	129	145.1	161	75.0	193	42.1	225
29,498	2	6,808	34	2,011	66	719.6	98	301.0	130	142.0	162	73.6	194	41.4	226
28,052	3	6,531	35	1,942	67	698.7	99	293.5	131	138.9	163	72.2	195	40.7	227
26,685	4	6,267	36	1,876	68	678.6	100	286.3	132	135.9	164	70.8	196	40.0	228
25,392	5	6,015	37	1,813	69	659.1	101	279.2	133	133.0	165	69.5	197	39.3	229
24,170	6	5,775	38	1,752	70	640.3	102	272.4	134	130.1	166	68.2	198	38.7	230
23,013	7	5,545	39	1,693	71	622.2	103	265.8	135	127.3	167	66.9	199	38.0	231
21,918	8	5,326	40	1,637	72	604.6	104	259.3	136	124.6	168	65.7	200	37.4	232
20,882	9	5,117	41	1,582	73	587.6	105	253.1	137	122.0	169	64.4	201	36.8	233
19,901	10	4,917	42	1,530	74	571.2	106	247.0	138	119.4	170	63.3	202	36.2	234
18,971	11	4,725	43	1,480	75	555.3	107	241.1	139	116.9	171	62.1	203	35.6	235
18,090	12	4,543	44	1,432	76	539.9	108	235.3	140	114.5	172	61.0	204	35.1	236
17,255	13	4,368	45	1,385	77	525.0	109	229.7	141	112.1	173	59.9	205	34.5	237
16,463	14	4,201	46	1,340	78	510.6	110	224.3	142	109.8	174	58.8	206	33.9	238
15,712	15	4,041	47	1,297	79	496.7	111	219.0	143	107.5	175	57.7	207	33.4	239
14,999	16	3,888	48	1,255	80	483.2	112	213.9	144	105.3	176	56.7	208	32.9	240
14,323	17	3,742	49	1,215	81	470.1	113	208.9	145	103.2	177	55.7	209	32.3	241
13,681	18	3,602	50	1,177	82	457.5	114	204.1	146	101.1	178	54.7	210	31.8	242
13,072	19	3,468	51	1,140	83	445.3	115	199.4	147	99.0	179	53.7	211	31.3	243
12,493	20	3,340	52	1,104	84	433.4	116	194.8	148	97.0	180	52.7	212	30.8	244
11,942	21	3,217	53	1,070	85	421.9	117	190.3	149	95.1	181	51.8	213	30.4	245
11,419	22	3,099	54	1,037	86	410.8	118	186.1	150	93.2	182	50.9	214	29.9	246
10,922	23	2,986	55	1,005	87	400.0	119	181.9	151	91.3	183	50.0	215	29.4	247
10,450	24	2,878	56	973.8	88	389.6	120	177.7	152	89.5	184	49.1	216	29.0	248
10,000	**25**	2,774	57	944.1	89	379.4	121	173.7	153	87.7	185	48.3	217	28.5	249
9,572	26	2,675	58	915.5	90	369.6	122	169.8	154	86.0	186	47.4	218	28.1	250
9,165	27	2,579	59	887.8	91	360.1	123	166.0	155	84.3	187	46.6	219		
8,777	28	2,488	60	861.2	92	350.9	124	162.3	156	82.7	188	45.8	220		
8,408	29	2,400	61	835.4	93	341.9	125	158.6	157	81.1	189	45.0	221		
8,057	30	2,316	62	810.6	94	333.2	126	155.1	158	79.5	190	44.3	222		
7,722	31	2,235	63	786.6	95	324.8	127	151.7	159	78.0	191	43.5	223		

Table 8 - Thermistor Resistance versus Temperature for High Temperature Models

APPENDIX D. IMPROVING THE ACCURACY OF THE CALCULATED PRESSURE

Most vibrating wire pressure transducers are sufficiently linear (±0.2 % F.S.) that the use of the linear calibration factor satisfies normal requirements. However, it should be noted that the accuracy of the calibration data, which is dictated by the accuracy of the calibration apparatus, is always ±0.1 % F.S.

This level of accuracy can be recaptured, even where the transducer is nonlinear, using a second order polynomial expression, which gives a better fit to the data then does a straight line.

The polynomial expression has the form:

$$\text{Pressure} = AR^2 + BR + C$$

Equation 8 - Second Order Polynomial Expression

Where;
R is the reading (digits channel B)
A, B, and C are coefficients

Appendix E shows a typical calibration report of a transducer that has fairly normal nonlinearity. The figure under the "Linearity (%F.S.)" column is

$$\frac{\text{Calculated Pressure-True Pressure}}{\text{Full Scale Pressure}} \text{ x } 100\% = \frac{G(R_1\text{-}R_0)\text{-}P}{\text{F.S.}} \text{ x } 100\%$$

Equation 9 - Linearity Calculation

Note: The linearity is calculated using the regression zero for R_0 shown on the calibration report.

For example, when P= 420 kPa, G ($R_1 - R_0$) = -0.1795(6749-9082), gives a calculated pressure of 418.8 kPa. The error is 1.2 kPa equal to 122 mm of water.

Whereas the polynomial expression gives a calculated pressure of A $(6749)^2$ + B (6749) + 1595.7 = 420.02 kPa and the actual error is only 0.02 kPa or two millimeters of water.

Note: If the polynomial equation is used it is important that the value of C be taken in the field following the procedures described in Section 3.2. The field value of C is calculated by inserting the initial field zero reading into the polynomial equation with the pressure, P, set to zero.

If the field zero reading is not available, the value of C can be calculated by using the zero pressure reading on the calibration report. In the above example the value of C would be derived from the equation: 0 = A$(9074)^2$ + B(9074) from which C = 1595.7

It should be noted that where *changes* of water levels are being monitored it makes little difference whether the linear coefficient or the polynomial expression is used.

APPENDIX E. TYPICAL CALIBRATION REPORT

GEOKON 48 Spencer St Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500INS-2 MPa

Serial Number: 1726650

Calibration Instruction: VW Pressure Transducers

Date of Calibration: August 18, 2017

This calibration has been verified/validated as of 11/13/2017

Temperature: 22.60 °C

Barometric Pressure: 990.1 mbar

Technician: Kathy Rogers

Applied Pressure (MPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8894	8894	8894	0.004	0.19	0.000	0.00
0.4	8158	8158	8158	0.399	-0.04	0.400	-0.01
0.8	7417	7418	7418	0.797	-0.14	0.800	0.00
1.2	6673	6673	6673	1.197	-0.14	1.200	0.00
1.6	5924	5925	5925	1.599	-0.03	1.600	0.01
2.0	5172	5173	5173	2.004	0.18	2.000	-0.01

(MPa) Linear Gage Factor (G): -0.0005374 (MPa/ digit)

Polynomial Gage factors: **A: -1.957E-09** **B: -0.0005098** **C: ____**

Thermal Factor (K): 0.0002449 (MPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.07794 (psi/ digit)

Polynomial Gage Factors: **A: -2.838E-07** **B: -0.07395** **C: ____**

Thermal Factor (K): 0.03552 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in MPa or psi. Barometric compensation is not required with vented transducers.

-tory Zero Reading: 8897 **Temperature: 22.7 °C** **Barometer: 995.5 mbar**

The above instrument was found to be in tolerance in all operating ranges.

-- above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

Figure 13 - Typical Calibration Report

APPENDIX F. MODEL 4500AR PIEZOMETER

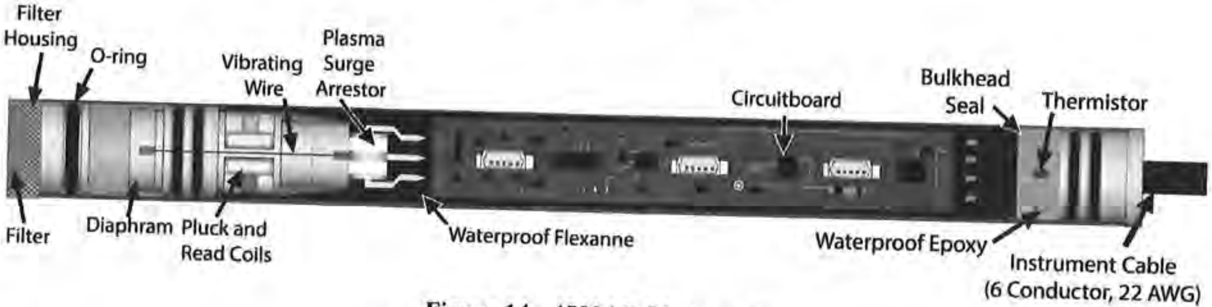


Figure 14 - 4500AR Piezometer

The Model 4500AR Piezometer is designed to be used with readout systems that can read frequency but do not have the capability to "pluck" the VW gauge. The sensor has built-in electronics that cause the gauge wire to vibrate continuously at its resonant frequency. The output from the sensor is a five-volt DC square wave at this frequency.

A DC input voltage in the range of 6 to 24 volts is required to operate the gauge. The current consumption is approximately 21 mA at 12VDC. The gauge output is independent of the input voltage.

Multiple sensors powered simultaneously can be read at quite fast rates, (up to five sensors per second,) and dynamic measurements on a single sensor can be made up to approximately 20Hz.

The gauge is installed in the field in the same way that the Model 4500 standard piezometer is installed. (See Section 3 and Section 4.)

4500AR Piezometer Wiring is shown in Table 9. The three pair cable is wired in pairs, with each pair comprising one colored and one black lead.

Wire Color	Function
Red	+6-24 VDC Power
Red's Black	Ground
White	Output
White's Black	Output Ground
Green	Thermistor +
Green's Black	Thermistor –
Bare	Shield

Table 9 - 4500AR Wiring Chart

Upon powerup the gauge will immediately start to "ring" at the resonant frequency and will continue to ring until the power is removed. Continuous operation will have no effect on the gauge life.

Note: The sensor is comprised of two transducers: the VW pressure sensor, and a thermistor for measuring temperature. The signal from the VW transducer is a high-level frequency and it will interfere with the thermistor output if left powered during the period that the thermistor is being read. If the temperature reading is important, the power to the pressure sensor should be switched off while the thermistor reading is taken.

APPENDIX G. PIEZOMETER PRESSURE AND WATER LEVEL

Frequently, when using a dip meter to check water levels in an open well, it happens that the water level, computed from a piezometer reading taken at the bottom of the well, does not agree with the water level measured directly by the dip meter. This will happen when the specific gravity of the water is not 1 gm/cc, the water is brackish or muddy, or both. It will also occur when there is a flow of water up or down the borehole. In addition, if the piezometer is removed to make room for the dip meter, the volume of the piezometer and cable displaces an equal volume of water, which can cause changes of the water level in a small diameter well.

GEOKON®

VWP-1

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921455

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8584	8584	8584	-0.298	-0.09	-0.085	-0.02
70.0	7873	7873	7873	70.24	0.08	70.17	0.06
140.0	7169	7169	7169	140.1	0.03	139.9	-0.03
210.0	6463	6463	6463	210.1	0.05	209.9	-0.01
279.9	5758	5759	5759	280.0	0.03	280.0	0.00
350.0	5055	5055	5055	349.8	-0.04	350.0	0.02

(kPa) Linear Gauge Factor (G): -0.09921 (kPa/ digit)

Polynomial Gauge factors: A: 1.451E-07 B: -0.1012 C: ______

Thermal Factor (K): -0.04248 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01439 (psi/ digit)

Polynomial Gauge Factors: A: 2.105E-08 B: -0.01468 C: ______

Thermal Factor (K): -0.006162 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8572 Temperature: 21.2 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-3

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921444

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8701	8702	8702	0.281	0.08	0.057	0.02
70.0	8083	8083	8083	69.92	-0.02	69.90	-0.02
140.0	7462	7463	7463	139.8	-0.06	139.9	-0.03
210.0	6839	6839	6839	210.0	0.00	210.1	0.03
279.9	6217	6217	6217	280.0	0.02	280.0	0.01
350.0	5593	5594	5594	350.2	0.06	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1126 (kPa/ digit)

Polynomial Gauge factors: A: -1.371E-07 B: -0.1106 C: ______

Thermal Factor (K): -0.1222 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01633 (psi/ digit)

Polynomial Gauge Factors: A: -1.988E-08 B: -0.01605 C: ______

Thermal Factor (K): -0.01773 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8695 Temperature: 22.2 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

VWP-4

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921438

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8724	8725	8725	-0.170	-0.05	0.070	0.02
70.0	8108	8108	8108	69.84	-0.04	69.83	-0.04
140.0	7489	7489	7489	140.1	0.04	140.0	0.00
210.0	6872	6873	6873	210.1	0.05	210.0	0.01
279.9	6257	6258	6258	280.0	0.01	280.0	0.01
350.0	5643	5643	5643	349.8	-0.06	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1136 (kPa/ digit)

Polynomial Gauge factors: **A: 1.633E-07** **B: -0.1159** **C:**

Thermal Factor (K): -0.06846 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01647 (psi/ digit)

Polynomial Gauge Factors: **A: 2.368E-08** **B: -0.01681** **C:**

Thermal Factor (K): -0.009930 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8717 **Temperature: 22.2 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-8

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921442

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8697	8698	8698	0.055	0.02	0.109	0.03
70.0	8063	8063	8063	69.83	-0.04	69.77	-0.06
140.0	7424	7424	7424	140.1	0.03	140.0	0.00
210.0	6787	6787	6787	210.1	0.05	210.0	0.02
279.9	6151	6151	6151	280.1	0.04	280.0	0.02
350.0	5516	5516	5516	349.9	-0.02	350.0	-0.01

(kPa) Linear Gauge Factor (G): -0.1100 (kPa/ digit)

Polynomial Gauge factors: A: 6.915E-08 B: -0.1109 C: ______

Thermal Factor (K): -0.1188 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01595 (psi/ digit)

Polynomial Gauge Factors: A: 1.003E-08 B: -0.01609 C: ______

Thermal Factor (K): -0.01724 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8691 Temperature: 21.9 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

8D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: November 18, 2019

This calibration has been verified/validated as of 11/26/2019

Serial Number: 1943860

Temperature: 21.20 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 995.3 mbar

Cable Length: 160 feet

Technician:

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8924	8924	8924	0.228	0.07	-0.009	0.00
70.0	8310	8311	8311	70.05	0.01	70.03	0.01
140.0	7697	7697	7697	139.9	-0.03	140.0	0.00
210.0	7082	7082	7082	209.9	-0.03	210.0	0.00
280.0	6466	6466	6466	280.0	-0.01	280.0	-0.01
349.9	5849	5849	5849	350.2	0.07	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1138 (kPa/ digit)

Polynomial Gauge factors: A: -1.453E-07 B: -0.1117 C: ______

Thermal Factor (K): -0.1734 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01651 (psi/ digit)

Polynomial Gauge Factors: A: -2.108E-08 B: -0.01620 C: ______

Thermal Factor (K): -0.02515 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8928 Temperature: 21.6 °C Barometer: 991.8 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-9

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921447

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8607	8608	8608	0.060	0.02	0.045	0.01
70.0	8021	8021	8021	69.89	-0.02	69.90	-0.02
140.0	7433	7433	7433	139.9	-0.02	139.9	-0.02
210.0	6844	6845	6845	210.0	0.00	210.0	0.01
279.9	6256	6257	6257	280.0	0.01	280.0	0.02
350.0	5668	5669	5669	350.0	0.00	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1191 (kPa/ digit)

Polynomial Gauge factors: A: -1.919E-08 B: -0.1188 C: ______

Thermal Factor (K): -0.08368 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01727 (psi/ digit)

Polynomial Gauge Factors: A: -2.783E-09 B: -0.01723 C: ______

Thermal Factor (K): -0.01214 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8599 Temperature: 22.2 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

9D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: November 18, 2019

This calibration has been verified/validated as of 11/26/2019

Serial Number: 1943862

Temperature: 21.20 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa-3 MPa

Barometric Pressure: 995.3 mbar

Cable Length: 150 feet

Technician:

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	9088	9089	9089	-0.153	-0.04	-0.025	-0.01
70.0	8402	8402	8402	70.07	0.02	70.04	0.01
140.0	7717	7717	7717	140.1	0.05	140.0	0.02
210.0	7034	7034	7034	210.0	0.01	209.9	-0.02
280.0	6350	6350	6350	280.0	0.00	279.9	-0.01
349.9	5667	5667	5667	349.8	-0.03	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1023 (kPa/ digit)

Polynomial Gauge factors: **A: 8.587E-08** **B: -0.1036** **C:** ______

Thermal Factor (K): -0.1781 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01484 (psi/ digit)

Polynomial Gauge Factors: **A: 1.246E-08** **B: -0.01502** **C:** ______

Thermal Factor (K): -0.02584 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 9086 **Temperature: 21.9 °C** **Barometer: 991.8 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-18

GEOKON

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921452

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8755	8756	8756	-0.175	-0.05	-0.026	-0.01
70.0	8154	8154	8154	70.09	0.03	70.04	0.02
140.0	7555	7555	7555	140.1	0.02	139.9	-0.02
210.0	6955	6956	6956	210.1	0.04	209.9	0.00
279.9	6357	6357	6357	280.0	0.02	280.0	0.01
350.0	5759	5759	5759	349.9	-0.03	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1168 (kPa/ digit)

Polynomial Gauge factors: A: 1.392E-07 B: -0.1188 C: ________

Thermal Factor (K): -0.08708 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01694 (psi/ digit)

Polynomial Gauge Factors: A: 2.019E-08 B: -0.01724 C: ________

Thermal Factor (K): -0.01263 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8748 Temperature: 21.6 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

18D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: November 18, 2019

This calibration has been verified/validated as of 11/26/2019

Serial Number: 1943861

Temperature: 21.20 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 995.3 mbar

Cable Length: 150 feet

Technician: [signature]

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	9036	9036	9036	-0.100	-0.03	-0.033	-0.01
70.0	8331	8331	8331	70.15	0.04	70.13	0.03
140.0	7631	7631	7631	139.9	-0.02	139.8	-0.04
210.0	6927	6927	6927	210.1	0.03	210.0	0.01
280.0	6225	6225	6225	280.0	0.01	280.0	0.00
349.9	5524	5524	5524	349.9	-0.02	349.9	0.00

(kPa) Linear Gauge Factor (G): -0.09965 (kPa/ digit)

Polynomial Gauge factors: **A: 4.522E-08** **B: -0.1003** **C:** ______

Thermal Factor (K): -0.1721 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01445 (psi/ digit)

Polynomial Gauge Factors: **A: 6.558E-09** **B: -0.01455** **C:** ______

Thermal Factor (K): -0.02497 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 9040 **Temperature: 21.6 °C** **Barometer: 991.8 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-19

GEOKON

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921454

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8823	8823	8823	0.230	0.07	0.013	0.00
70.0	8217	8218	8218	69.99	0.00	69.96	0.00
140.0	7611	7611	7611	139.9	-0.04	139.9	-0.02
210.0	7003	7003	7003	209.9	-0.02	210.0	0.00
279.9	6394	6395	6395	280.0	0.02	280.0	0.01
350.0	5785	5785	5785	350.2	0.07	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1152 (kPa/ digit)

Polynomial Gauge factors: **A: -1.308E-07** **B: -0.1133** **C: ______**

Thermal Factor (K): -0.1144 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01671 (psi/ digit)

Polynomial Gauge Factors: **A: -1.897E-08** **B: -0.01643** **C: ______**

Thermal Factor (K): -0.01660 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8816 **Temperature: 21.7 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-20

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921440

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8779	8780	8780	0.056	0.02	0.069	0.02
70.0	8155	8156	8156	69.82	-0.04	69.88	-0.03
140.0	7529	7530	7530	139.8	-0.05	139.9	-0.03
210.0	6902	6902	6902	210.0	0.00	210.0	0.02
279.9	6276	6276	6276	280.0	0.00	280.0	0.02
350.0	5650	5650	5650	349.9	-0.01	350.0	-0.01

(kPa) Linear Gauge Factor (G): -0.1118 (kPa/ digit)

Polynomial Gauge factors: A: -2.715E-08 B: -0.1114 C: ________

Thermal Factor (K): -0.1282 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01622 (psi/ digit)

Polynomial Gauge Factors: A: -3.938E-09 B: -0.01616 C: ________

Thermal Factor (K): -0.01860 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8772 Temperature: 21.7 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON.

VWP-25

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921450

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8773	8774	8774	-0.178	-0.05	-0.078	-0.02
70.0	8182	8182	8182	70.07	0.03	70.12	0.04
140.0	7594	7594	7594	139.9	-0.02	139.9	-0.01
210.0	7005	7005	7005	209.9	-0.03	209.9	-0.02
279.9	6415	6416	6416	279.9	-0.02	279.9	0.00
350.0	5825	5826	5826	350.0	-0.01	350.1	0.02

(kPa) Linear Gauge Factor (G): -0.1188 (kPa/ digit)

Polynomial Gauge factors: A: 3.602E-08 B: -0.1193 C:

Thermal Factor (K): -0.06067 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01723 (psi/ digit)

Polynomial Gauge Factors: A: 5.224E-09 B: -0.01730 C:

Thermal Factor (K): -0.008800 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8766 Temperature: 21.4 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-26

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921453

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8654	8655	8655	0.059	0.02	-0.014	0.00
70.0	8060	8061	8061	70.02	0.01	69.99	0.01
140.0	7466	7467	7467	140.0	0.00	140.0	0.00
210.0	6872	6873	6873	209.9	0.00	209.9	-0.01
279.9	6278	6278	6278	280.0	0.01	279.9	0.00
350.0	5682	5683	5683	350.1	0.04	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1178 (kPa/ digit)

Polynomial Gauge factors: **A: -3.023E-08** **B: -0.1173** **C:**

Thermal Factor (K): -0.03155 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01708 (psi/ digit)

Polynomial Gauge Factors: **A: -4.384E-09** **B: -0.01702** **C:**

Thermal Factor (K): -0.004576 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8649 **Temperature: 21.5 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-27

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921446

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8627	8628	8628	-0.284	-0.08	0.068	0.02
70.0	8009	8009	8009	69.96	0.00	69.92	-0.02
140.0	7392	7392	7392	140.0	0.01	139.8	-0.06
210.0	6773	6773	6773	210.3	0.11	210.1	0.04
279.9	6159	6159	6159	280.1	0.04	280.0	0.03
350.0	5547	5547	5547	349.6	-0.11	349.9	-0.01

(kPa) Linear Gauge Factor (G): -0.1136 (kPa/ digit)

Polynomial Gauge factors: A: 2.621E-07 B: -0.1173 C: ______

Thermal Factor (K): -0.1012 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01647 (psi/ digit)

Polynomial Gauge Factors: A: 3.801E-08 B: -0.01701 C: ______

Thermal Factor (K): -0.01467 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8632 Temperature: 22.0 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-30

GEOKON

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921451

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8698	8698	8698	-0.120	-0.03	0.007	0.00
70.0	8116	8116	8116	69.95	-0.01	69.97	0.00
140.0	7534	7535	7535	140.0	-0.01	139.9	-0.02
210.0	6953	6953	6953	210.0	0.00	209.9	0.00
279.9	6371	6372	6372	280.0	0.01	280.0	0.02
350.0	5791	5791	5791	349.9	-0.03	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1204 (kPa/ digit)

Polynomial Gauge factors: A: 7.521E-08 B: -0.1215 C: ______

Thermal Factor (K): -0.07631 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01746 (psi/ digit)

Polynomial Gauge Factors: A: 1.091E-08 B: -0.01762 C: ______

Thermal Factor (K): -0.01107 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8690 Temperature: 22.5 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-33

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921439

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8636	8637	8637	-0.562	-0.16	-0.059	-0.02
70.0	7944	7945	7945	70.16	0.05	70.11	0.04
140.0	7259	7259	7259	140.2	0.07	139.9	-0.03
210.0	6574	6574	6574	210.2	0.08	209.9	-0.02
279.9	5891	5891	5891	280.0	0.02	280.0	0.01
350.0	5211	5211	5211	349.5	-0.13	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1022 (kPa/ digit)

Polynomial Gauge factors: A: 2.921E-07 B: -0.1062 C: ______

Thermal Factor (K): -0.05477 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01482 (psi/ digit)

Polynomial Gauge Factors: A: 4.237E-08 B: -0.01541 C: ______

Thermal Factor (K): -0.007944 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8627 Temperature: 21.9 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

33D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: November 18, 2019

This calibration has been verified/validated as of 11/26/2019

Serial Number: 1943866

Temperature: 21.20 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 995.3 mbar

Cable Length: 150 feet

Technician: [signature]

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8964	8965	8965	-0.161	-0.05	-0.054	-0.02
70.0	8312	8312	8312	70.08	0.02	70.12	0.03
140.0	7663	7663	7663	139.9	-0.01	140.0	-0.01
210.0	7013	7013	7013	209.9	-0.01	209.9	-0.01
280.0	6363	6363	6363	279.9	-0.03	279.9	-0.02
349.9	5713	5713	5713	349.9	-0.02	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1077 (kPa/ digit)

Polynomial Gauge factors: A: 4.09E-08 B: -0.1083 C: ______

Thermal Factor (K): -0.07397 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01561 (psi/ digit)

Polynomial Gauge Factors: A: 5.932E-09 B: -0.01570 C: ______

Thermal Factor (K): -0.01073 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8963 Temperature: 21.9 °C Barometer: 991.8 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-41

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921443

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8638	8639	8639	0.287	0.08	0.073	0.02
70.0	8033	8033	8033	69.79	-0.05	69.82	-0.04
140.0	7422	7423	7423	139.9	-0.04	140.0	0.01
210.0	6813	6813	6813	209.8	-0.04	210.0	0.01
279.9	6202	6202	6202	280.0	0.00	280.0	0.01
350.0	5590	5590	5590	350.2	0.06	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1148 (kPa/ digit)

Polynomial Gauge factors: A: -1.65E-07 B: -0.1124 C: ______

Thermal Factor (K): -0.09576 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01665 (psi/ digit)

Polynomial Gauge Factors: A: -2.393E-08 B: -0.01631 C: ______

Thermal Factor (K): -0.01389 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8631 Temperature: 22.0 °C Barometer: 995 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON.

41-D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: September 12, 2019

This calibration has been verified/validated as of 09/25/2019

Serial Number: 1933662

Temperature: 22.90 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 1000.4 mbar

Cable Length: 140 feet

Technician:

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8979	8979	8979	-0.113	-0.03	0.005	0.00
70.0	8360	8359	8360	69.95	-0.01	69.96	0.00
140.0	7740	7740	7740	140.0	0.02	140.0	0.00
210.0	7121	7121	7121	210.0	0.02	210.0	0.01
280.0	6503	6503	6503	279.9	-0.02	279.9	-0.02
349.9	5885	5885	5885	349.8	-0.03	349.9	0.00

(kPa) Linear Gauge Factor (G): -0.1131 (kPa/ digit)

Polynomial Gauge factors: A: 7.378E-08 B: -0.1142 C:

Thermal Factor (K): -0.1029 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01640 (psi/ digit)

Polynomial Gauge Factors: A: 1.07E-08 B: -0.01656 C:

Thermal Factor (K): -0.01493 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8996 Temperature: 23.2 °C Barometer: 989.9 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

VWP-43

GEOKON®

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921441

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8649	8649	8649	0.000	0.00	0.075	0.02
70.0	8045	8045	8045	69.82	-0.04	69.80	-0.05
140.0	7437	7437	7437	140.1	0.03	140.0	0.01
210.0	6832	6832	6832	210.0	0.02	210.0	0.01
279.9	6227	6227	6227	280.0	0.01	280.0	0.01
350.0	5622	5622	5622	349.9	-0.02	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1156 (kPa/ digit)

Polynomial Gauge factors: **A: 6.491E-08** **B: -0.1165** **C:**

Thermal Factor (K): -0.1069 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01677 (psi/ digit)

Polynomial Gauge Factors: **A: 9.414E-09** **B: -0.01690** **C:**

Thermal Factor (K): -0.01551 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8642 **Temperature: 21.9 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

43D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: November 18, 2019

This calibration has been verified/validated as of 11/26/2019

Serial Number: 1943859

Temperature: 21.20 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 995.3 mbar

Cable Length: 160 feet

Technician:

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8877	8878	8878	0.053	0.02	0.015	0.00
70.0	8217	8218	8218	69.94	-0.02	69.94	-0.02
140.0	7555	7555	7555	140.1	0.03	140.1	0.04
210.0	6896	6896	6896	209.9	-0.03	209.9	-0.02
280.0	6234	6234	6234	280.0	-0.01	280.0	-0.01
349.9	5572	5573	5573	350.0	0.01	350.0	0.00

(kPa) Linear Gauge Factor (G): -0.1059 (kPa/ digit)

Polynomial Gauge factors: A: -2.166E-08 B: -0.1056 C: ________

Thermal Factor (K): -0.1839 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01536 (psi/ digit)

Polynomial Gauge Factors: A: -3.141E-09 B: -0.01531 C: ________

Thermal Factor (K): -0.02667 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8879 Temperature: 22.0 °C Barometer: 991.8 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

VWP-44

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921448

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8786	8787	8787	0.297	0.08	0.105	0.03
70.0	8201	8202	8202	69.86	-0.03	69.85	-0.03
140.0	7614	7614	7614	139.7	-0.07	139.8	-0.05
210.0	7023	7023	7023	210.0	0.01	210.1	0.04
279.9	6433	6434	6434	280.1	0.05	280.1	0.05
350.0	5845	5845	5845	350.1	0.03	349.9	-0.02

(kPa) Linear Gauge Factor (G): -0.1189 (kPa/ digit)

Polynomial Gauge factors: **A: -1.294E-07** **B: -0.1170** **C:** ______

Thermal Factor (K): -0.04389 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01725 (psi/ digit)

Polynomial Gauge Factors: **A: -1.877E-08** **B: -0.01697** **C:** ______

Thermal Factor (K): -0.006366 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8781 **Temperature: 21.4 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON.

VWP-47

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 12, 2019

This calibration has been verified/validated as of 07/18/2019

Serial Number: 1921449

Temperature: 23.00 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 985.2 mbar

Cable Length: 70 feet

Technician: Kathy Rogers

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8723	8724	8724	0.059	0.02	0.026	0.01
70.0	8128	8128	8128	69.96	0.00	69.92	-0.02
140.0	7531	7531	7531	140.0	0.01	140.0	0.00
210.0	6935	6935	6935	210.0	0.01	209.9	0.00
279.9	6338	6339	6339	280.0	0.02	280.0	0.01
350.0	5742	5742	5742	350.0	0.02	350.0	0.01

(kPa) Linear Gauge Factor (G): -0.1174 (kPa/ digit)

Polynomial Gauge factors: **A: 8.497E-09** **B: -0.1175** **C:** ______

Thermal Factor (K): -0.1013 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01703 (psi/ digit)

Polynomial Gauge Factors: **A: 1.232E-09** **B: -0.01704** **C:** ______

Thermal Factor (K): -0.01470 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8718 **Temperature: 21.6 °C** **Barometer: 995 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON®

47D

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: September 12, 2019

This calibration has been verified/validated as of 09/25/2019

Serial Number: 1933663

Temperature: 22.90 °C

Calibration Instruction: CI-Pressure Transducer 7 kPa~3 MPa

Barometric Pressure: 1000.4 mbar

Cable Length: 140 feet

Technician:

Applied Pressure (kPa)	Gauge Reading 1st Cycle	Gauge Reading 2nd Cycle	Average Gauge Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8919	8919	8919	0.109	0.03	-0.051	-0.01
70.0	8278	8278	8278	70.08	0.03	70.10	0.04
140.0	7639	7639	7639	139.8	-0.04	139.9	-0.01
210.0	6999	6999	6999	209.7	-0.08	209.8	-0.05
280.0	6354	6354	6354	280.1	0.03	280.1	0.04
349.9	5713	5713	5713	350.1	0.03	349.9	-0.01

(kPa) Linear Gauge Factor (G): -0.1092 (kPa/ digit)

Polynomial Gauge factors: **A: -1.115E-07** **B: -0.1075** **C:**

Thermal Factor (K): -0.1168 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gauge Factor (G): -0.01583 (psi/ digit)

Polynomial Gauge Factors: **A: -1.617E-08** **B: -0.01560** **C:**

Thermal Factor (K): -0.01694 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)^*$

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)^*$

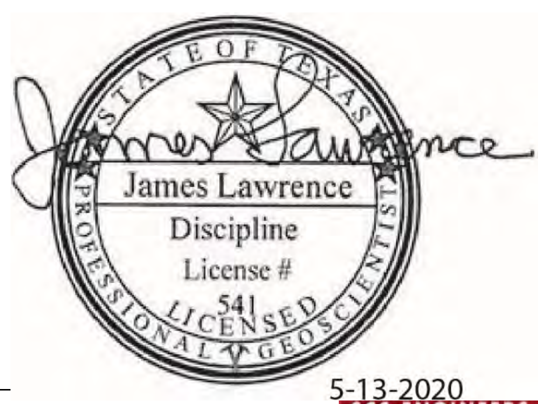
*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8931 **Temperature: 23.2 °C** **Barometer: 989.9 mbar**

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

APPENDIX III-4.H

STANDPIPE PIEZOMETER COMPLETION DATA



5-13-2020

Monitoring Well Data Sheet

Site Name: City of Waco Landfill

County: Mclennan
Monitor Well I.D. No.: PZ-1

Date of Installation: 10/04/2018
Date of Development: 11/30/2018

Latitude: 31 42' 16.86" N Longitude: 96° 55' 59.13" W

Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M

Method of well development: Surge

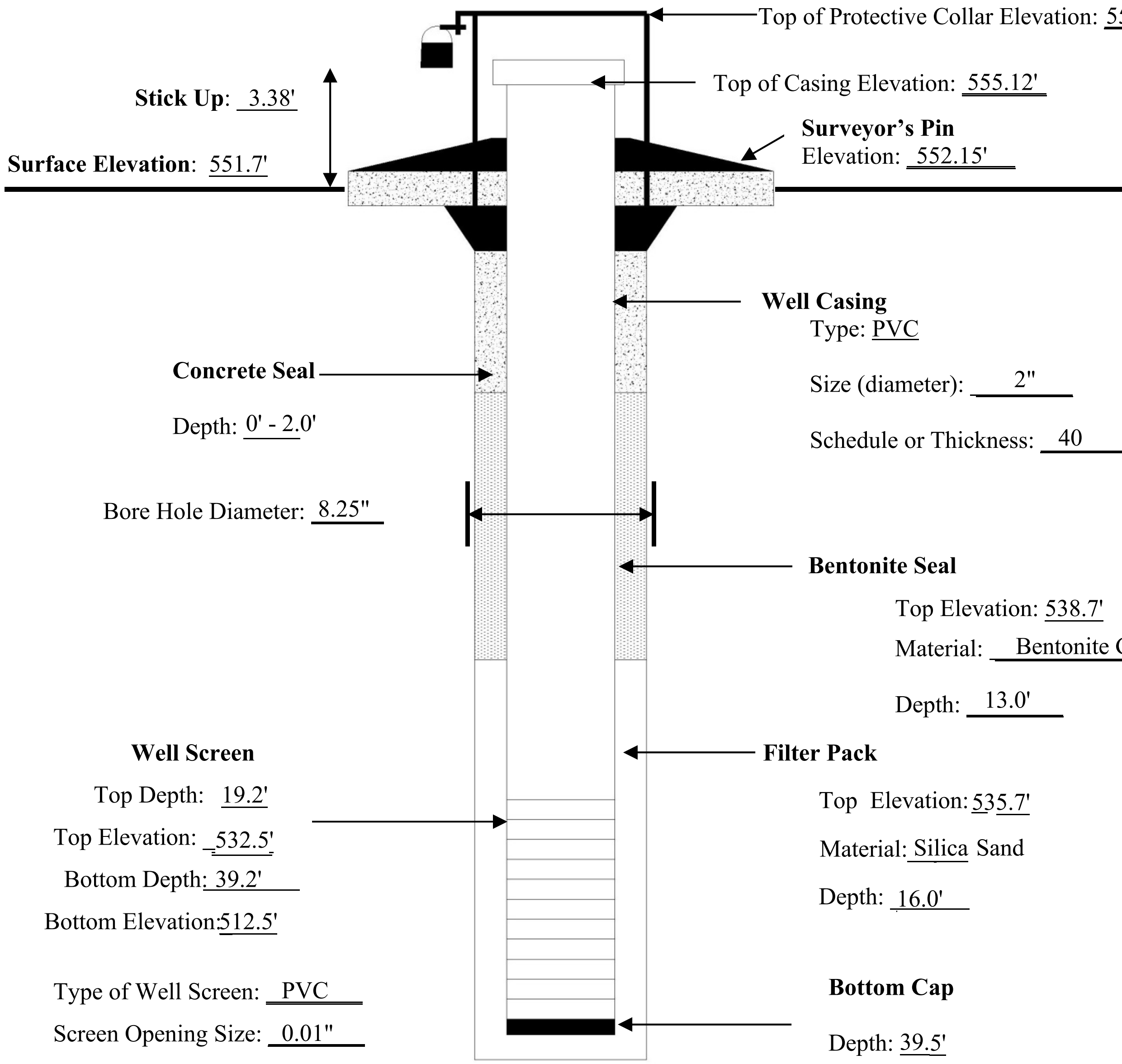
SCS Field Staff Supervising Installation: Tim Derstine, P.G.

Static Water Level after Well Development: ____________

Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum

Concrete Surface Pad (with steel reinforcement) Dimensions: 2' x 2'



Top of Protective Collar Elevation: 555.49'

Stick Up: 3.38'

Top of Casing Elevation: 555.12'

Surveyor's Pin
Elevation: 552.15'

Surface Elevation: 551.7'

Well Casing
Type: PVC

Concrete Seal

Size (diameter): 2"

Depth: 0' - 2.0'

Schedule or Thickness: 40

Bore Hole Diameter: 8.25"

Bentonite Seal

Top Elevation: 538.7'

Material: Bentonite Grout

Depth: 13.0'

Well Screen

Filter Pack

Top Depth: 19.2'

Top Elevation: 535.7'

Top Elevation: 532.5'

Material: Silica Sand

Bottom Depth: 39.2'

Depth: 16.0'

Bottom Elevation: 512.5'

Bottom Cap

Type of Well Screen: PVC

Screen Opening Size: 0.01"

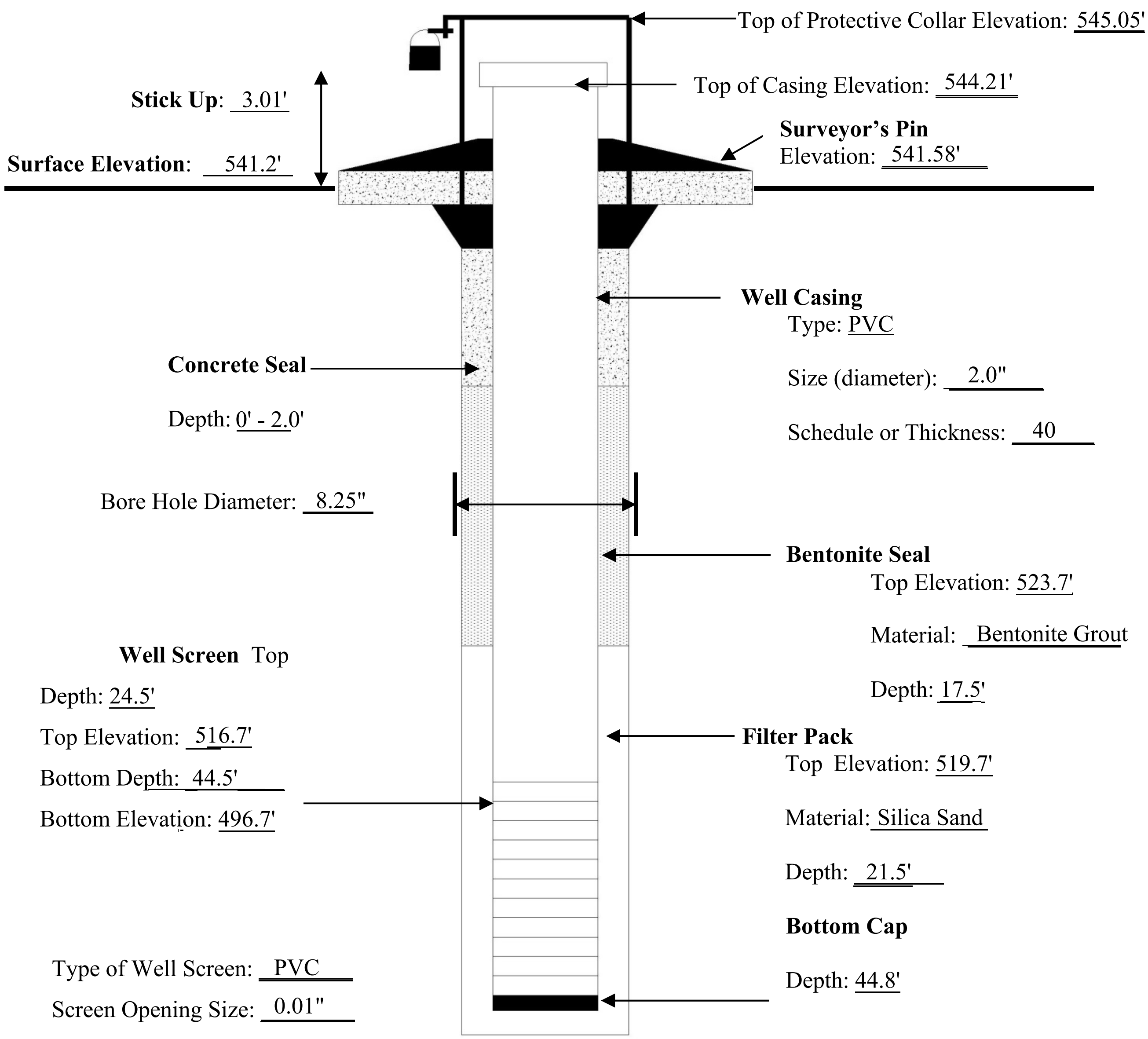
Depth: 39.5'

Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: McLennan
Monitor Well I.D. No.: PZ-3
Date of Installation: 10/10/2018
Date of Development: 11/28/2018
Latitude: 31° 41' 54.30" N Longitude: 96° 55' 43.84" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: Surge

SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development:
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

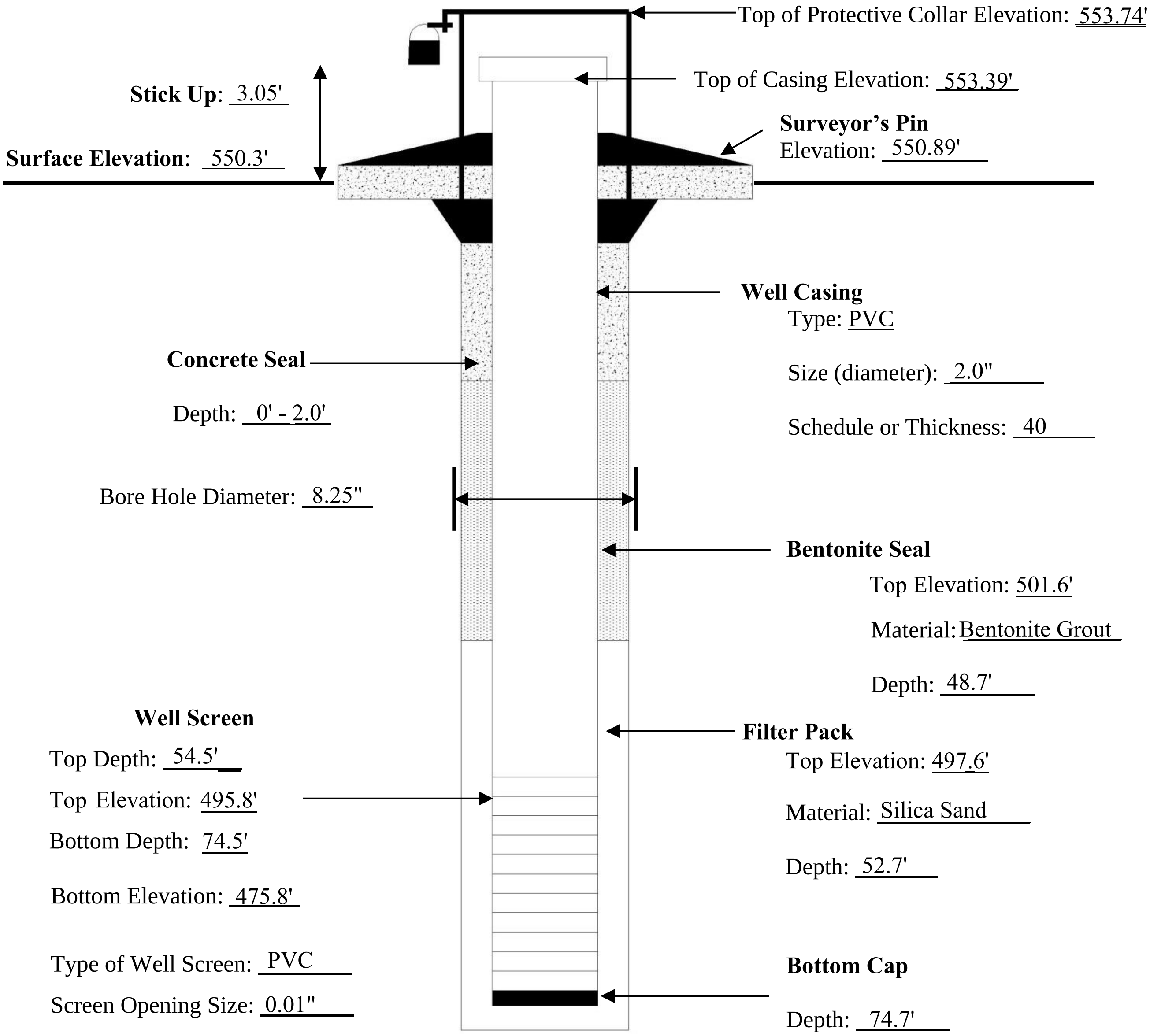
Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-8
Date of Installation: 11/28/2018
Date of Development: ___________
Latitude: 31° 42' 11.59" N
Longitude: 96° 55' 12.21" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: ____ _________
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development: _____________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

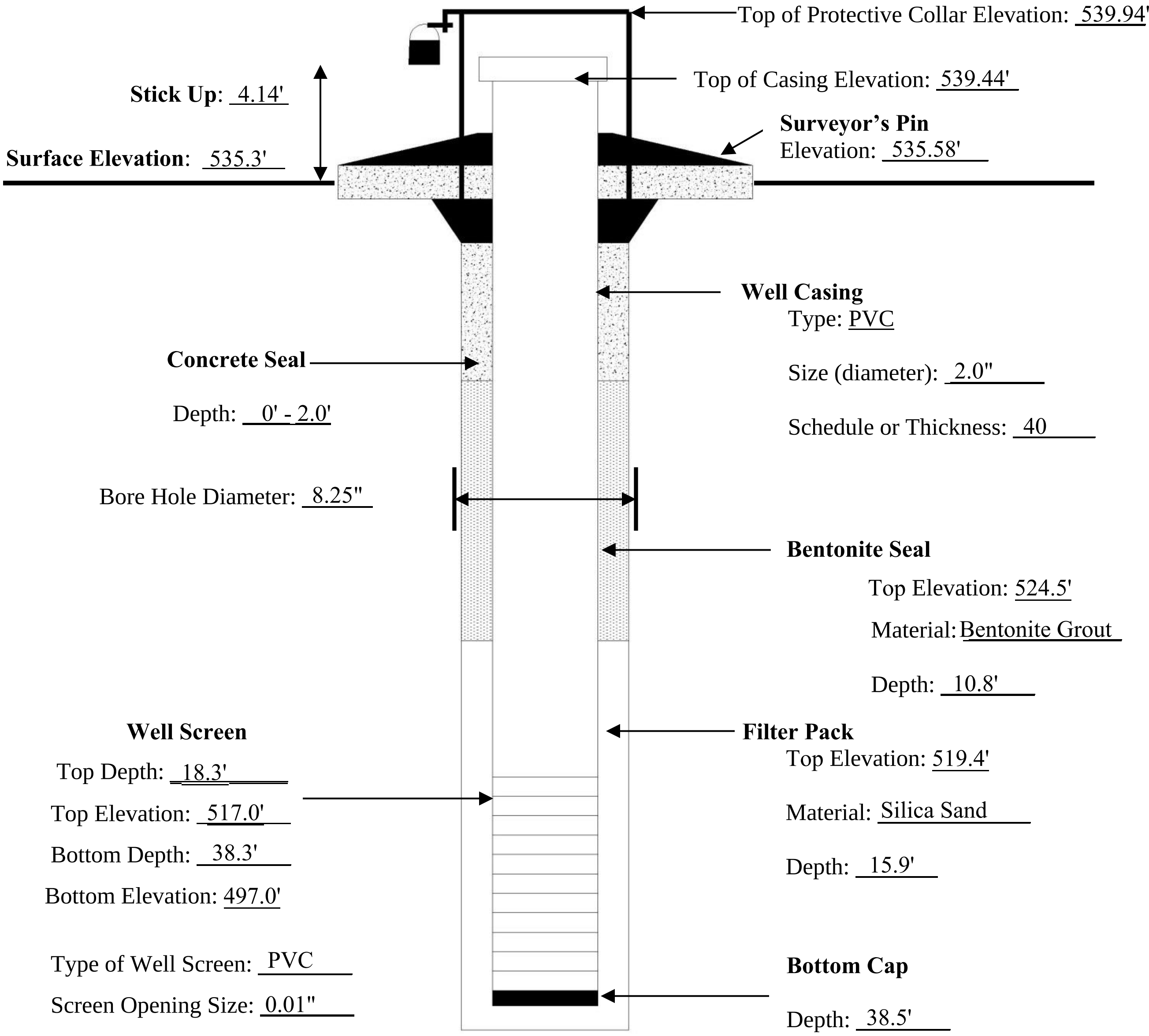
Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-9
Date of Installation: 10/10/2018
Date of Development: ___________
Latitude: 31° 42' 10.46" N
Longitude: 96°55' 37.43" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: ____
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development: _____________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

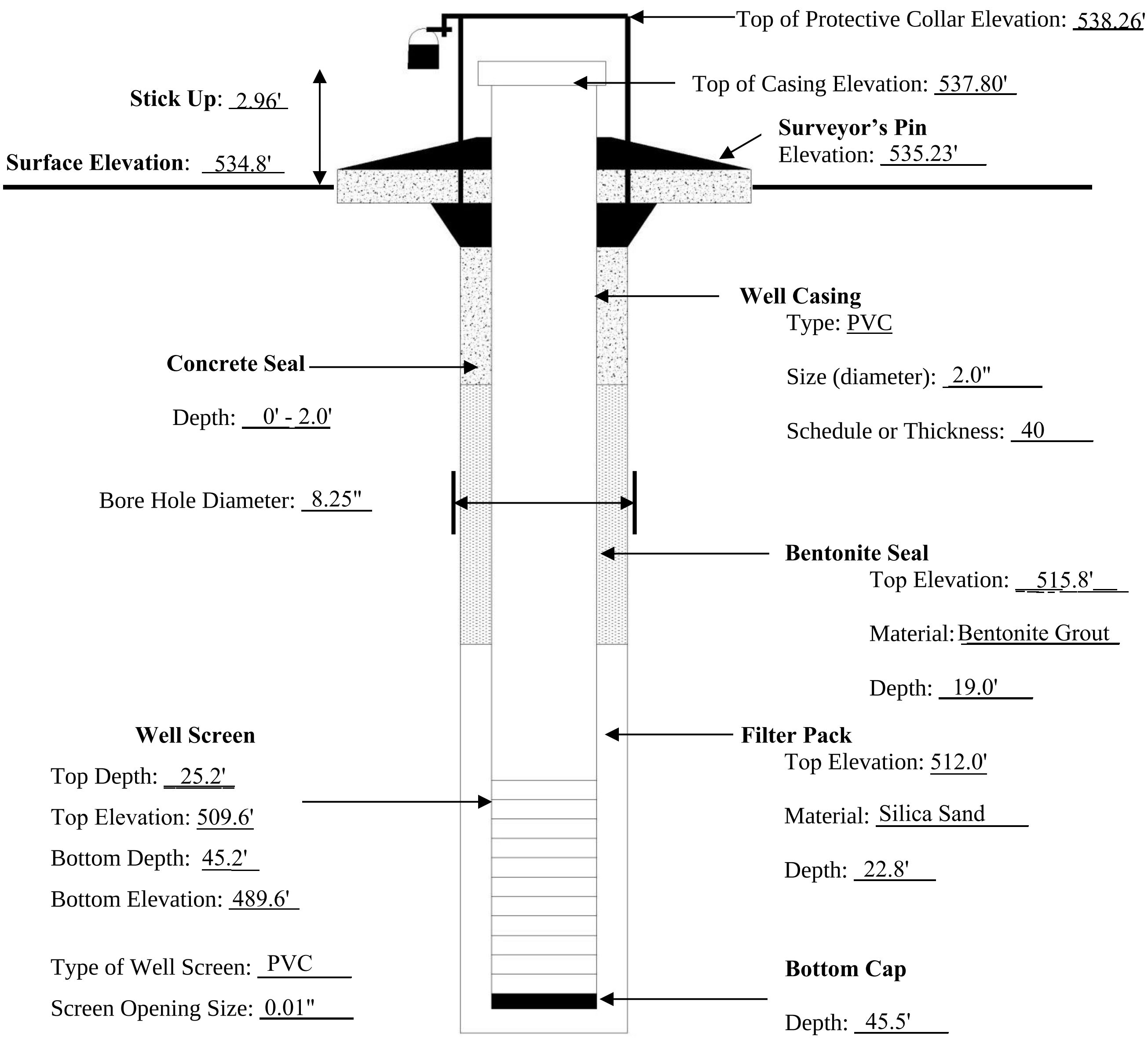
Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-18
Date of Installation: 10/30/2018
Date of Development: 11/20/2018
Latitude: 31° 42' 28.96" N
Longitude: 96° 55' 26.98" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: Surge
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development:
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill

County: Limestone

Monitor Well I.D. No.: PZ-20

Date of Installation: 10/30/2018

Date of Development: 11/20/2018

Latitude: 31° 42' 34.93" N

Easting: 96° 55' 14.45" W

Well Driller Name and License Number: West Drilling, Ricardo Garcia, License No. 54637

Method of well development: Surge

SCS Field Staff Supervising Installation: Valerie Wooters

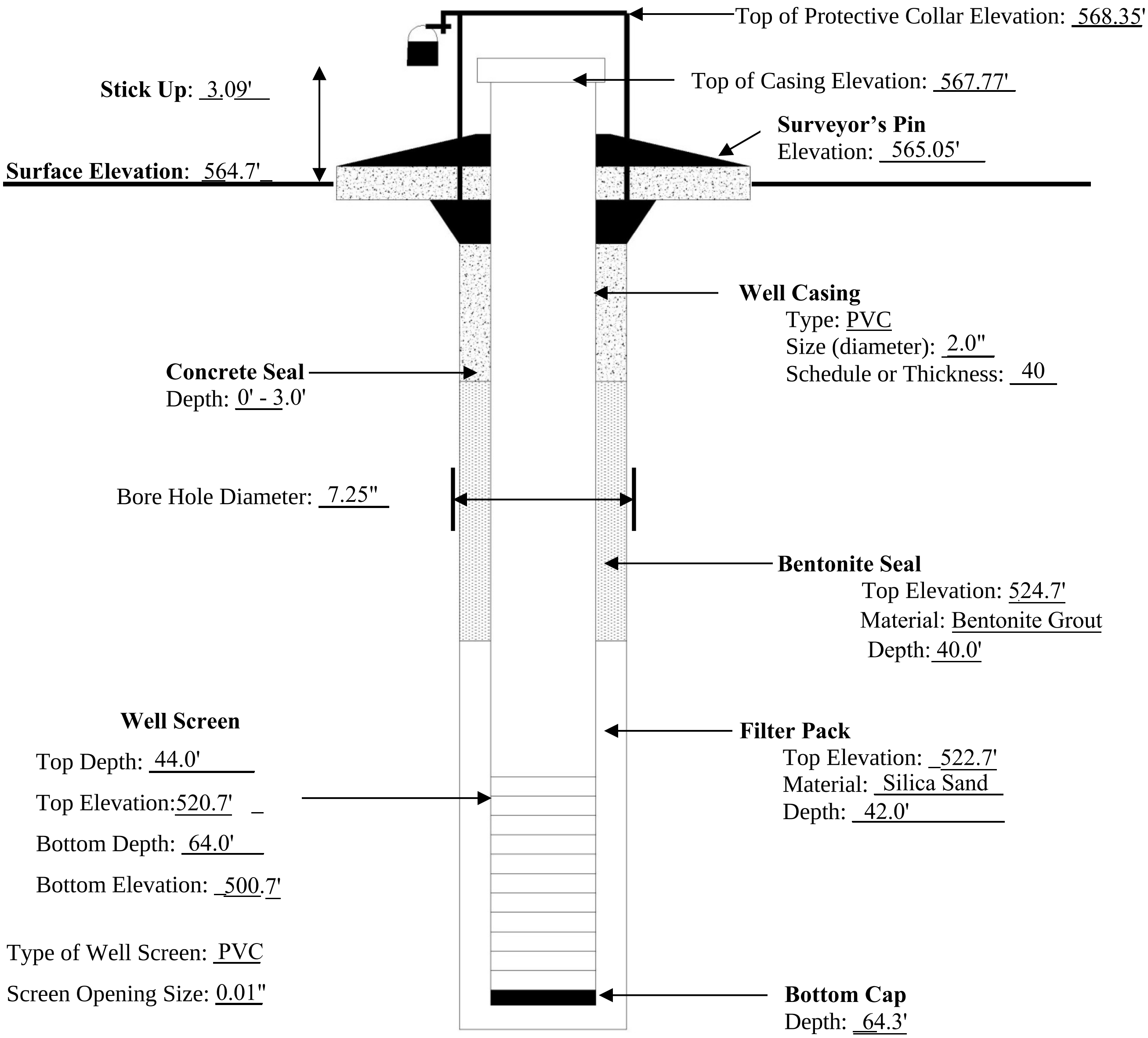
Static Water Level after Well Development: ____________

Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

Type of Locking Device: Pad Lock

Type of Case Protection: Aluminum

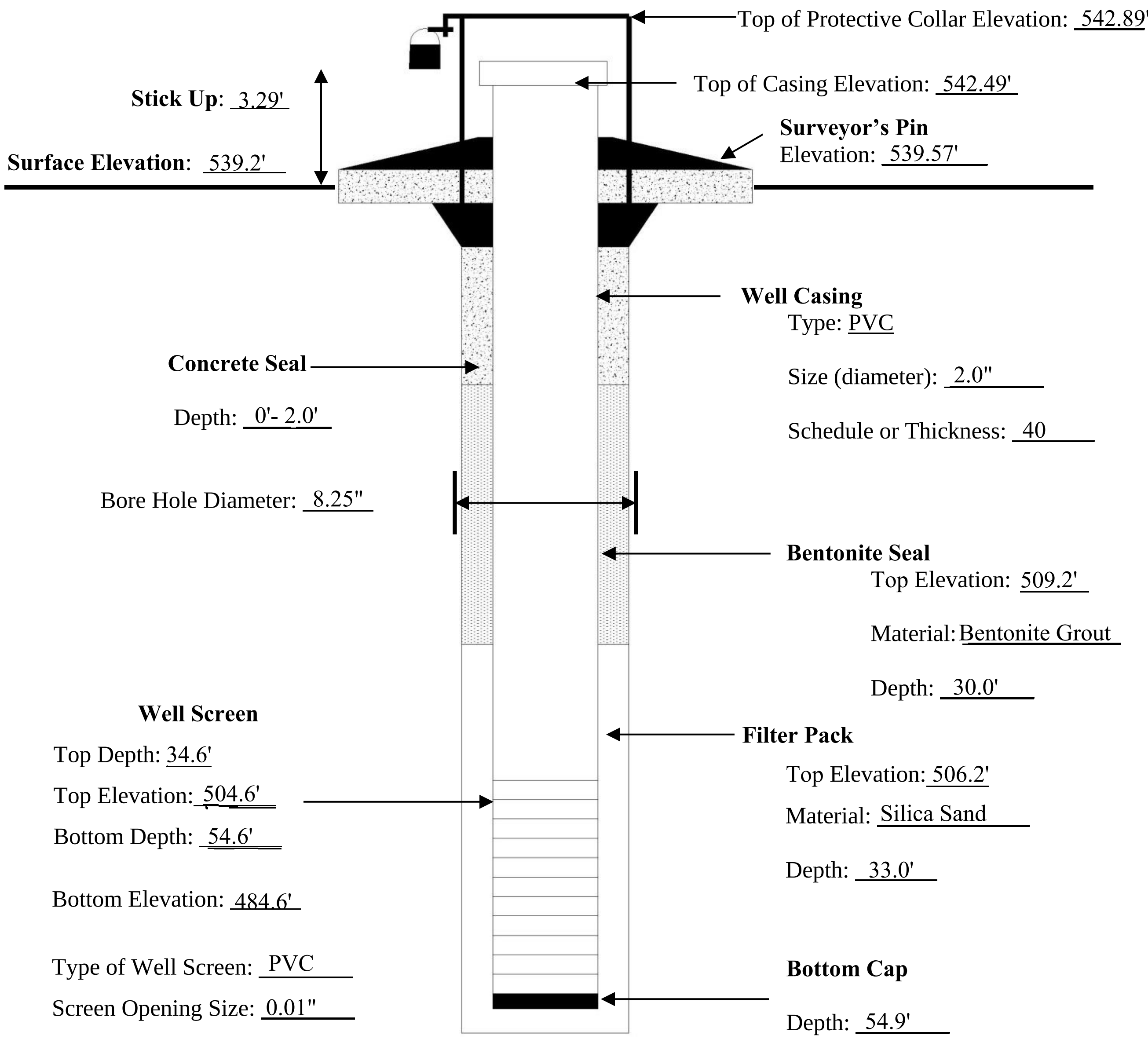
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-33
Date of Installation: 11/20/2018
Date of Development: ___________
Latitude: 31° 42' 00.00" N
Longitude: 96° 55' 14.54" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: ___________
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development: ______________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

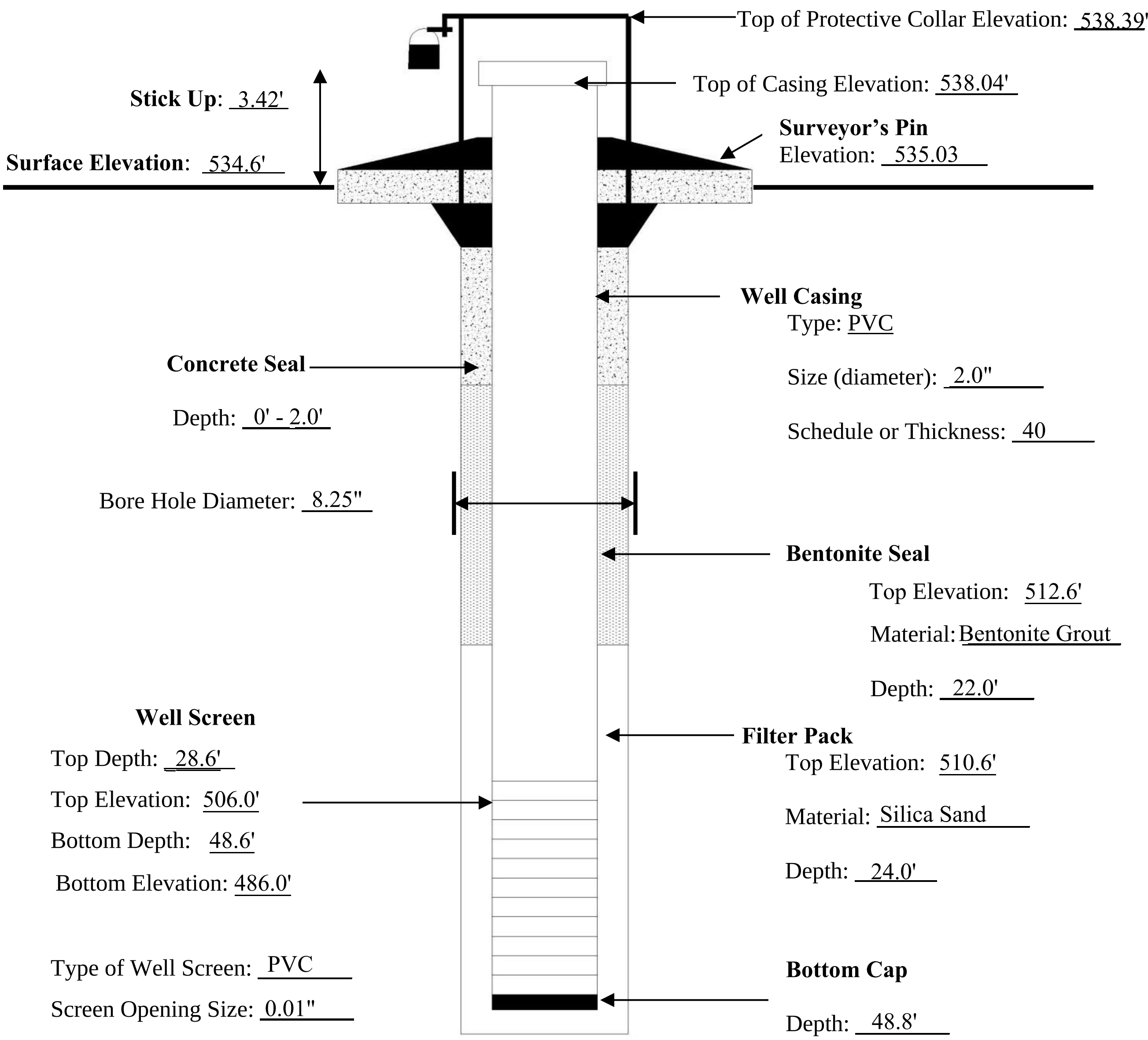
Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-41
Date of Installation: 12/18/2018
Date of Development: ___________
Latitude: 31° 42' 10.66" N
Longitude: 96° 54' 59.07" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: ____ ________
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development: _____________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

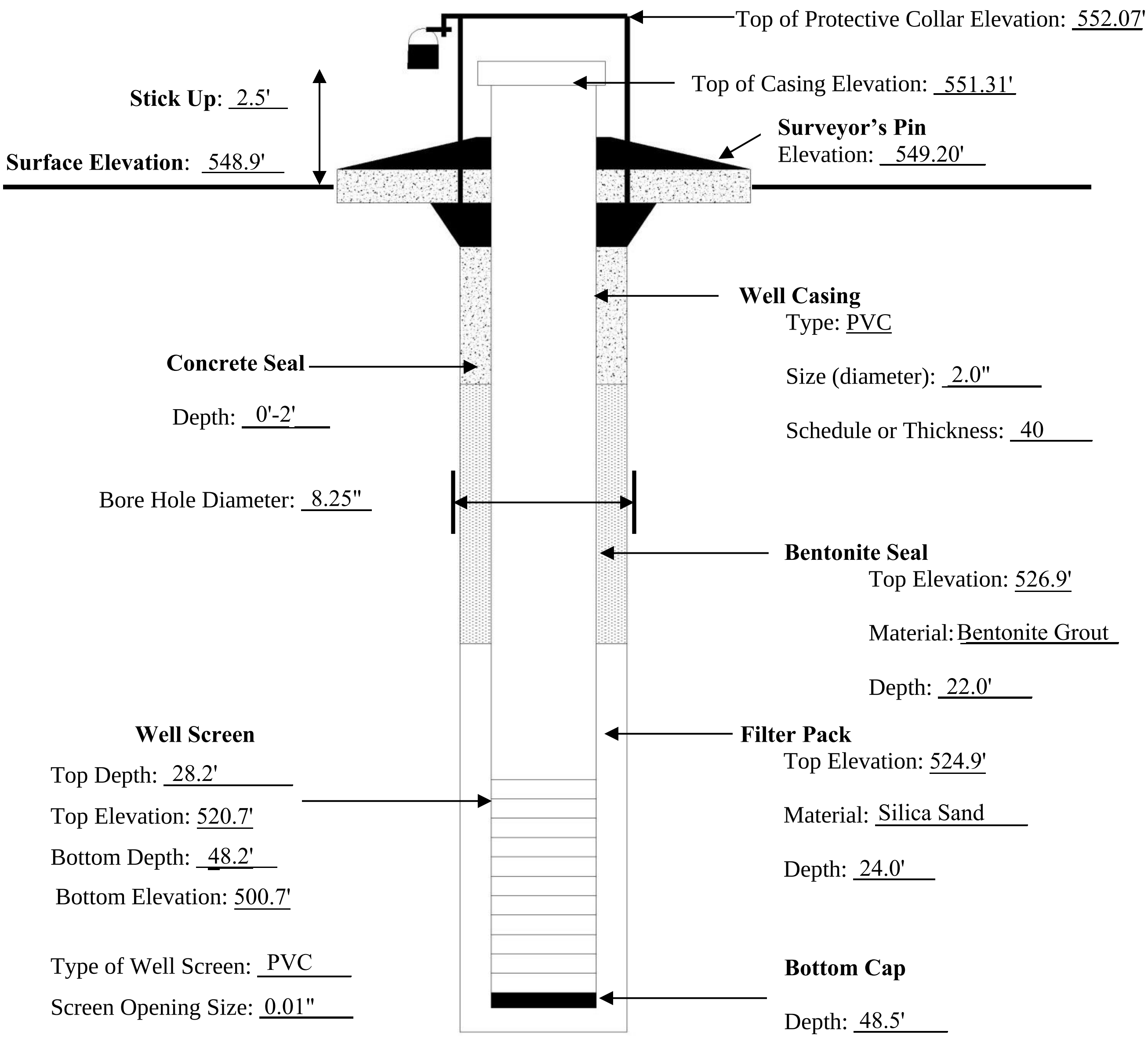
Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-43
Date of Installation: 11/16/2018
Date of Development: ___________
Latitude: 31° 42' 20.55" N
Longitude: 96° 55' 01.03" W
Well Driller Name and License Number Best Drilling, Loyd Bruce Milton, License No. 4926M
Method of well development: ___________
SCS Field Staff Supervising Installation: Tim Derstine, P.G.
Static Water Level after Well Development: _____________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

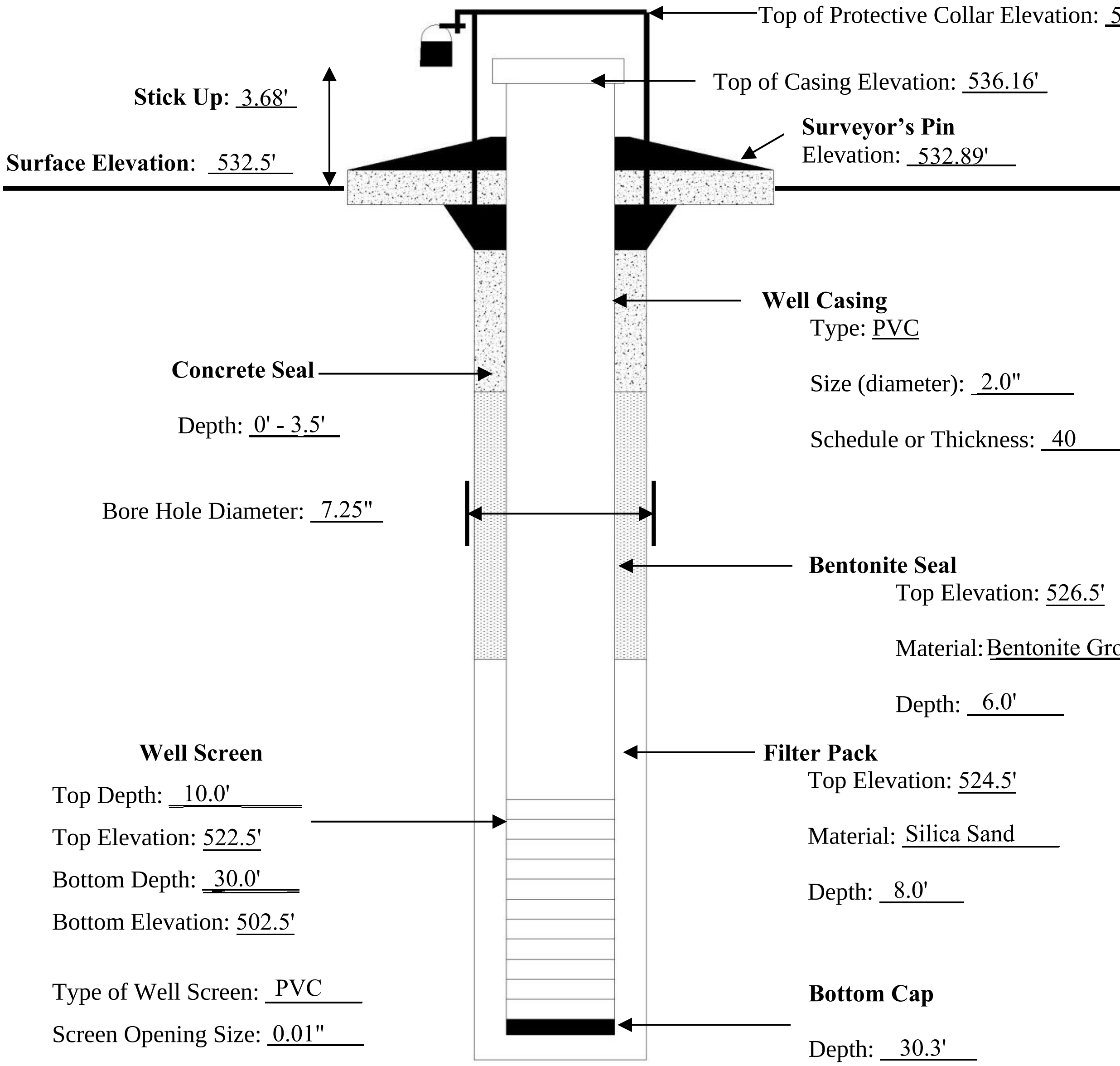
Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



Monitoring Well Data Sheet

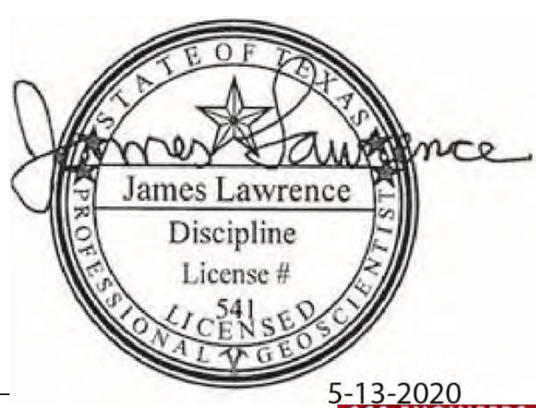
Site Name: City of Waco Landfill
County: Limestone
Monitor Well I.D. No.: PZ-47
Date of Installation: 10/12/2018
Date of Development: ___________
Latitude: 31° 42' 04.15" N
Longitude: 96° 55' 28.39" W
Well Driller Name and License Number West Drilling, Ricardo Garcia, License No. 54637
Method of well development: ___________
SCS Field Staff Supervising Installation: Valerie Wooters
Static Water Level after Well Development: ______________
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation, Cretaceous

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 2.0' x 2.0'



APPENDIX III-4.I

VIBRATING WIRE PIEZOMETER COMPLETION DATA



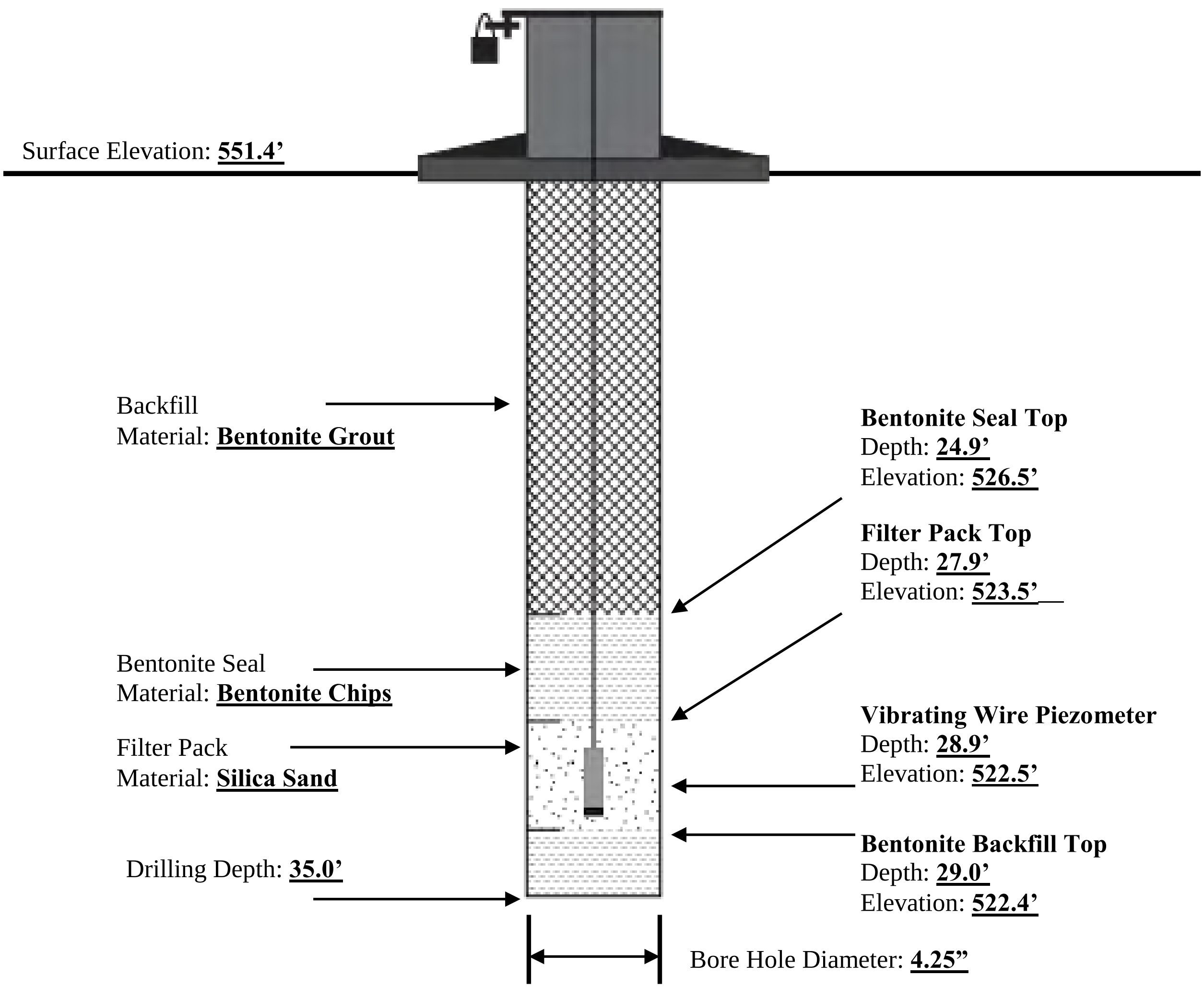
5-13-2020

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Mclennan
VWP I.D. No.: VWP-1
Date of Installation: 8/1/2019
Probe Serial No.: 1921455
Northing: 10599904.81
Easting: 3353867.3
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



SCS ENGINEERS

SCS ENGINEERS

1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-1 (VWP-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/4/18 **COMPLETED** 10/4/18
GROUND ELEVATION 551.7 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 21.38 ft / Elev 530.32 ft

DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.	WELL DIAGRAM	VWP DIAGRAM
0 – 2.0						Silty Clay, dark brown, slightly moist to moist, soft	549.7		
2.0 – 15.0				CL-ML		(CL-ML) Silty Clay, red/orange to brown, slightly moist to moist, firm to stiff, with orange staining in joints	536.7		
15.0 – 28.0						Silty Clay Shale, orange-brown mottled brown, slightly moist, stiff, non-calcareous, very weathered Color change to orange-brown mottled tan to light gray and calcareous at 20 feet	523.7		
28.0 – 35			Weathered to Unweathered zone			Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered Slight orange staining in joints 30-39 feet.			-VWP

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Telephone: 817-571-2288

WELL NUMBER B-1 (VWP-1)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered Slight orange staining in joints 30-39 feet. *(continued)*	
					39.3	512.4	

Bottom of borehole at 39.0 feet.

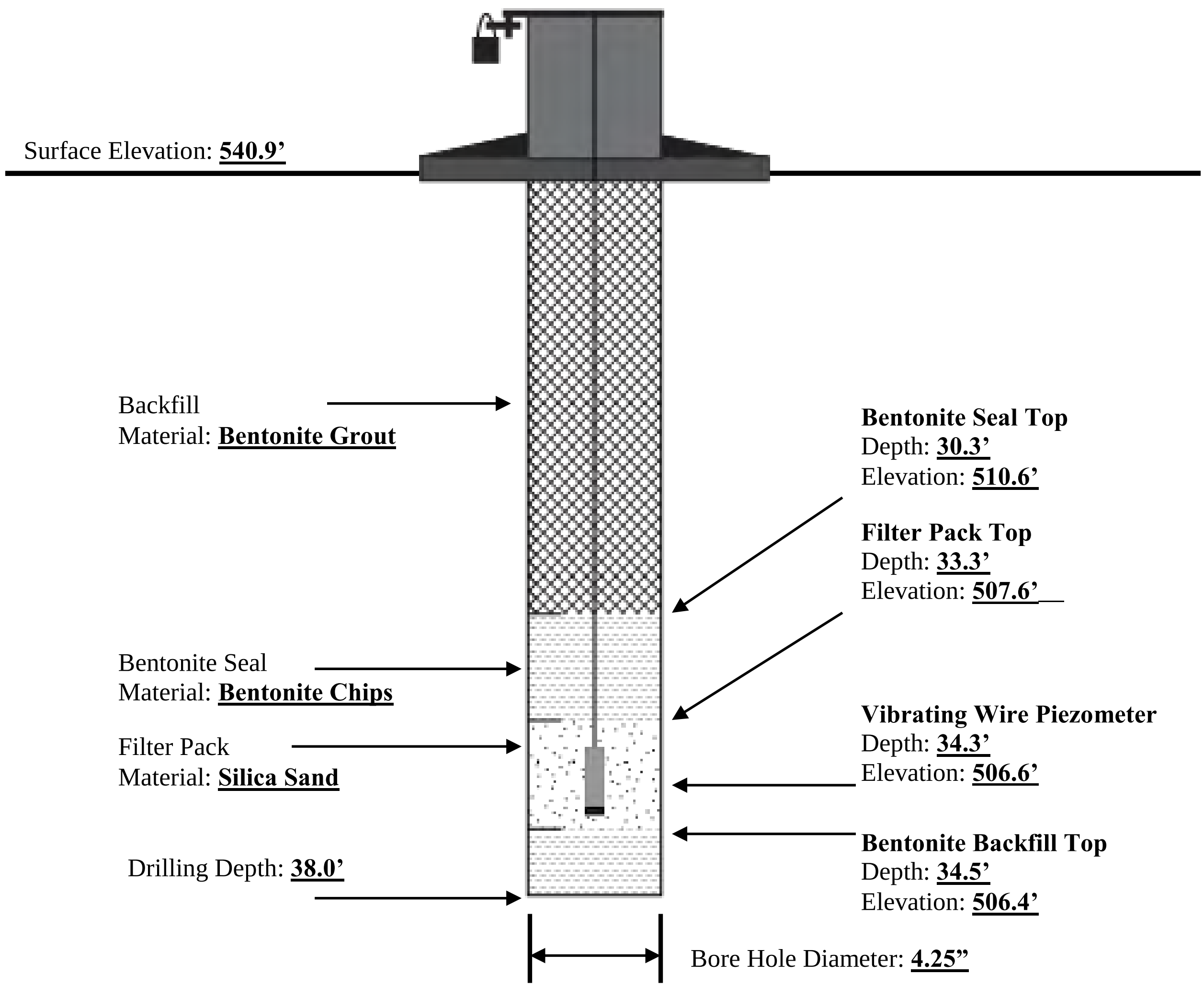
GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Mclennan VWP I.D. No.: VWP-3
Date of Installation: 8/1/2019 Probe Serial No.: 1921444
Northing: 10597665.32 Easting: 3355259.69
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



SCS ENGINEERS

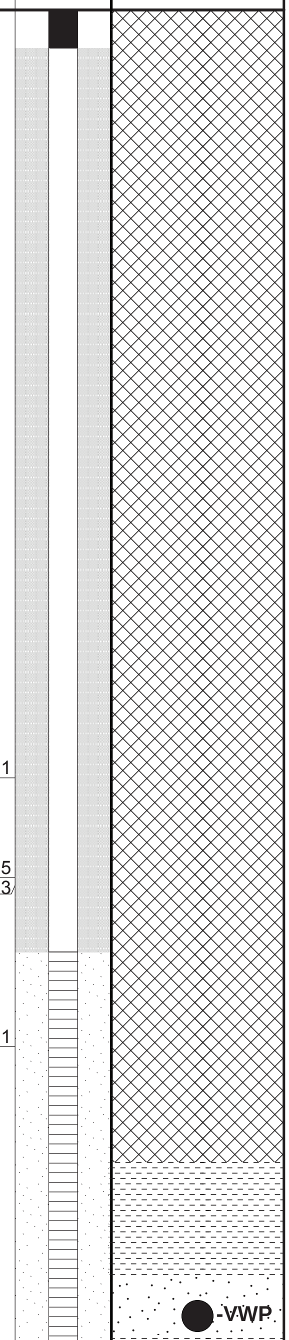
SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-3 (VWP-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 541.1 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0						Blind Drill	
20.0				SP-SC		(SP-SC) Sand, brown, soft, moist to wet, with traces of clay, fine to medium grained	521.1
22.6						Silty Clay, dark brown, hard to stiff, moist	518.5
22.8				CL		(CL) Silty Clay, orange-brown mottled brown, hard, slightly moist, calcareous, with weathered shale	518.3
27.0						Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered	514.1
35						No mineral deposits 35-39 feet	

WELL DIAGRAM / VWP DIAGRAM



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1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-3 (VWP-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM	VWP DIAGRAM
35		56	PP = 4.5+ tsf			Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered No mineral deposits 35-39 feet *(continued)*			
			Weathered to Unweathered zone			39.0	502.1		
40		70	PP = 4.5+ tsf			Silty Clay Shale, dark gray, very hard, slightly moist to dry, calcareous, unweathered			
45						45.0	496.1		

Bottom of borehole at 45.0 feet.

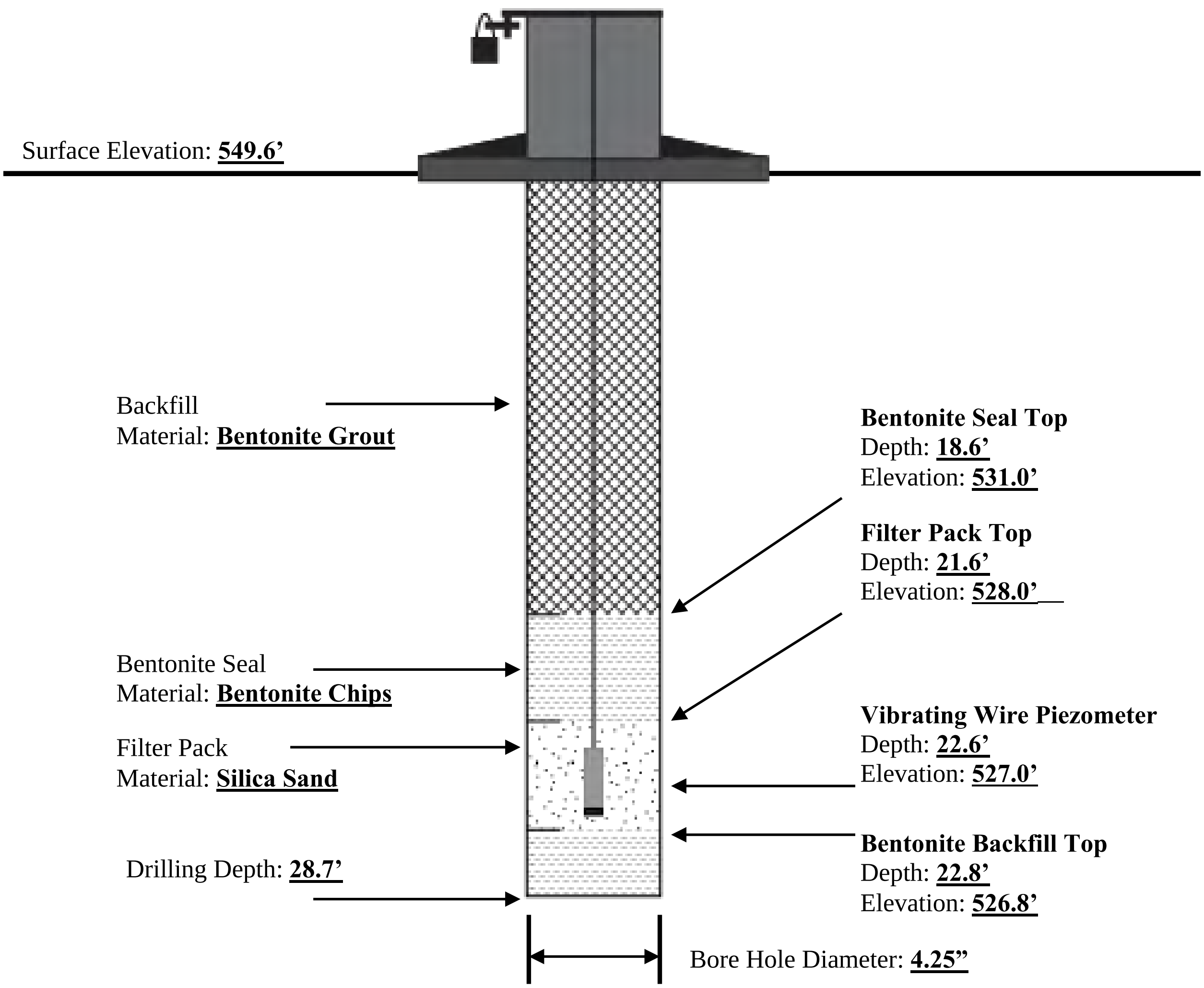
GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400_______________________
County: __Limestone____ VWP I.D. No.:_VWP-4____
Date of Installation: _8/2/2019_ Probe Serial No.: 1921438
Northing: 10599528.00_________ Easting:_3355130.33_______________
Well Driller Name and License Number __West Drilling___________________________

SCS Field Staff Supervising Installation:__Doug Steen_________________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



SCS ENGINEERS

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER A4 (VWP-4)

CLIENT City of Waco		**PROJECT NAME** City of Waco Landfill MSW-2400	
PROJECT NUMBER 16216088.00		**PROJECT LOCATION** Waco, Texas	
DATE STARTED 1/23/18	**COMPLETED** 1/23/18	**GROUND ELEVATION** 550.04 ft	**HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling		**GROUND WATER LEVELS:**	
DRILLING METHOD Hollow stem auger/air rotary		**AT TIME OF DRILLING** 48.77 ft / Elev 501.27 ft	
LOGGED BY T. Millbrand	**CHECKED BY** J. Lawrence	**AT END OF DRILLING** 96.59 ft / Elev 453.45 ft	
NOTES		**AFTER DRILLING** --- No Groundwater	

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.	VWP Diagram
0					SC	(SC) Topsoil/Fill material		
2.0						Topsoil/Fill material, with dakr brown clay, soft, moist	548.0	
4.0					CH	(CH) Clay, dark brown, hard, moist, calcareous Color change to light brown at 8 feet. Pebbles throughout 8-10 ft Color change to mottled brown/grey at 16 feet Sand lenses throughout 18-20 feet	546.0	VWP
28.0						Clayey shale, dark grey, fissile, calcareous	522.0	
30.0						Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout	520.0	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

(Continued Next Page)

BORING NUMBER A4 (VWP-4)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout *(continued)*
40							
45							
50							
55							
60							
65							
70							
75							

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-
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Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER A4 (VWP-4)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout *(continued)*
80							
85							
90							
95							
100							101.0 449.0

Bottom of borehole at 101.0 feet.

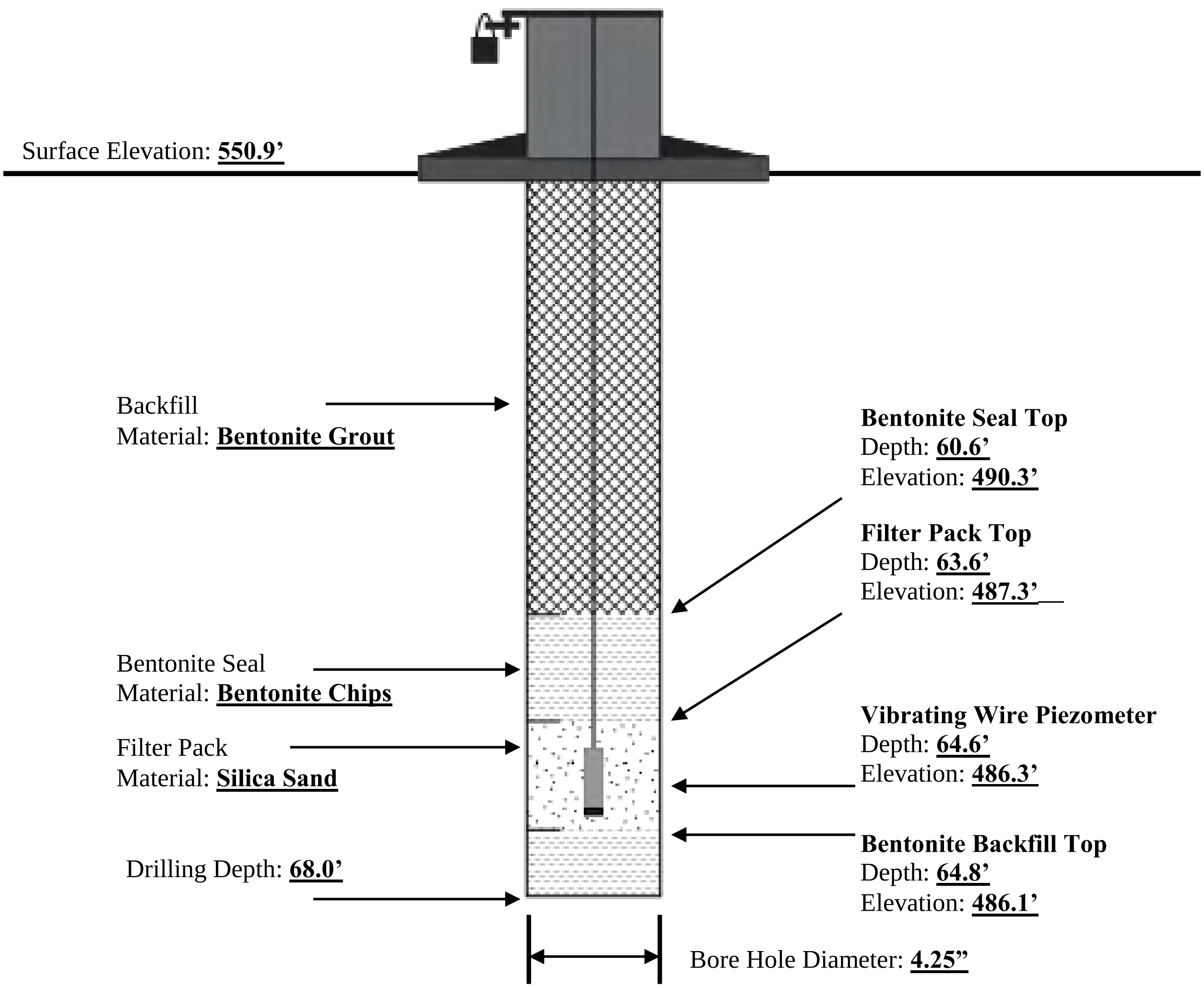
GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400___________________
County: __Limestone____ VWP I.D. No.:_VWP-8____
Date of Installation: _8/1/2019_ Probe Serial No.: 1921442
Northing:_10599489.18________ Easting:__3357935.817______________
Well Driller Name and License Number __West Drilling_________________________

SCS Field Staff Supervising Installation:__Doug Steen______________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



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Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-8 (VWP-8)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/27/18 **COMPLETED** 11/28/18
GROUND ELEVATION 550.34ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
ft **GROUND WATER LEVELS:**
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
0							Clayey Silt, dark brown, firm, moist, with roots and organics		
1.5					CL-ML		(CL-ML) Silty Clay, gray to light gray, stiff to hard, moist to slightly moist, with white calcareous chalky material Trace of light gravel and orange-brown staining 6.5-10 feet	549.3	
5	ST1								
	SPT1								
10.0	ST2				CL-ML		(CL-ML) Silty Clay, orange-brown stained gray and brown, stiff to hard, slighty moist, calcareous, with white chalky material and silty gray interbeds	540.8	
15	ST3								
	SPT2								
20.0	ST4						Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous White chalky material and silty gray interbeds 20-25 feet	530.8	
25	ST5								
	SPT3								
30	ST6								
35							Crystalline material in joints/bedding 35-43.8 feet		

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GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:50 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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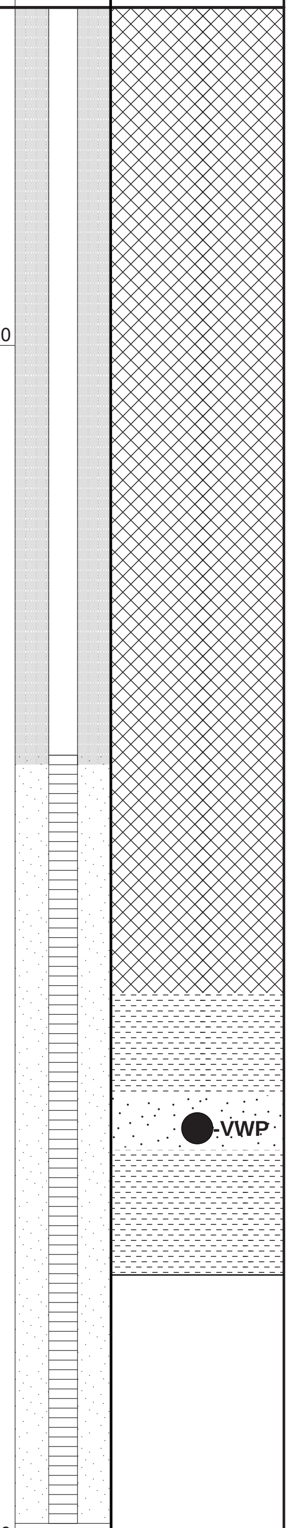
WELL NUMBER B-8 (VWP-8)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35	ST7						Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous
	SPT4						
40	ST8			Weathered to Unweathered zone			
43.8							507.0
							Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, with silty/micaceous lenses and fossil remnants in interbeds, unweathered Orange-brown staining 47-55 feet
45	ST9						
	SPT5						
50	ST10						
55	ST11						
60							
65	ST12						
70							
75 (75.0)							475.8

Bottom of borehole at 75.0 feet.

WELL DIAGRAM | VWP DIAGRAM

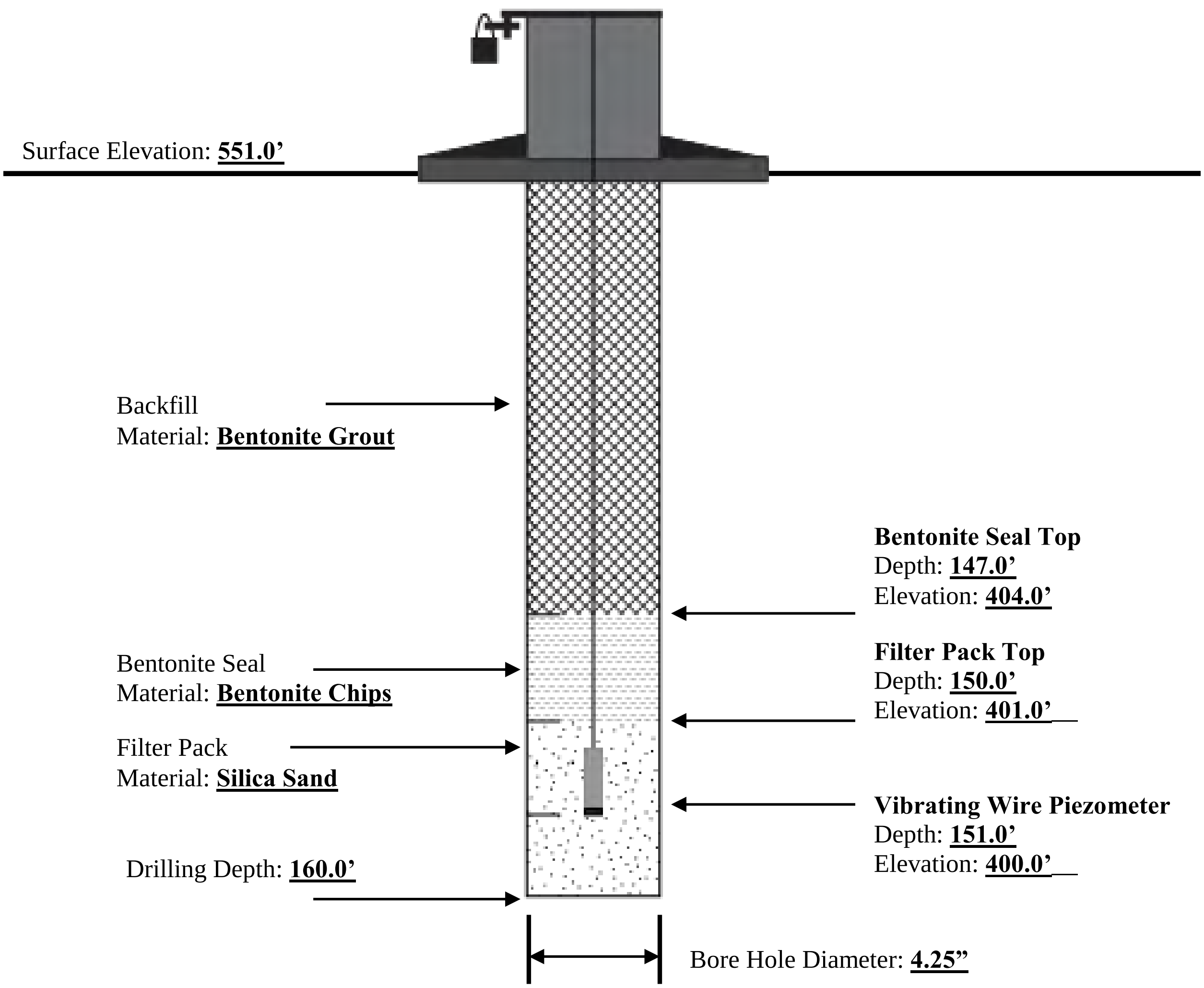


Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400____________________
County: __Limestone____ VWP I.D. No.:_VWP-8D_____
Date of Installation: _12/5/2019_ Probe Serial No.: 1943860
Northing: 10599489.18________ Easting:_3357935.817____________
Well Driller Name and License Number __West Drilling____________________

SCS Field Staff Supervising Installation:__Asher Boudreaux____________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'______________



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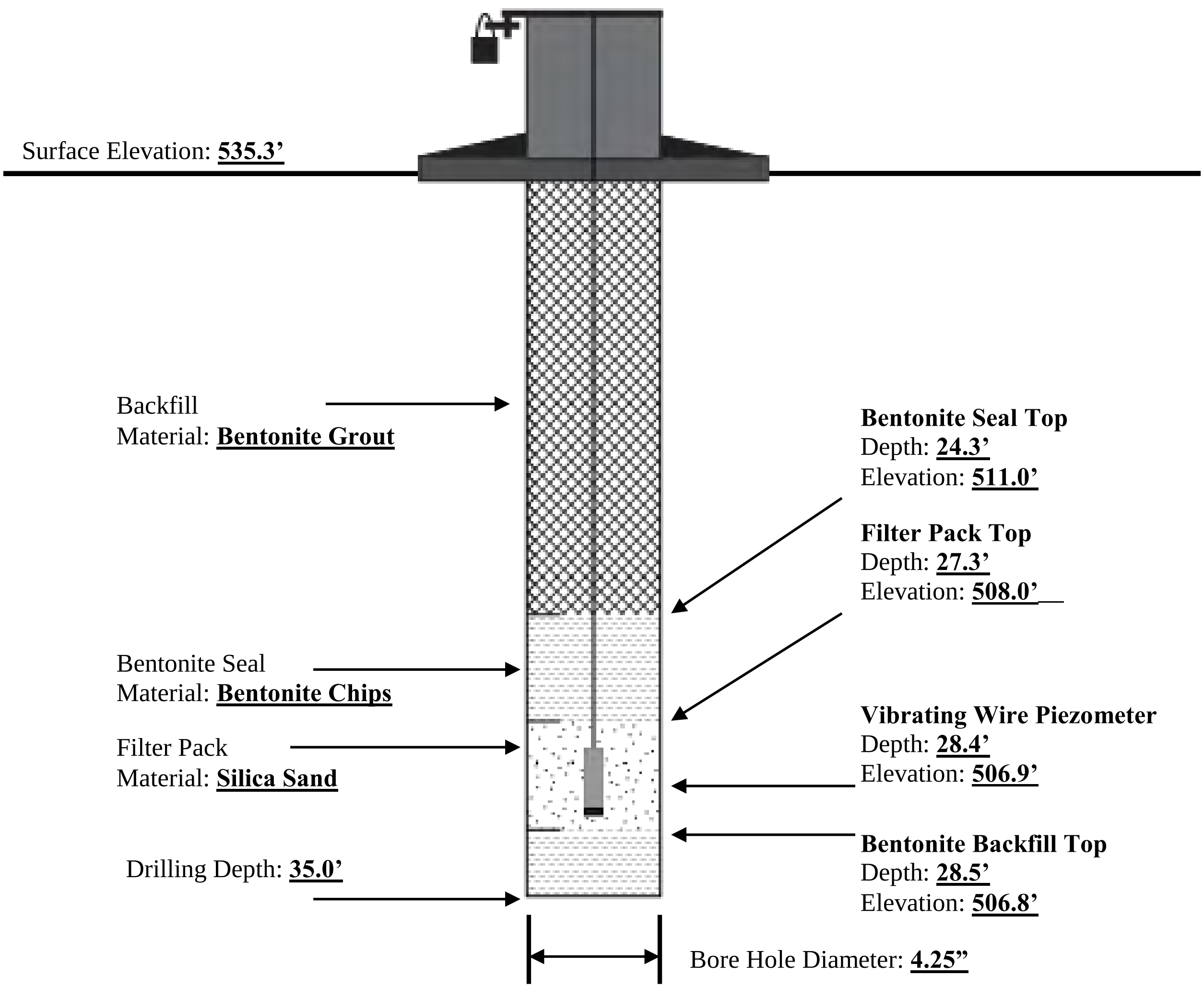
Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-9
Date of Installation: 8/2/2019
Probe Serial No.: 1921447
Northing: 10599314.37
Easting: 3355762.305
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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WELL NUMBER B-9 (VWP-9)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/9/18 **COMPLETED** 10/10/18
GROUND ELEVATION 535.30 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
▽ **AT TIME OF DRILLING** 25.10 ft / Elev 510.05 ft
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elev.
0–5				CL-ML	(CL-ML) Silty Clay, dark brown to gray, stiff, slightly moist to moist, organic rich, with limestone fragments and shells Color change to gray at 2.5 feet	5.0 / 530.2
5–10	ST1			CL-ML	(CL-ML) Silty Clay, light gray/tan mottled orange-brown, hard, slightly moist, with minor sub-round gravel	10.0 / 525.2
10–28.5	ST2, ST3, ST4, ST5		Weathered to Unweathered zone		Silty Clay Shale, gray and orange-brown mottled yellow-brown, hard, slightly moist to dry, calcareous, with trace of gravel Chalk/limestone in joints 15-20 feet Color change to orange-brown mottled gray at 20 feet Limestone lenses in fractures 25-28.5 feet ▽	28.5 / 506.7
28.5–35	ST6				Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-30 feet	

WELL DIAGRAM

VWP DIAGRAM

-VWP

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WELL NUMBER B-9 (VWP-9)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7					Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures		
40						40.0 495.2		

Bottom of borehole at 40.0 feet.

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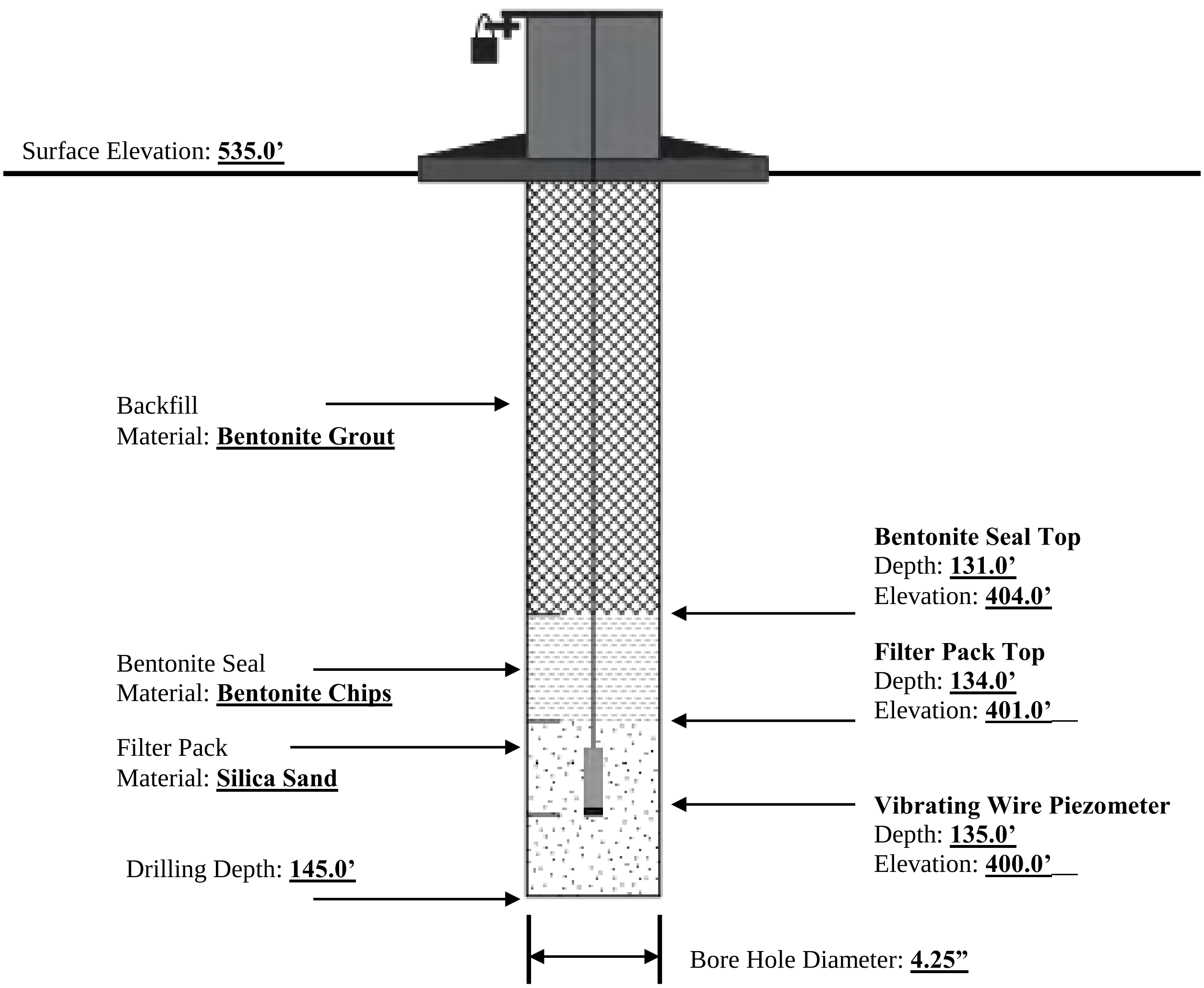
Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-9D
Date of Installation: 12/12/2019
Probe Serial No.: 1943862
Northing: 10599314.37
Easting: 3355762.305
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Asher Boudreaux
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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WELL NUMBER B-9 (VWP-9D)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/9/18 **COMPLETED** 12/13/19
GROUND ELEVATION 535.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling; West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING 25.10 ft / Elev 510.20 ft
LOGGED BY T. Derstine; A. Boudreaux **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elev.
0–5				CL-ML	(CL-ML) Silty Clay, dark brown to gray, stiff, slightly moist to moist, organic rich, with limestone fragments and shells Color change to gray at 2.5 feet	5.0 / 530.3
5–10	ST1			CL-ML	(CL-ML) Silty Clay, light gray/tan mottled orange-brown, hard, slightly moist, with minor sub-round gravel	10.0 / 525.3
10–28.5	ST2 ST3 ST4 ST ST5		Weathered to Unweathered zone		Silty Clay Shale, gray and orange-brown mottled yellow-brown, hard, slightly moist to dry, calcareous, with trace of gravel Chalk/limestone in joints 15-20 feet Color change to orange-brown mottled gray at 20 feet Limestone lenses in fractures 25-28.5 feet	28.5 / 506.8
28.5–35	ST6				Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet	

WELL DIAGRAM | VWP DIAGRAM

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WELL NUMBER B-9 (VWP-9D)

CLIENT City of Waco | **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 | **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7					Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures		
40					40.0	40-45' no sample recovery (495.3)		
45					45.0	Shale with minor, very fine sand. Dark gray, hard to very hard, damp to moist, well laminated (490.3)		
50								
55								
60						Shale with minor, very fine sand. Dark gray, hard to very hard, damp to moist, laminated		
65								
70								
75								

(Continued Next Page)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
75						75-80' small fossils present		
80						Becoming harder with depth		
85								
90						Fewer laminations with depth		
95								
100								
105								
110						Shale with minor, very fine sand. Dark gray, very hard, moist, trace lamination		
115								

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WELL NUMBER B-9 (VWP-9D)

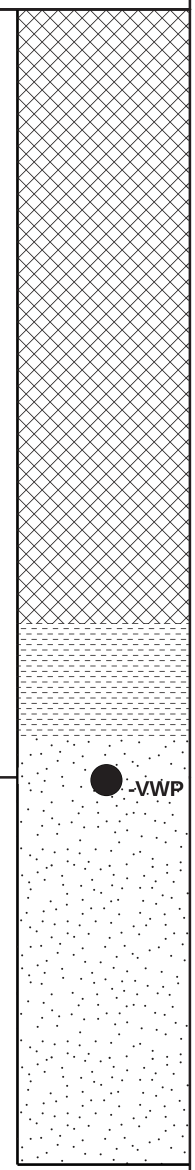
CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115							
120						Becoming harder with depth	
125						Fewer laminations with depth	
130						Shale with minor, very fine sand. Dark gray, very hard, moist, scarce lamination	
135						135.0 400.3	

Bottom of borehole at 135.0 feet.

VWP DIAGRAM

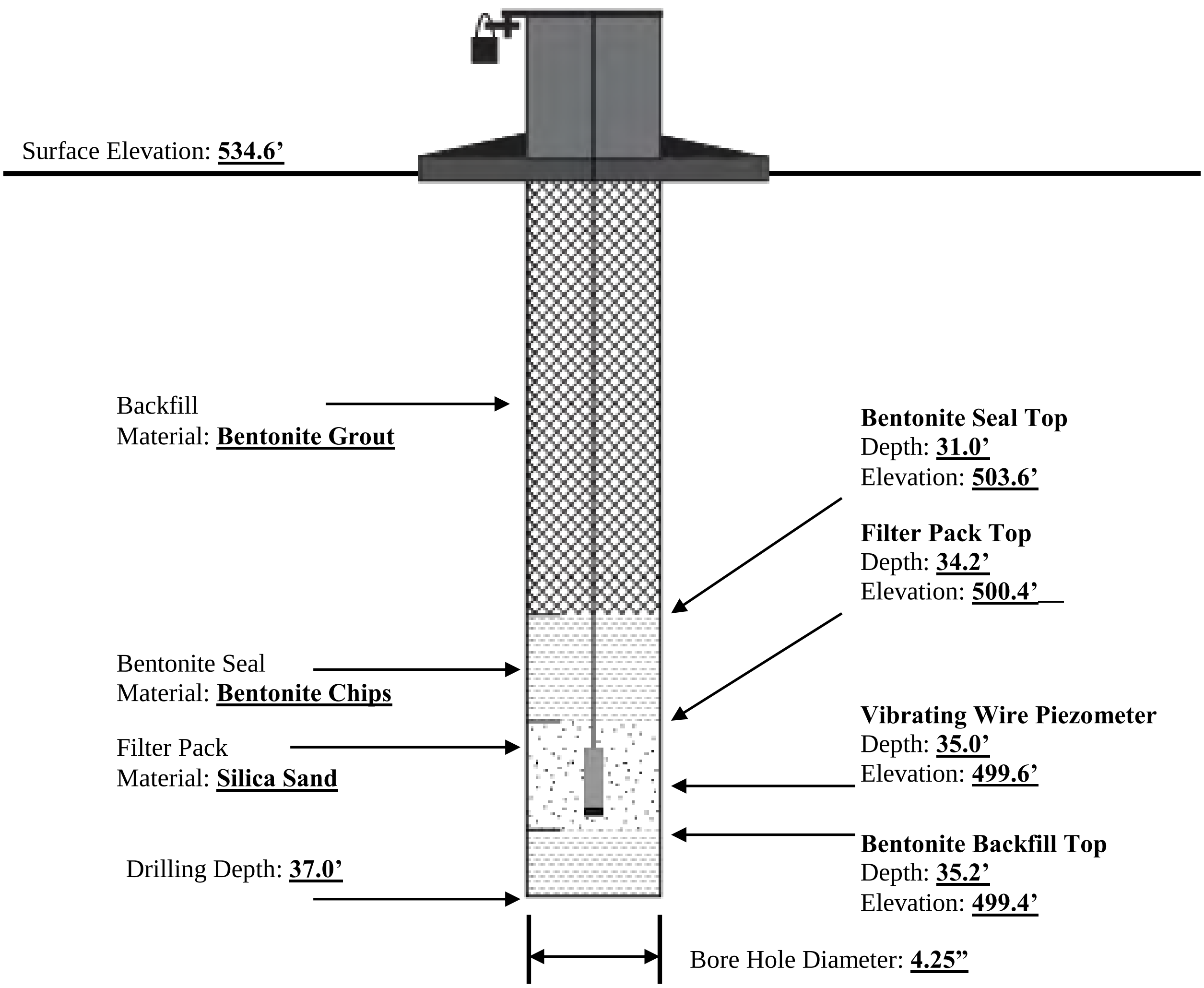


Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-18
Date of Installation: 7/25/2019
Probe Serial No.: 1921452
Northing: 10601254.04
Easting: 3356694.758
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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WELL NUMBER B-18 (VWP-18)

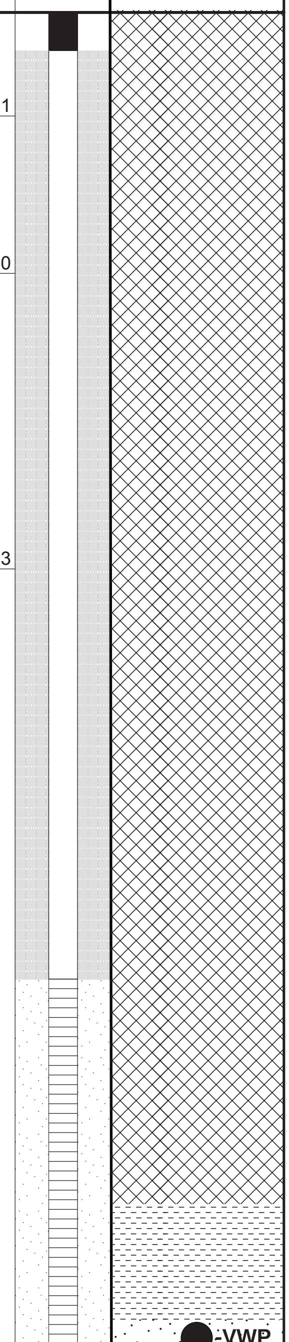
CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/30/18
GROUND ELEVATION 534.75 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0				CL-ML		(CL-ML) Silty Clay Topsoil, dark brown, soft to firm, moist, organic	
2.7				CL-ML		(CL-ML) Silty Clay, brown, firm to stiff, moist, with traces of small to medium gravel and chalk in fractures/joints	532.1
6.8				CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, calcareous Silty lenses in bedding 10-14.5 feet	528.0
14.5			Weathered to Unweathered zone			Silty Shale, gray, hard, slightly moist, calcareous, unweathered Slight orange-brown staining 14.5-30 feet Trace of shells 30-56 feet Silty lenses in bedding 30-35 feet	520.3

Samples: ST1 (approx. 5.5–7.5 ft), ST2 (approx. 10.5–12.5 ft), ST3 (approx. 15.5–17.5 ft), ST4 (approx. 20.5–22.5 ft), ST5 (approx. 25.5–27.5 ft)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

WELL DIAGRAM | VWP Diagram



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WELL NUMBER B-18 (VWP-18)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP Diagram
35						Silty Shale, gray, hard, slightly moist, calcareous, unweathered		
	ST6							
40								
45								
	ST7							
50								
55								
	ST8				56.0	478.8		

Bottom of borehole at 56.0 feet.

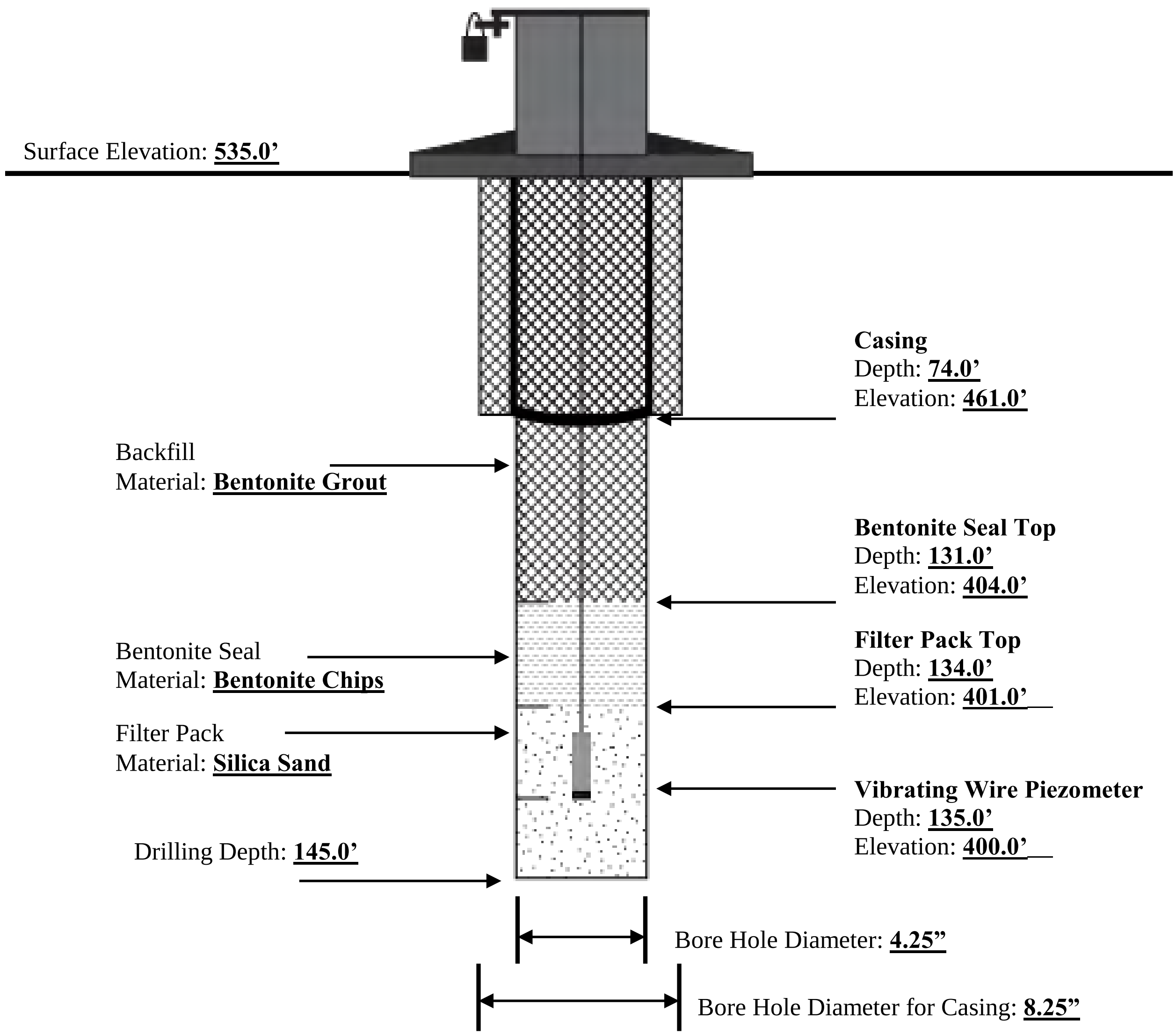
GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:51 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-18D
Date of Installation: 12/18/2019
Probe Serial No.: 1943861
Northing: 10601254.04
Easting: 3356694.758
Well Driller Name and License Number: West Drilling

SCS Field Staff Supervising Installation: Asher Boudreaux
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400_______________________

County: __Limestone____ VWP I.D. No.:_VWP-19____

Date of Installation: _7/25/2019_ Probe Serial No.: 1921454

Northing:_10601429.00________ Easting:__3357202.00_______________

Well Driller Name and License Number __West Drilling_____________________________

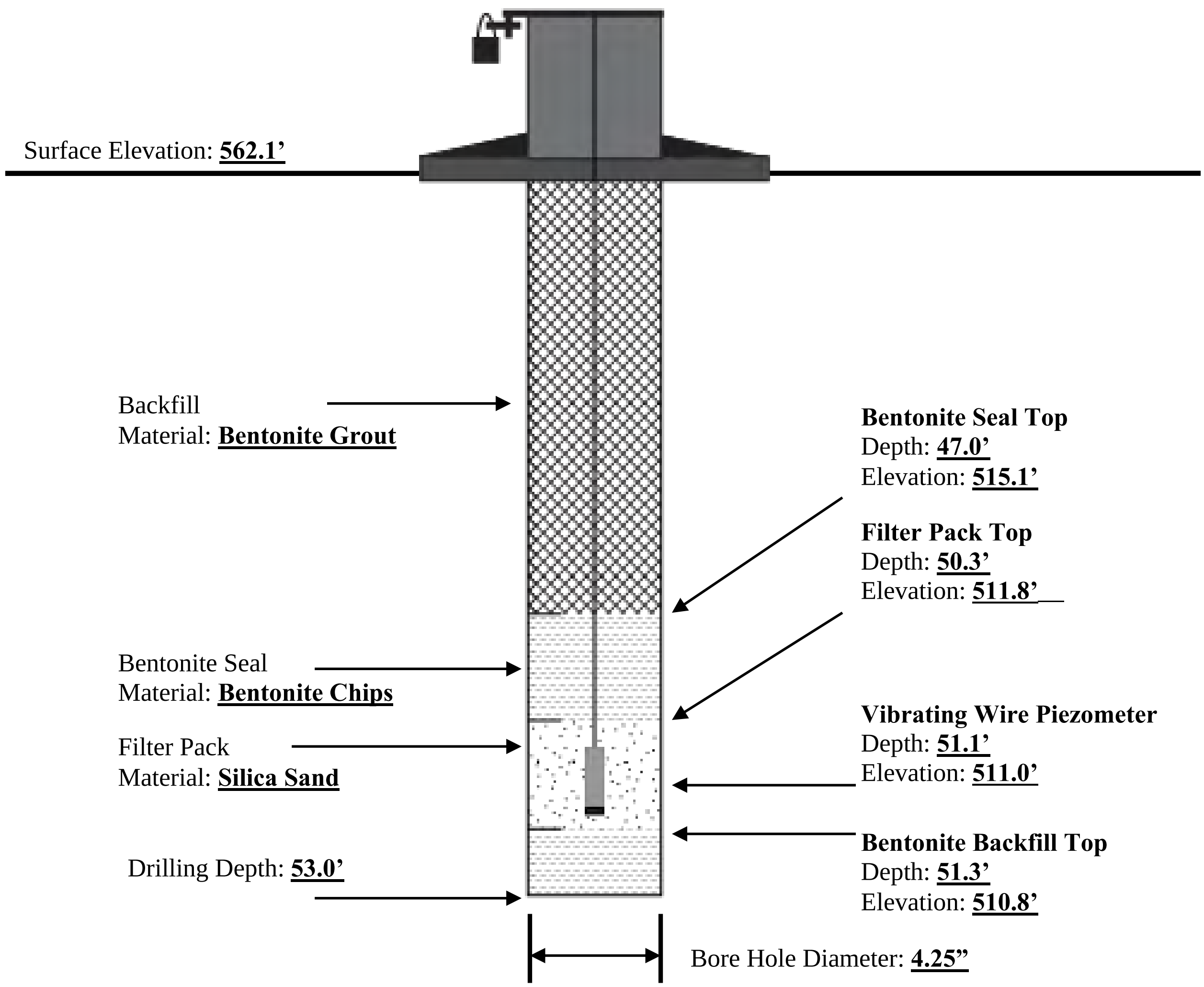
SCS Field Staff Supervising Installation:__Doug Steen___________________________

Static Water Level after Well Development:___N/A_____

Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___

Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



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BORING NUMBER B-19 (VWP-19)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/30/18 **COMPLETED** 10/30/18
GROUND ELEVATION 562.05 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	VWP Diagram
0				CL-ML		(CL-ML) Silty Clay, dark brown, soft, moist, calcareous	
4.0						558.1	
5				CL-ML		(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous Chalk in fractures/joints 4-20 feet	
	ST1						
10							
	ST2						
15						Very weathered zones 15-20 feet	
	ST3						
20							
	ST4						
25							
	ST5						
30							
	ST6						
35							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:51 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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BORING NUMBER B-19 (VWP-19)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	Depth / Elev.	MATERIAL DESCRIPTION	VWP Diagram
35	ST7			CL-ML		(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous	
40	ST8			CL	40.0 / 522.1	(CL) Clay, dark gray with orange to tan mottling, dry, hard, calcareous, with soft weathered shale zones	
45							
50	ST9				49.0 / 513.1	Silty Clay Shale, dark gray, hard, dry, calcareous, with chalk in joints/fractures, weathered	VWP
55			Weathered to Unweathered zone		53.0 / 509.1	Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet	
60	ST10						
65							
70	ST11						
75							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:51 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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Telephone: 817-571-2288

BORING NUMBER B-19

CLIENT City of Waco | **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 | **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
75						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet *(continued)*	
80	ST12						
85					87.0		475.1

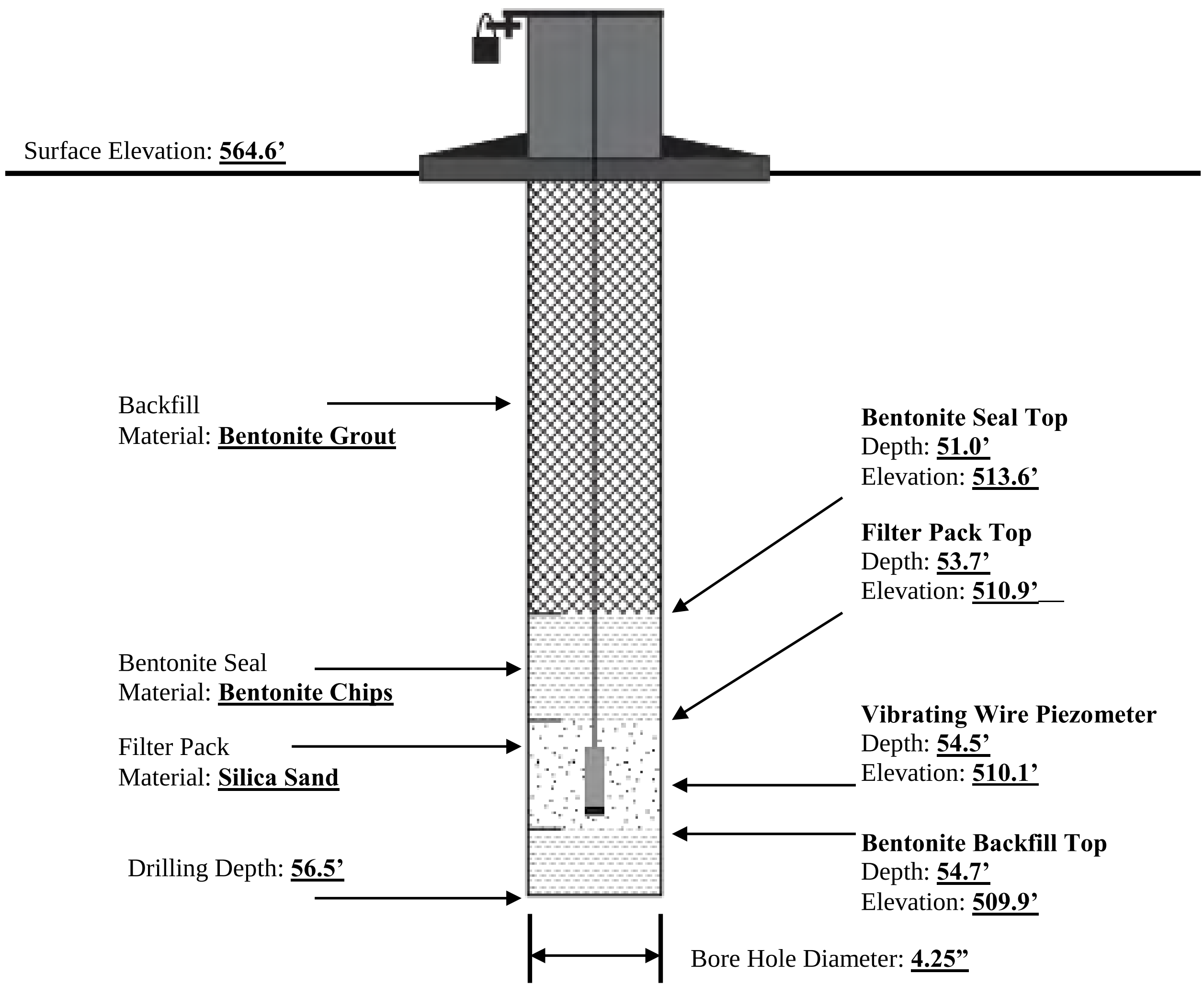
Bottom of borehole at 87.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-20
Date of Installation: 7/25/2019
Probe Serial No.: 1921440
Northing: 10601846.53 Easting: 3357666.42
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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Telephone: 817-571-2288

WELL NUMBER B-20 (VWP-20)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/29/18
GROUND ELEVATION 564.1 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 7.90 ft / Elev 556.20 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
0				CL-ML		(CL-ML) Silty Clay, gray mottled tan, hard, dry, with <1/8" pebbles and chalk in fractures/joints, calcareous		
5						5.0 ... 559.1		
5	ST1			CL-ML		(CL-ML) Silty Clay, tan/gray mottled orange, hard, dry, calcareous <1/8" pebbles 5-10 feet Chalk in joints/fractures 5-10 feet		
10	ST2							
15	ST3					Very unconsolidated/weathered 15-35 feet		
20	ST4							
25	ST5					Mineral deposits 24-25 feet		
30	ST6							
35						35.0 ... 529.1		

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WELL NUMBER B-20 (VWP-20)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7			CL		(CL) Clay, dark gray with orange/tan mottling, hard, dry, calcareous, with weathered shale Mineral deposits in fractures 25-35 feet		
40	ST8					43.0 — 521.1		
						Silty Clay Shale, dark gray, hard, dry, calcareous, weathered		
45	ST9		Weathered to Unweathered zone			47.0 — 517.1		
						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Orange-brown oxidation staining 50-55 feet Chalk/limestone in fractures 50-55 feet		
50								
55	ST10					No oxidation staining beginning at 57.5 feet		VWP
60								
65	ST11							
70						73.0 — 491.1		

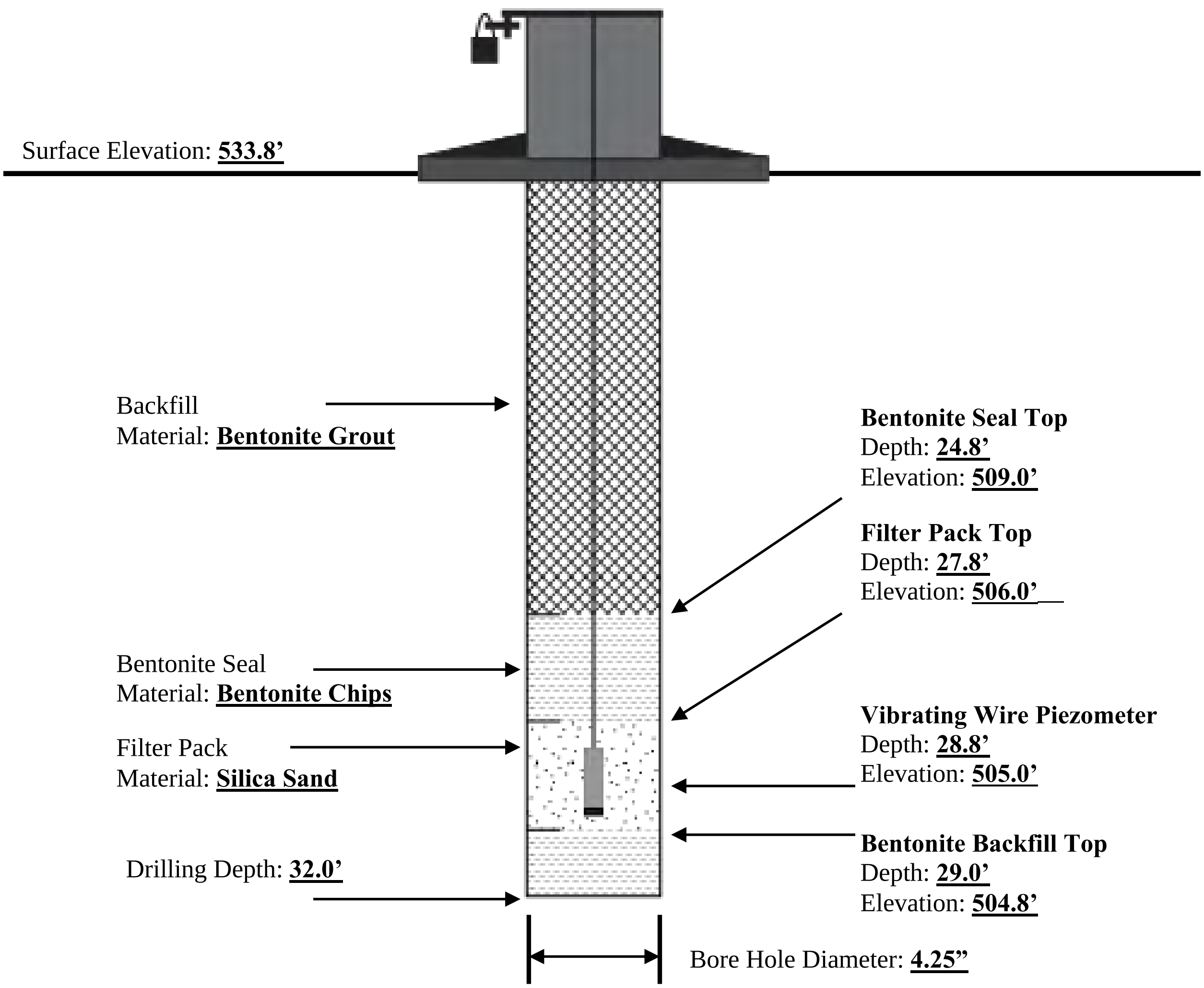
Bottom of borehole at 73.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400_______________________
County: __Limestone____ VWP I.D. No.:_VWP-25____
Date of Installation: _8/2/2019_ Probe Serial No.: 1921450
Northing:_10599102.9________ Easting:__3356251.06______________
Well Driller Name and License Number __West Drilling____________________________

SCS Field Staff Supervising Installation:__Doug Steen__________________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



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BORING NUMBER B-25 (VWP-25)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 533.25 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.	VWP Diagram
0–5.0				CL-ML	(CL-ML) Silty Clay, dark gray, soft to hard, slightly moist to dry, calcareous, with chalk in joints Color change to light gray 4-5 feet	528.3	
5.0–23.0	ST1, ST2, ST3, ST4			CL-ML	(CL-ML) Silty Clay, orange/gray/tan mottled, hard, slightly moist to dry, calcareous, with chalk in joints and sub-rounded pebbles 1/8" No pebbles 15-20 feet Silty Sand lenses in fractures 15-23 feet	510.3	
23.0–25.0				CL	(CL) Shaley Clay, dark gray, medium hard to soft, dry, calcareous, weathered	508.3	
25.0–33.0	ST5, ST6		Weathered to Unweathered zone		Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Intermittent weathered zones 25-33 feet	500.3	VWP

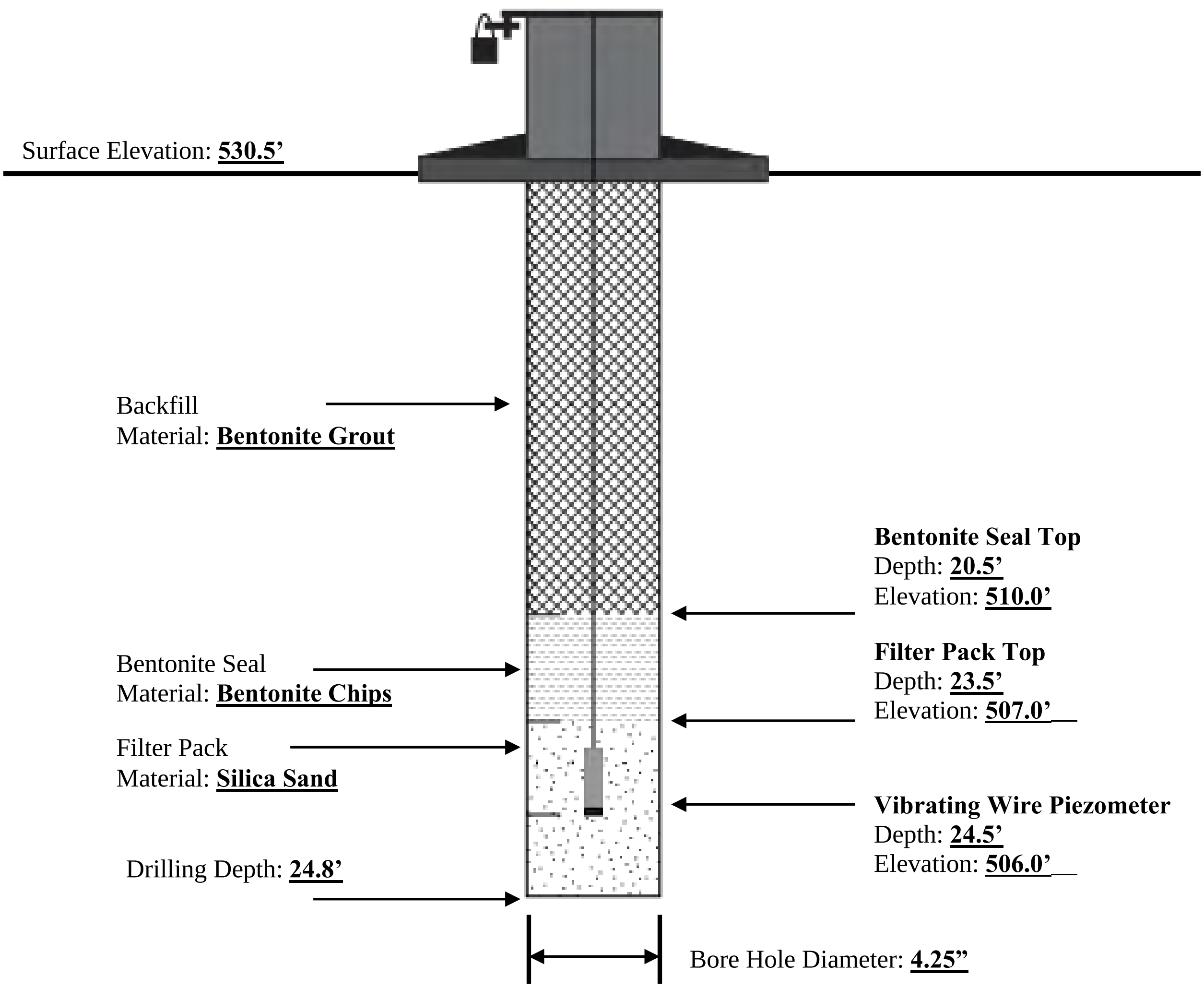
Bottom of borehole at 33.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-26
Date of Installation: 7/26/2019
Probe Serial No.: 1921453
Northing: 10599457.3
Easting: 3356929.04
Well Driller Name and License Number: West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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BORING NUMBER B-26 (VWP-26)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/18/18 **COMPLETED** 11/18/18
GROUND ELEVATION 530.45 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	VWP Diagram
0 – 1.4							Top Soil, black, soft, moist, with roots and small gravel (1.4 / 529.1)	
1.4 – 5.0					CL-ML		(CL-ML) Silty Clay, llight brown, hard, slightly moist, with small round to sub-rounded gravel up to 1/4", slightly calcareous (5.0 / 525.5)	
5.0 – 15.0	ST1, SPT1, ST2				CL-ML		(CL-ML) Silty Clay, tan to light brown mottled orange and gray, very hard, dry, slightly calcareous Orange staining 10-15 feet (15.0 / 515.5)	
15.0 – 20.0	ST3, SPT2				CL-ML		(CL-ML) Silty Clay, tan/brown with orange staining, hard to very hard, calcareous Color change to dark gray at 20 feet (20.0 / 510.5)	
20.0 – 26.0	ST4, ST5			Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, dark gray to gray with orange staining, very soft to very hard, dry, slightly to moderately calcareous Transition zone into weathered shale (26.0 / 504.5)	VWP
26.0 – 35	SPT3, ST6						Clay (Shale), dark gray, very soft to very hard, dry, with fossil remnants, slightly calcareous, unweathered Trace of orange staining 25-30 feet	

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BORING NUMBER B-26 (VWP-26)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							36.0 494.5

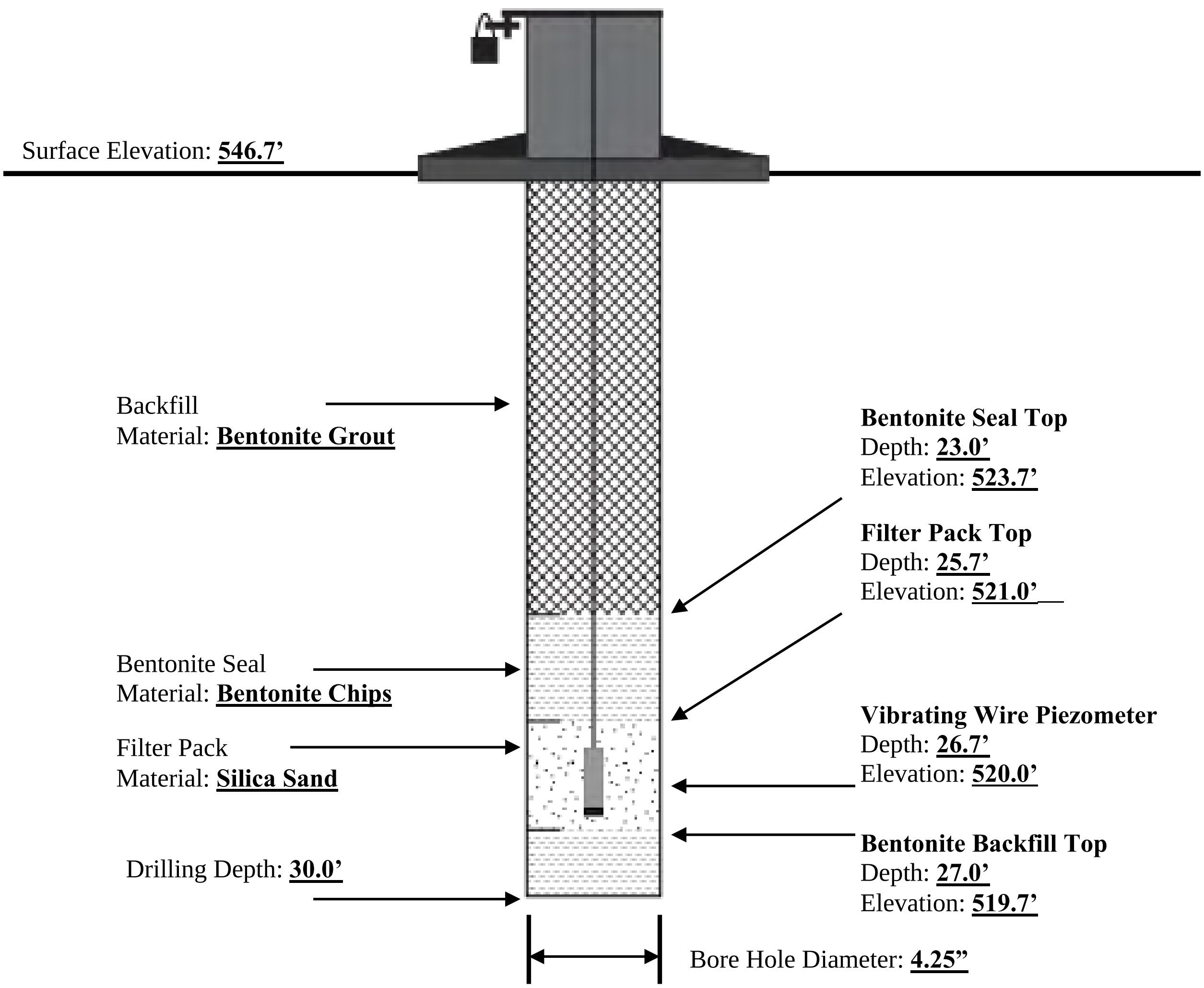
Bottom of borehole at 36.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400
County: __Limestone___ VWP I.D. No.:_VWP-27____
Date of Installation: _7/26/2019_ Probe Serial No.: 1921446
Northing:_10600427.7_______ Easting:__3358308.89_____________
Well Driller Name and License Number __West Drilling

SCS Field Staff Supervising Installation:__Doug Steen
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



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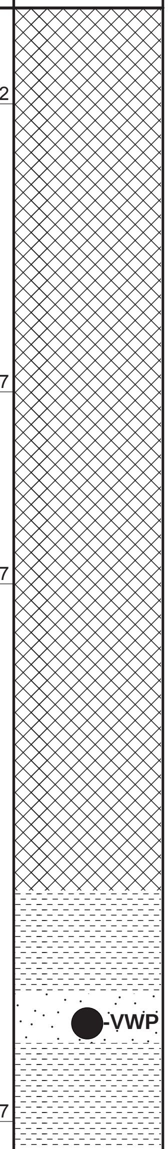
BORING NUMBER B-27 (VWP-27)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/14/18 **COMPLETED** 11/14/18
GROUND ELEVATION 546.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0 – 2.5					MH	(MH) Clayey Silt, dark brown, soft to firm, very moist, organic (2.5 / 544.2)
2.5 – 10.0	ST1				MH	(MH) Clayey Silt, brown, stiff to hard, moist to slightly moist, with white chalk and fossil fragments, calcareous (10.0 / 536.7)
10.0 – 15.0	ST2, SPT1				CL-ML	(CL-ML) Silty Clay, orange-brown mottled brown and gray, hard, slightly moist, calcareous (15.0 / 531.7)
15.0 – 29.0	ST3, SPT2, ST4, SPT3, ST5, SPT4			Weathered to Unweathered zone		Silty Shale, orange-brown mottled brown and light gray, hard, slightly moist, calcareous, weathered White crystalline lenses in interbeds 17.7-21.4 feet Orange-brown and crystalline in interbeds 25-29 feet (29.0 / 517.7)
29.0 – 35	SS5, ST6					Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered Orange-brown staining in joints/bedding 29-40 feet Occasional fossil fragments 33-38 feet Fossil fragments 40.8-53 feet

VWP Diagram



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BORING NUMBER B-27 (VWP-27)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered Orange-brown staining in joints/bedding 29-40 feet Occasional fossil fragments 33-38 feet Fossil fragments 40.8-53 feet *(continued)*
40	ST7						
	SPT6						
45							
50	ST8						
	SPT7						53.0 493.7

Bottom of borehole at 53.0 feet.

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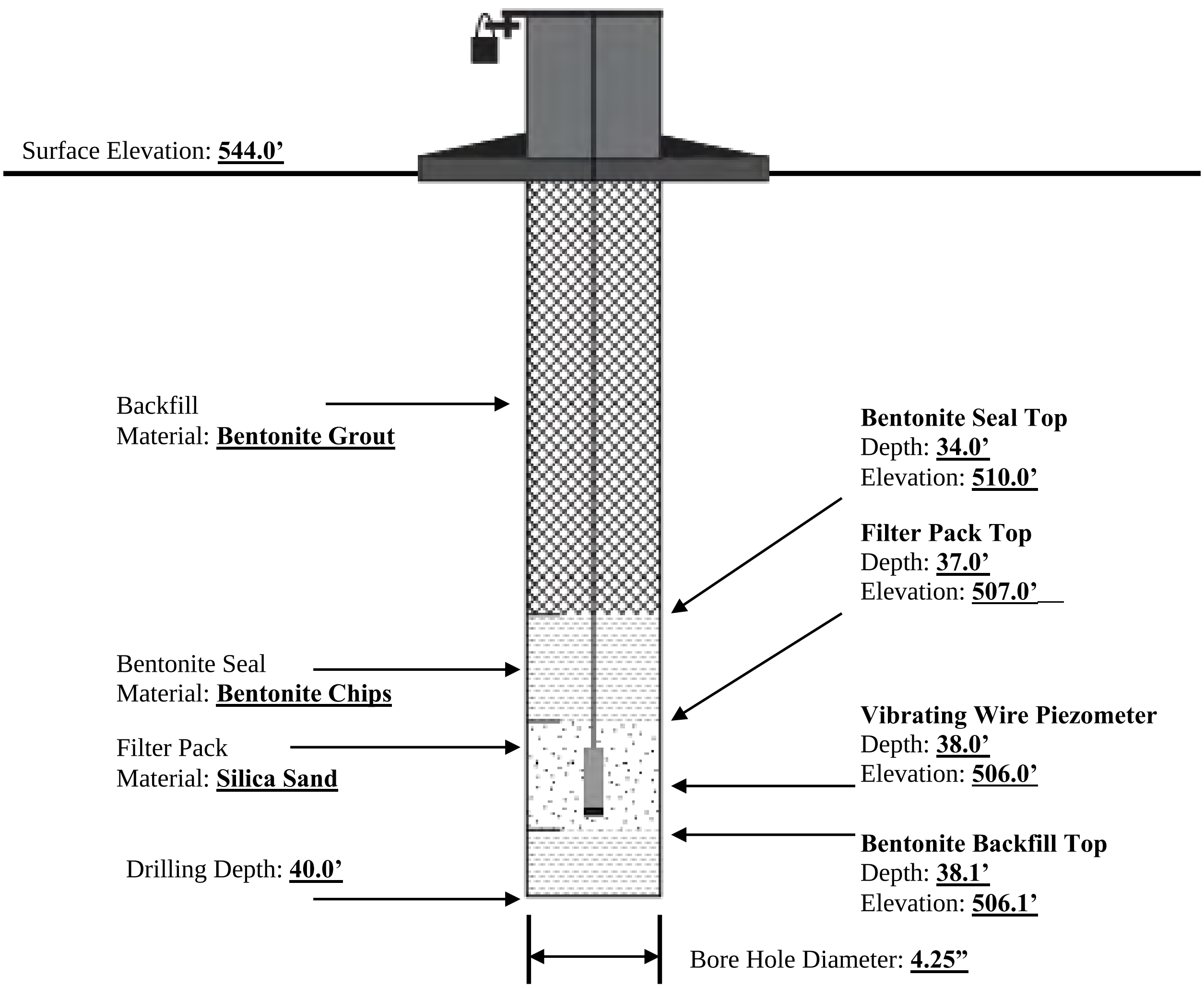
Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400______________________________
County: __Limestone____ VWP I.D. No.:_VWP-30____
Date of Installation: _7/26/2019_ Probe Serial No.: 1921451
Northing:_10598886.4________ Easting:__3357828.13_______________
Well Driller Name and License Number __West Drilling______________________________

SCS Field Staff Supervising Installation:__Doug Steen___________________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



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BORING NUMBER B-30 (VWP-30)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/17/18 **COMPLETED** 11/18/18
GROUND ELEVATION 543.05 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	VWP Diagram
0							Top Soil, dark brown to black, very soft, with organic material and silt	
2.0					CL-ML		(CL-ML) Silty Clay, gray, medium to very hard, slightly moist, with some round to sub-rounded pebles and chalky white material (541.1)	
5.0	ST1				CL-ML		(CL-ML) Silty Clay, gray mottled orange and brown, moderately hard, slightly moist, with some round to sub-rounded pebbles up to 1/2" and white chalky material, calcareous (538.1)	
	SPT1	57.6						
10.0	ST2	31.8			CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and orange, medium soft, slightly moist, with white chalky material, calcareous (533.1) Minor pebbles less than 1/8" 10-15 feet	
15	ST3						No pebbles or chalky white material 15-20 feet Turning gray 15-20 feet	
	SPT2							
20	ST4						Crystalline deposits and very hard 20-25 feet	
25.0	ST5				CL-ML		(CL-ML) Silty Clay, light brown/orange to gray, medium hard to very hard, dry, calcareous, weathered (518.1) Red-brown staining along fractures, medium soft to hard, and crystalline deposits 30-35 feet	
	SPT3							
30	ST6				CL-ML			
35								

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BORING NUMBER B-30 (VWP-30)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	VWP Diagram
35	ST7				CL-ML		37.3 — 505.8	
	SPT4						Silty Clay Shale Marl, gray to dark gray, very hard, dry, with orange-brown staining, calcareous unweathered	VWP
							Less orange staining 40-45 feet	
40	ST8							
45	ST9						Some orange mottling and hard to very hard 45-48 feet	
	SPT5						48.0 — 495.1	

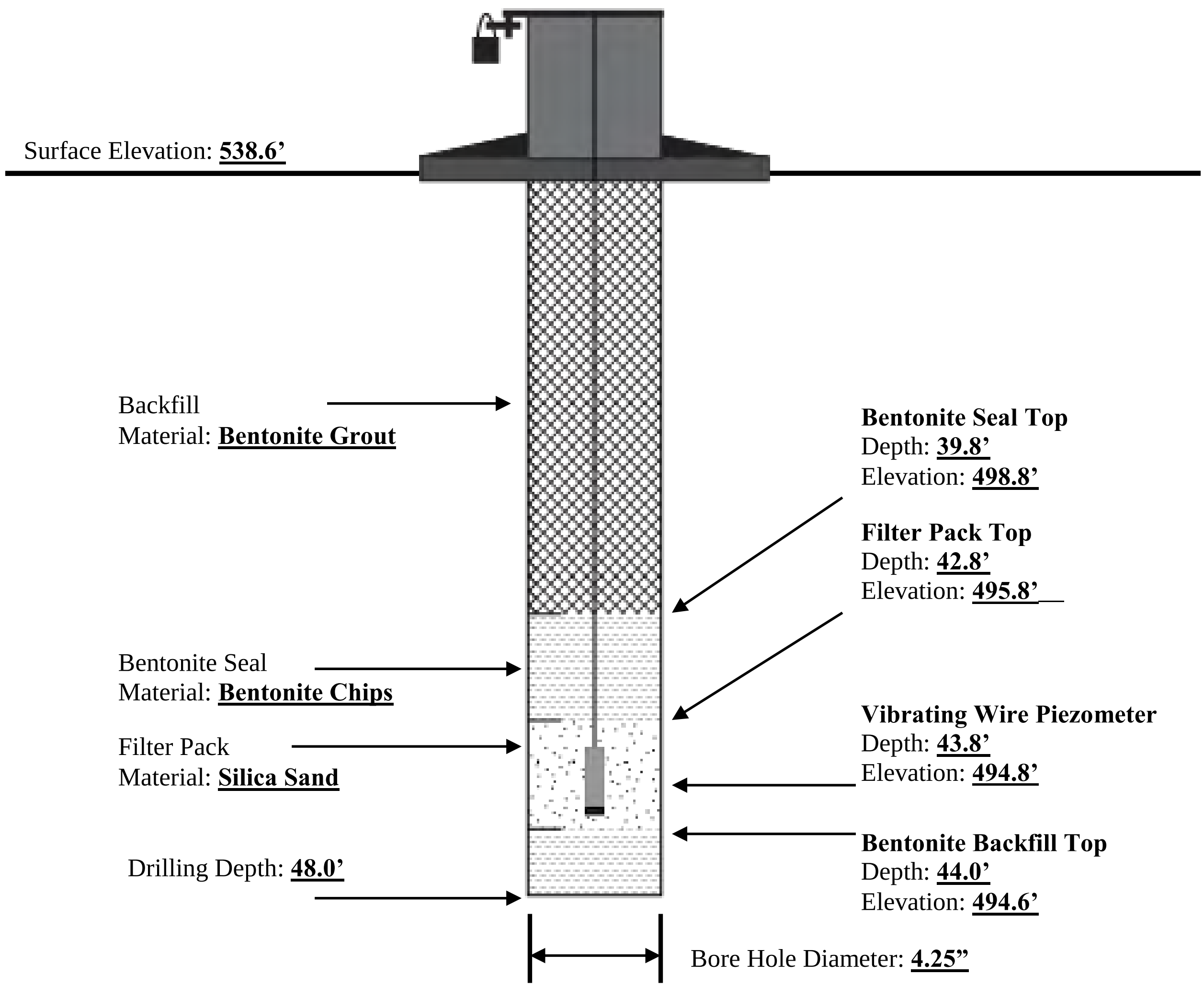
Bottom of borehole at 48.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone VWP I.D. No.: VWP-33
Date of Installation: 8/1/2019 Probe Serial No.: 1921439
Northing: 10598320.64 Easting: 3357774.619
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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WELL NUMBER B-33 (VWP-33)

CLIENT	City of Waco	**PROJECT NAME**	City of Waco Landfill MSW-2400
PROJECT NUMBER	16216088.00	**PROJECT LOCATION**	Waco, Texas
DATE STARTED	11/19/18 **COMPLETED** 11/20/18	**GROUND ELEVATION**	539.4 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR	BEST Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Continuous Flight Auger	**AT TIME OF DRILLING**	--- No Groundwater
LOGGED BY	T. Derstine **CHECKED BY** J. Lawrence	**AT END OF DRILLING**	--- No Groundwater
NOTES		**AFTER DRILLING**	--- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
0–1.5						1.5	Clayey Silt Topsoil, dark brown, soft to firm, moist, with roots and organics (537.9)		
1.5–15.0	ST1, SPT1, ST2, SPT2				CL-ML	15.0	(CL-ML) Silty Clay, orange-brown mottled brown/tan, hard, moist to slightly moist, with white chalky material, calcareous Silty/micaceous interbeds 5-15 feet (524.4)		
15.0–28.0	ST3, ST4, ST5, SPT3				CL-ML	28.0	(CL-ML) Silty Clay, orange-brown mottled brown and light gray, hard, slightly moist, with black iron staining, fossil remnants, and silty/micaceous interbeds, calcareous Weathered shale marl transition zone and mostly gray color at 25 feet (511.4)		
28.0–30.0				Weathered to Unweathered zone	CL-ML	30.0	(CL-ML) Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, unweathered Orange-brown staining at 28.2 and 29.7 feet (509.4)		
30.0–35	ST6						Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered		

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WELL NUMBER B-33 (VWP-33)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7						Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered *(continued)*		
	SPT4								
40									
									VWP
45	ST8								
	SPT5								
50									
55							55.0	484.4	

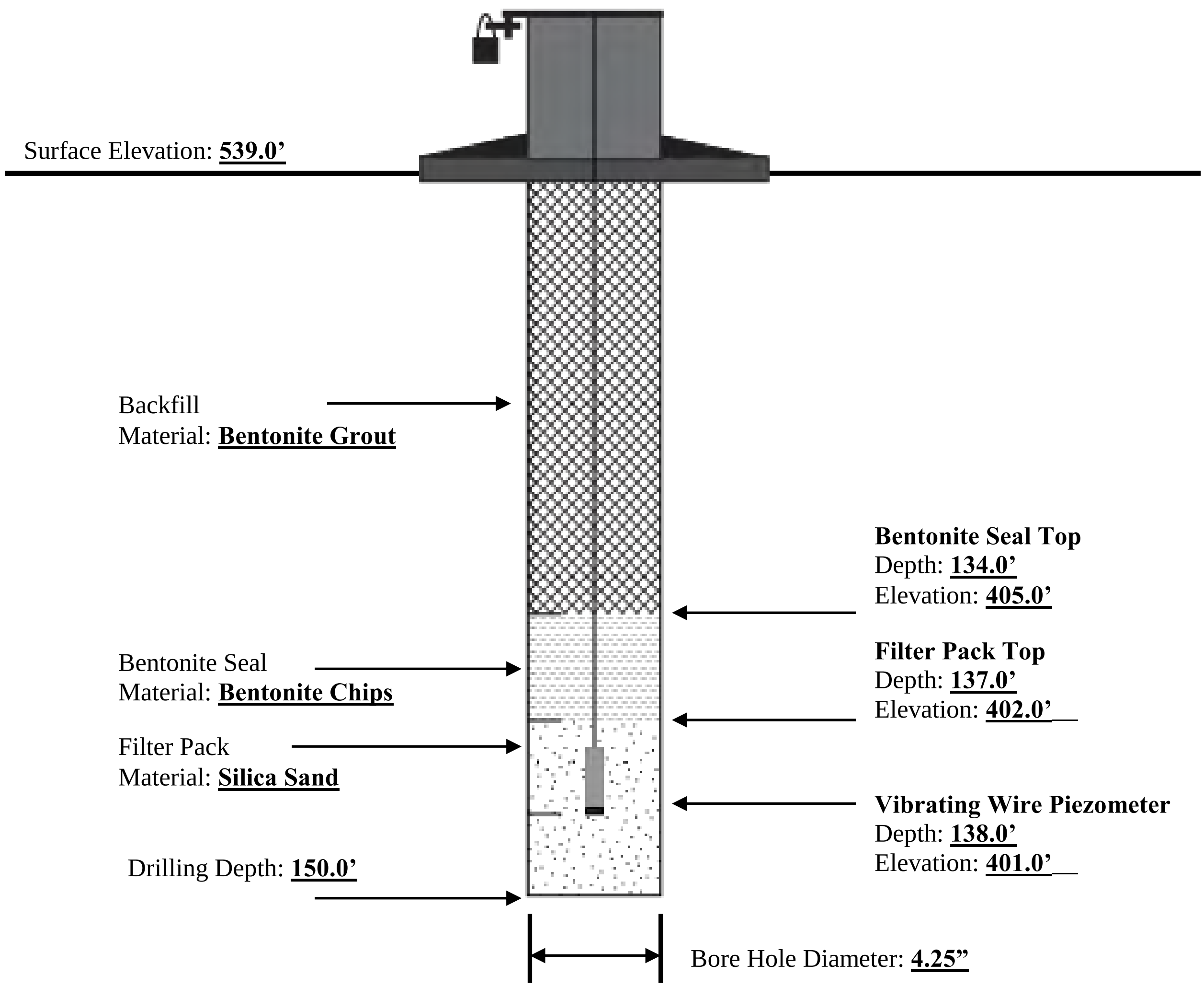
Bottom of borehole at 55.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone — VWP I.D. No.: VWP-33D
Date of Installation: 12/4/2019 — Probe Serial No.: 1943866
Northing: 10598320.64 — Easting: 3357774.619
Well Driller Name and License Number: West Drilling

SCS Field Staff Supervising Installation: Asher Boudreaux
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock — Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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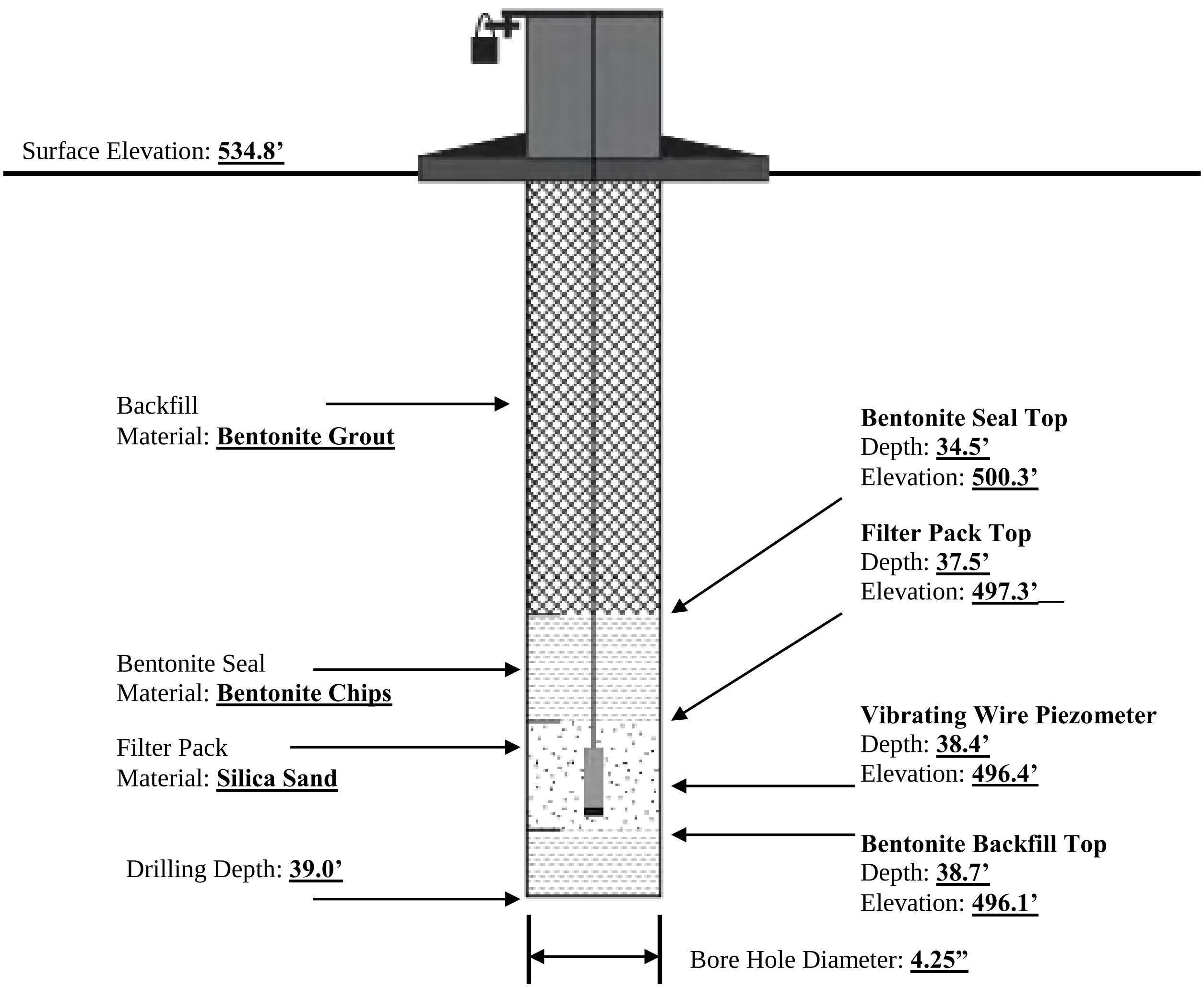
Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone — VWP I.D. No.: VWP-41
Date of Installation: 7/26/2019 — Probe Serial No.: 1921443
Northing: 10599450.64 — Easting: 3359083.912
Well Driller Name and License Number: West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock — Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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WELL NUMBER B-41 (VWP-41)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/17/18 **COMPLETED** 12/18/18
GROUND ELEVATION 535 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
0 – 5.0				CL-ML		(CL-ML) Silty Clay, dark brown to gray, soft to stiff, moist to very moist, with a trace of gravel and roots/organics	530.0	
5.0 – 12.0				CL-ML		(CL-ML) Silty Clay, gray grading to brown and orange-brown stained, stiff, moist, with trace of small to large sub-rounded gravel and white chalky material Color change to orange-brown stained brown at 10 feet	523.0	
12.0 – 29.0				CL-ML		(CL-ML) Silty Clay Shale Marl, orange-brown stained brown and gray, stiff to hard, moist, with white crystalline lenses in bedding, calcareous	506.0	
29.0 – 35						Shale Marl, dark gray with orange-brown staining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet		

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WELL NUMBER B-41 (VWP-41)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35						Shale Marl, dark gray with orange-brown staining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet *(continued)*		VWP
40			Weathered to Unweathered zone					
43.0						492.0 Shale Marl, gray to dark gray, hard, slightly moist, with lighter limey/silty lenses, fossil remnants, and crystalline areas, unweathered		
45								
50								
55								
60						60.0 — 475.0		

Bottom of borehole at 60.0 feet.

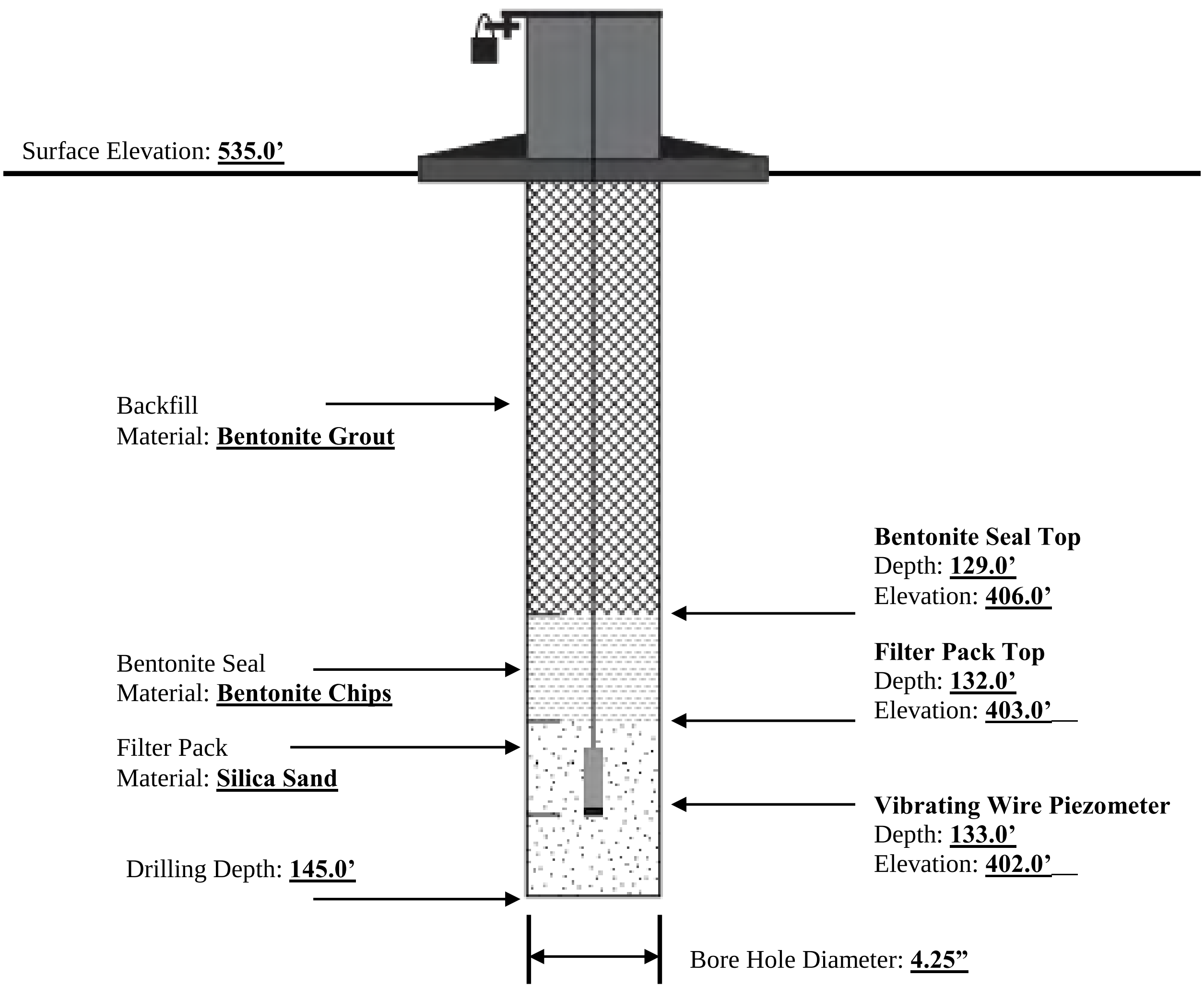
GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/4/19 15:51 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-41D
Date of Installation: 10/7/2019
Probe Serial No.: 1933662
Northing: 10599450.64 Easting: 3359083.912
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Tyson Milbrand
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



SCS ENGINEERS

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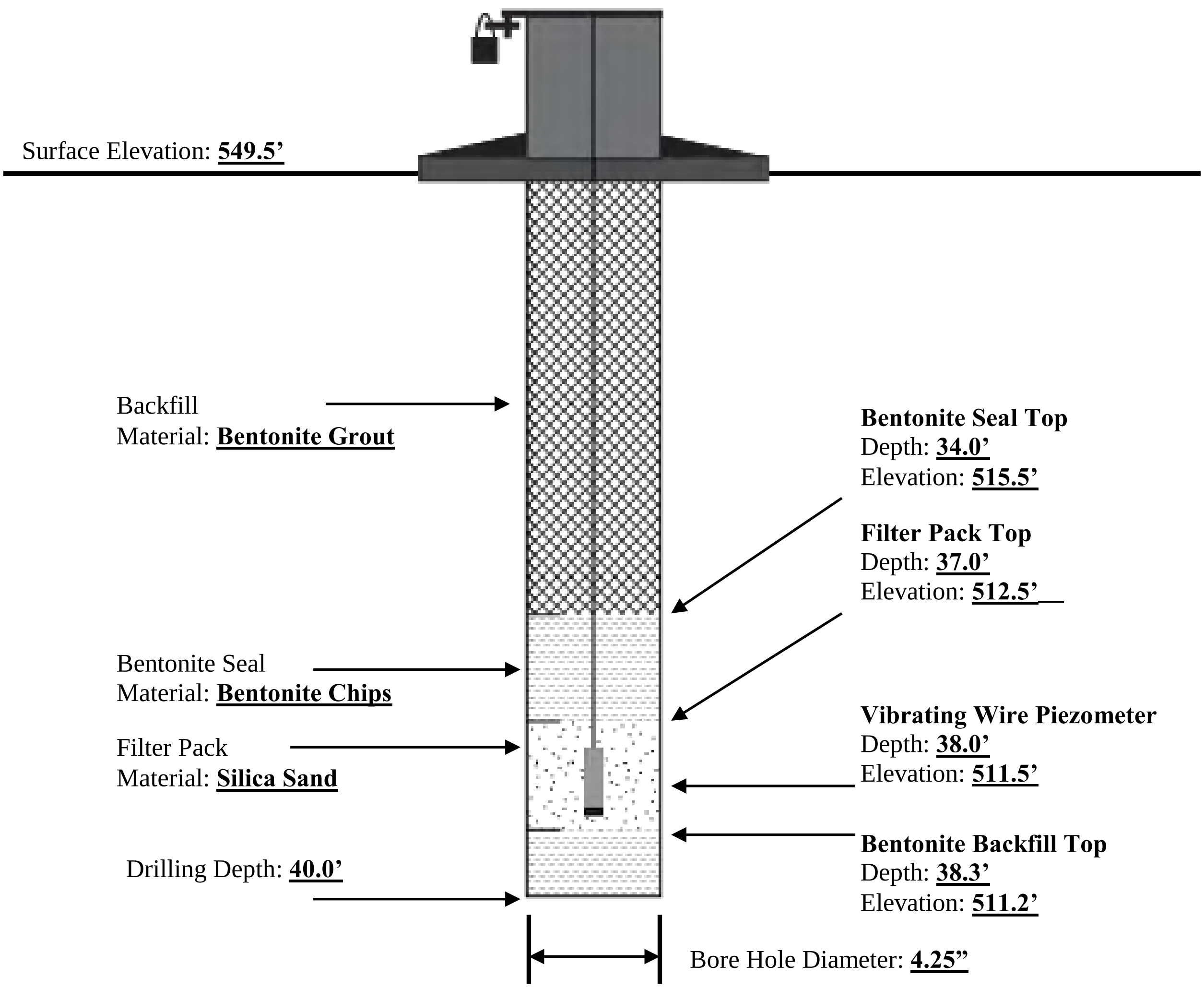
Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-43
Date of Installation: 7/26/2019
Probe Serial No.: 1921441
Northing: 10600433.69
Easting: 3358875.537
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



SCS ENGINEERS

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-43 (VWP-43)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/15/18 **COMPLETED** 11/16/18
GROUND ELEVATION 549.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
0 – 1.0					MH		(MH) Clayey Silt, dark brown, soft, very moist, with trace of gravel and organics (548.7)		
1.0 – 5.0					CL-ML		(CL-ML) Silty Clay, dark brown, hard, moist, with trace of gravel and organics (544.7)		
5.0 – 10.0	ST1 SPT1				CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, with white chalky material in interbeds, calcareous (539.7)		
10.0 – 25.0	ST2 ST3 SPT2 ST4				CL-ML		(CL-ML) Silty Clay (weathered shale/marl), orange-brown stained light gray and brown, stiff to hard, slightly moist, calcareous, weathered White chalky material in interbeds 10-16 feet Black iron staining in joints/interbeds 20-24 feet Weathered to unweathered transition at 25 feet (524.7)		
25.0 – 32.0	ST5 SPT3 ST6			Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, (shale/marl) gray with some orange-brown staining, hard, calcareous, with white fossil remnants (517.7)		

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

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-
1901 Central Drive STE 550
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Telephone: 817-571-2288

WELL NUMBER B-43 (VWP-43)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7						Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered		
							Occasional orange-brown staining and fossil remnants in beds 32-43 feet		VWP
40	ST8						White crystalline material in bedding/joints at 35 feet		
45	ST9						Micaceous interbeds and traces of fossil remnants 45-70 feet *(continued)*		
	SPT4								
50									
55	ST10								
	SPT5								
60									
65	ST11								
70									
75							75.0 — 474.7		

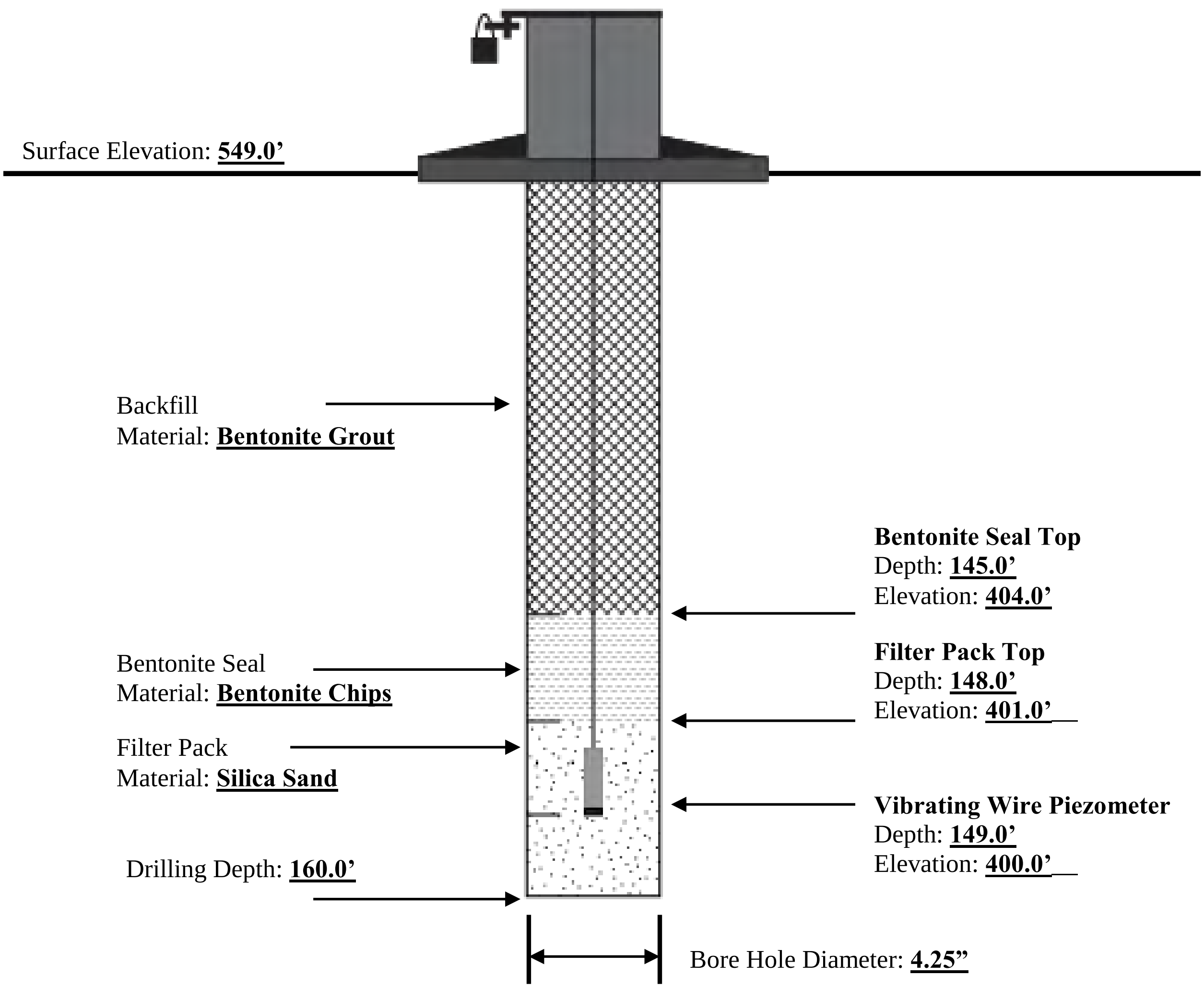
Bottom of borehole at 75.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400_
County: __Limestone__ VWP I.D. No.:_VWP-43D_
Date of Installation: _12/3/2019_ Probe Serial No.: 1943859
Northing:_10600433.69_ Easting:__3358875.537_
Well Driller Name and License Number __West Drilling_

SCS Field Staff Supervising Installation:__Asher Boudreaux_
Static Water Level after Well Development:___N/A_
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_ Type of Case Protection:___Aluminum_
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_



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SCS ENGINEERS

SCS Engineers
1901 Central Dr
Ste. 550
Bedford, TX 76021

WELL NUMBER B-43 (VWP-43D)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DATE STARTED 11/15/18 **COMPLETED** 12/17/19

GROUND ELEVATION 548.86 ft **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR BEST Drilling; West Drilling

GROUND WATER LEVELS:

DRILLING METHOD Continuous Flight Auger

AT TIME OF DRILLING --- No Groundwater

LOGGED BY T. Derstine; A. Boudreaux **CHECKED BY** J. Lawrence

AT END OF DRILLING --- No Groundwater

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0–1.0					MH	(MH) Clayey Silt, dark brown, soft, very moist, with trace of gravel and organics	547.9
1.0–5.0					CL-ML	(CL-ML) Silty Clay, dark brown, hard, moist, with trace of gravel and organics	543.9
5.0–10.0	ST1, SPT1				CL-ML	(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, with white chalky material in interbeds, calcareous	538.9
10.0–25.0	ST2, ST3, SPT2, ST4				CL-ML	(CL-ML) Silty Clay (weathered shale/marl), orange-brown stained light gray and brown, stiff to hard, slightly moist, calcareous, weathered White chalky material in interbeds 10-16 feet Black iron staining in joints/interbeds 20-24 feet Weathered to unweathered transition at 25 feet	523.9
25.0–32.0	ST5, SPT3, ST6			Weathered to Unweathered zone	CL-ML	(CL-ML) Silty Clay, (shale/marl) gray with some orange-brown staining, hard, calcareous, with white fossil remnants	516.9

WELL DIAGRAM | VWP DIAGRAM

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/5/20 12:11 - L:\VALERIE\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35	ST7						Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered Occasional orange-brown staining and fossil remnants in beds 32-43 feet White crystalline material in bedding/joints at 35 feet Micaceous interbeds and traces of fossil remnants 45-70 feet		
40	ST8								
45	ST9								
	SPT4								
50									
55	ST10								
	SPT5								
60									
65	ST11								
70									
75							75.0	473.9	

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CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
75							Shale with minor, very fine sand to silt. Dark gray, very hard, moist, laminated Few, small fossils		
80							Becoming harder with depth Fewer laminations with depth 80-85' very small mica flakes		
85							85-95' some fossils		
90									
95									
100									
105									
110							Large bivalve fossil @ 110' Shale with minor, very fine sand. Dark gray, very hard, moist, trace lamination		
115									

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/5/20 12:11 - L:\VALERIE\BENTLEY\GINT\PROJECTS\SITE 50 WACO.GPJ

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CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
115							Shale with minor, very fine sand to silt. Dark gray, very hard, moist, laminated		
120							Becoming harder with depth		
125							Trace sands transitioning to no sands below 125'		
130							Scarce laminations		
135							Featureless		
140									
145							Shale. Dark gray, very hard, moist, no lamination		
150							150.0 398.9		-VWP

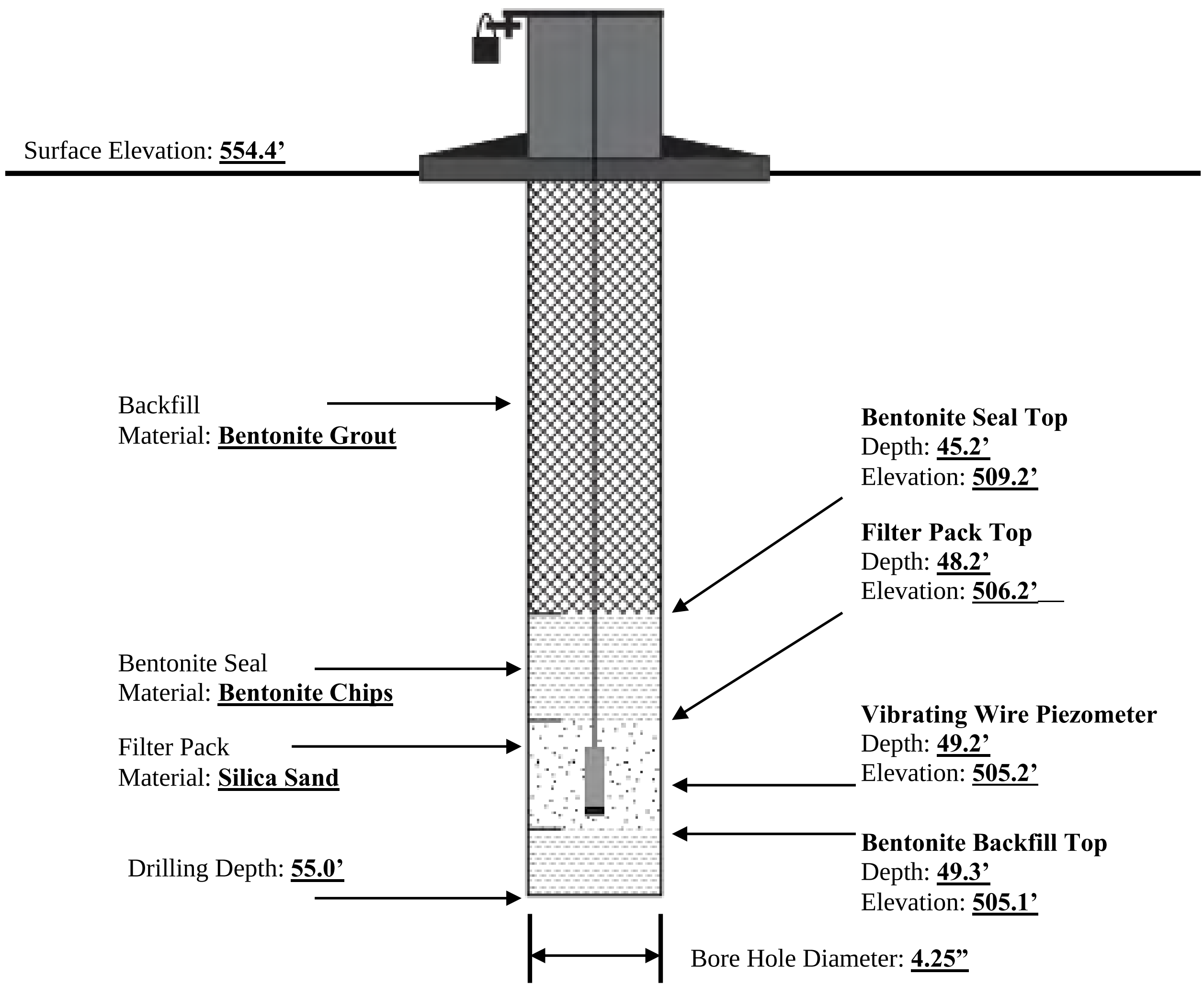
Bottom of borehole at 150.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: _Waco 2400______________________
County: __Limestone___ VWP I.D. No.:_VWP-44____
Date of Installation: _8/1/2019_ Probe Serial No.: 1921448
Northing:_10599103.1_______ Easting:_3354540.62_______________
Well Driller Name and License Number __West Drilling____________________________

SCS Field Staff Supervising Installation:__Doug Steen___________________________
Static Water Level after Well Development:___N/A_____
Name of Geologic Formation(s) in which Well is completed:___Wolfe City Formation_

Type of Locking Device:_____Pad Lock_______ Type of Case Protection:___Aluminum___
Concrete Surface Pad (with steel reinforcement) Dimensions:__6'X6'_______________



SCS ENGINEERS

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and Maps\Appendices\Appendix III-4.__ Vibrating Wire Piezometer Completion Data.pdf

SCS ENGINEERS

1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

BORING NUMBER B-44 (VWP-44)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 551.2 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	VWP Diagram
0				CL		(CL) Clay, dark brown to black, hard, moist, non-calcareous Calcareous 4-5 feet.	
5	ST1			CL-ML		5.0 / 546.2 (CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous	
10	ST2						
15	ST3					No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet	
20	ST4						
25	ST5						
30	ST6						
35							

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1901 Central Drive STE 550
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Telephone: 817-571-2288

BORING NUMBER B-44 (VWP-44)

CLIENT City of Waco

PROJECT NAME City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00

PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION		VWP Diagram
35	ST7		Weathered to Unweathered zone	CL-ML			(CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet *(continued)*		
						39.5	Shaley Clay, dark gray, hard, dry, slightly calcareous, weathered	511.7	
40	ST8					41.0	Silty Clay Shale, dark gray, hard, dry, calcareous, with limestone intrusions in fractures	510.2	
45	ST9								
50	ST10								VWP
55							No limestone intrusions in fractures 55-76 feet		
60	ST11								
65							Interbedded heavily weathered zones 65-76 feet		
70	ST12								
75									

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1901 Central Drive STE 550
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Telephone: 817-571-2288

BORING NUMBER B-44 (VWP-44)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

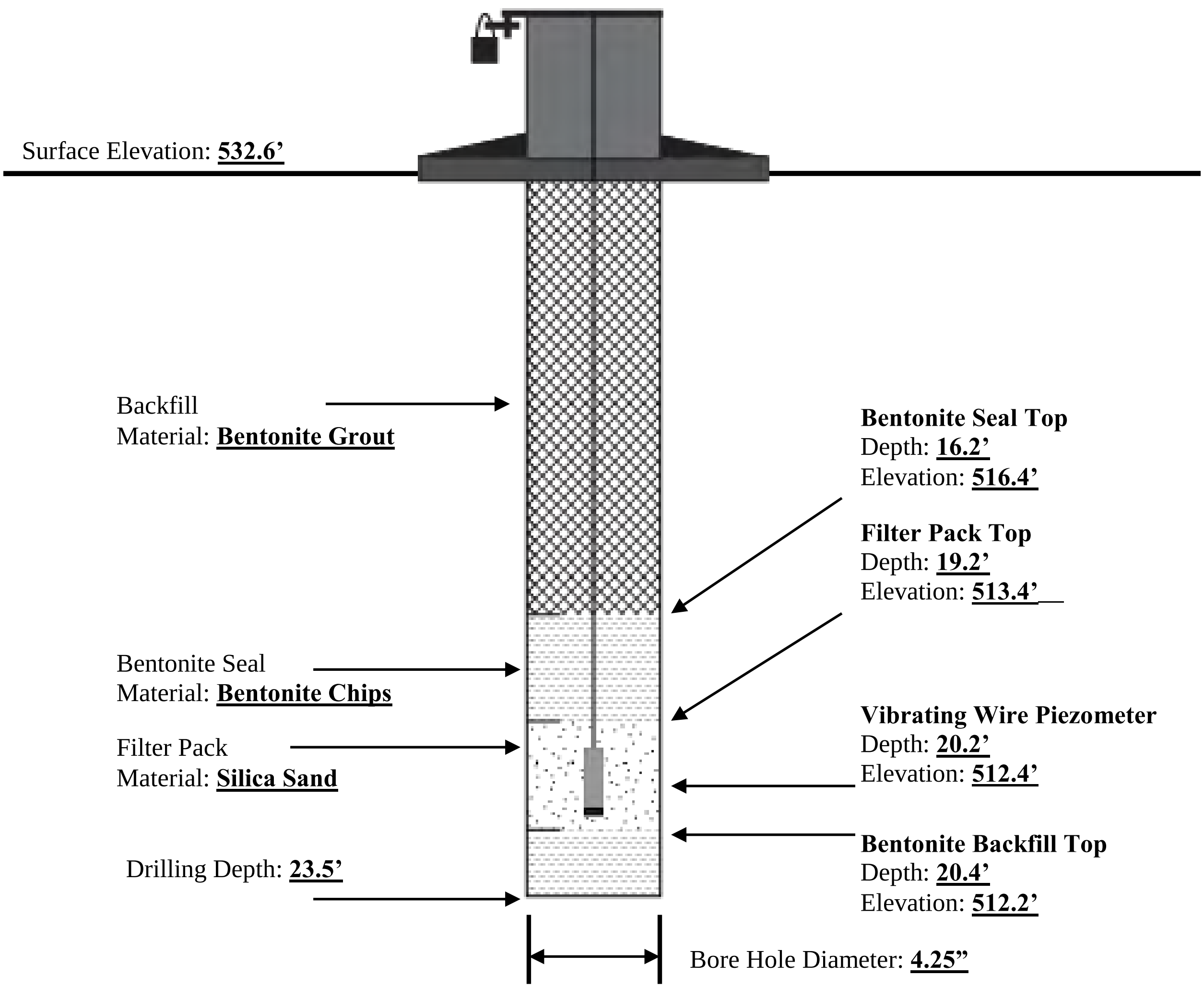
DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75	ST13					76.0 — 475.2
						Bottom of borehole at 76.0 feet.

Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone — VWP I.D. No.: VWP-47
Date of Installation: 8/2/2019 — Probe Serial No.: 1921449
Northing: 10598701.96 Easting: 3356561.53
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Doug Steen
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



SCS ENGINEERS

SCS ENGINEERS
1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

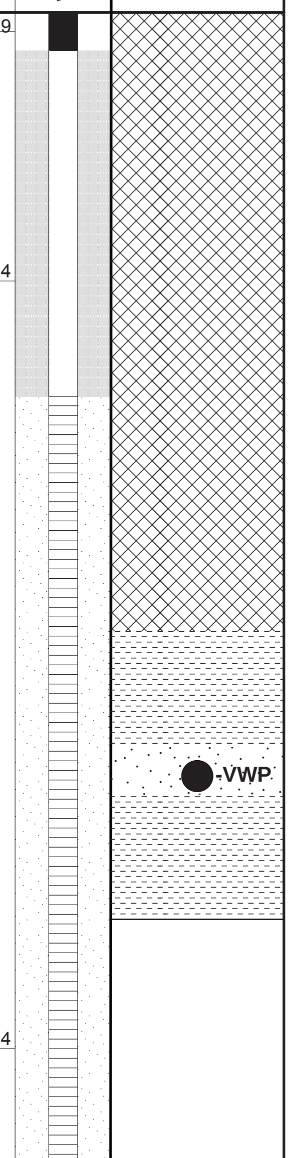
WELL NUMBER B-47 (VWP-47)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/12/18
GROUND ELEVATION 532.4 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	Depth	Elevation
0				ML	(ML) Silt, dark brown, soft, moist	0.5	531.9
				CL	(CL) Clay, light gray, hard, dry, calcareous, with chalk in fractures	7.0	525.4
5–7	ST1						
10–12	ST2			CL-ML	(CL-ML) Silty Clay, orange-tan mottled gray, hard, dry, calcareous, with chalk in fractures/joints Trace of sub-angular gravel 1/8" at 7-10 feet	27.0	505.4
15–17	ST3						
20–22	ST4						
25–27	ST5						
				CL	(CL) Clay, gray with orange-brown mottling, hard, slighty moist to dry, calcareous, with weathered shale, weathered	33.0	499.4
35			Weathered to Unweathered zone				

WELL DIAGRAM

VWP DIAGRAM



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1901 Central Drive STE 550
Bedford, Texas 76021
Telephone: 817-571-2288

WELL NUMBER B-47 (VWP-47)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	VWP DIAGRAM
35						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 38-57 *(continued)*		
40								
45	ST6							
50								
55	ST7					57.0 475.4		

Bottom of borehole at 57.0 feet.

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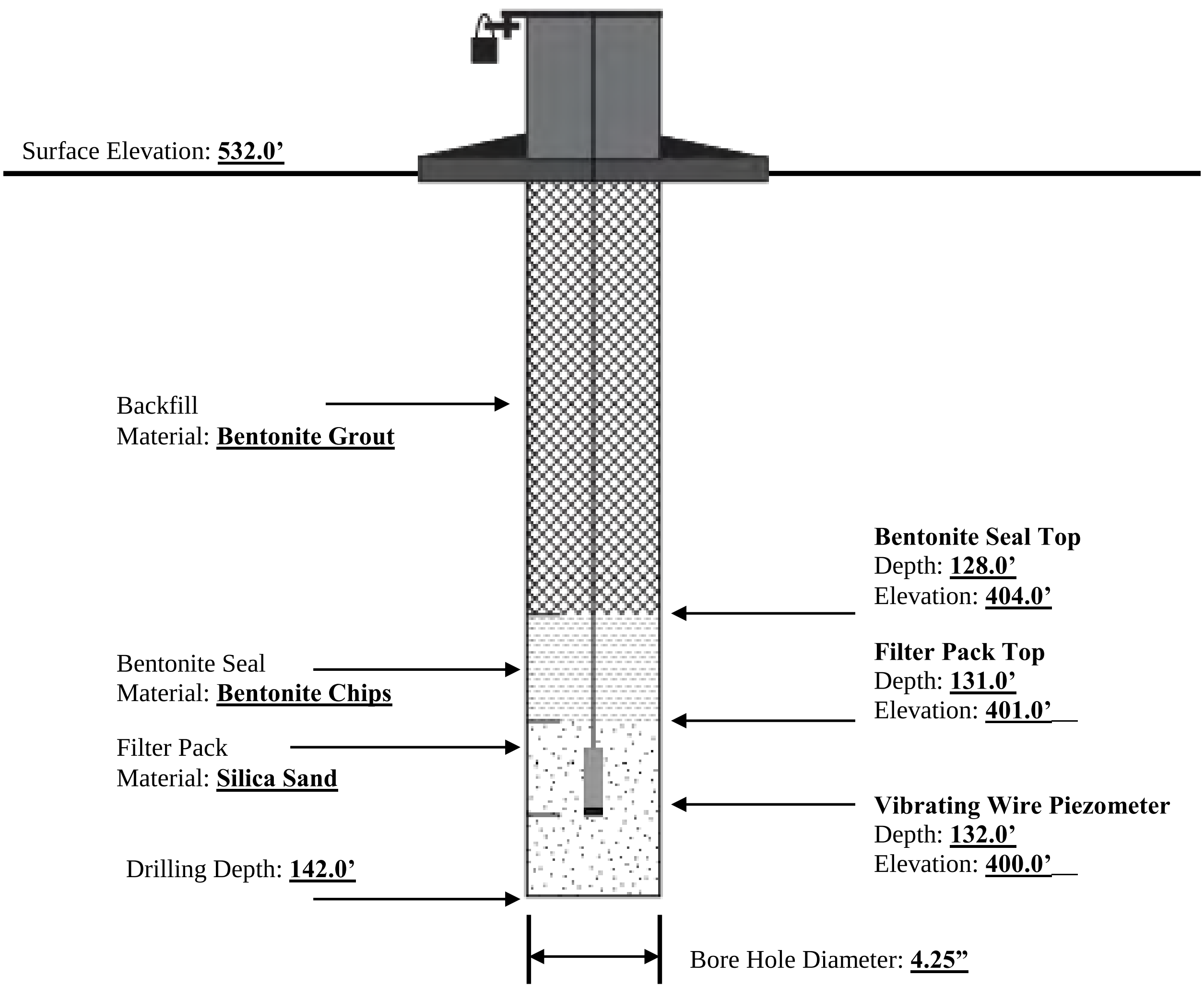
Vibrating Wire Piezometer Data Sheet

Site Name: Waco 2400
County: Limestone
VWP I.D. No.: VWP-47D
Date of Installation: 10/8/2019
Probe Serial No.: 1933663
Northing: 10598701.96
Easting: 3356561.53
Well Driller Name and License Number West Drilling

SCS Field Staff Supervising Installation: Tyson Milbrand
Static Water Level after Well Development: N/A
Name of Geologic Formation(s) in which Well is completed: Wolfe City Formation

Type of Locking Device: Pad Lock
Type of Case Protection: Aluminum
Concrete Surface Pad (with steel reinforcement) Dimensions: 6'X6'



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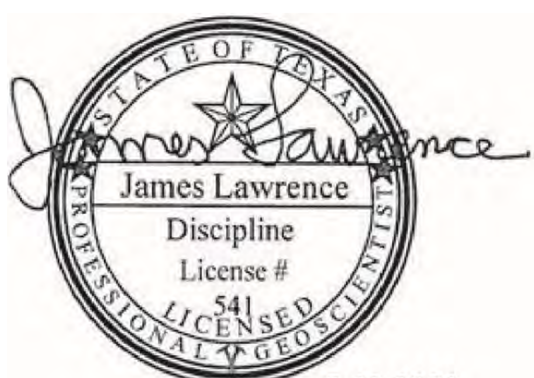
APPENDIX III-4.J

PRECIPITATION AND GROUNDWATER ELEVATION DATA



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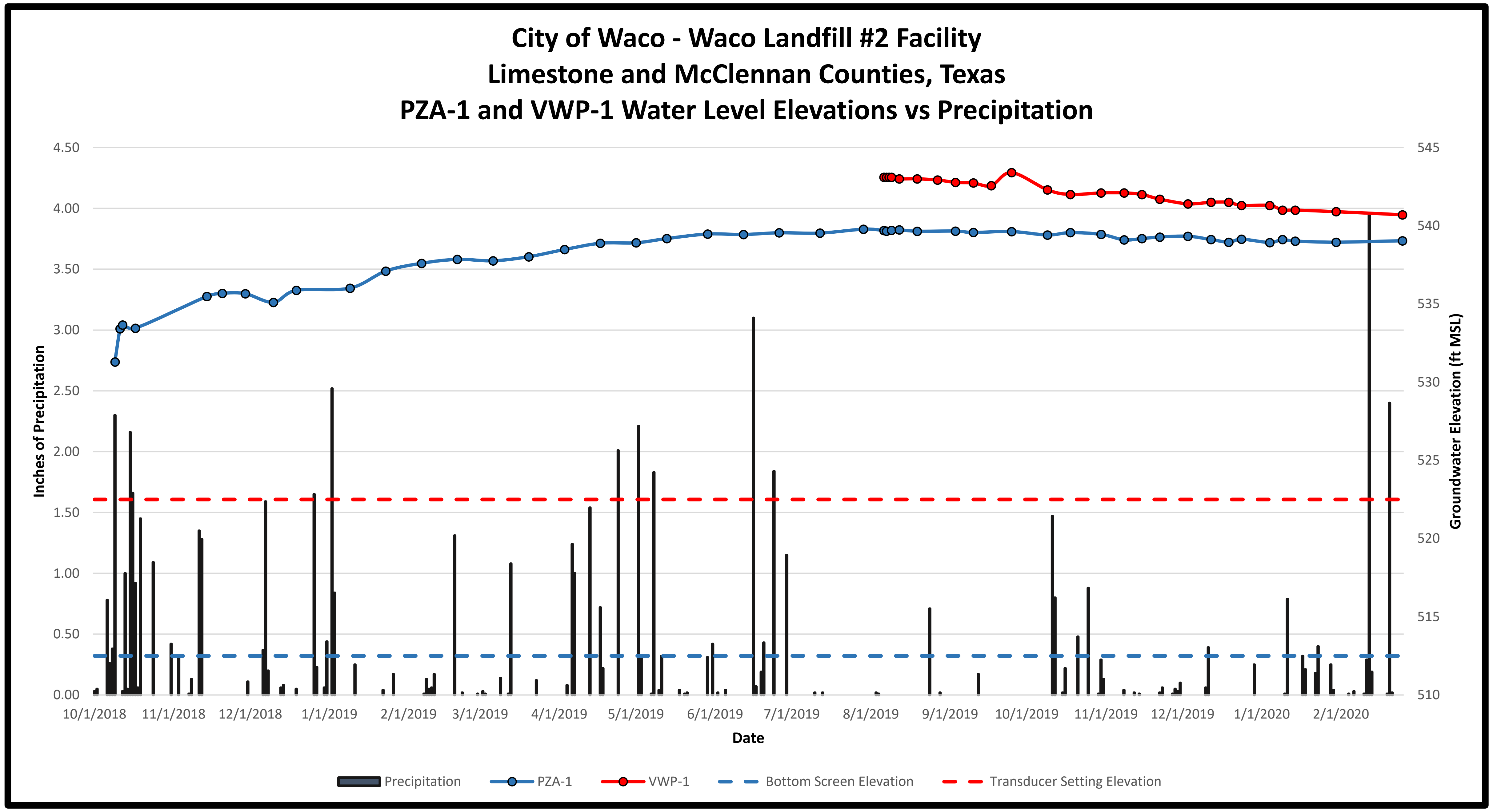
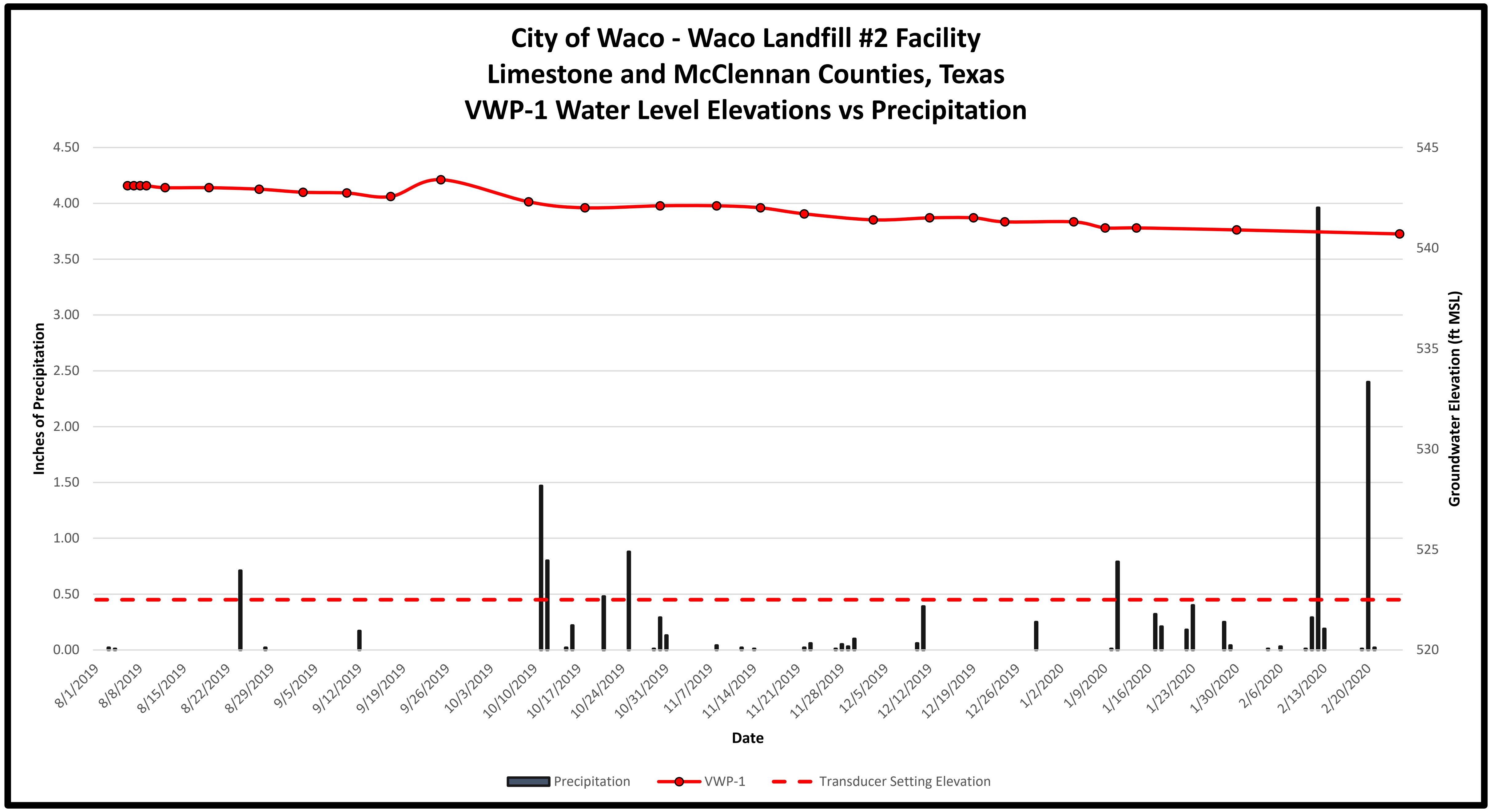
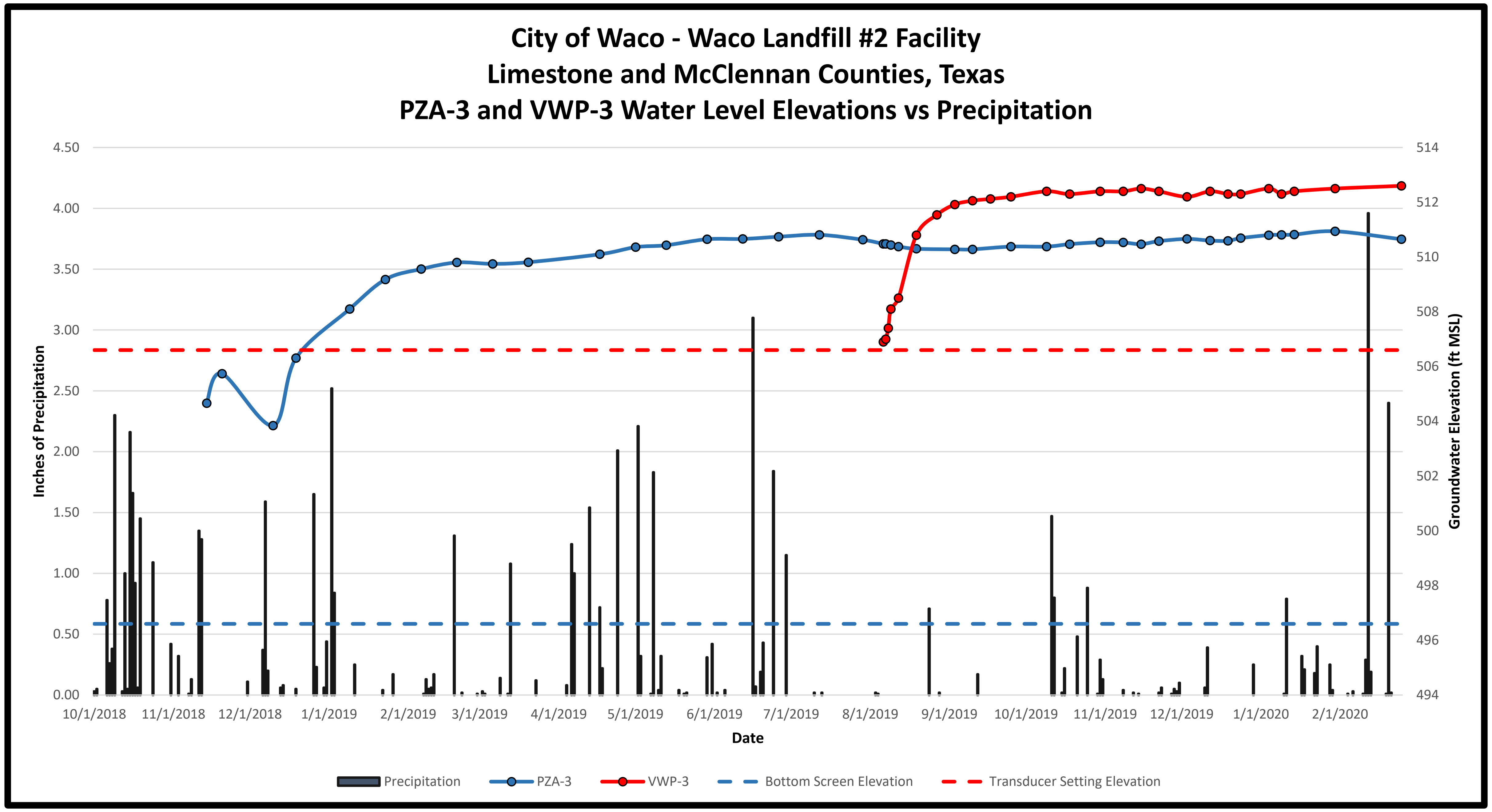


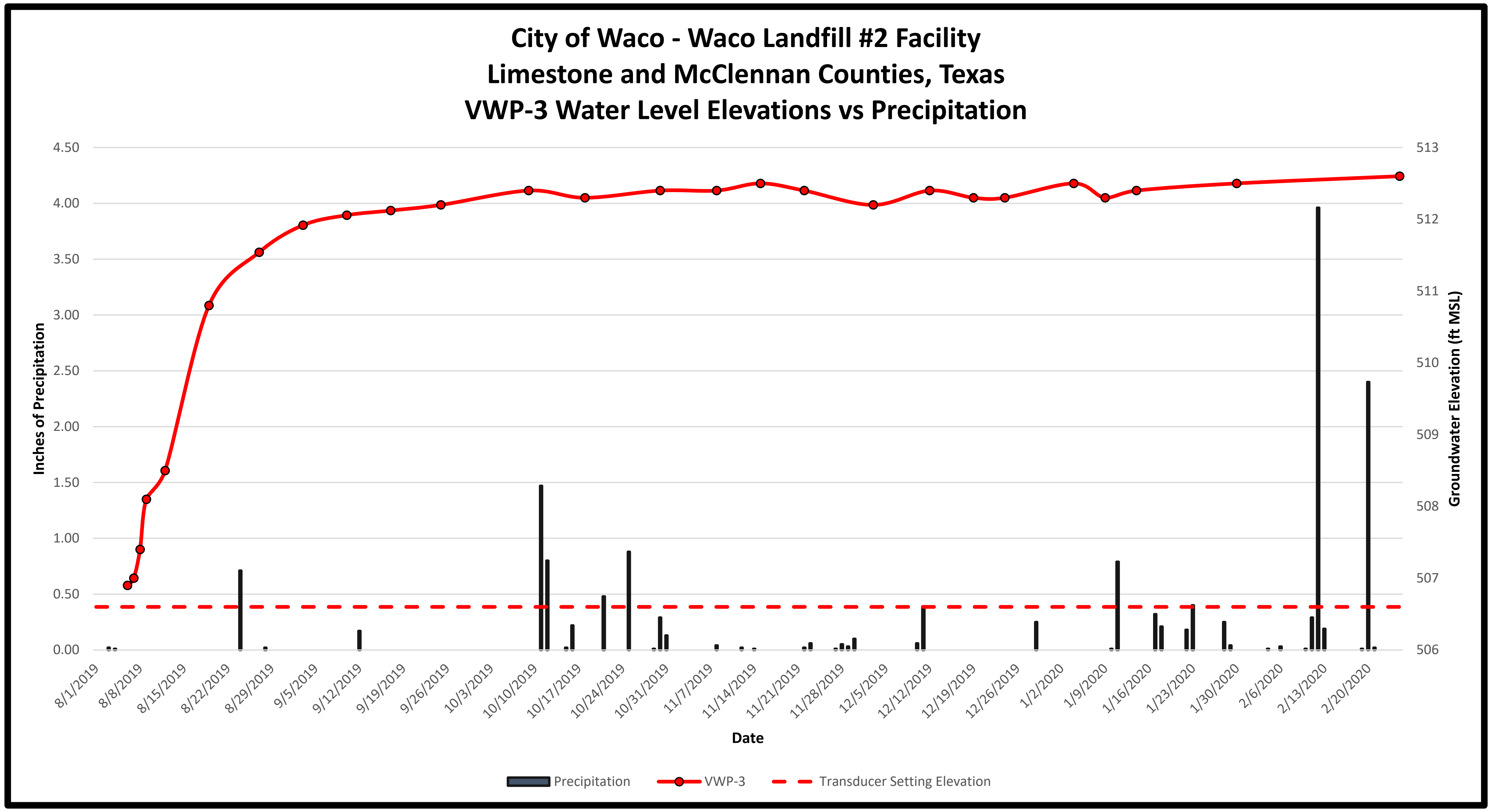
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-1 and VWP-1 Water Level Elevations vs Precipitation
Inches of Precipitation
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Groundwater Elevation (ft MSL)
545
540
535
530
525
520
515
510
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
Date
Precipitation
PZA-1
VWP-1
Bottom Screen Elevation
Transducer Setting Elevation



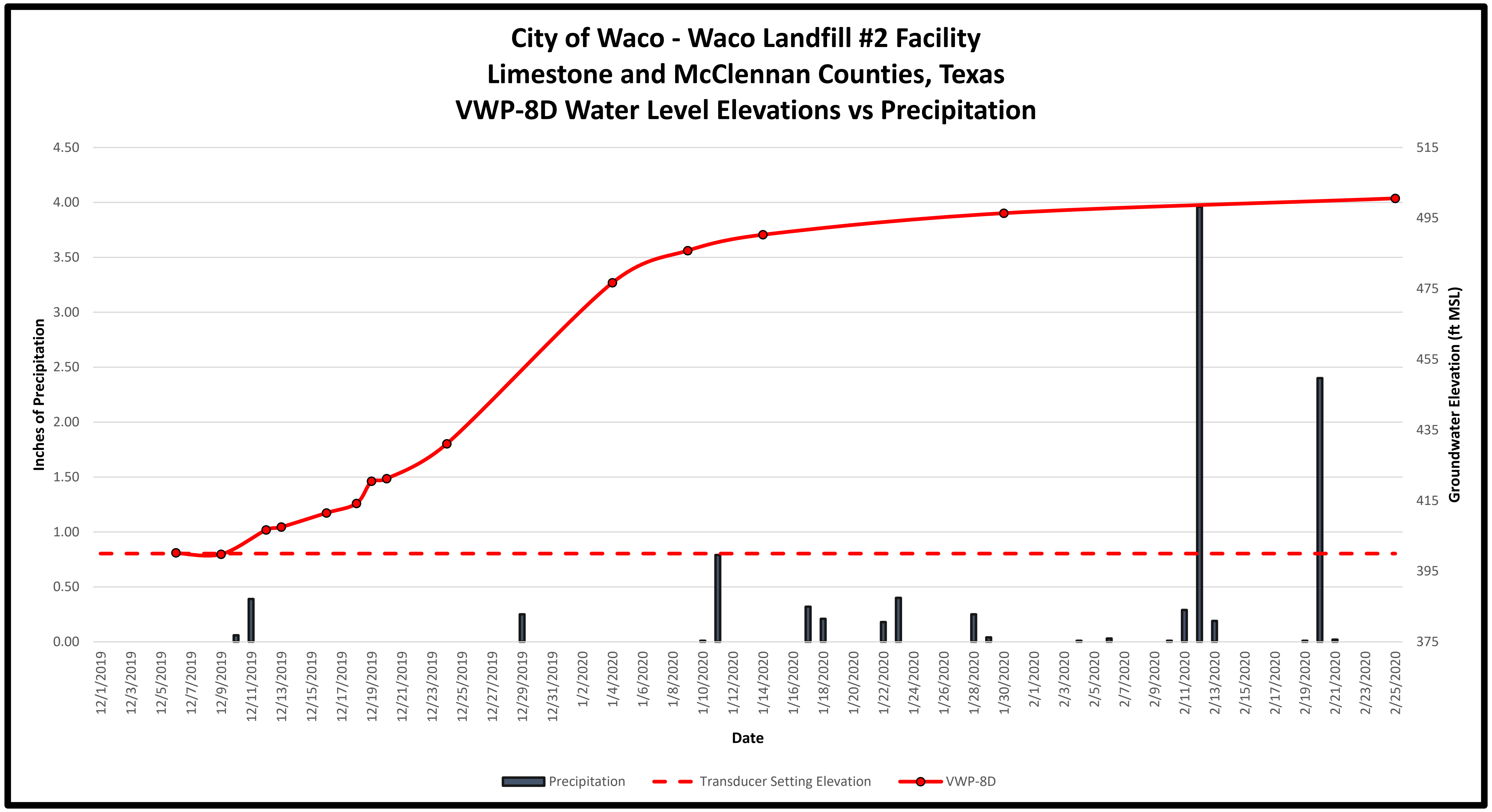
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-1 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
545
540
535
530
525
520
8/1/2019
8/8/2019
8/15/2019
8/22/2019
8/29/2019
9/5/2019
9/12/2019
9/19/2019
9/26/2019
10/3/2019
10/10/2019
10/17/2019
10/24/2019
10/31/2019
11/7/2019
11/14/2019
11/21/2019
11/28/2019
12/5/2019
12/12/2019
12/19/2019
12/26/2019
1/2/2020
1/9/2020
1/16/2020
1/23/2020
1/30/2020
2/6/2020
2/13/2020
2/20/2020
Date
Precipitation
VWP-1
Transducer Setting Elevation



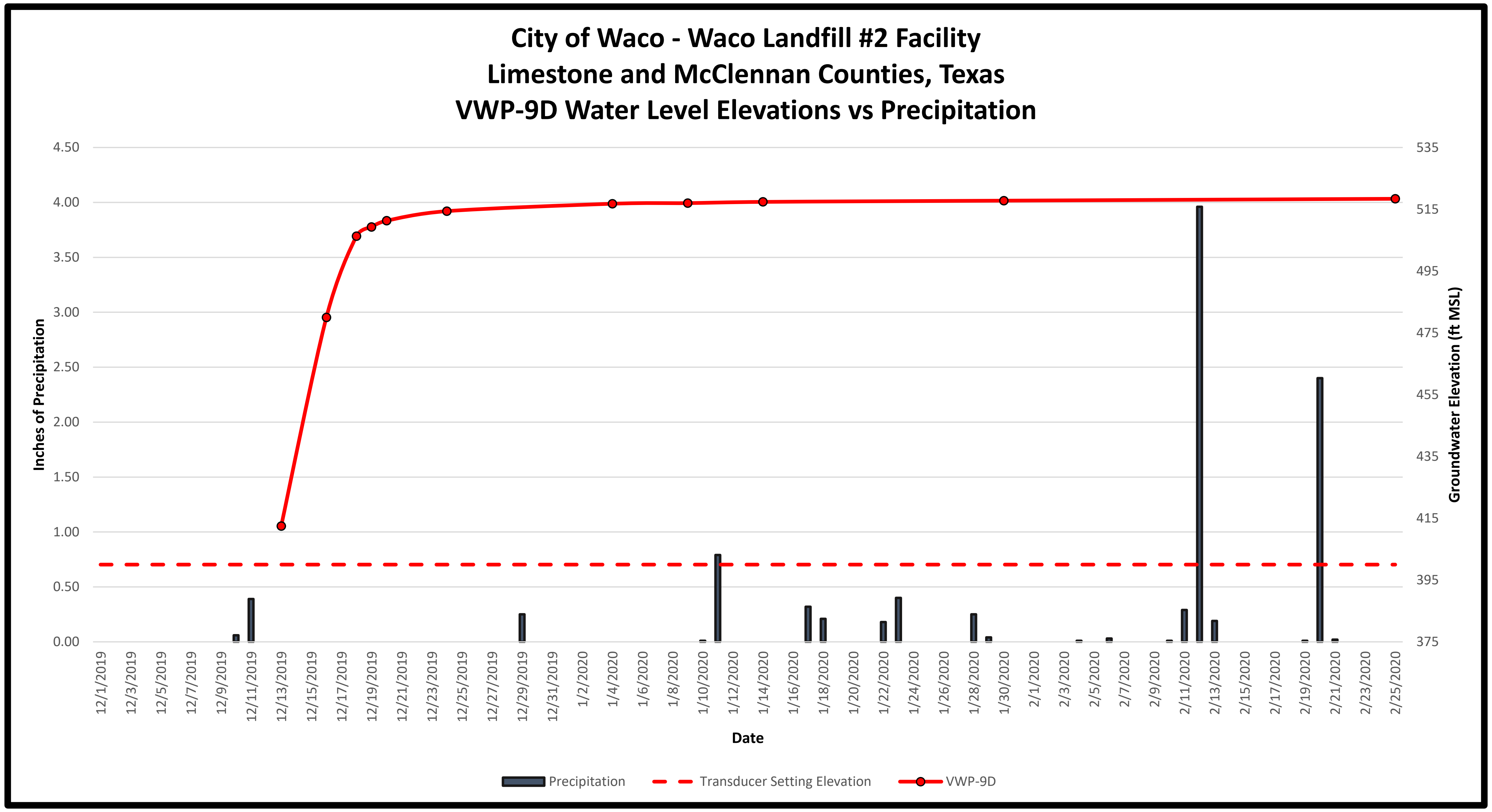
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-3 and VWP-3 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
514
512
510
508
506
504
502
500
498
496
494
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
Precipitation
PZA-3
VWP-3
Bottom Screen Elevation
Transducer Setting Elevation

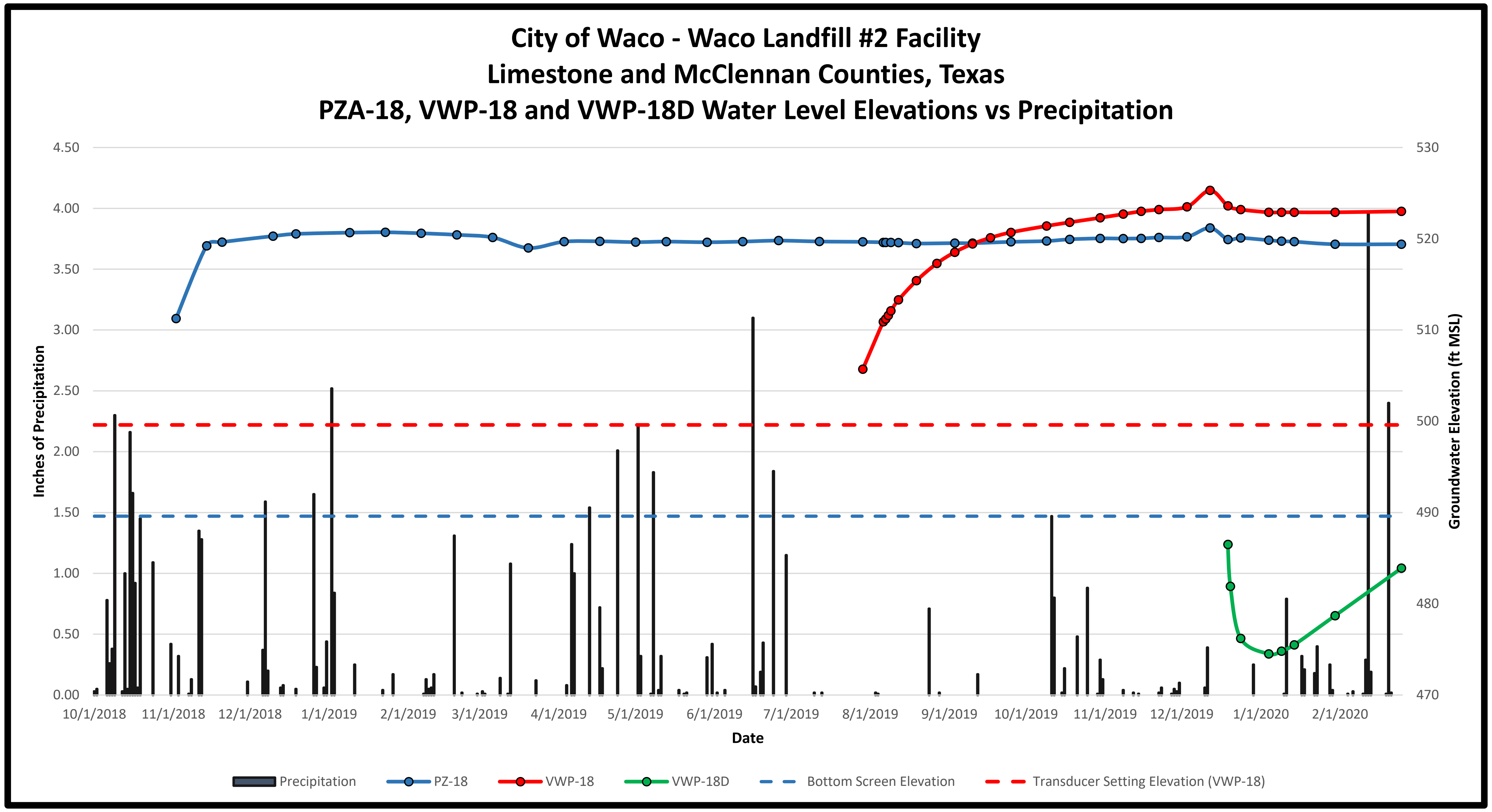


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-3 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
513
512
511
510
509
508
507
506
8/1/2019
8/8/2019
8/15/2019
8/22/2019
8/29/2019
9/5/2019
9/12/2019
9/19/2019
9/26/2019
10/3/2019
10/10/2019
10/17/2019
10/24/2019
10/31/2019
11/7/2019
11/14/2019
11/21/2019
11/28/2019
12/5/2019
12/12/2019
12/19/2019
12/26/2019
1/2/2020
1/9/2020
1/16/2020
1/23/2020
1/30/2020
2/6/2020
2/13/2020
2/20/2020
Date
Precipitation
VWP-3
Transducer Setting Elevation

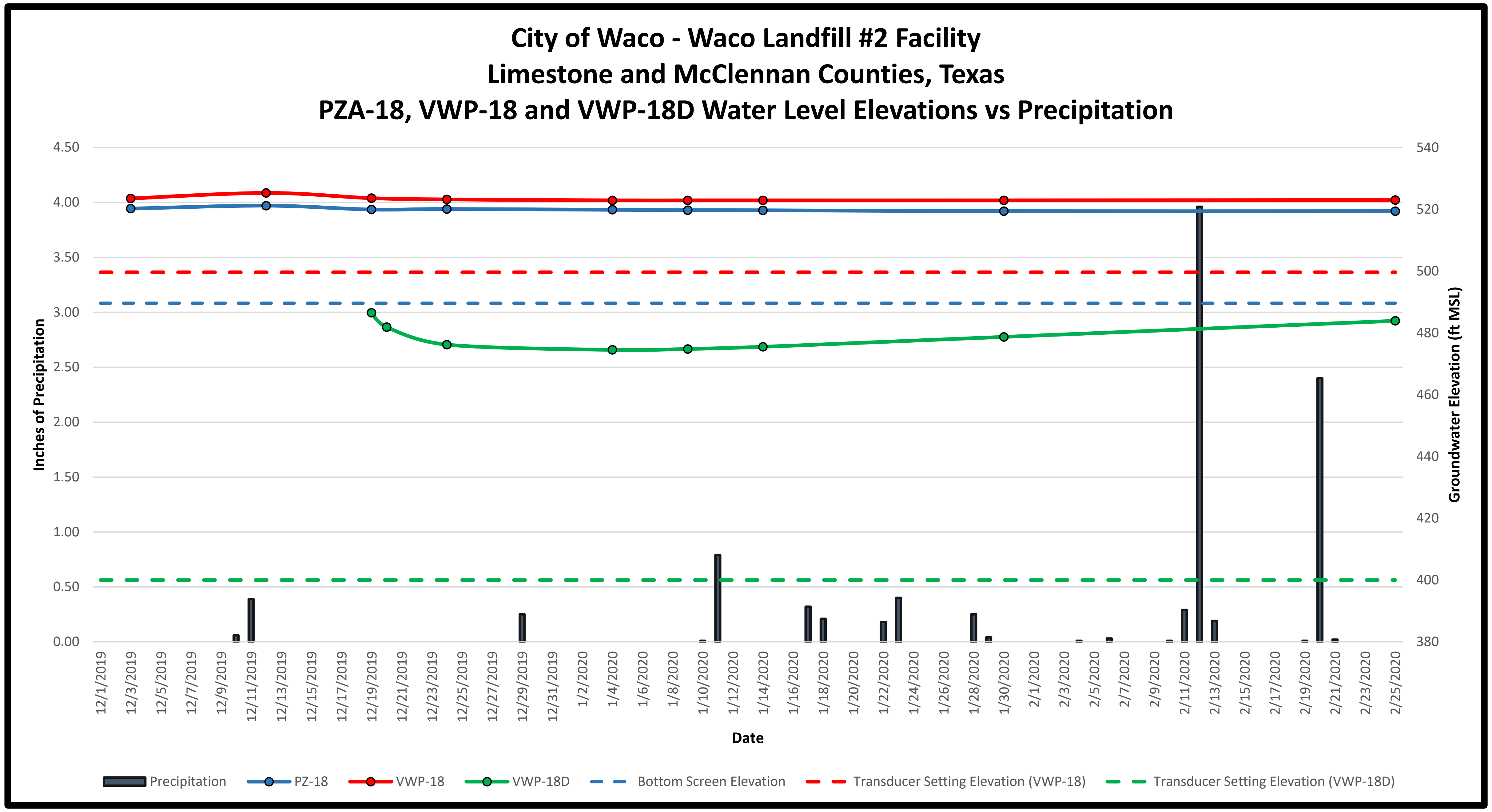


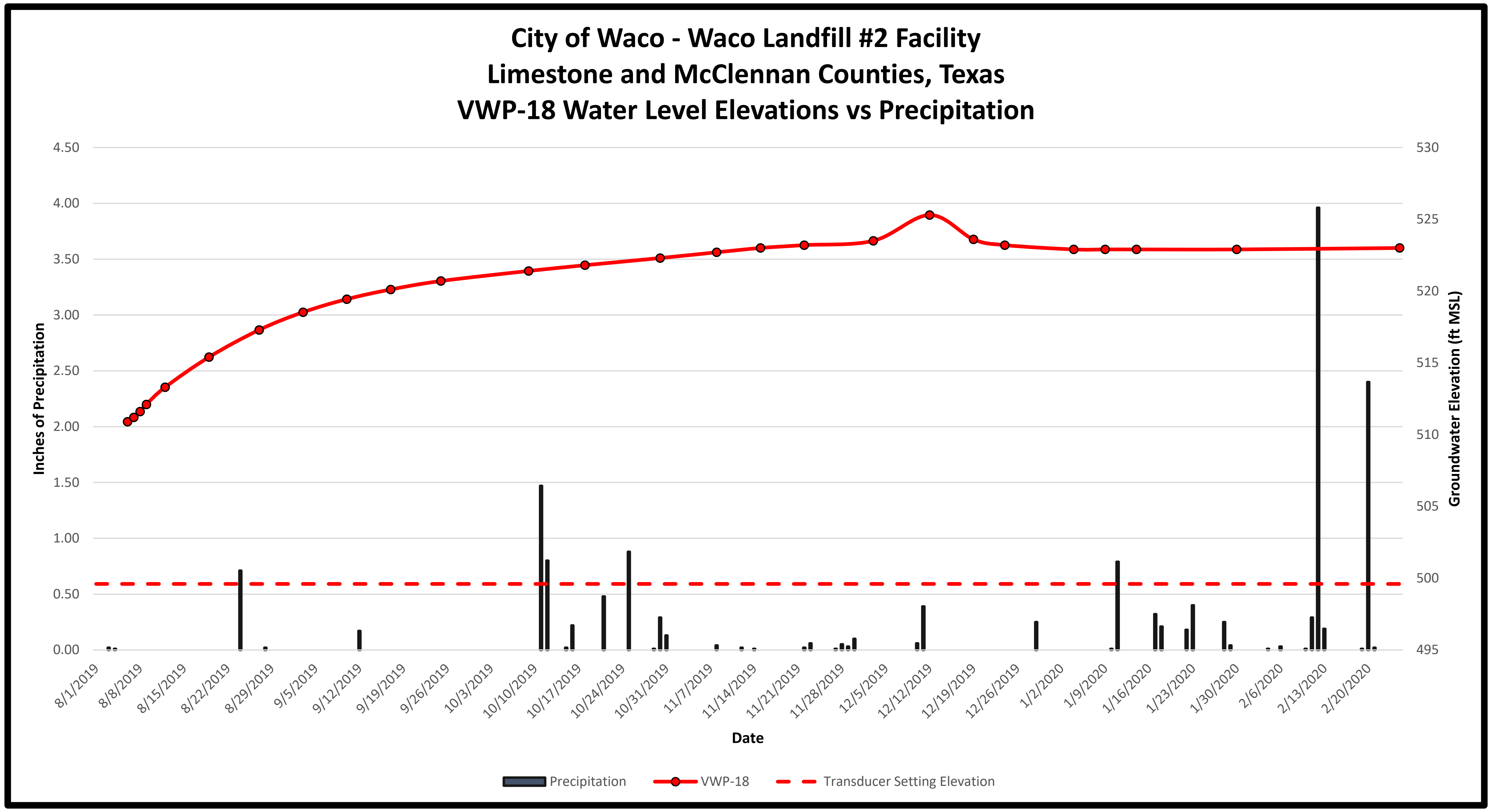
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-8D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-8D


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-9D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-9D

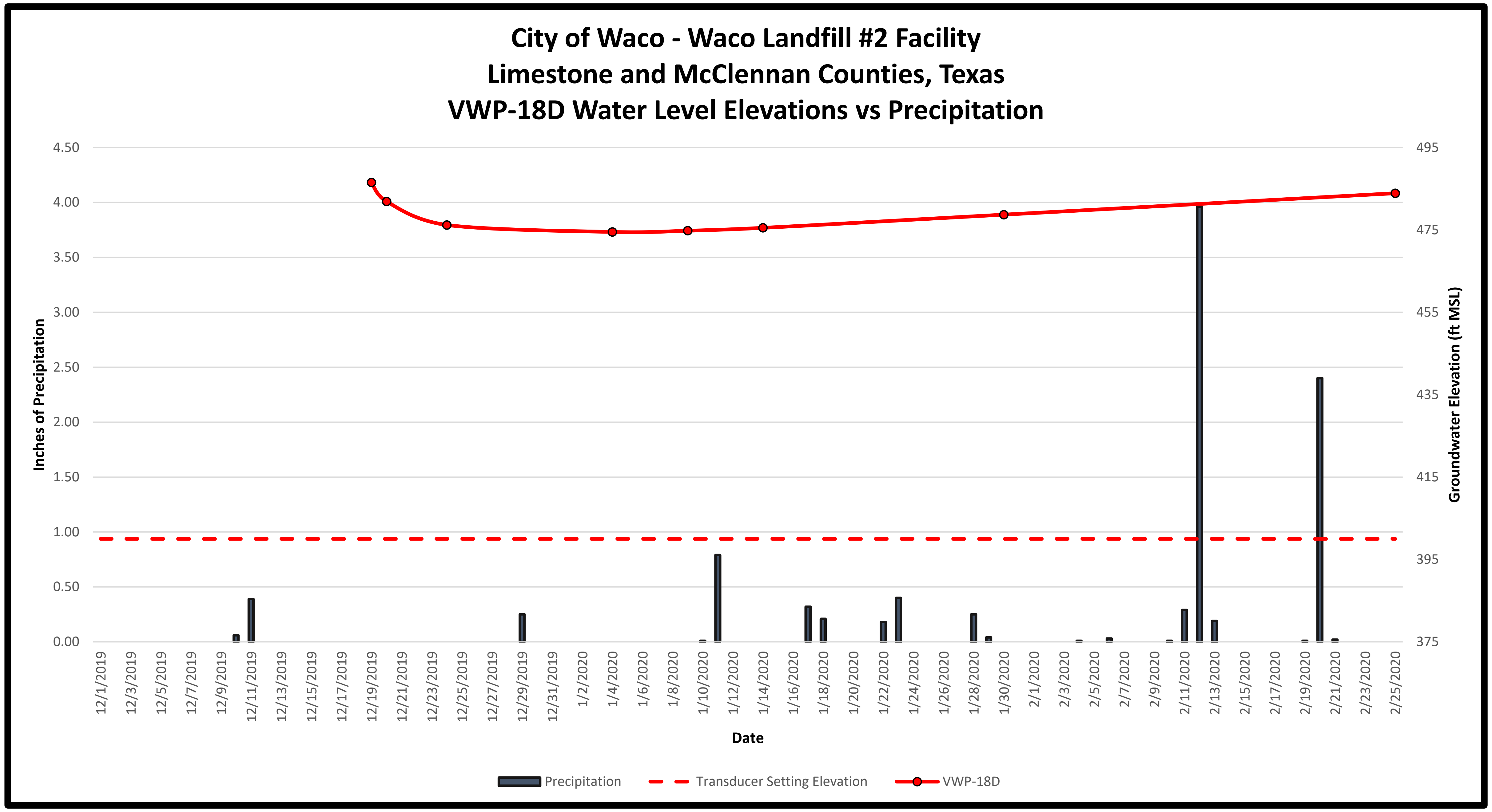


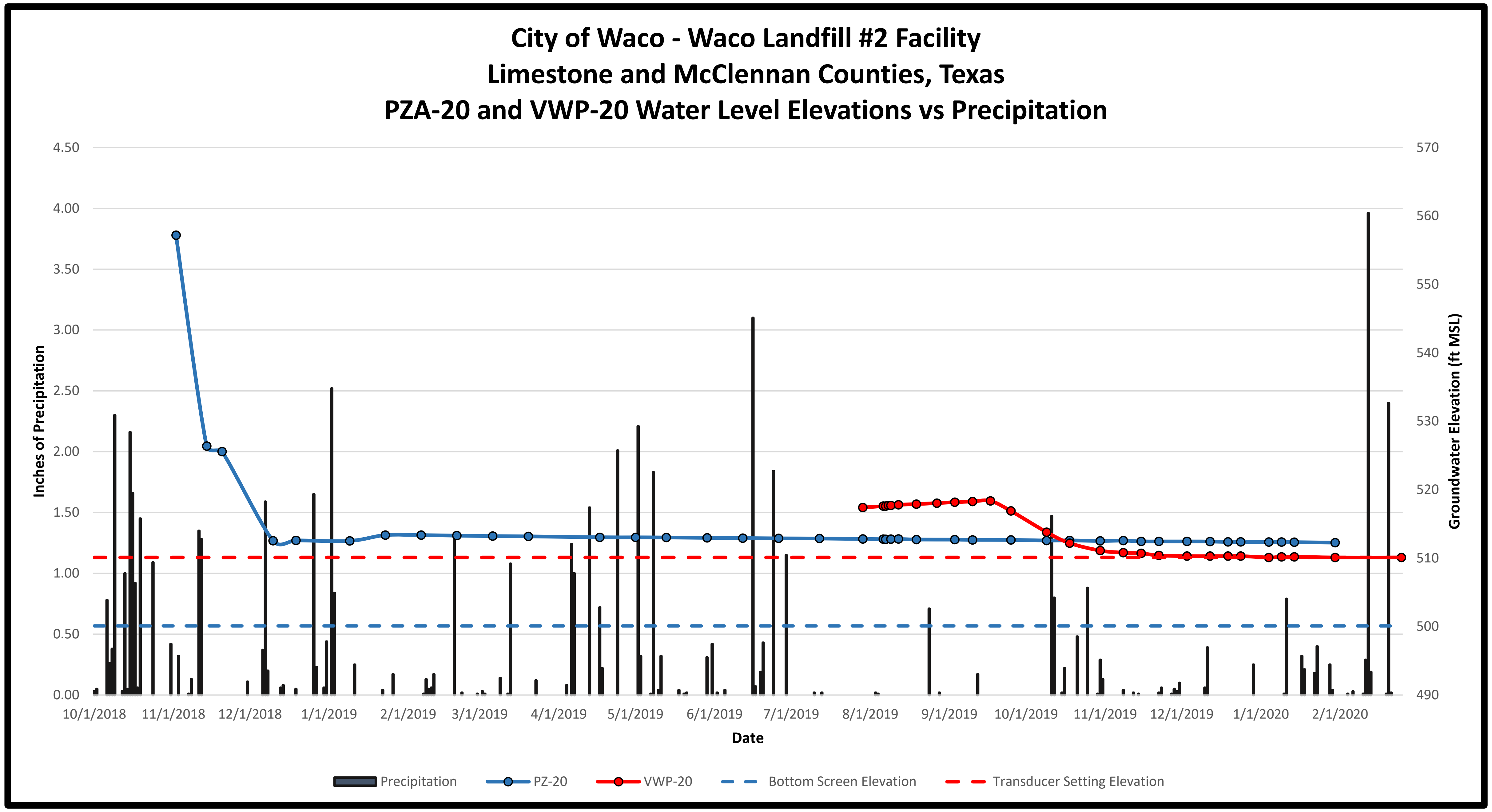
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-18, VWP-18 and VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
530
520
510
500
490
480
470
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
Date
Precipitation
PZ-18
VWP-18
VWP-18D
Bottom Screen Elevation
Transducer Setting Elevation (VWP-18)


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-18, VWP-18 and VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
PZ-18
VWP-18
VWP-18D
Bottom Screen Elevation
Transducer Setting Elevation (VWP-18)
Transducer Setting Elevation (VWP-18D)

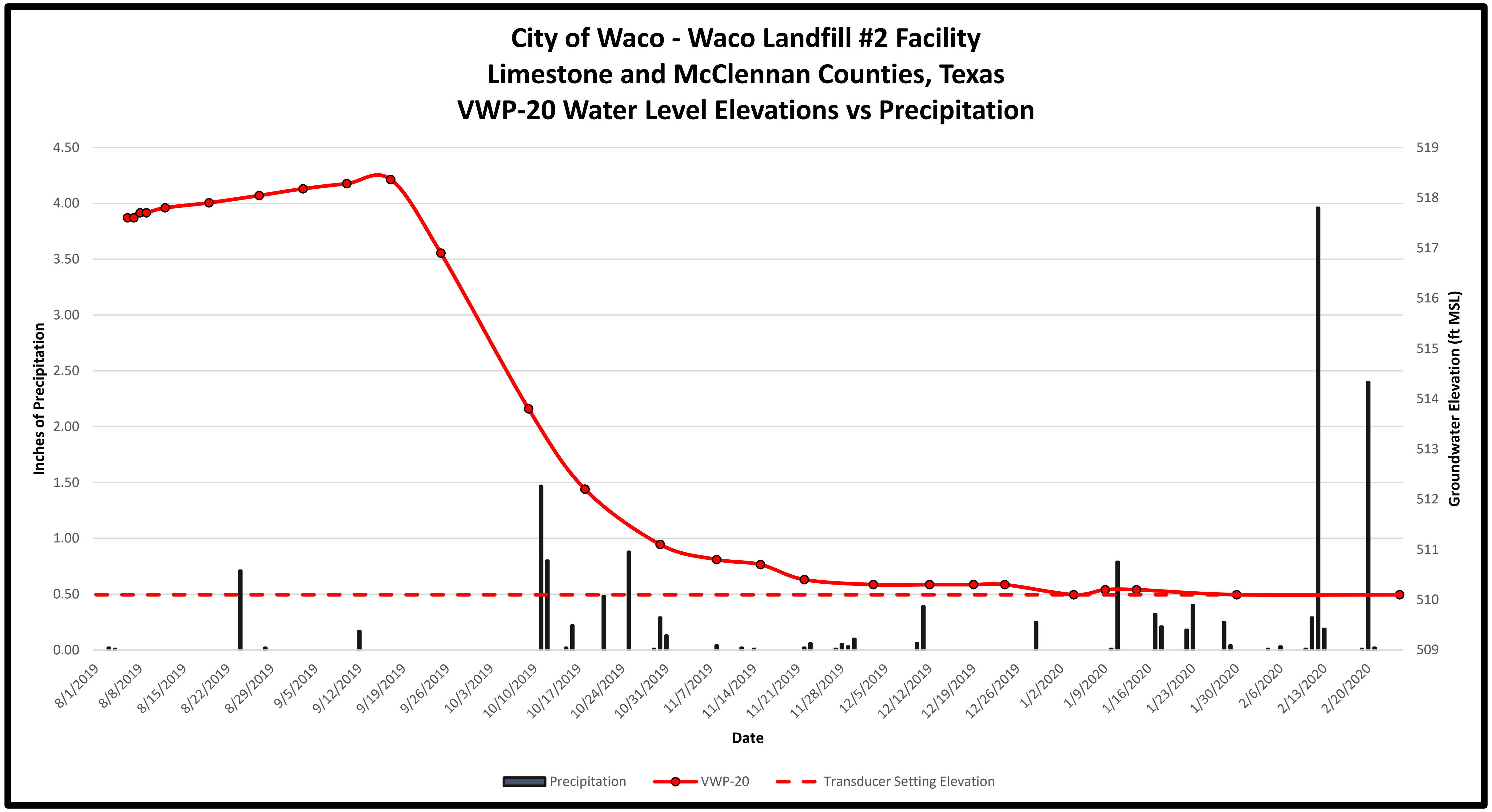


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-18 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
530
525
520
515
510
505
500
495
8/1/2019
8/8/2019
8/15/2019
8/22/2019
8/29/2019
9/5/2019
9/12/2019
9/19/2019
9/26/2019
10/3/2019
10/10/2019
10/17/2019
10/24/2019
10/31/2019
11/7/2019
11/14/2019
11/21/2019
11/28/2019
12/5/2019
12/12/2019
12/19/2019
12/26/2019
1/2/2020
1/9/2020
1/16/2020
1/23/2020
1/30/2020
2/6/2020
2/13/2020
2/20/2020
Date
Precipitation
VWP-18
Transducer Setting Elevation

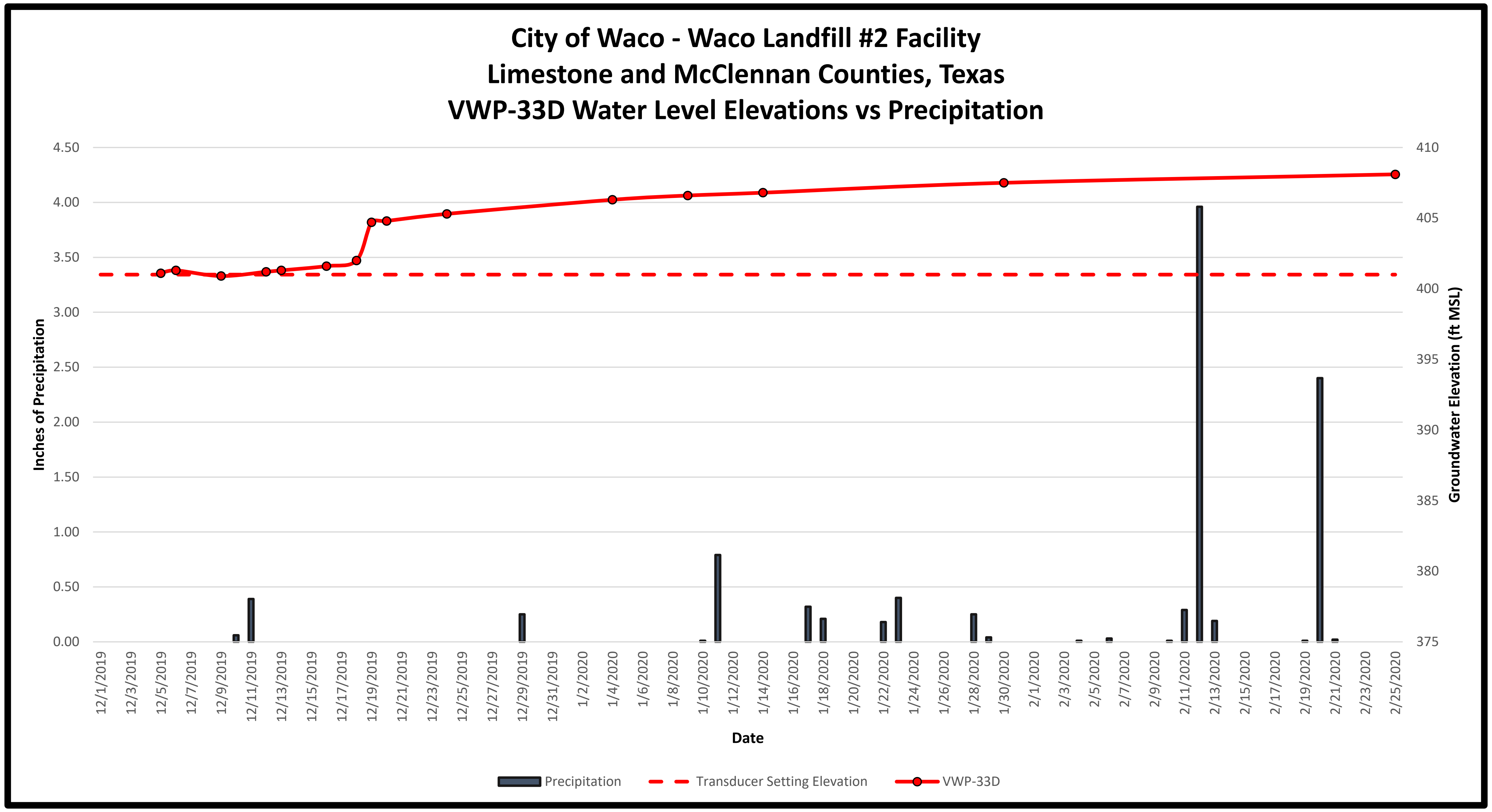

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-18D



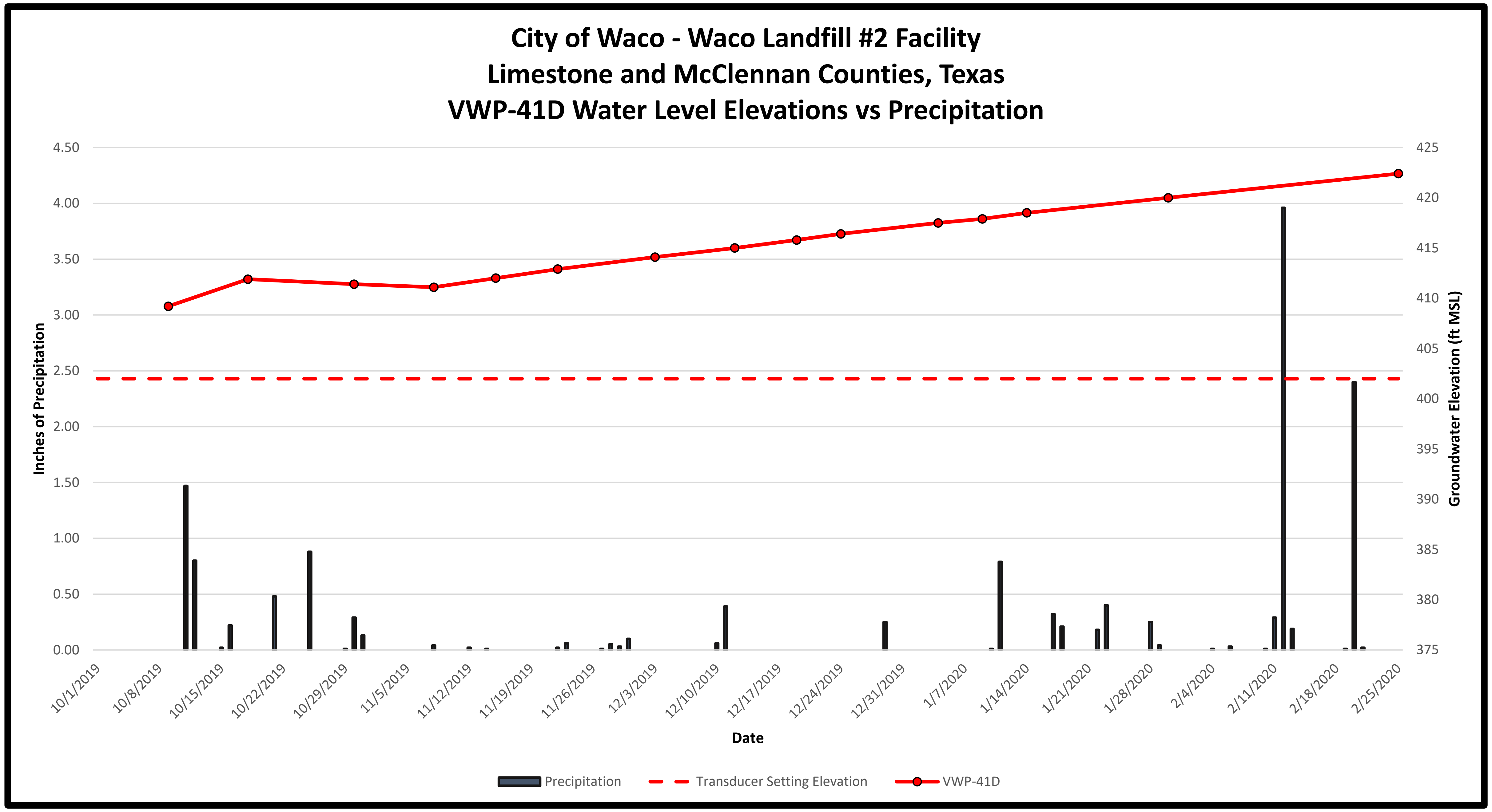
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-20 and VWP-20 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
570
560
550
540
530
520
510
500
490
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
Precipitation
PZ-20
VWP-20
Bottom Screen Elevation
Transducer Setting Elevation

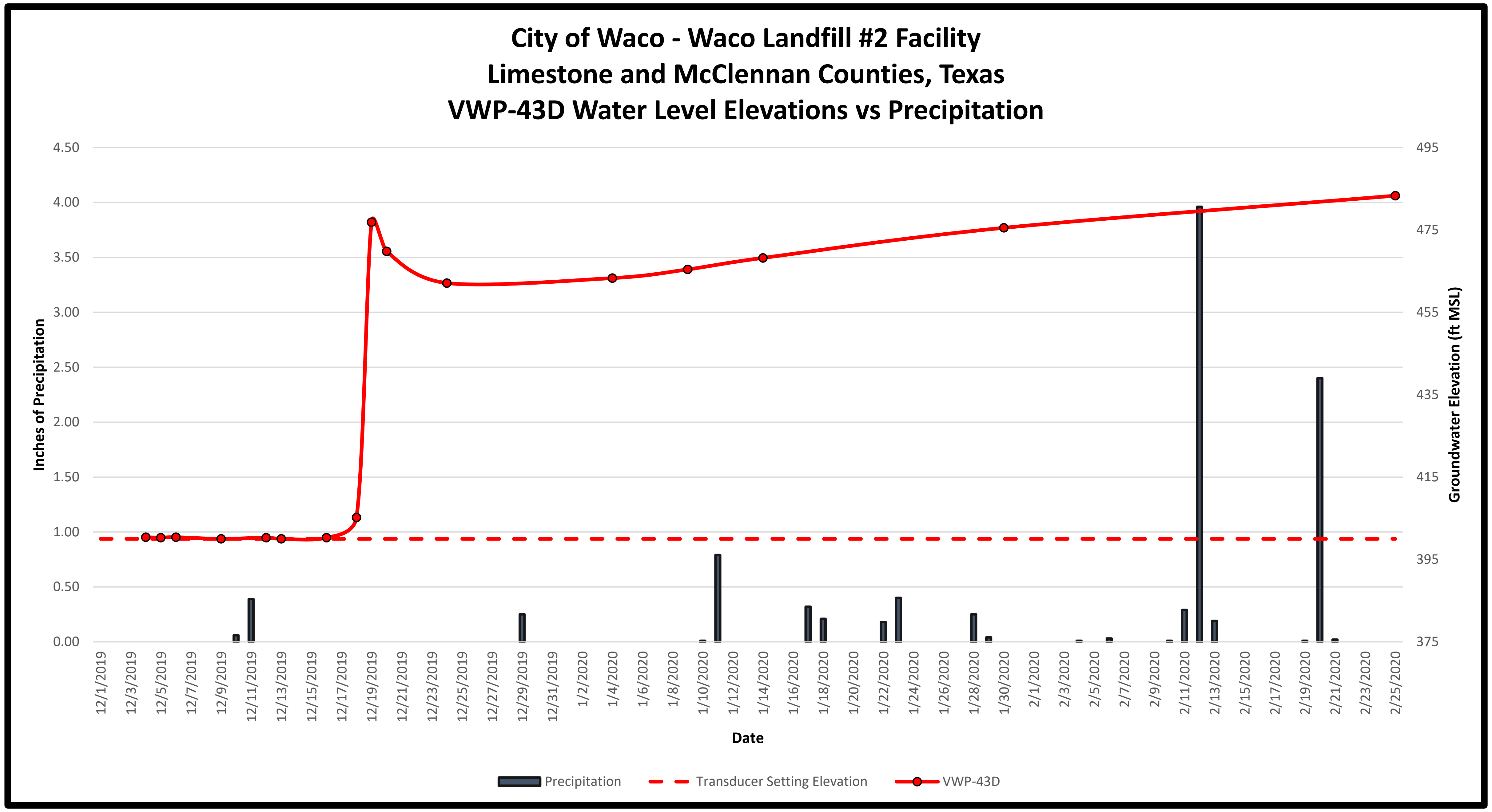


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-20 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
519
518
517
516
515
514
513
512
511
510
509
8/1/2019
8/8/2019
8/15/2019
8/22/2019
8/29/2019
9/5/2019
9/12/2019
9/19/2019
9/26/2019
10/3/2019
10/10/2019
10/17/2019
10/24/2019
10/31/2019
11/7/2019
11/14/2019
11/21/2019
11/28/2019
12/5/2019
12/12/2019
12/19/2019
12/26/2019
1/2/2020
1/9/2020
1/16/2020
1/23/2020
1/30/2020
2/6/2020
2/13/2020
2/20/2020
Precipitation
VWP-20
Transducer Setting Elevation

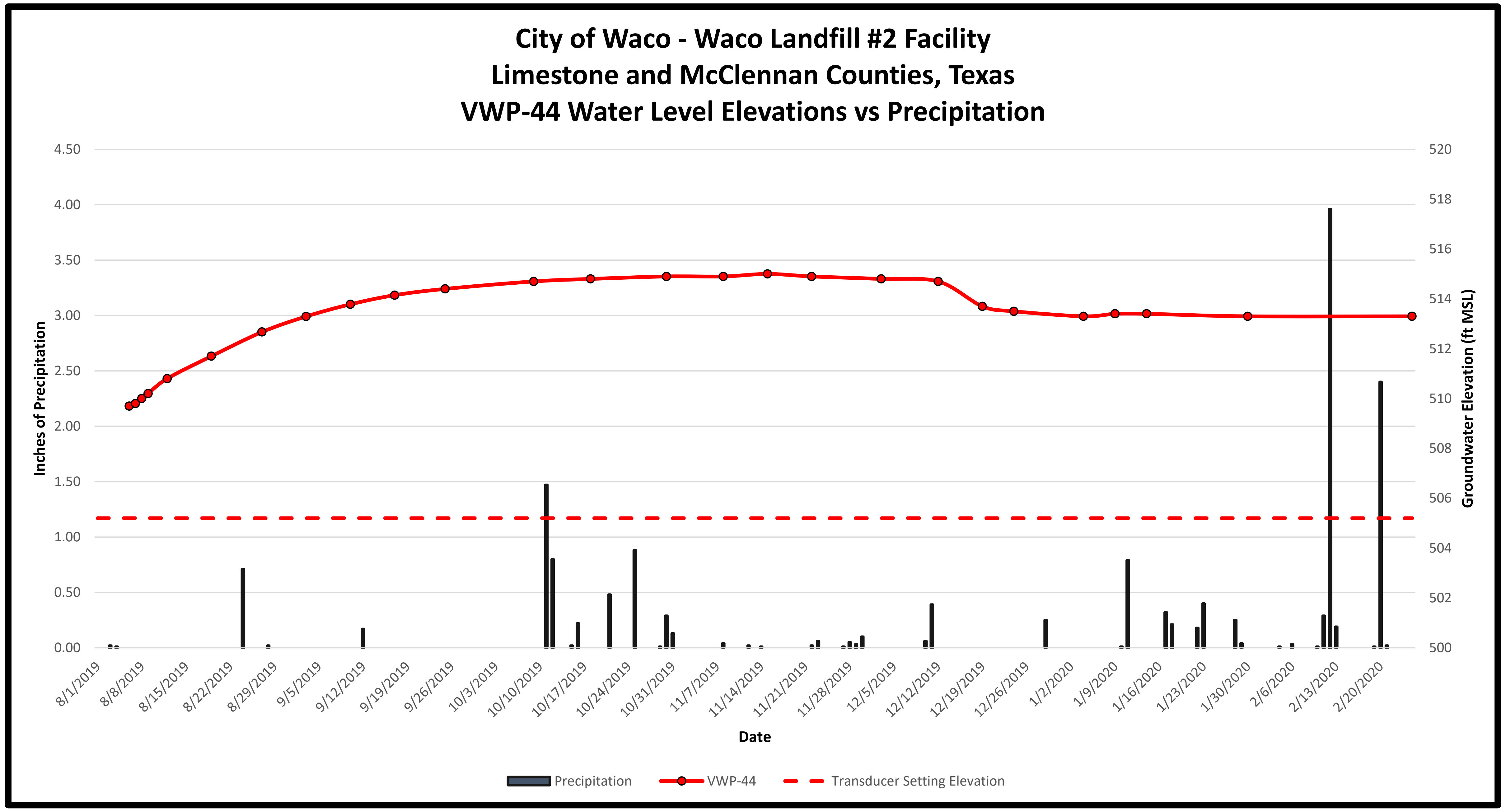


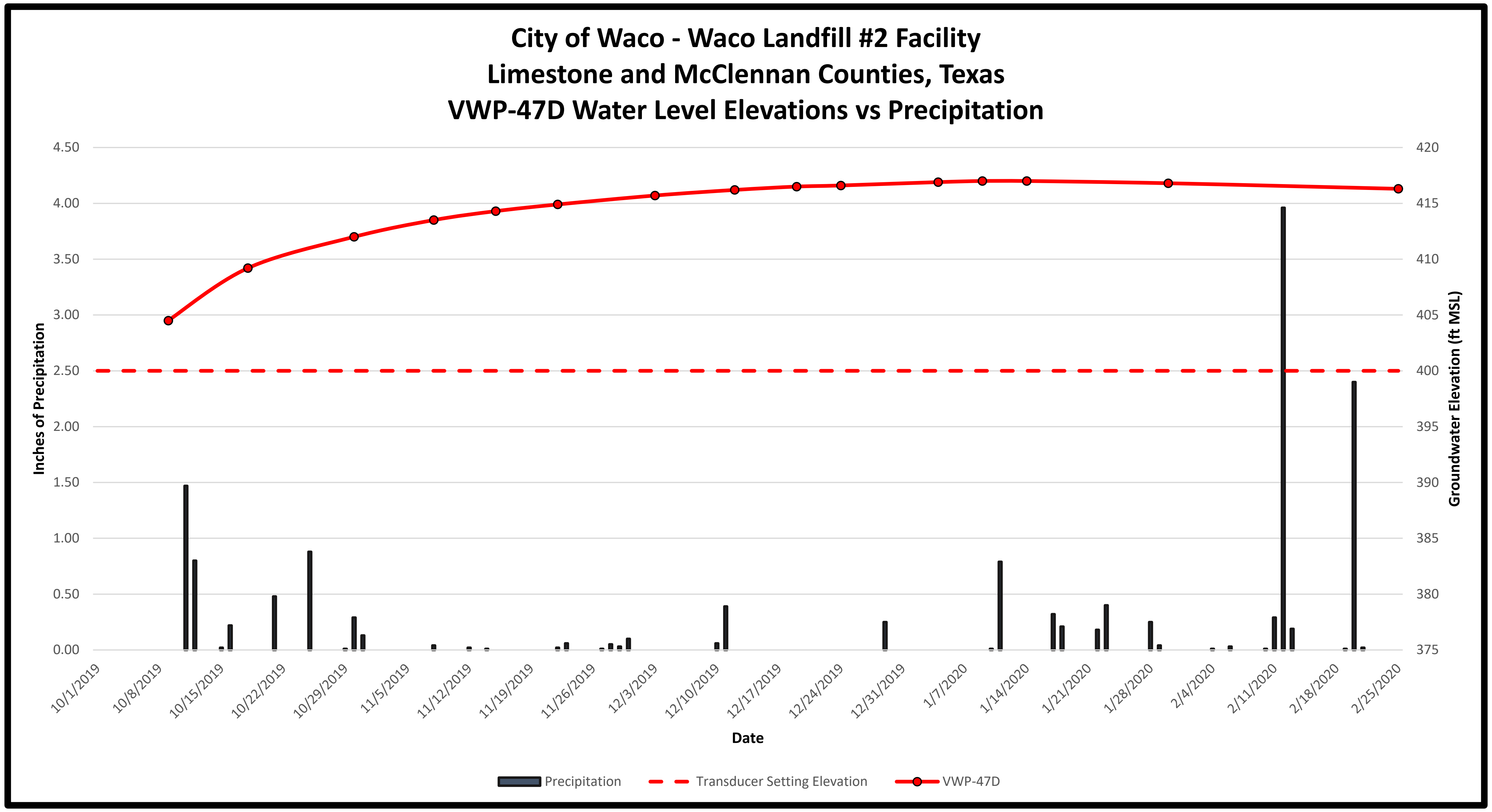
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-33D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-33D


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-41D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
425
420
415
410
405
400
395
390
385
380
375
10/1/2019
10/8/2019
10/15/2019
10/22/2019
10/29/2019
11/5/2019
11/12/2019
11/19/2019
11/26/2019
12/3/2019
12/10/2019
12/17/2019
12/24/2019
12/31/2019
1/7/2020
1/14/2020
1/21/2020
1/28/2020
2/4/2020
2/11/2020
2/18/2020
2/25/2020
Date
Precipitation
Transducer Setting Elevation
VWP-41D



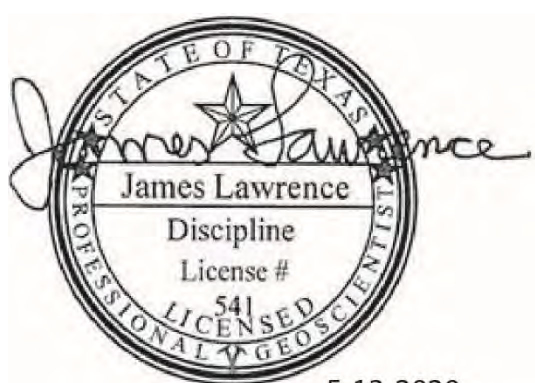
City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-43D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-43D


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-44 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
VWP-44
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-47D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
420
415
410
405
400
395
390
385
380
375
10/1/2019
10/8/2019
10/15/2019
10/22/2019
10/29/2019
11/5/2019
11/12/2019
11/19/2019
11/26/2019
12/3/2019
12/10/2019
12/17/2019
12/24/2019
12/31/2019
1/7/2020
1/14/2020
1/21/2020
1/28/2020
2/4/2020
2/11/2020
2/18/2020
2/25/2020
Precipitation
Transducer Setting Elevation
VWP-47D

APPENDIX III-4.K

STANDPIPE PIEZOMETER HISTORIC WATER LEVEL DATA



5-13-2020

Appendix III-4.K: Standpipe Piezometer Historic Water Level Data

Depth to water (ft, TOC)

Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019
PZ-1	18.02	17.52	17.27	17.36	17.10	16.64	16.24	16.21	15.94	15.65	15.68	15.57	15.59	15.34	15.42	15.46	15.41	15.38	15.47
PZ-3	35.03	34.65	34.41	34.46	34.40	n/a	34.11	33.85	33.78	33.56	33.55	33.47	33.40	33.58	33.73	33.73	33.77	33.83	33.91
PZ-8	DRY	77.17	77.19	77.56	77.57	DRY	DRY	77.53	77.54	DRY	77.55	77.54	77.57	DRY	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	17.09	17.20	17.37	17.65	18.81	18.12	18.08	18.17	18.11	18.18	18.11	18.00	18.10	18.14	18.20	18.21	18.21	18.23	18.32
PZ-20	54.40	54.41	54.48	54.55	54.59	n/a	54.72	54.73	54.75	54.80	54.84	54.88	54.90	54.97	55.00	55.01	54.99	54.97	55.05
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	51.64	51.75	DRY	DRY	51.63	51.64	51.64	51.65	51.63	51.65	51.64	DRY	DRY	DRY	DRY	DRY	DRY
PZ-43	DRY	50.41	50.41	50.44	DRY	DRY	DRY	DRY	50.44	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	33.50	33.49	33.44	33.89	DRY	DRY	DRY	DRY	33.93	DRY	DRY	33.92	33.90	DRY	DRY	DRY	DRY	DRY	DRY

Well I.D.	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
PZ-1	15.46	15.55	15.49	15.71	15.56	15.67	16.02	15.94	15.84	15.79	16	16.17	15.98	16.19	16	16.1	16.17	16.08
PZ-3	33.93	33.93	33.83	33.83	33.74	33.67	33.68	33.74	33.63	13.55	33.61	33.62	33.52	33.41	33.4	33.39	33.27	33.56
PZ-8	DRY	DRY	DRY	DRY	DRY	DRY	77.55	77.58	77.56	77.57	77.58	77.57	77.56	77.57	77.57	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	18.28	18.28	18.14	18.05	17.86	17.76	17.78	17.76	17.66	17.59	16.61	17.88	17.71	17.96	18.07	18.12	18.4	18.4
PZ-20	55.06	55.10	55.11	55.19	55.18	55.25	55.21	55.32	55.33	55.33	55.34	55.4	55.39	55.42	55.41	55.44	55.5	N/A
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	51.63	51.63	DRY	DRY	DRY	DRY	51.63	DRY	51.64	51.65	51.63	51.64	51.64	51.62	51.63	DRY	DRY	DRY
PZ-43	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	50.46	50.46	50.46	50.46	50.45	50.43	50.45	DRY	DRY	DRY
PZ-47	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Water Level Elevation (ft msl, from T.O.C)

Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019
PZ-1	537.10	537.60	537.85	537.76	538.02	538.48	538.88	538.91	539.18	539.47	539.44	539.55	539.53	539.78	539.70	539.66	539.71	539.74	539.65
PZ-3	509.18	509.56	509.80	509.75	509.81	n/a	510.10	510.36	510.43	510.65	510.66	510.74	510.81	510.63	510.48	510.48	510.44	510.38	510.30
PZ-8	DRY	476.22	476.20	475.83	475.82	DRY	DRY	475.86	475.85	DRY	475.84	475.85	475.82	DRY	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	520.71	520.60	520.43	520.15	518.99	519.68	519.72	519.63	519.69	519.62	519.69	519.80	519.70	519.66	519.60	519.59	519.59	519.57	519.48
PZ-20	513.37	513.36	513.29	513.22	513.18	n/a	513.05	513.04	513.02	512.97	512.93	512.89	512.87	512.80	512.77	512.76	512.78	512.80	512.72
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	486.40	486.29	DRY	DRY	486.41	486.40	486.40	486.39	486.41	486.39	486.40	DRY	DRY	DRY	DRY	DRY	DRY
PZ-43	DRY	500.90	500.90	500.87	DRY	DRY	DRY	DRY	500.87	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	502.66	502.67	502.72	502.27	DRY	DRY	DRY	DRY	502.23	DRY	DRY	502.24	502.26	DRY	DRY	DRY	DRY	DRY	DRY

Well I.D.	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
PZ-1	539.66	539.57	539.63	539.41	539.56	539.45	539.1	539.18	539.28	539.33	539.12	538.95	539.14	538.93	539.12	539.02	538.95	539.04
PZ-3	510.28	510.28	510.38	510.38	510.47	510.54	510.53	510.47	510.58	510.66	510.60	510.59	510.69	510.80	510.81	510.82	510.94	510.65
PZ-8	DRY	DRY	DRY	DRY	DRY	DRY	475.84	475.81	475.83	475.82	475.81	475.82	475.83	475.82	475.82	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	519.52	519.52	519.66	519.75	519.94	520.04	520.02	520.04	520.14	520.21	521.19	519.92	520.09	519.84	519.73	519.68	519.4	519.4
PZ-20	512.71	512.67	512.66	512.58	512.59	512.52	512.56	512.45	512.44	512.44	512.43	512.37	512.38	512.35	512.36	512.33	512.27	N/A
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	486.41	486.41	DRY	DRY	DRY	DRY	486.41	DRY	486.4	486.39	486.41	486.4	486.4	486.42	486.41	DRY	DRY	DRY
PZ-43	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	500.85	500.85	500.85	500.85	500.86	500.88	500.86	DRY	DRY	DRY
PZ-47	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Height of Water Column (ft)

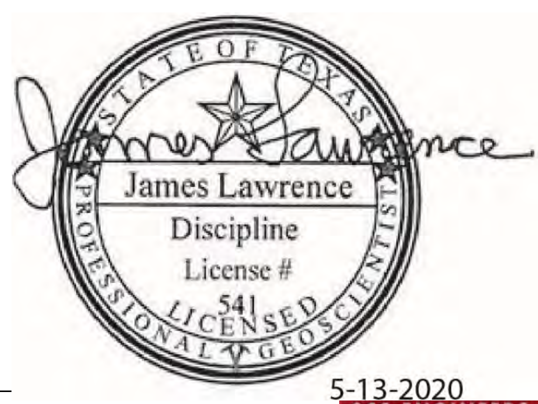
Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019
PZ-1	24.92	25.42	25.67	25.58	25.84	26.30	26.70	26.73	27.00	27.29	27.26	27.37	27.35	27.60	27.52	27.48	27.53	27.56	27.47
PZ-3	12.97	13.35	13.59	13.54	13.60	N/A	13.89	14.15	14.22	14.44	14.45	14.53	14.60	14.42	14.27	14.27	14.23	14.17	14.09
PZ-8	DRY	0.59	0.57	0.20	0.19	DRY	DRY	0.23	0.22	DRY	0.21	0.22	0.19	DRY	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	31.72	31.61	31.44	31.16	30.00	30.69	30.73	30.64	30.70	30.63	30.70	30.81	30.71	30.67	30.61	30.60	30.60	30.58	30.49
PZ-20	12.64	12.63	12.56	12.49	12.45	DRY	12.32	12.31	12.29	12.24	12.20	12.16	12.14	12.07	12.04	12.03	12.05	12.07	11.99
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	0.16	0.05	DRY	DRY	0.17	0.16	0.16	0.15	0.17	0.15	0.16	DRY	DRY	DRY	DRY	DRY	DRY
PZ-43	DRY	0.16	0.16	0.13	DRY	DRY	DRY	DRY	0.13	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	0.47	0.48	0.53	0.08	DRY	DRY	DRY	DRY	0.04	DRY	DRY	0.05	0.07	DRY	DRY	DRY	DRY	DRY	DRY

Well I.D.	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
PZ-1	27.48	27.39	27.45	27.23	27.38	27.27	26.92	27	27.1	27.15	26.94	26.77	26.96	26.75	26.94	26.84	26.77	26.86
PZ-3	14.07	14.07	14.17	14.17	14.26	14.33	14.32	14.26	14.37	34.45	14.39	14.38	14.48	14.59	14.6	14.61	14.73	14.44
PZ-8	DRY	DRY	DRY	DRY	DRY	DRY	0.21	0.18	0.2	0.19	0.18	0.19	0.2	0.19	0.19	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	30.53	30.53	30.67	30.76	30.95	31.05	31.03	31.05	31.15	31.22	32.23	30.93	31.1	30.85	30.74	30.69	30.41	30.41
PZ-20	11.98	11.94	11.93	11.85	11.86	11.79	11.83	11.72	11.71	11.71	11.7	11.64	11.65	11.62	11.63	11.6	11.54	N/A
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	0.17	0.17	DRY	DRY	DRY	DRY	0.17	DRY	0.16	0.15	0.17	0.16	0.16	0.18	0.17	DRY	DRY	DRY
PZ-43	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	0.11	0.11	0.11	0.11	0.12	0.14	0.12	DRY	DRY	DRY
PZ-47	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Well I.D.	Latitude	Longitude	Ground Surface Elevation (ft msl)	Concrete Slab Elevation (ft msl)	Top of PVC Pipe (ft msl)	Top of Steel Casing Elevation (ft msl)	Total Well Depth (ft below TOC)
PZ-1	31° 42' 16.86706" N	96° 55' 59.13570" W	551.74	552.12	555.12	555.49	42.94
PZ-3	31° 41' 54.27334" N	96° 55' 43.84234" W	541.20	541.58	544.21	545.05	48.00
PZ-8	31° 42' 11.59335" N	96° 55' 12.20821" W	550.34	550.89	553.39	553.74	77.76
PZ-9	31° 42' 10.45884" N	96° 55' 37.43147" W	535.30	535.58	539.44	539.94	37.45
PZ-18	31° 42' 28.96389" N	96° 55' 26.98650" W	534.84	535.23	537.80	538.26	48.81
PZ-20	31° 42' 34.92848" N	96° 55' 14.44772" W	564.68	565.05	567.77	568.35	67.04
PZ-33	31° 42' 00.00182" N	96° 55' 14.53975" W	539.20	539.57	542.49	542.89	57.59
PZ-41	31° 42' 10.66572" N	96° 54' 59.07613" W	534.62	535.03	538.04	538.39	51.80
PZ-43	31° 42' 20.55019" N	96° 55' 01.03302" W	548.86	549.20	551.31	552.07	50.57
PZ-47	31° 42' 04.14903" N	96° 55' 28.39274" W	532.48	532.89	536.16	536.59	33.97

APPENDIX III-4.L

VIBRATING WIRE PIEZOMETER HISTORIC WATER LEVEL DATA



5-13-2020

Appendix III-4.L: Vibrating Wire Piezometer Historic Water Level Data

Reading (Dg)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019
VWP-1	——	7948.2	7948.7	7949.2	7950.2	7952.6	7952.7	7954.5	7959.1	7960.2	7965.5	7941.4	7973.3	7981.3	7980.2	7978.7	7982.5	7990.5
VWP-3	——	8684.3	8682.5	8673.1	8652.7	8642.8	8583.1	8562.5	8552.5	8548.8	8547.2	8545.2	8539.6	8541.9	8539.0	8540.1	8538.3	8540.4
VWP-4	——	8716.0	8717.2	8717.8	8718.8	8720.7	8717.0	8718.1	8717.5	8715.1	8718.6	8720.3	8713.6	8723	8716.2	8708.5	8708.8	8717
VWP-8	——	8690.2	8691.1	8691.3	8692.6	8694.8	8689.9	8691.3	8690.0	8687.3	8690.7	8693.3	8686.8	8696.6	8688.4	8681.2	8681.9	8689.2
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-9	——	8599.6	8600.6	8601.4	8601.7	8603.9	8600.8	8599.5	8600.4	8598.3	8600.9	8603.2	8597.4	8605.5	8599.2	8591.1	8591.9	8600.3
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-18	8599.2	8467.5	8458.0	8449.0	8435.3	8404.8	8351.2	8303.2	8271.7	8248.4	8231.2	8217	8199.5	8187.3	8174.3	8163.9	8157.1	8152.1
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-19	8812.8	8814.8	8815.0	8815.2	8815.5	8815.8	8816.2	8816.9	8815.5	8815.3	8814.8	8815.8	8815.1	8815.6	8815.6	8811.7	8809.9	8813.7
VWP-20	8576.4	8570.1	8569.5	8568.8	8568.2	8566.3	8561.8	8558.6	8555.0	8552.3	8550.1	8587.9	8672.3	8715.2	8743.6	8751.9	8754.9	8763.4
VWP-25	——	8766.4	8767.7	8768.4	8768.5	8770.5	8766.6	8765.5	8766.7	8764.3	8767.4	8769.5	8762.9	8771.3	8765.0	8757.5	8758.2	8765.6
VWP-26	8645.4	8648.0	8648.4	8648.6	8649.7	8651.7	8647.0	8648.0	8646.8	8644.3	8646.8	8649.4	8643.0	8652.7	8644.4	8637.4	8637.9	8645.1
VWP-27	8618.6	8620.8	8621.4	8622.0	8622.6	8624.6	8619.4	8620.7	8619.8	8617.5	8620.5	8622.5	8616.5	8625.7	8618.4	8610.7	8611.2	8619.1
VWP-30	8779.3	8692.9	8691.1	8690.5	8689.6	8689.8	8689.9	8688.8	8688.6	8686.6	8689.5	8691.2	8684.8	8692.9	8688.4	8679.3	8679.8	8686.8
VWP-33	——	8625.2	8626.2	8627.3	8629.9	8633.5	8630.3	8634.2	8634.6	8633.5	8638.6	8639.5	8620.7	8631.7	8622.5	8614.3	8614.6	8624.1
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-41	8628.6	8631.7	8632.7	8632.9	8633.8	8636.3	8631.5	8632.6	8631.8	8629.4	8632.9	8635.3	8629.0	8638.4	8630.8	8623.8	8624.3	8631.7
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	8788.2	8717.3	8730.9	8739.7	8715.6	8692.4
VWP-43	8641.7	8643.8	8644.3	8645.2	8645.4	8647.1	8643.8	8644.0	8643.8	8641.8	8644.6	8646.3	8640.6	8648.4	8642.4	8634.7	8635.4	8643.5
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-44	——	8661.3	8656.4	8652.5	8646.3	8633.6	8609.6	8585.6	8569.9	8557.7	8548.5	8542.1	8535.2	8532.3	8529.8	8528.5	8528.4	8529
VWP-47	——	8718.1	8718.9	8719.1	8719.9	8722.8	8718.9	8718.8	8718.7	8716.3	8719.2	8721.1	8715.4	8723	8716.7	8709	8709.3	8717.2
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	8801.7	8673.1	8596.5	8556.3	8534.6	8517.5

VWP ID	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
VWP-1	7999.3	——	——	——	——	7998.3	——	——	——	7996.6	——	8004.3	8003.8	8011.9	8011.7	8016.0	8020.7
VWP-3	8543.8	——	——	——	——	8538.7	——	——	——	8541.3	——	8542.3	8537.1	8541.3	8539.9	8537.6	8535.5
VWP-4	8717.5	——	——	——	——	8714.4	——	——	——	8708	——	8714.9	8709.9	8719.1	8716.7	8716.7	8719.3
VWP-8	8690.4	——	——	——	——	8687.6	——	——	——	8681.4	——	8689.1	8682.5	8693.2	8690.1	8689.2	8692.4
VWP-8D	——	——	——	8929.3	8942.3	8762.4	8739.4	8637	8563.8	8399.3	8380.9	8121.1	6927.9	6688.5	6570.0	6411.4	6299.4
VWP-9	8600.3	——	——	——	——	8592.7	——	——	——	8590.7	——	8598.2	8593.2	8601.1	8599.0	8599.5	8601.5
VWP-9D	——	——	——	——	——	——	8712.3	6743.6	5978.5	5890.9	5830.6	5739.9	5669.8	5664.2	5654.6	5642.3	5625.6
VWP-18	8144.3	——	——	——	——	8098.2	——	——	——	8143.3	——	8151.6	8160.2	8160.4	8160.9	8160.2	8157.1
VWP-18D	——	——	——	——	——	——	——	——	——	6433.5	6572.6	6743.7	6796.6	6784.6	6764.6	6669.5	6514.2
VWP-19	8814	——	——	——	——	8811.1	——	——	——	8809.3	——	8812.2	8812.2	8813.8	8813.7	8814.2	8816.8
VWP-20	8766.3	——	——	——	——	8765.3	——	——	——	8765.9	——	8764.8	8770.7	8767.4	8768.5	8769.5	8769.4
VWP-25	8765.8	——	——	——	——	8758.3	——	——	——	8756.2	——	8763.7	8758.5	8767.6	8764.5	8764.8	8766.6
VWP-26	8646	——	——	——	——	8642.8	——	——	——	8637.1	——	8644.1	8637.8	8647.8	8644.9	8644.6	8647.4
VWP-27	8619.8	——	——	——	——	8617.2	——	——	——	8610.7	——	8617.8	8611.6	8621.4	8618.9	8618.8	8621.4
VWP-30	8687.5	——	——	——	——	8684.6	——	——	——	8679.2	——	8686	8680.8	8689.7	8687.5	8685.2	8599.3
VWP-33	8624.6	——	——	——	——	8621.6	——	——	——	8614.3	——	8622.9	8616.4	8627.5	8624.8	8624.3	8627.3
VWP-33D	——	——	8958	8953.7	8965.7	8957	8955.5	8945	8935.6	8860.3	8856.3	8844.5	8817.3	8808.1	8801.7	8783.2	8765.6
VWP-41	8632.7	——	——	——	——	8629.5	——	——	——	8624.1	——	8630.8	8625.6	8634.9	8632.4	8632.1	8635.2
VWP-41D	8660.7	——	——	——	——	8634.7	——	——	——	8613.9	——	8599.5	8570.7	8558.2	8544.1	8504.1	8441.0
VWP-43	8644.1	——	——	——	——	8641.1	——	——	——	8635.1	——	8642.5	8636.3	8645.4	8643.8	8643.3	8645.5
VWP-43D	——	8871.2	8874.3	8870.9	8881.9	8872.7	8883.1	8874.7	8736.7	6716.3	6916.7	7132.4	7099.7	7039.9	6961.8	6755.9	6534.9
VWP-44	8531.6	——	——	——	——	8534.5	——	——	——	8560.7	——	8565.9	8569.3	8566.3	8567.1	8569.3	8568.7
VWP-47	8717.5	——	——	——	——	8709.6	——	——	——	8708.2	——	8715.7	8710.3	8719.4	8716.5	8717.5	8719.6
VWP-47D	8495.5	——	——	——	——	8482.8	——	——	——	8474	——	8470.2	8463.2	8461.7	8461.5	8466.1	8479.8

Temperature (˚C)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019
VWP-1	——	21.5	21.5	21.5	21.5	21.5	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.3	21.3	21.3	21.4	21.4
VWP-3	——	21.5	21.6	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.5
VWP-4	——	20.8	20.8	20.8	20.8	20.7	20.8	20.8	20.8	20.8	20.8	20.9	21.0	21	21.1	21.2	21.2	21.3
VWP-8	——	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20	20.0	20	20.0	20	20.0	20
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-9	——	21.2	21.1	21.2	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.2	21.2	21.1	21.2
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-18	20.8	20.8	20.8	20.7	20.7	20.8	20.8	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.6	20.7
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-19	21.7	21.6	21.7	21.7	21.7	21.7	21.6	21.7	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
VWP-20	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7
VWP-25	——	19.5	19.4	19.5	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5
VWP-26	19.7	19.7	19.6	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.8	19.9	20	20.0	20.1	20.1	20.1
VWP-27	20.8	20.8	20.8	20.8	20.8	20.7	20.8	20.7	20.8	20.8	20.8	20.8	20.8	20.9	20.9	21	21.0	21.1
VWP-30	20.3	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.1	20.1	20.1	20.2	20.1
VWP-33	——	21.6	21.6	21.6	21.5	21.5	21.5	21.4	21.5	21.5	21.5	21.5	21.4	21.4	21.5	21.5	21.4	21.5
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-41	19.7	19.7	19.7	19.6	19.7	19.7	19.7	19.7	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.7	19.6	19.6
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	21.7	21.4	21.4	21.3	21.3	21.4
VWP-43	20.4	20.4	20.3	20.3	20.3	20.3	20.3	20.2	20.2	20.3	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-44	——	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.0	22.1	22.1	22.1	22.1	22.1	22	22.0	22.1
VWP-47	——	19.4	19.4	19.4	19.4	19.4	19.5	19.6	19.6	19.9	20.0	20.2	20.5	20.7	20.9	21.1	21.1	21.3
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	22.1	21.3	21.2	21.2	21.2	21.2

VWP ID	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
VWP-1	21.5	——	——	——	——	21.4	——	——	——	21.4	——	21.4	21.5	21.4	21.4	21.5	21.5
VWP-3	21.4	——	——	——	——	21.4	——	——	——	21.4	——	21.5	21.5	21.5	21.5	21.4	21.5
VWP-4	21.3	——	——	——	——	21.3	——	——	——	21.4	——	21.4	21.5	21.4	21.4	21.4	21.4
VWP-8	20.0	——	——	——	——	20	——	——	——	20	——	20	20	20.0	20.0	20.0	20.0
VWP-8D	——	——	——	22.7	22	21.9	21.9	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.7	21.8
VWP-9	21.4	——	——	——	——	21.2	——	——	——	21.3	——	21.3	21.3	21.3	21.3	21.4	21.5
VWP-9D	——	——	——	——	——	——	22.4	22.5	22.4	22.5	22.5	22.4	22.5	22.5	22.5	22.5	22.5
VWP-18	20.7	——	——	——	——	20.7	——	——	——	20.7	——	20.7	20.7	20.7	20.8	20.8	20.8
VWP-18D	——	——	——	——	——	——	——	——	——	22.7	22.4	22.4	22.2	22.3	22.3	22.2	22.2
VWP-19	21.6	——	——	——	——	21.6	——	——	——	21.6	——	21.6	21.6	21.5	21.7	21.6	21.6
VWP-20	21.7	——	——	——	——	21.8	——	——	——	21.7	——	21.7	21.7	21.7	21.7	21.7	21.7
VWP-25	19.6	——	——	——	——	19.5	——	——	——	19.5	——	19.6	19.6	20.2	19.7	19.6	19.7
VWP-26	20.2	——	——	——	——	20.3	——	——	——	20.3	——	20.3	20.4	20.4	20.5	20.5	20.5
VWP-27	21.1	——	——	——	——	21.2	——	——	——	21.2	——	21.3	21.4	21.3	21.3	21.4	21.4
VWP-30	20.1	——	——	——	——	20.1	——	——	——	20.1	——	20.1	20.1	20.2	20.2	20.2	20.2
VWP-33	21.4	——	——	——	——	21.4	——	——	——	21.5	——	21.5	21.5	21.5	21.5	21.4	21.5
VWP-33D	——	——	23.5	22.7	22.4	22.3	22.3	22.2	22.3	22.2	22.2	22.2	22.1	22.2	22.2	22.1	22.1
VWP-41	19.6	——	——	——	——	19.6	——	——	——	19.6	——	19.6	19.7	19.6	19.6	19.6	19.7
VWP-41D	21.4	——	——	——	——	21.3	——	——	——	21.2	——	21.3	21.3	21.3	21.3	21.3	21.3
VWP-43	20.2	——	——	——	——	20.2	——	——	——	20.2	——	20.2	20.2	20.2	20.2	20.3	20.3
VWP-43D	——	22.4	22.1	22	21.9	21.9	21.9	21.8	21.9	21.8	21.9	21.8	21.8	21.8	21.8	21.8	21.8
VWP-44	22.0	——	——	——	——	22.1	——	——	——	22	——	22	22	22.0	22.0	22.0	22.0
VWP-47	21.3	——	——	——	——	21.3	——	——	——	21.3	——	21.3	21.2	21.2	21.0	20.8	20.5
VWP-47D	21.1	——	——	——	——	21.2	——	——	——	21.1	——	21.2	21.1	21.2	21.2	21.1	21.1

Pressure (PSI)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019
VWP-1	——	8.929532	8.922337	8.915142	8.900752	8.866216	8.8653932	8.8394912	8.7732972	8.7574682	8.6812012	9.0280002	8.5689592	8.4544554	8.4702844	8.4918694	8.4365712	8.3214512
VWP-3	——	0.148887	0.176508	0.331783	0.664915	0.826582	1.801483	2.137881	2.301181	2.361602	2.389503	2.422163	2.513611	2.476052	2.523409	2.505446	2.53484	2.498774
VWP-4	——	-0.033429	-0.053193	-0.063075	-0.079545	-0.109845	-0.049899	-0.068016	-0.058134	-0.018606	-0.076251	-0.105243	0.004113	-0.150705	-0.039702	0.086124	0.081183	-0.054864
VWP-8	——	0.027982	0.013627	0.010437	-0.010298	-0.045388	0.032767	0.010437	0.031172	0.074237	0.020007	-0.021463	0.082212	-0.074098	0.056692	0.171532	0.160367	0.043932
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-9	——	-0.017939	-0.033995	-0.049025	-0.052992	-0.090986	-0.037449	-0.014998	-0.030541	0.005726	-0.039176	-0.078897	0.021269	-0.118618	-0.011031	0.128856	0.116254	-0.030028
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-18	2.640668	4.871666	5.032596	5.186319	5.418397	5.933804	6.841788	7.656171	8.189781	8.584483	8.875851	9.116399	9.412849	9.619517	9.839737	10.015913	10.132368	10.215805
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-19	-0.39417	-0.42593	-0.430932	-0.434274	-0.439287	-0.4443	-0.449324	-0.462681	-0.437627	-0.434285	-0.42593	-0.44264	-0.430943	-0.439298	-0.439298	-0.374129	-0.344051	-0.407549
VWP-20	3.149094	3.25128	3.261012	3.272366	3.282098	3.312916	3.385906	3.43781	3.496202	3.539996	3.57568	2.962564	1.593596	0.897758	0.43711	0.302484	0.253824	0.115954
VWP-25		-0.041373	-0.062892	-0.075833	-0.076676	-0.111136	-0.043939	-0.024986	-0.045662	-0.00431	-0.057723	-0.093906	0.019812	-0.12492	-0.016371	0.112854	0.099913	-0.027589
VWP-26	-0.0795304	-0.123938	-0.130313	-0.134186	-0.152974	-0.1871344	-0.1068584	-0.1239384	-0.103442	-0.0607424	-0.1034424	-0.148308	-0.0394536	-0.2055872	-0.0638232	0.0552792	0.0467392	-0.0762368
VWP-27	-0.097272	-0.133506	-0.143388	-0.15327	-0.163152	-0.194625	-0.110448	-0.130392	-0.117036	-0.079155	-0.128565	-0.161505	-0.062685	-0.215676	-0.095445	0.029907	0.021672	-0.109908
VWP-30	-1.67265	-0.162999	-0.131571	-0.121095	-0.105381	-0.108873	-0.110619	-0.091413	-0.087921	-0.053001	-0.103635	-0.133317	-0.021573	-0.161892	-0.083322	0.075564	0.065727	-0.055386
VWP-33	——	-0.05623	-0.07105	-0.087352	-0.125089	-0.1784412	-0.1310172	-0.1880208	-0.194743	-0.1784412	-0.2540232	-0.2673612	0.0120492	-0.1509708	-0.0154212	0.1061028	0.1024512	-0.0391332
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-41	0.087249	0.035634	0.018984	0.017043	0.000669	-0.040956	0.038964	0.020649	0.035358	0.075318	0.017043	-0.022917	0.081978	-0.074532	0.052008	0.167169	0.160233	0.037023
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	3.121894	4.289133	4.066093	3.923266	4.318506	4.697493
VWP-43	-0.001269	-0.036486	-0.04332	-0.058413	-0.061767	-0.090276	-0.034935	-0.036738	-0.033384	-0.001395	-0.0468	-0.075309	0.02028	-0.110526	-0.009906	0.119223	0.107484	-0.028353
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-44	——	1.9263516	2.0108766	2.0781516	2.1851016	2.4041766	2.8181766	3.2321766	3.5030016	3.7140882	3.8721516	3.9825516	4.1015766	4.1516016	4.1947266	4.2177882	4.2195132	4.2085266
VWP-47	——	-0.017259	-0.030883	-0.034289	-0.047913	-0.0973	-0.032353	-0.03212	-0.030417	0.006045	-0.044812	-0.080109	0.012552	-0.119816	-0.015467	0.112724	0.107615	-0.029862
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	1.938147	3.987437	5.201709	5.838075	6.181586	6.452279

VWP ID	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
VWP-1	8.194203	——	——	——	——	8.2092092	——	——	——	8.2336722	——	8.1228692	8.129448	8.0135052	8.0163832	7.95389	7.886257
VWP-3	2.445025	——	——	——	——	2.528308	——	——	——	2.48585	——	2.467747	2.552663	2.484077	2.506939	2.546271	2.578791
VWP-4	-0.063099	——	——	——	——	-0.012042	——	——	——	0.092373	——	-0.02127	0.060087	-0.090444	-0.050916	-0.050916	-0.093738
VWP-8	0.024792	——	——	——	——	0.069452	——	——	——	0.168342	——	0.045527	0.150797	-0.019868	0.029577	0.043932	-0.007108
VWP-8D	——	——	——	0.108153	-0.088872	2.883792	3.263522	4.956661	6.165193	8.881088	9.184872	13.47417	33.173902	37.126396	39.082831	41.703832	43.550437
VWP-9	-0.032456	——	——	——	——	0.101224	——	——	——	0.13455	——	0.005025	0.091375	-0.045058	-0.008791	-0.01864	-0.054394
VWP-9D	——	——	——	——	——	——	5.41438	34.627304	45.983972	47.281372	48.176224	49.524796	50.562496	50.6456	50.788064	50.970596	51.218424
VWP-18	10.347937	——	——	——	——	11.128871	——	——	——	10.364877	——	10.224275	10.078591	10.075203	10.06547	10.077328	10.129842
VWP-18D	——	——	——	——	——	——	——	——	——	37.45382	35.451316	32.978921	32.21951	32.390413	32.679413	34.056105	36.30019
VWP-19	-0.412562	——	——	——	——	-0.364103	——	——	——	-0.334025	——	-0.382484	-0.382484	-0.40756	-0.409209	-0.415904	-0.45935
VWP-20	0.068916	——	——	——	——	0.083276	——	——	——	0.075404	——	0.093246	-0.002452	0.051074	0.033232	0.017012	0.018634
VWP-25	-0.031915	——	——	——	——	0.09819	——	——	——	0.134373	——	0.004268	0.093864	-0.068209	-0.010396	-0.014685	-0.046579
VWP-26	-0.0920664	——	——	——	——	-0.037868	——	——	——	0.059488	——	-0.060072	0.0470744	-0.123726	-0.0746512	-0.0695272	-0.1173512
VWP-27	-0.121437	——	——	——	——	-0.080082	——	——	——	0.026973	——	-0.091431	0.009216	-0.150723	-0.109548	-0.109368	-0.15219
VWP-30	-0.067608	——	——	——	——	-0.016974	——	——	——	0.07731	——	-0.041418	0.049374	-0.107127	-0.068715	-0.028557	1.471257
VWP-33	-0.0457488	——	——	——	——	-0.0012888	——	——	——	0.1061028	——	-0.0213492	0.0749808	-0.089521	-0.0495072	-0.0413028	-0.0865572
VWP-33D	——	——	0.063913	0.13962	-0.044481	0.092399	0.115814	0.280792	0.426453	1.602959	1.665399	1.849597	2.275262	2.417801	2.517705	2.807563	3.082299
VWP-41	0.020373	——	——	——	——	0.073653	——	——	——	0.163563	——	0.052008	0.137199	-0.016257	0.025368	0.030363	-0.022641
VWP-41D	5.217373	——	——	——	——	5.645266	——	——	——	5.987879	——	6.222546	6.694866	6.899866	7.131106	7.787106	8.821946
VWP-43	-0.038415	——	——	——	——	0.011895	——	——	——	0.112515	——	-0.011583	0.092391	-0.060216	-0.033384	-0.02655	-0.063444
VWP-43D	——	0.15444	0.114825	0.169716	0.003423	0.144735	-0.015009	0.116682	2.233695	33.269706	30.188895	26.87841	27.380682	28.29921	29.498826	32.66145	36.05601
VWP-44	4.1643132	——	——	——	——	4.1136516	——	——	——	3.6623382	——	3.5726382	3.5139882	3.5657382	3.5519382	3.5139882	3.5243382
VWP-47	-0.034971	——	——	——	——	0.099566	——	——	——	0.123408	——	-0.004317	0.089115	-0.065858	-0.013531	-0.027621	-0.058974
VWP-47D	6.802233	——	——	——	——	7.00158	——	——	——	7.142578	——	7.201038	7.313542	7.335593	7.338759	7.267635	7.050764

Pressure Head (feet H_2O)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019
VWP-1	——	20.63	20.62	20.60	20.57	20.49	20.49	20.43	20.27	20.24	20.06	20.86	19.80	19.54	19.57	19.62	19.50	19.23
VWP-3	——	0.34	0.41	0.77	1.54	1.91	4.16	4.94	5.32	5.46	5.52	5.60	5.81	5.72	5.83	5.79	5.86	5.77
VWP-4	——	-0.08	-0.12	-0.15	-0.18	-0.25	-0.12	-0.16	-0.13	-0.04	-0.18	-0.24	0.01	-0.35	-0.09	0.20	0.19	-0.13
VWP-8	——	0.06	0.03	0.02	-0.02	-0.10	0.08	0.02	0.07	0.17	0.05	-0.05	0.19	-0.17	0.13	0.40	0.37	0.10
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-9	——	-0.04	-0.08	-0.11	-0.12	-0.21	-0.09	-0.03	-0.07	0.01	-0.09	-0.18	0.05	-0.27	-0.03	0.30	0.27	-0.07
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-18	6.10	11.26	11.63	11.98	12.52	13.71	15.81	17.69	18.92	19.84	20.51	21.07	21.75	22.23	22.74	23.14	23.41	23.61
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-19	-0.91	-0.98	-1.00	-1.00	-1.02	-1.03	-1.04	-1.07	-1.01	-1.00	-0.98	-1.02	-1.00	-1.02	-1.02	-0.86	-0.80	-0.94
VWP-20	7.28	7.51	7.54	7.56	7.58	7.66	7.82	7.94	8.08	8.18	8.26	6.85	3.68	2.07	1.01	0.70	0.59	0.27
VWP-25	——	-0.10	-0.15	-0.18	-0.18	-0.26	-0.10	-0.06	-0.11	-0.01	-0.13	-0.22	0.05	-0.29	-0.04	0.26	0.23	-0.06
VWP-26	-0.18	-0.29	-0.30	-0.31	-0.35	-0.43	-0.25	-0.29	-0.24	-0.14	-0.24	-0.34	-0.09	-0.48	-0.15	0.13	0.11	-0.18
VWP-27	-0.22	-0.31	-0.33	-0.35	-0.38	-0.45	-0.26	-0.30	-0.27	-0.18	-0.30	-0.37	-0.14	-0.50	-0.22	0.07	0.05	-0.25
VWP-30	-3.87	-0.38	-0.30	-0.28	-0.24	-0.25	-0.26	-0.21	-0.20	-0.12	-0.24	-0.31	-0.05	-0.37	-0.19	0.17	0.15	-0.13
VWP-33	——	-0.13	-0.16	-0.20	-0.29	-0.41	-0.30	-0.43	-0.45	-0.41	-0.59	-0.62	0.03	-0.35	-0.04	0.25	0.24	-0.09
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-41	0.20	0.08	0.04	0.04	0.00	-0.09	0.09	0.05	0.08	0.17	0.04	-0.05	0.19	-0.17	0.12	0.39	0.37	0.09
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	7.21	9.91	9.40	9.07	9.98	10.85
VWP-43	0.00	-0.08	-0.10	-0.13	-0.14	-0.21	-0.08	-0.08	-0.08	0.00	-0.11	-0.17	0.05	-0.26	-0.02	0.28	0.25	-0.07
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-44	——	4.45	4.65	4.80	5.05	5.56	6.51	7.47	8.09	8.58	8.95	9.20	9.48	9.59	9.69	9.75	9.75	9.73
VWP-47	——	-0.04	-0.07	-0.08	-0.11	-0.22	-0.07	-0.07	-0.07	0.01	-0.10	-0.19	0.03	-0.28	-0.04	0.26	0.25	-0.07
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	4.48	9.21	12.02	13.49	14.28	14.91

VWP ID	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
VWP-1	18.94	——	——	——	——	18.97	——	——	——	19.03	——	18.77	18.79	18.52	18.52	18.38	18.22
VWP-3	5.65	——	——	——	——	5.84	——	——	——	5.74	——	5.70	5.90	5.74	5.79	5.88	5.96
VWP-4	-0.15	——	——	——	——	-0.03	——	——	——	0.21	——	-0.05	0.14	-0.21	-0.12	-0.12	-0.22
VWP-8	0.06	——	——	——	——	0.16	——	——	——	0.39	——	0.11	0.35	-0.05	0.07	0.10	-0.02
VWP-8D	——	——	——	0.25	-0.21	6.66	7.54	11.45	14.25	20.52	21.22	31.14	76.66	85.79	90.31	96.37	100.64
VWP-9	-0.07	——	——	——	——	0.23	——	——	——	0.31	——	0.01	0.21	-0.10	-0.02	-0.04	-0.13
VWP-9D	——	——	——	——	——	——	12.51	80.02	106.26	109.26	111.33	114.44	116.84	117.03	117.36	117.78	118.36
VWP-18	23.91	——	——	——	——	25.72	——	——	——	23.95	——	23.63	23.29	23.28	23.26	23.29	23.41
VWP-18D	——	——	——	——	——	——	——	——	——	86.55	81.92	76.21	74.45	74.85	75.52	78.70	83.88
VWP-19	-0.95	——	——	——	——	-0.84	——	——	——	-0.77	——	-0.88	-0.88	-0.94	-0.95	-0.96	-1.06
VWP-20	0.16	——	——	——	——	0.19	——	——	——	0.17	——	0.22	-0.01	0.12	0.08	0.04	0.04
VWP-25	-0.07	——	——	——	——	0.23	——	——	——	0.31	——	0.01	0.22	-0.16	-0.02	-0.03	-0.11
VWP-26	-0.21	——	——	——	——	-0.09	——	——	——	0.14	——	-0.14	0.11	-0.29	-0.17	-0.16	-0.27
VWP-27	-0.28	——	——	——	——	-0.19	——	——	——	0.06	——	-0.21	0.02	-0.35	-0.25	-0.25	-0.35
VWP-30	-0.16	——	——	——	——	-0.04	——	——	——	0.18	——	-0.10	0.11	-0.25	-0.16	-0.07	3.40
VWP-33	-0.11	——	——	——	——	0.00	——	——	——	0.25	——	-0.05	0.17	-0.21	-0.11	-0.10	-0.20
VWP-33D	——	——	0.15	0.32	-0.10	0.21	0.27	0.65	0.99	3.70	3.85	4.27	5.26	5.59	5.82	6.49	7.12
VWP-41	0.05	——	——	——	——	0.17	——	——	——	0.38	——	0.12	0.32	-0.04	0.06	0.07	-0.05
VWP-41D	12.06	——	——	——	——	13.05	——	——	——	13.84	——	14.38	15.47	15.94	16.48	17.99	20.39
VWP-43	-0.09	——	——	——	——	0.03	——	——	——	0.26	——	-0.03	0.21	-0.14	-0.08	-0.06	-0.15
VWP-43D	——	0.36	0.27	0.39	0.01	0.33	-0.03	0.27	5.16	76.88	69.76	62.11	63.27	65.39	68.17	75.47	83.32
VWP-44	9.62	——	——	——	——	9.51	——	——	——	8.46	——	8.26	8.12	8.24	8.21	8.12	8.14
VWP-47	-0.08	——	——	——	——	0.23	——	——	——	0.29	——	-0.01	0.21	-0.15	-0.03	-0.06	-0.14
VWP-47D	15.72	——	——	——	——	16.18	——	——	——	16.51	——	16.64	16.90	16.95	16.96	16.79	16.29

Inferred Groundwater Elevation (ft MSL)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019
VWP-1	——	543.1	543.1	543.1	543.1	543.0	543.0	542.9	542.8	542.7	542.6	543.4	542.3	542.0	542.1	542.1	542.0	541.7
VWP-3	——	506.9	507.0	507.4	508.1	508.5	510.8	511.5	511.9	512.1	512.1	512.2	512.4	512.3	512.4	512.4	512.5	512.4
VWP-4	——	526.9	526.9	526.9	526.8	526.7	526.9	526.8	526.9	527.0	526.8	526.8	527.0	526.7	526.9	527.2	527.2	526.9
VWP-8	——	486.4	486.3	486.3	486.3	486.2	486.4	486.3	486.4	486.5	486.3	486.3	486.5	486.1	486.4	486.7	486.7	486.4
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-9	——	506.9	506.8	506.8	506.8	506.7	506.8	506.9	506.8	506.9	506.8	506.7	506.9	506.6	506.9	507.2	507.2	506.8
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
VWP-18	505.7	510.9	511.2	511.6	512.1	513.3	515.4	517.3	518.5	519.4	520.1	520.7	521.4	521.8	522.3	522.7	523.0	523.2

VWP ID	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020
VWP-1	541.4	——	——	——	——	541.5	——	——	——	541.5	——	541.3	541.3	541.0	541.0	540.9	540.7
VWP-3	512.2	——	——	——	——	512.4	——	——	——	512.3	——	512.3	512.5	512.3	512.4	512.5	512.6
VWP-4	526.9	——	——	——	——	527.0	——	——	——	527.2	——	527.0	527.1	526.8	526.9	526.9	526.8
VWP-8	486.4	——	——	——	——	486.5	——	——	——	486.7	——	486.4	486.6	486.3	486.4	486.4	486.3
VWP-8D	——	——	——	400.2	399.8	406.7	407.5	411.5	414.2	420.5	421.2	431.1	476.7	485.8	490.3	496.4	500.6
VWP-9	506.8	——	——	——	——	507.1	——	——	——	507.2	——	506.9	507.1	506.8	506.9	506.9	506.8
VWP-9D	——	——	——	——	——	——	412.5	480.0	506.3	509.3	511.3	514.4	516.8	517.0	517.4	517.8	518.4
VWP-18	523.5	——	——	——	——	525.3	——	——	——	523.6	——	523.2	522.9	522.9	522.9	522.9	523.0

VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	486.5	481.9	476.2	474.5	474.8	475.5	478.7	483.9
VWP-19	510.1	510.0	510.0	510.0	510.0	510.0	510.0	509.9	510.0	510.0	510.0	510.0	510.0	510.0	510.0	510.1	510.2	510.1	510.0	——	——	——	——	510.2	——	——	——	510.2	——	510.1	510.1	510.1	510.1	510.0	509.9
VWP-20	517.4	517.6	517.6	517.7	517.7	517.8	517.9	518.0	518.2	518.3	518.4	516.9	513.8	512.2	511.1	510.8	510.7	510.4	510.3	——	——	——	——	510.3	——	——	——	510.3	——	510.3	510.1	510.2	510.2	510.1	510.1
VWP-25	——	504.9	504.9	504.8	504.8	504.7	504.9	504.9	504.9	505.0	504.9	504.8	505.0	504.7	505.0	505.3	505.2	504.9	504.9	——	——	——	——	505.2	——	——	——	505.3	——	505.0	505.2	504.8	505.0	505.0	504.9
VWP-26	505.8	505.7	505.7	505.7	505.6	505.6	505.8	505.7	505.8	505.9	505.8	505.7	505.9	505.5	505.9	506.1	506.1	505.8	505.8	——	——	——	——	505.9	——	——	——	506.1	——	505.9	506.1	505.7	505.8	505.8	505.7
VWP-27	519.8	519.7	519.7	519.6	519.6	519.6	519.7	519.7	519.7	519.8	519.7	519.6	519.9	519.5	519.8	520.1	520.1	519.7	519.7	——	——	——	——	519.8	——	——	——	520.1	——	519.8	520.0	519.7	519.7	519.7	519.6
VWP-30	502.1	505.6	505.7	505.7	505.8	505.7	505.7	505.8	505.8	505.9	505.8	505.7	506.0	505.6	505.8	506.2	506.2	505.9	505.8	——	——	——	——	506.0	——	——	——	506.2	——	505.9	506.1	505.8	505.8	505.9	509.4
VWP-33	——	494.7	494.6	494.6	494.5	494.4	494.5	494.4	494.3	494.4	494.2	494.2	494.8	494.5	494.8	495.0	495.0	494.7	494.7	——	——	——	——	494.8	——	——	——	495.0	——	494.8	495.0	494.6	494.7	494.7	494.6
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	401.1	401.3	400.9	401.2	401.3	401.6	402.0	404.7	404.8	405.3	406.3	406.6	406.8	407.5	408.1
VWP-41	496.6	496.5	496.4	496.4	496.4	496.3	496.5	496.4	496.5	496.6	496.4	496.3	496.6	496.2	496.5	496.8	496.8	496.5	496.4	——	——	——	——	496.6	——	——	——	496.8	——	496.5	496.7	496.4	496.5	496.5	496.3
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	409.2	411.9	411.4	411.1	412.0	412.9	414.1	——	——	——	——	415.0	——	——	——	415.8	——	416.4	417.5	417.9	418.5	420.0	422.4
VWP-43	511.5	511.4	511.4	511.4	511.4	511.3	511.4	511.4	511.4	511.5	511.4	511.3	511.5	511.2	511.5	511.8	511.7	511.4	511.4	——	——	——	——	511.5	——	——	——	511.8	——	511.5	511.7	511.4	511.4	511.4	511.4
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	400.4	400.3	400.4	400.0	400.3	400.0	400.3	405.2	476.9	469.8	462.1	463.3	465.4	468.2	475.5	483.3
VWP-44	——	509.7	509.8	510.0	510.2	510.8	511.7	512.7	513.3	513.8	514.1	514.4	514.7	514.8	514.9	514.9	515.0	514.9	514.8	——	——	——	——	514.7	——	——	——	513.7	——	513.5	513.3	513.4	513.4	513.3	513.3
VWP-47	——	512.4	512.3	512.3	512.3	512.2	512.3	512.3	512.3	512.4	512.3	512.2	512.4	512.1	512.4	512.7	512.6	512.3	512.3	——	——	——	——	512.6	——	——	——	512.7	——	512.4	512.6	512.2	512.4	512.3	512.3
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	404.5	409.2	412.0	413.5	414.3	414.9	415.7	——	——	——	——	416.2	——	——	——	416.5	——	416.6	416.9	417.0	417.0	416.8	416.3

*** Pressure (P, in psi) calculated using the following linear equation provided by Geokon:**

$P = G(R_1 - R_0) + K(T_1 - T_0)$ *$- (S_1 - S_0)$*

where:

G = Linear Gauge Factor (psi/digit)

R_1 = Instrument Reading (digits)

R_0 = Initial Zero Instrument Reading (digits)

T_1 = Temperature Reading (˚C)

T_0 = Initial Zero Temperature Reading (˚C)

K = Thermal Factor (psi/˚C)

S_1 = Measured Barometric pressure (psi)

S_0 = Intiial Zero Barometric pressure (psi)

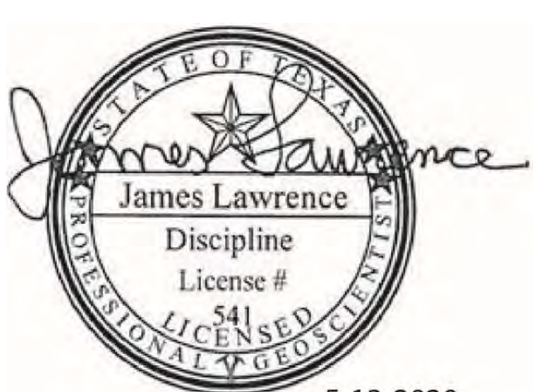
Note: Barometric corrections not performed as VWPs are installed in sealed boreholes, per Geokon Model 4500 Series Instruction Manual, p. 6.

***Note:** Values in **red** represent a zero pressure head. Elevation values in **red** are associated with the subsurface location of the transducer and should **not** be considered an inferred groundwater elevation.

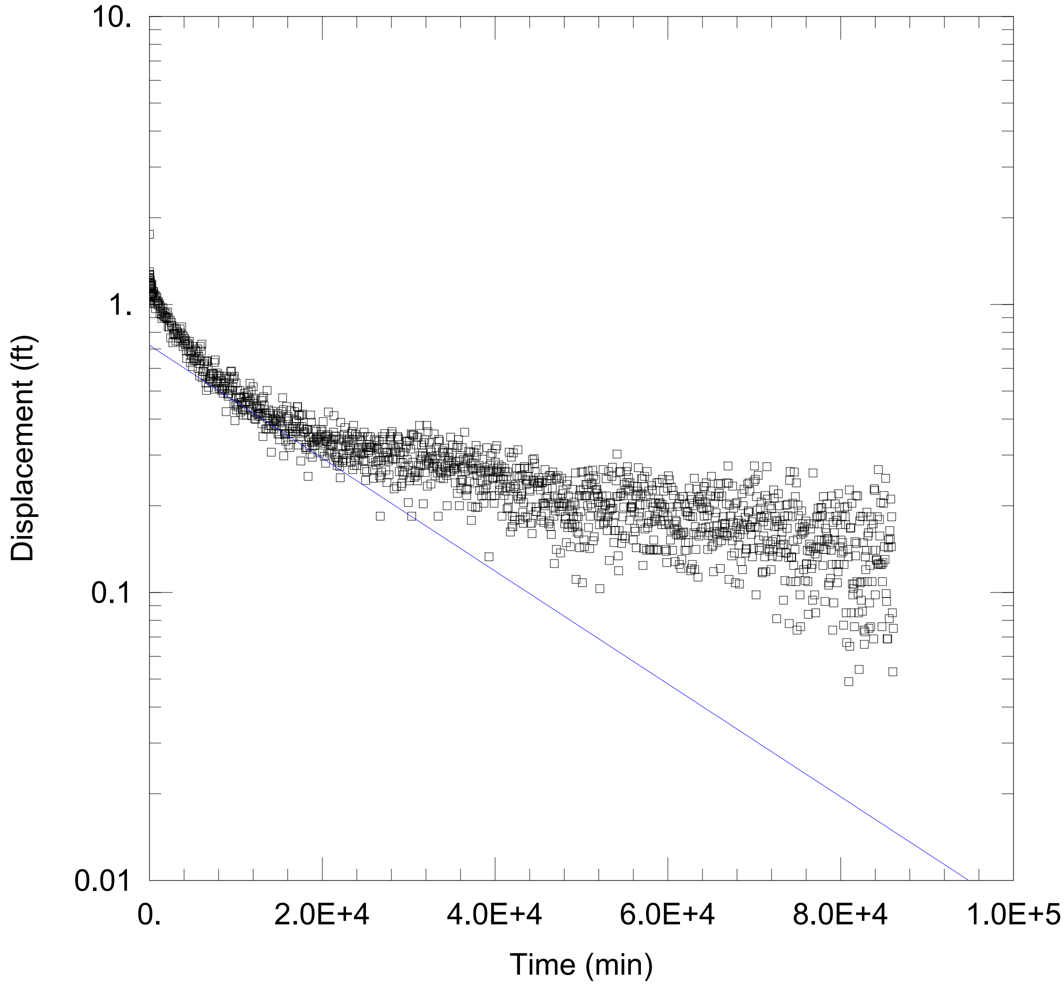
MSW-2400 Vibrating Wire Piezometer (VWP) Reference Information										
VWP ID	**Surface Elevation (ft MSL)**	**VWP Elevation (ft MSL)**	**VWP Depth**	**Serial Number**	**Factory Zero Reading (digits)**	**Factory Zero Temperature (˚C)**	**Field Zero Reading (digits)**	**Field Zero Temperature (˚C)**	**Linear Gauge Factor G (psi/digit)**	**Thermal Factor K (psi/˚C)**
VWP-1	551.40	522.50	28.90	1921455	8572	21.2	8562.1	37.0	-0.01439	-0.006162
VWP-3	540.90	506.60	34.30	1921444	8695	22.2	8678.0	35.7	-0.01633	-0.01773
VWP-4	549.59	527.00	22.59	1921438	8717	22.2	8707.7	31.2	-0.01647	-0.00993
VWP-8	550.90	486.30	64.60	1921442	8691	21.9	8679.2	31.8	-0.01595	-0.01724
VWP-8D	551.00	400.00	151.00	1943860	8928	21.6	8945.6	16.3	-0.01651	-0.02515
VWP-9	535.25	506.90	28.35	1921447	8599	22.2	8593.5	28.4	-0.01727	-0.01214
VWP-9D	535.00	400.00	135.00	1943862	9086	21.9	9082.2	19.5	-0.01484	-0.02584
VWP-18	534.60	499.60	35.00	1921452	8748	21.6	8743.9	35.8	-0.01694	-0.01263
VWP-18D	535.00	400.00	135.00	1943861	9040	21.6	9034.1	17.7	-0.01445	-0.02497
VWP-19	562.10	511.00	51.10	1921454	8816	21.7	8775.8	35.2	-0.01671	-0.01660
VWP-20	564.55	510.10	54.45	1921440	8772	21.7	8756.1	34.3	-0.01622	-0.01860
VWP-25	533.80	505.00	28.80	1921450	8766	21.4	8759.3	28.7	-0.01723	-0.00880
VWP-26	530.50	506.00	24.50	1921453	8649	21.5	8637.1	33.3	-0.01708	-0.004576
VWP-27	546.70	520.00	26.70	1921446	8632	22.0	8610.2	23.6	-0.01647	-0.01467
VWP-30	544.05	506.00	38.05	1921451	8690	22.5	8676.4	31.5	-0.01746	-0.01107
VWP-33	538.60	494.80	43.80	1921439	8627	21.9	8617.6	28.7	-0.01482	-0.00794
VWP-33D	539.00	401.00	138.00	1943866	8963	21.9	8965.6	18.4	-0.01561	-0.01073
VWP-41	534.80	496.40	38.40	1921443	8631	22.0	8627.5	27.3	-0.01665	-0.01389
VWP-41D	535.00	402.00	133.00	1933662	8996	23.2	8975.1	25.5	-0.01640	-0.01493
VWP-43	549.50	511.50	38.00	1921441	8642	21.9	8637.0	25.4	-0.01677	-0.01551
VWP-43D	549.00	400.00	149.00	1943859	8879	22.0	8888.2	18.4	-0.01536	-0.02667
VWP-44	554.35	505.20	49.15	1921448	8781	21.4	8767.4	37.2	-0.01725	-0.006366
VWP-47	532.60	512.40	20.20	1921449	8718	21.6	8708.8	29.0	-0.01703	-0.0147
VWP-47D	532.00	400.00	132.00	1933663	8931	23.2	8923.6	22.6	-0.01583	-0.01694

APPENDIX III-4.M

SLUG TEST DATA



5-13-2020



PZ-1 SLUG IN TEST

Data Set: M:\Projects\Waco\16216088.00 New LF\Site 50\Aquifer Testing\PZ-1\PZ-1 Slug In Test.aqt
Date: 05/09/19 Time: 15:20:07

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-1 Slug In
Test Date: 3/18/2019

AQUIFER DATA

Saturated Thickness: 25.84 ft Anisotropy Ratio (Kz/Kr): 1.

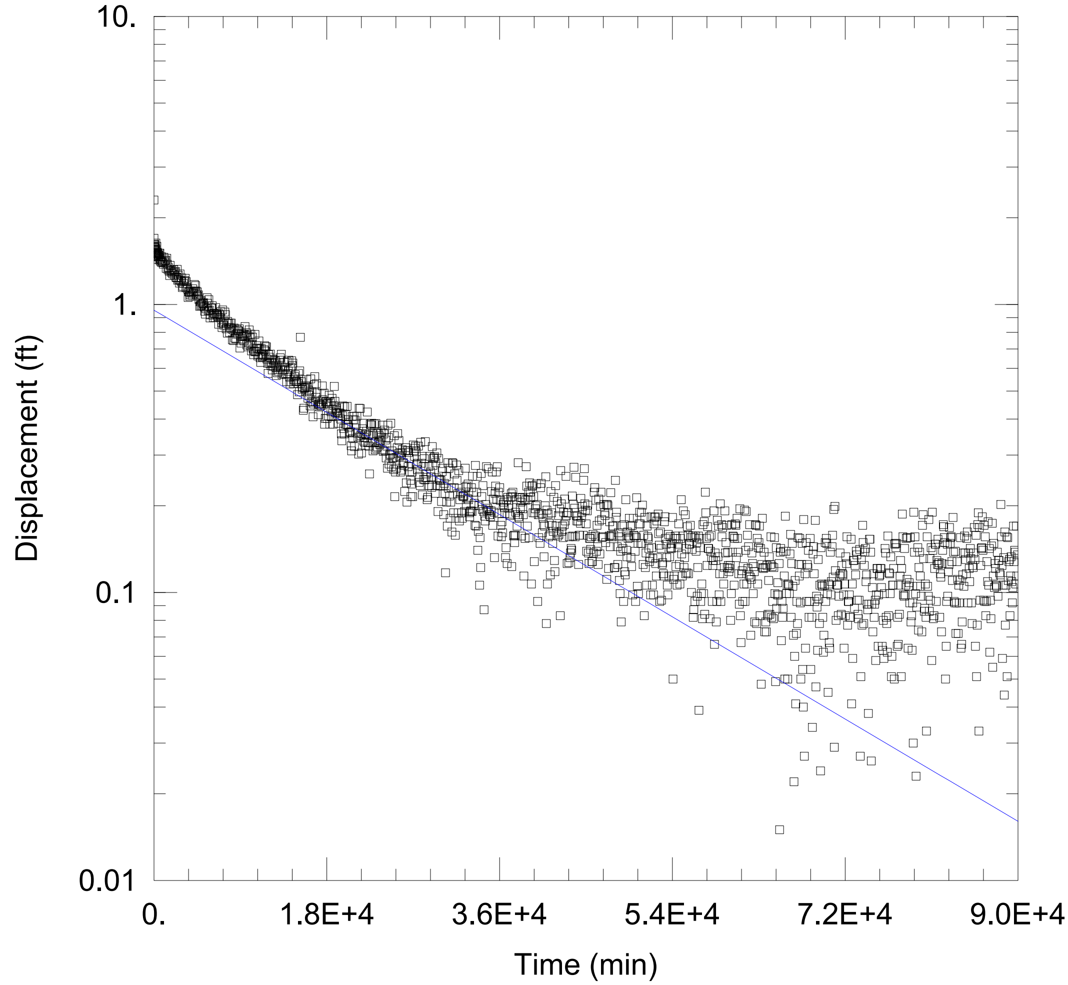
WELL DATA (PZ-1)

Initial Displacement: 1.753 ft
Total Well Penetration Depth: 42.58 ft
Casing Radius: 0.089 ft

Static Water Column Height: 25.84 ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 2.03E-8 cm/sec y0 = 0.7208 ft



PZ-1 SLUG OUT

Data Set: M:\Projects\Waco\16216088.00 New LF\Site 50\Aquifer Testing\PZ-1\PZ-1 slug out.aqt
Date: 05/09/19 Time: 15:20:58

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-1 out
Test Date: 3/20/2019

AQUIFER DATA

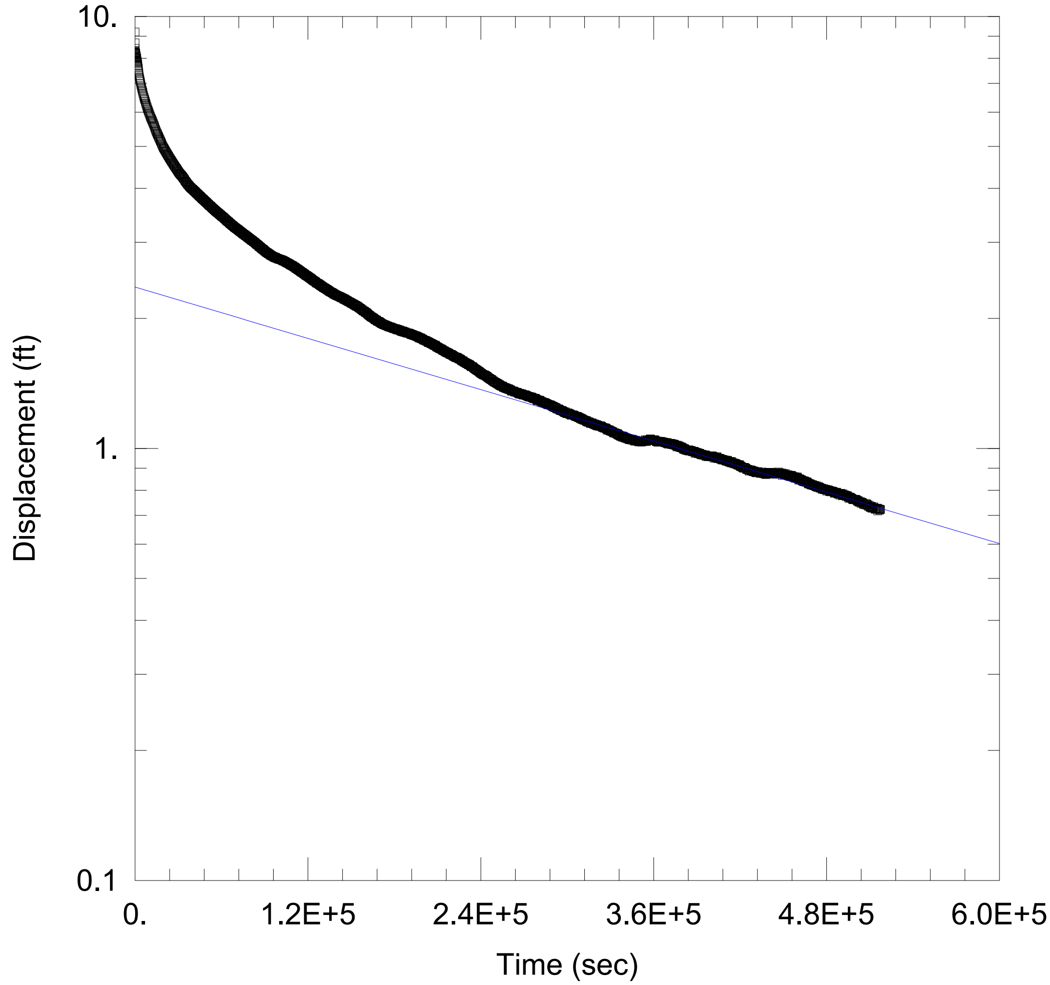
Saturated Thickness: 25.84 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-1 slug out)

Initial Displacement: 2.303 ft
Total Well Penetration Depth: 42.57 ft
Casing Radius: 0.089 ft
Static Water Column Height: 25.84 ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.043E-8 cm/sec
y0 = 0.955 ft



PZ-3 SLUG IN 3.2.2020

Data Set: M:\...\PZ-3 Slug in 3.2.2020.aqt
Date: 03/03/20 Time: 13:12:50

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-3 Slug In
Test Date: 2/25/2020

AQUIFER DATA

Saturated Thickness: 14.44 ft
Anisotropy Ratio (Kz/Kr): 1.

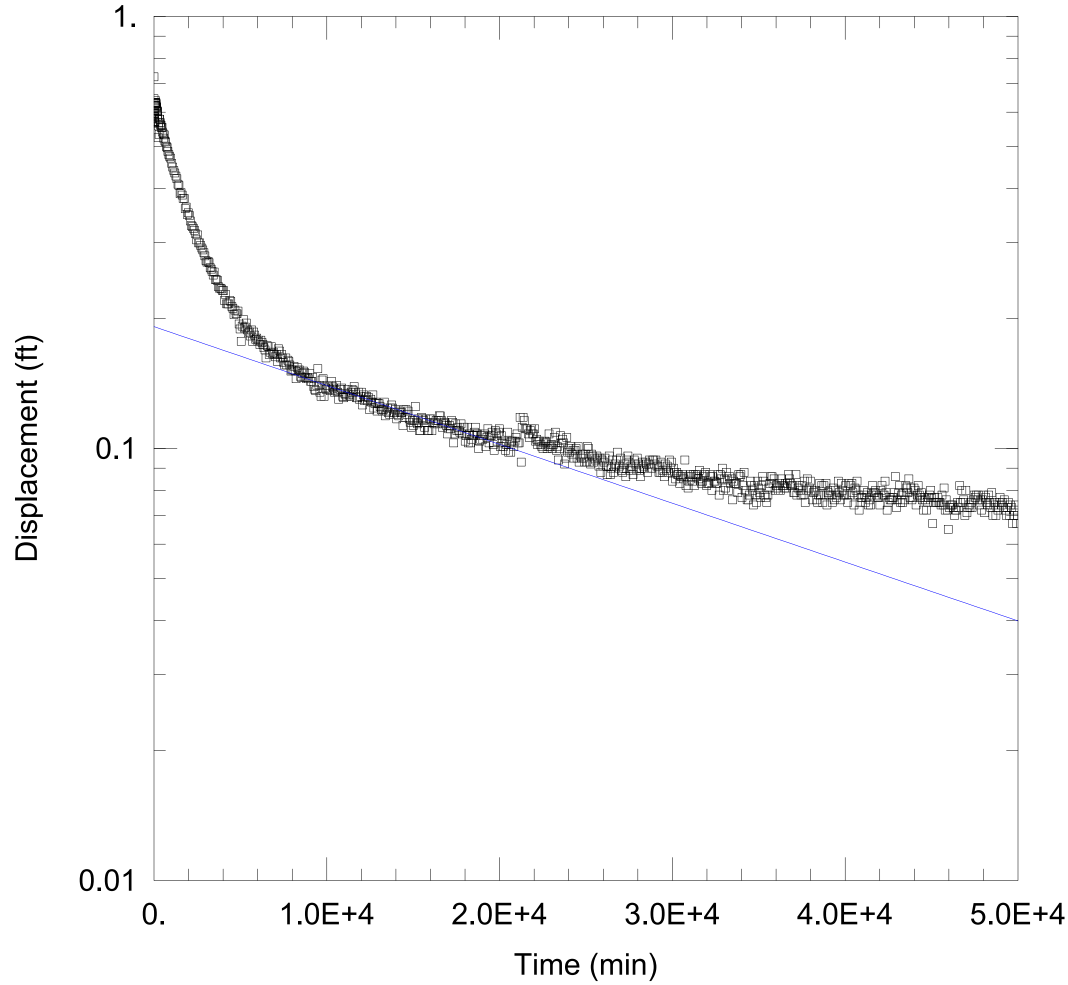
WELL DATA (PZ-3)

Initial Displacement: 10.51 ft
Total Well Penetration Depth: 47.54 ft
Casing Radius: 0.089 ft
Static Water Column Height: 14.44 ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 6.967E-8 cm/sec
y0 = 2.363 ft



PZ-18 SLUG IN TEST

Data Set: M:\Projects\Waco\16216088.00 New LF\Site 50\Aquifer Testing\PZ-18\PZ-18 Slug In.aqt
Date: 05/09/19 Time: 15:58:12

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-18
Test Date: 3/18/2019

AQUIFER DATA

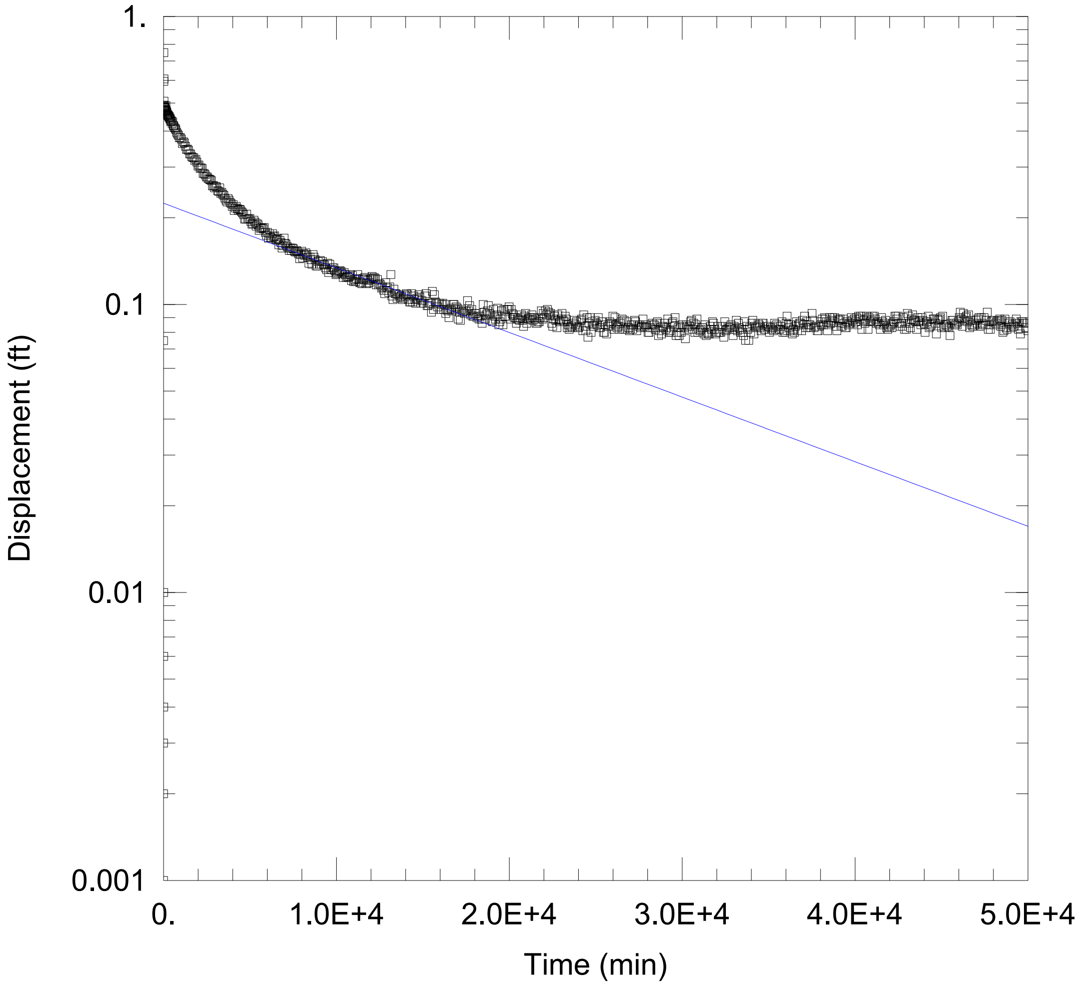
Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-18)

Initial Displacement: 1.016 ft
Total Well Penetration Depth: 48.14 ft
Casing Radius: 0.089 ft
Static Water Column Height: 30. ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 1.435E-8 cm/sec y0 = 0.1914 ft



PZ-18 SLUG OUT

Data Set: M:\Projects\Waco\16216088.00 New LF\Site 50\Aquifer Testing\PZ-18\PZ-18 out.aqt
Date: 05/09/19 Time: 16:00:06

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-18
Test Date: 3/20/2019

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

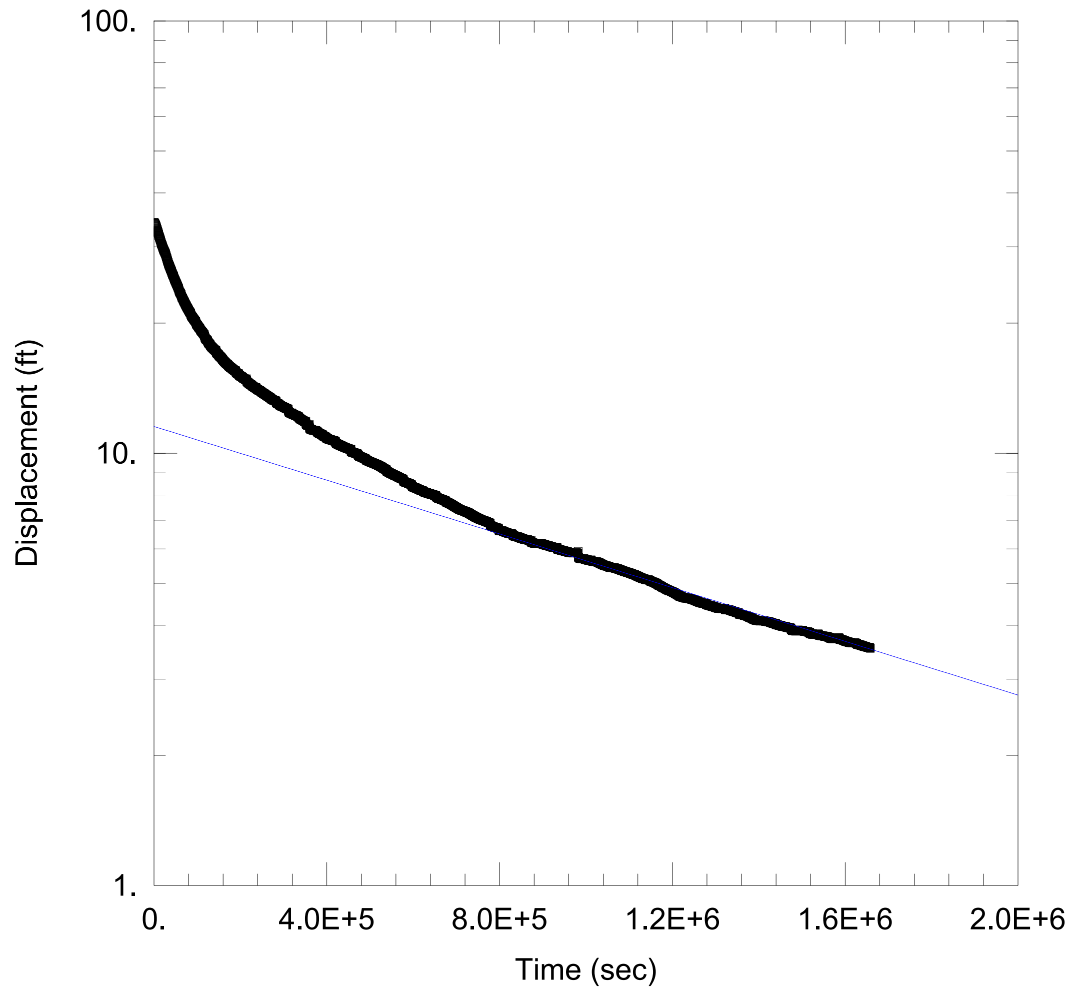
WELL DATA (PZ-18)

Initial Displacement: 0.0748 ft
Total Well Penetration Depth: 48.14 ft
Casing Radius: 0.089 ft

Static Water Column Height: 30. ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 2.363E-8 cm/sec y0 = 0.2245 ft



PZ-20 SLUG IN 3.2.2020

Data Set: M:\...\PZ-20 Slug In 3.2.2020.aqt
Date: 03/03/20 Time: 13:27:52

PROJECT INFORMATION

Company: SCS Engineers
Client: City of Waco
Project: 16216088.00
Location: Waco, TX
Test Well: PZ-20
Test Date: 2/11/2020

AQUIFER DATA

Saturated Thickness: 22.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-20 Feb 2020)

Initial Displacement: 34.11 ft
Total Well Penetration Depth: 67.09 ft
Casing Radius: 0.089 ft
Static Water Column Height: 44.2 ft
Screen Length: 20. ft
Well Radius: 0.089 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.05E-8 cm/sec
y0 = 11.53 ft