September 2020

Volume 1
C-147 Registration Package for
RODNEY ROBINSON AST CONTAINMENT

TRANSMITTAL LETTER AND CLOSURE COST ESTIMATE
C-147 FORM
SURVEY
AST OPERATIONS AND CLOSURE PLANS
SITING CRITERIA DEMONSTRATION
APPENDIX WELL LOGS and
VARIANCE REQUESTS

View east from center of proposed containment.

Prepared for:
Solaris Water Midstream LLC
9811 Katy Freeway Suite 900
Houston, TX 77024

Prepared by:
R.T. Hicks Consultants, Ltd.
901 Rio Grande NW F-142
Albuquerque, New Mexico

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Since 1996

September 30, 2020

Ms. Susan Lucas Kamat
NMOCD
1220 S. St. Francis Blvd
Santa Fe, NM
Via Email Susan.LucasKamat@state.nm.us

RE: Solaris Water Midstream – Rodney Robinson Above-Ground Storage Tank at Unit Letters B&G, Section 1, T23S, R34E, Lea County

Dear Ms. Lucas Kamat:

On behalf of Solaris Water Midstream, LLC, Hicks Consultants submits the attached permit application for one above-ground storage tank. The package follows the order of Form C-147 to allow for an easier review. Construction will begin upon OCD approval of this application.

The following elements of the submission are germane to your review.

In addition to this transmittal letter, Volume 1 contains

a) The C-147 form
b) Site survey
c) Operation and Closure Plans for the AST Containment
d) Site specific information that demonstrates compliance with siting criteria for the location and supporting data.
e) Variances applicable to the Rodney Robinson AST Containment. We have included variance request statements with technical memorandums to support use of either 40 mil LLDPE primary/40 mil LLDPE secondary liner system or 40 mil LLDPE primary/30 mil LLDPE secondary liner system as equal to, or better than, what is proposed in the rule.
f) Stamped letters from Ron Frobel PE discussing the applicability of engineering variances to a wide variety of site conditions for in-ground containments; CV included.

Volume 2 contains

a) Engineering drawings of the AST Containment. Solaris proposes to utilize 40 mil LLDPE for primary liner and either 40 mil LLDPE or 30 mil LLDPE as secondary liner (based on availability) with leak detection system.
b) Design and Construction Plan for the AST

I have personally evaluated the applicability of all non-engineering variances to the text of Rule 34 listed below. In my opinion, these variances, all of which have been previously approved by OCD, are applicable to the location of the Rodney Robinson AST facility and all containments in the Permian Basin of New Mexico:

- Alternative chloride testing method

We urge OCD to carefully evaluate the freeboard variance arguments in the discussion by Mr. Frobel. The denial of this variance request for the Quail Ranch Air Gap AST was surprising to us and if this variance is also denied, we would appreciate an explanation of OCD logic.

In compliance with 19.15.34.10 of the Rule, this submission Solaris will transmit a copy of this application to the BLM who is the owner of the surface upon which the containments will be constructed.

As usual, we will provide OCD with a cost estimate based upon the bid from the construction contractor for restoration of the pad in conformance with Rule 34 mandates. The cost of tank removal and sampling will be included in the cost estimate. The bond will be in place prior to any water is in the AST Containment.

If you have any questions or concerns regarding this registration or the attached C-147, please contact me. As always, we appreciate your work ethic and attention to detail.

Sincerely,
R.T. Hicks Consultants

Randall T. Hicks PG
Principal

Copy: Solaris Water Midstream

C-147

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-147
Revised April 3, 2017

Recycling Facility and/or Recycling Containment

Type of Facility: ☐ Recycling Facility ☒ Recycling Containment*****

Type of action: ☒ Permit ☐ Registration
☐ Modification ☐ Extension
☐ Closure ☐ Other (explain) _____

*** At the time C-147 is submitted to the division for a Recycling Containment, a copy shall be provided to the surface owner.**

Be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.

Operator: Solaris Midstream LLC OGRID #: 371643

Address: 9811 Katy Freeway, Suite 900, Houston, TX, 77024

Facility or well name (include API# if associated with a well): Rodney Robinson Above-Ground Storage Tank

OCD Permit Number: _____(For new facilities the permit number will be assigned by the district office)

U/L or Qtr/Qtr: B, G Section: 1 Township: 23S Range: 32E County: Lea

Surface Owner: ☒ Federal ☐ State ☐ Private ☐ Tribal Trust or Indian Allotment

2.

☒ **Recycling Facility:**

Location of (if applicable): Latitude: 32.337630 Longitude: 103.625955 approximately (NAD83)

Proposed Use: ☒ Drilling* ☒ Completion* ☒ Production* ☒ Plugging *

******The re-use of produced water may NOT be used until fresh water zones are cased and cemented***

☐ Other, ***requires permit for other uses. Describe use, process, testing, volume of produced water and ensure there will be no adverse impact on groundwater or surface water.***

☒ Fluid Storage

☐ Above ground tanks ☒ Recycling containment ☐ Activity permitted under 19.15.17 NMAC explain type_____

☐ Activity permitted under 19.15.36 NMAC explain type:_____ ☐ Other explain _____

☐ For multiple or additional recycling containments, attach design and location information of each containment

☐ **Closure Report (required within 60 days of closure completion):** ☐ Recycling Facility Closure Completion Date:_____

3.

☒ **Recycling Containment:**

☐ Annual Extension after initial 5 years (attach summary of monthly leak detection inspections for previous year)

Center of Recycling Containment (if applicable)): Latitude: 32.337630 Longitude: 103.625955 approx. (NAD83)

☐ For multiple or additional recycling containments, attach design and location information of each containment

☒ Lined ☒ Liner type: Thickness 40 mil Primary, 40 mil or 30 mil Secondary ☒ LLDPE ☐ HDPE ☐ PVC ☐ Other

_____

☐ String-Reinforced

Liner Seams: ☒ Welded ☐ Factory ☐ Other Volume: See Volume 2 Dimensions See Volume 2 .

☐ Recycling Containment Closure Completion Date:_____

4.

Bonding:

☐ Covered under bonding pursuant to 19.15.8 NMAC per 19.15.34.15(A)(2) NMAC **(These containments are limited to only the wells owned or operated by the owners of the containment.)**

☒ Bonding in accordance with 19.15.34.15(A)(1). Amount of bond $__See Transmittal Letter__ **(work on these facilities cannot commence until bonding amounts are approved)**

☒ Attach closure cost estimate and documentation on how the closure cost was calculated. (See Transmittal Letter)

5.

Fencing:

☒ Four-foot height, four strands of barbed wire evenly spaced between one and four feet

☐ Alternate. Please specify:_____.

6.

Signs:

☒ 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers

☐ Signed in compliance with 19.15.16.8 NMAC

7.

Variances:

Justifications and/or demonstrations that the proposed variance will afford reasonable protection against contamination of fresh water, human health, and the environment.

Check the below box only if a variance is requested:

☒ *Variance(s): Requests must be submitted to the appropriate division district for consideration of approval. If a Variance is requested, include the variance information on a separate page and attach it to the C-147 as part of the application.*

If a Variance is requested, it must be approved prior to implementation. See Volume 2 for Variances

8.

Siting Criteria for Recycling Containment

Instructions: The applicant must provide attachments that demonstrate compliance for each siting criteria below as part of the application. Potential examples of the siting attachment source material are provided below under each criteria.

General siting

Ground water is less than 50 feet below the bottom of the Recycling Containment. NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells FIGURES 1-2	☐ Yes ☒ No ☐ NA
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; written approval obtained from the municipality FIGURE 3	☐ Yes ☒ No ☐ NA
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Minerals Division FIGURE 4	☐ Yes ☒ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; topographic map FIGURE 5	☐ Yes ☒ No
Within a 100-year floodplain. FEMA map FIGURE 6	☐ Yes ☒ No
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse, or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; visual inspection (certification) of the proposed site FIGURE 7	☐ Yes ☒ No
Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. - Visual inspection (certification) of the proposed site; aerial photo; satellite image FIGURE 8	☐ Yes ☒ No
Within 500 horizontal feet of a spring or a fresh water well used for domestic or stock watering purposes, in existence at the time of initial application. FIGURES 1 and 7 - NM Office of the State Engineer - iWATERS database search; visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 500 feet of a wetland. FIGURE 9 - US Fish and Wildlife Wetland Identification map; topographic map; visual inspection (certification) of the proposed site	☐ Yes ☒ No

9.

Recycling Facility and/or Containment Checklist:

Instructions: Each of the following items must be attached to the application. Indicate, by a check mark in the box, that the documents are attached.

- ☒ Design Plan - based upon the appropriate requirements.
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements.
- ☒ Closure Plan - based upon the appropriate requirements.
- ☒ Site Specific Groundwater Data -
- ☒ Siting Criteria Compliance Demonstrations –
- ☒ **Certify that notice of the C-147 (only) has been sent to the surface owner(s)**

10.

Operator Application Certification:

I hereby certify that the information and attachments submitted with this application are true, accurate and complete to the best of my knowledge and belief.

Name (Print): Bradley Todd Carpenter Title: Operations Manager

Signature: Todd Carpenter Date: 9-30-2020

e-mail address todd.carpenter@solarismidstream.com Telephone: 432-413-0918

11.

OCD Representative Signature: _____ **Approval Date:** _____

Title: _____ **OCD Permit Number:** _____

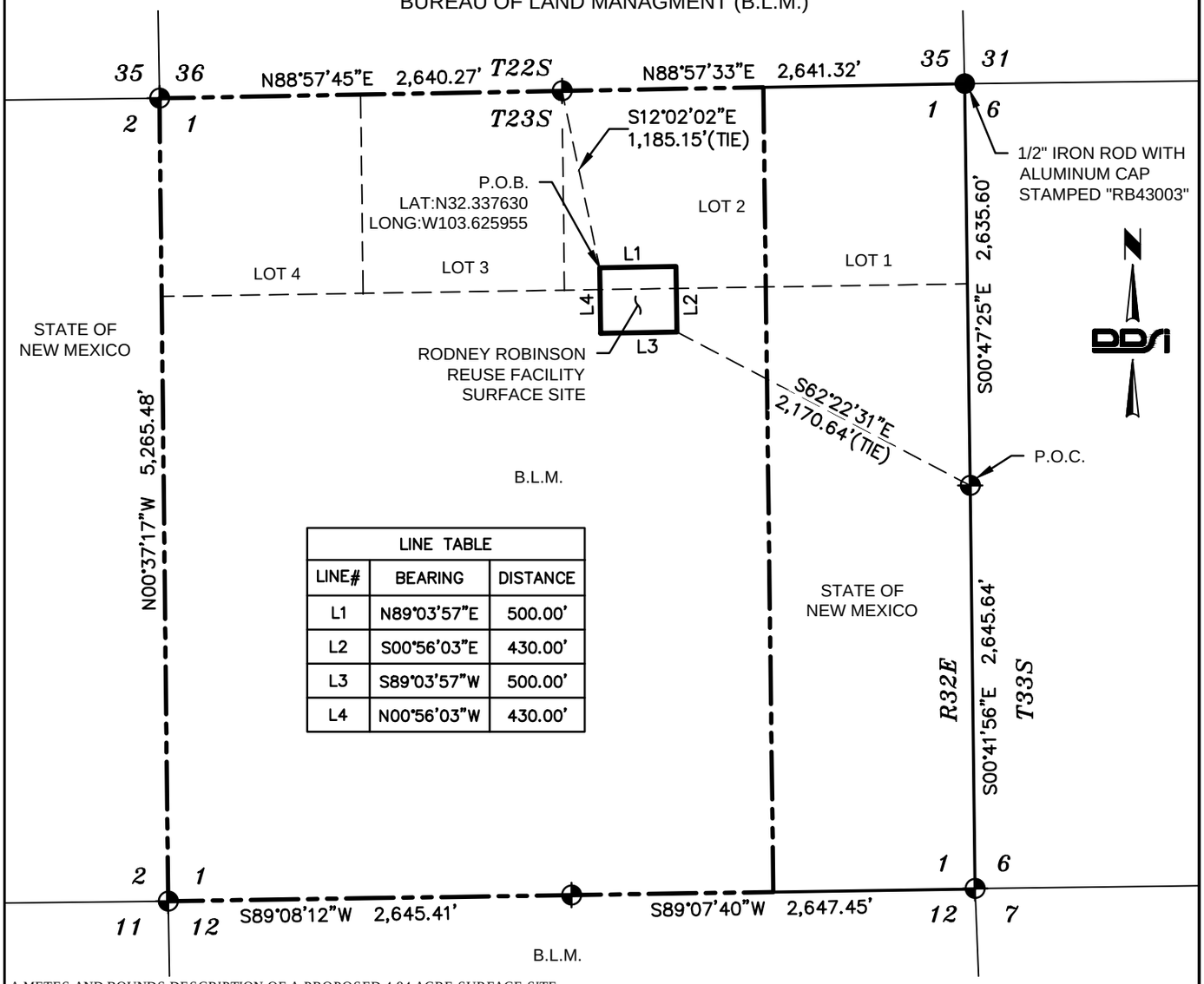
☐ OCD Conditions _____

☐ Additional OCD Conditions on Attachment

Survey For Containment and Recycling Facility

EXHIBIT A

SECTION 1, TOWNSHIP 23 SOUTH, RANGE 32 EAST, N.M.P.M.
LEA COUNTY, NEW MEXICO
BUREAU OF LAND MANAGMENT (B.L.M.)



LINE TABLE		
LINE#	BEARING	DISTANCE
L1	N89°03'57"E	500.00'
L2	S00°56'03"E	430.00'
L3	S89°03'57"W	500.00'
L4	N00°56'03"W	430.00'

A METES AND BOUNDS DESCRIPTION OF A PROPOSED 4.94 ACRE SURFACE SITE

BEING A 4.94 ACRE TRACT OF LAND IN SECTION 1, TOWNSHIP 23 SOUTH, RANGE 32 EAST, N.M.P.M., IN LEA COUNTY, NEW MEXICO, SAID SURFACE SITE BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTH QUARTER CORNER OF SAID SECTION 1 BEING A FOUND BRASS CAP MONUMENT STAMPED "U.S. GENERAL LAND OFFICE SURVEY" , THENCE SOUTH 12°02'02" EAST, 1,185.15 FEET TO THE POINT OF BEGINNING; THENCE NORTH 89°03'57" EAST, 500.00 FEET; THENCE SOUTH 00°56'03" EAST, 430.00 FEET FROM WHICH THE EAST QUARTER CORNER OF SAID SECTION 1, BEING A FOUND BRASS CAP MONUMENT STAMPED "U.S. GENERAL LAND OFFICE SURVEY", BEARS SOUTH 62°22'31" EAST, 2,170.64 FEET; THENCE SOUTH 89°03'57" WEST, 500.00 FEET; THENCE NORTH 00°56'03" WEST, 430.00 FEET TO THE POINT OF BEGINNING, AND CONTAINING 4.94 ACRES (215,000 SQUARE FEET) OF LAND.

BASIS OF BEARING: BEARINGS SHOWN HEREON ARE BASED UPON UNIVERSAL TRANSVERSE MERCATOR ZONE 13 NORTH, US SURVEY FEET, NORTH AMERICAN DATUM OF 1983. ALL DISTANCES ARE GRID. COORDINATES SHOWN ARE IN N.A.D. 1983.

NOTES:
1. RESEARCH HAS BEEN PROVIDED BY OTHERS.
2. THIS PLAT IS FOR EASEMENT PURPOSES ONLY.
3. EASEMENTS, SETBACKS, AND OTHER ENCUMBRANCES ARE NOT SHOWN BY AGREEMENT WITH CLIENT.
4. P.O.C. = POINT OF COMMENCEMENT
5. P.O.B. = POINT OF BEGINNING
6. P.O.T. = POINT OF TERMINATION
7. MODIFICATION IN ANY WAY OF THE FOREGOING DESCRIPTION TERMINATES LIABILITY OF SURVEYOR.

LEGEND:
= DENOTES SURFACE SITE ABOVE
= DENOTES PIPELINE
= DENOTES FOUND CORNER AS NOTED
= DENOTES FOUND BRASS CAP MONUMENT STAMPED "U.S. GENERAL LAND OFFICE SURVEY"

EASEMENT TABLE		
SURFACE SITE	215,000 SQ. FEET	4.94 ACRES

SURVEYOR'S CERTIFICATE

I, CHRIS E. CARLSON, NEW MEXICO PROFESSIONAL SURVEYOR NO. 24876, DO HEREBY CERTIFY THAT THIS EASEMENT SURVEY PLAT AND THE ACTUAL SURVEY ON THE GROUND UPON WHICH IT IS BASED WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION; THAT I AM RESPONSIBLE FOR THIS SURVEY; THAT THIS SURVEY MEETS THE MINIMUM STANDARDS FOR SURVEYING IN NEW MEXICO; AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER CERTIFY THAT THIS SURVEY IS NOT A LAND DIVISION OR SUBDIVISION IN THE NEW MEXICO SUBDIVISION ACT AND THAT THIS INSTRUMENT IS AN EASEMENT SURVEY PLAT OF ACROSS AN EXISTING TRACT OR TRACTS.

DATE OF SIGNATURE: 09/22/2020
CHRIS E. CARLSON N.M.P.S. NO. 24876

CHRIS E. CARLSON
NEW MEXICO
24876
PROFESSIONAL SURVEYOR

NO.	REVISION DESCRIPTION	DATE	BY

0 500' 1000'
SCALE 1"= 1000'

DOWNTOWN DESIGN SERVICES, INC.
16 E. 16TH ST. SUITE 400
TULSA, OK 74119
Tel: 918-592-3374 Fax: 918-221-3940
www.ddsiglobal.com

SOLARIS WATER MIDSTREAM, LLC.

RODNEY ROBINSON REUSE FACILITY
LOCATION OF A PROPOSED SURFACE SITE IN
SECTION 1, TOWNSHIP 23 SOUTH, RANGE 32 EAST, N.M.P.M.,
LEA COUNTY, NEW MEXICO

FIELD DATE: 09/21/2020		SURFACE SITE
DRAFTING DATE: 09/22/2020		PAGE 1 OF 1
JOB No. 2020-235	APPROVED BY: CEC DRAWN BY: DMB	TRACT: RRRF-1

Operation and Maintenance Plan and Closure Plan

General Specifications

This plan provides additional protocols to cause the proposed recycling containments (AST Containments) to conform to NMOCD Rules.

The operator will maintain and operate the recycling containments and facility in accordance with the following plan to contain liquids and maintain the integrity of the liner to prevent contamination of fresh water and protect public health and the environment.

- The operator will use the treated produced water in the containments for drilling, completion (stimulation), producing or processing oil or gas or both. If other uses are planned, the operator will notify the OCD though the submission of a modified C-147.

19.15.34.10 B
Recycling containments may hold produced water for use in connection with drilling, completion, producing or processing oil or gas or both.

- For all exploration and production operations that use produced water, the operator will conduct these activities in a manner consistent with hydrogen sulfide gas provisions in 19.15.11 NMAC or NORM provisions in 19.15.35 NMAC, as applicable.

19.15.34.8 A
(5) All operations in which produced water is used shall be conducted in a manner consistent with hydrogen sulfide gas provisions in 19.15.11 NMAC or NORM provisions in 19.15.35 NMAC, as applicable.

- The operator will address all releases from the recycling and re-use of produced water in accordance with 19.15.29 NMAC.

19.15.34.8 A
(6) All releases from the recycling and re-use of produced water shall be handled in accordance with 19.15.29 NMAC.

- The operator will not discharge into or store any hazardous waste in the recycling containments, but they may hold fluids such was freshwater, brackish water, recycled and treated water, water generated by oil or gas processing facilities, or other waters that are gathered for well drilling or completion. The recycling facility will not be used for the disposal of produced water. The operator will maintain the containments free of miscellaneous solid waste or debris.

19.15.34.10 B
Recycling containments may hold produced water for use in connection with drilling, completion, producing or processing oil or gas or both. Such fluids may include fresh water, brackish water, recycled and treated water, fluids added to water to facilitate well drilling or completion, water produced with oil and gas, flowback from operations, water generated by an oil or gas processing facility or other waters that are gathered for well drilling or completion but may not include any hazardous waste.

19.15.34.9 G
Recycling facilities may not be used for the disposal of produced water.

- The operator will verify that no oil is on the surface of the contained fluid. If oil is observed, the oil shall be removed using an absorbent boom or other device and properly disposed at an approved facility. An absorbent boom or other device will be maintained on site.

19.15.34.13 B
(1) The operator shall remove any visible layer of oil from the surface of the recycling containment
(7) The operator shall install, or maintain on site, an oil absorbent boom or other device to contain an unanticipated release.

- The operator will install and use a header and diverter described in the design/construction plan in order to prevent damage to the liner by erosion, fluid

19.15.34.13 B
(3) The injection or withdrawal of fluids from the containment shall be accomplished through a header, diverter or other hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.

jets or impact from installation and removal of hoses or pipes during injection or withdrawal of liquids.

- *Pursuant to a requested variance*, the operator will maintain at least 2-feet of freeboard in each AST containment. Under extenuating circumstances, which will be noted on the inspection log as described below, the operator may temporarily exceed the freeboard mandate.

19.15.34.13 B
(2) The operator shall maintain at least three feet of freeboard at each containment.

- If the liner develops a leak or if any penetration of the liner occurs above the liquid's surface, then the operator will repair the damage or initiate replacement of the liner within 48 hours of discovery or will seek a variance from the division district office within this time period.

19.5.34.13 B
(4) If the containment's primary liner is compromised above the fluid's surface, the operator shall repair the damage or initiate replacement of the primary liner within 48 hours of discovery or seek an extension of time from the division district office.

- If visible inspection suggests that the liner developed a leak or if any penetration of the liner occurs below the liquid's surface, then the operator will remove all liquid above the damage or leak line within 48 hours of discovery. The operator will also notify the district division office within this same 48 hours of the discovery and repair the damage or replace the liner.

(5) If the primary liner is compromised below the fluid's surface, the operator shall remove all fluid above the damage or leak within 48 hours of discovery, notify the division district office and repair the damage or replace the primary liner.

- In the event of a leak due to a hole in the liner, the following steps will be followed:
    1. If the source of the fluid is uncertain, comparative field tests may need to be performed on both the water in the containment and that which may have been released (e.g. pH, conductance, and chloride).
    2. If the fluid is found to be coming from the containment, determine the location from which the leak is originating.
    3. Mark the point where the water is coming out of the tank.
    4. Locate the puncture or hole in the liner.
    5. Empty the containment to the point of damage in liner.
    6. Clean area of liner that needs to be repaired.
    7. Cut out piece of material (patch or tape) to overlay liner.

8. Either weld the patch to the injured area in the liner or apply tape over the rupture.
9. Make sure rupture is completely covered.
10. Monitor as needed.

The operator will inspect and remove, as necessary, surface water run-on accumulated in the secondary containment

Monitoring, Inspections, and Reporting

The containment will contain enough produced water to prevent any shifting of the liner. Weekly inspections shall occur when there is 1-foot depth or more of produced water in the containment. Monthly inspections shall occur when there is less than 1-foot depth of produced water in the containment, as well as when the ASTs are emptied and prior to refilling. An inspection log will be maintained by the operator and will be made available to the division upon request. Inspection will include: freeboard monitoring, leak detection, identifying potential hazards that may have developed, change in site conditions or if the contents of the containment change from the initial use.
An "Inspection Form" meeting the requirements according to NMAC 19.15.34 is to be filled out during these routine inspections. The form also provides a list of observations that will enable early detection of uneven tank panel settlement, soil settlement, liner damage, insufficient liner slack, or leaks. The form is reproduced at the end of this section.

Weekly inspections consist of:

- Reading and recording the fluid height of staff gauges and freeboard
- Recording any evidence of visible oil on surface
- Visually inspecting the containments exposed liners
- Checking the leak detection system for any evidence of a loss of integrity of the primary liner
- Inspect any diversion ditches and berms around the containment to check for erosion and collection of surface water run-on.
- Inspect the leak detection system for evidence of damage or malfunction and monitor for leakage.

- Inspect netting (may not be used if Mega Blaster Pro avian deterrent is used) for damage or dead wildlife, including migratory birds. Operator shall report the discovery of a dead animal to the appropriate wildlife agency and to the district within 30 days of discovery. Further prevention measures may be required.

19.15.34.12 E
Netting. The operator shall ensure that a recycling containment is screened, netted or otherwise protective of wildlife, including migratory birds. The operator shall on a monthly basis inspect for and, within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

Additional monitoring to identify hazards that may have developed, changes in site conditions, tank use, and to enable early detection of structural issues such as uneven tank panel settlement, soil settlement, liner damage, insufficient liner slack or leaks. If changes are noted the AST contractor should be notified

- If observed conditions indicate a potential tank failure is imminent, the vicinity will be immediately cleared and the AST will be drained.

Monthly, the operator will:

- Report to the division, the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148.
- Record sources and disposition of all recycled water.

Cessation of Operations

If less than 20% of the total fluid capacity is utilized every six months, beginning from the first withdraw, operation of the facility has ceased and the division district office will be notified. The division district may grant an extension not to exceed six months to determine the cessation of operations.

19.15.34.13 C
A recycling containment shall be deemed to have ceased operations if less than 20% of the total fluid capacity is used every six months following the first withdrawal of produced water for use. The operator must report cessation of operations to the appropriate division district office. The appropriate division district office may grant an extension to this determination of cessation of operations not to exceed six months.

The operator will remove all fluids from the recycling facility within 60 days of cessation of operations. An extension, not to exceed 2 months, may be granted by the district division for the removal of fluids from the facility.

19.15.34.14 A
Once the operator has ceased operations, the operator shall remove all fluids within 60 days and close the containment within six months from the date the operator ceases operations from the containment for use. The division district office may grant an extension for the removal of all fluids not to exceed two months.

The breakdown of the containments follows the reverse order of the setup steps presented in the set-up manual.

Quarterly Inspection Log Sheet - AST Containment

Inspect weekly while fluids present (>1 foot); Monthly when fluids <1 foot								
Inspection Date	Inspector (Initials)	Describe any 1. Tear of Liner 2. Break in Berms and Run-on of Stormwater 3. Dead Wildlife 4. Oil on Fluid				Report Fluid Freeboard	Leak Detection System Functioning (yes/no)	Comments
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			
			None Observed		Yes Describe			

Weekly inspections consist of:

- reading and recording the fluid height of staff gauges,
- recording any evidence that the pond surface shows visible oil,
- visually inspecting the containment's exposed liners
- checking the leak detection system for any evidence of a loss of integrity of the primary liner.
- inspect diversion ditches and berms around the containment to check for erosion and collection of surface water run-on.
- inspect the leak detection system for evidence of damage or malfunction and monitor for leakage.

Monthly, the operator will:

A. Inspect the containment for dead migratory birds and other wildlife. Within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

B. Report to the division the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148.

C. Record sources and disposition of all recycled water.

Closure Plan

The containments are expected to contain a small volume of solids, the majority of which will be windblown sand and dust with some mineral precipitates from the water.

The operator will notify the division district (phone or email) before initiating closure of the containments and/or facility.

Excavation and Removal Closure Plan – Protocols and Procedures

1. Residual fluids in the containments will be sent to disposal at a division-approved facility.
2. The operator will remove all solid contents and transfer those materials to the following division-approved facility:
3. If possible, geomembrane textiles and liners that exhibit good integrity may be recycled for use as an under liner of tank batteries or other use as approved by OCD.
4. Disassemble the recycling containment infrastructure according to manufacturer's recommendations
5. After the disassemble of the containments and removal of the contents and liners, soils beneath the tanks will be tested as follows
    a. Collect a five-point (minimum) composite from beneath the liner to include any obviously stained or wet soils, or any other evidence of impact from the containments for laboratory analyses for the constituents listed in Table I of 19.15.34.14 NMAC.
    b. If any concentration is higher than the parameters listed in Table I, additional delineation may be required, and closure activities will not proceed without Division approval.
    c. If all constituents' concentrations are less than or equal to the parameters listed in Table I, then the operator will backfill the facility as necessary using non-waste containing, uncontaminated, earthen material and proceed to reclaim the surface to pre-existing conditions.

19.15.34.14 B
The operator shall close a recycling containment by first removing all fluids, contents and synthetic liners and transferring these materials to a division approved facility.

19.15.34.14 C
The operator shall test the soils beneath the containment for contamination with a five-point composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I below.
(1) If any contaminant concentration is higher than the parameters listed in Table I, the division may require additional delineation upon review of the results and the operator must receive approval before proceeding with closure.
(2) If all contaminant concentrations are less than or equal to the parameters listed in Table I, then the operator can proceed to backfill with non-waste containing, uncontaminated, earthen material.

Closure Documentation

Within 60 days of closure completion, the operator will submit a closure report (Form C-147) to the District Division, with necessary attachments to document all closure activities are complete, including sampling results and details regarding backfilling and capping as necessary.

19.15.34.14 D
Within 60 days of closure completion, the operator shall submit a closure report on form C-147, including required attachments, to document all closure activities including sampling results and the details on any backfilling, capping or covering, where applicable. The closure report shall certify that all information in the report and attachments is correct and that the operator has complied with all applicable closure requirements and conditions specified in division rules or directives.

In the closure report, the operator will certify that all information in the report and attachments is correct and that the operator has complied with all applicable closure requirements and conditions specified in the closure plan.

Reclamation and Re-vegetation

The operator will reclaim the surface to safe and stable pre-existing conditions that blends with the surrounding undisturbed area. "Pre-existing conditions" may include a caliche well pad that existed prior to the construction of the recycling containment and that supports active oil and gas operations.

Areas not reclaimed as described herein due to their use in production or drilling operations will be stabilized and maintained to minimize dust and erosion.

For all areas disturbed by the closure process that will not be used for production operations or future drilling, the operator will substantially restore the surface to the condition that existed prior to the construction of the recycling containment:

1. Replace topsoils and subsoils to their original relative positions
2. Contour so as to achieve erosion control, long-term stability and preservation of surface water flow patterns
3. Reseed in the first favorable growing season following closure

Federal, state trust land, or tribal lands may impose alternate reclamation and re-vegetation obligations that provide equal or better protection of fresh water, human health, and the environment. Re-vegetation and reclamation plans imposed by the surface owner will be outlined in communications with the OCD.

The operator will notify the division when the site meets the surface owner's requirements or exhibits a uniform vegetative cover that reflects a life-form ratio of plus or minus fifty percent (50%) of pre-disturbance levels and a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels, excluding noxious weeds. The operator will notify the Division when reclamation and re-vegetation is complete.

19.15.34.14 E
Once the operator has closed the recycling containment, the operator shall reclaim the containment's location to a safe and stable condition that blends with the surrounding undisturbed area. Topsoils and subsoils shall be replaced to their original relative positions and contoured so as to achieve erosion control, long-term stability and preservation of surface water flow patterns. The disturbed area shall then be reseeded in the first favorable growing season following closure of a recycling containment. The operator shall substantially restore the impacted surface area to the condition that existed prior to the construction of the recycling containment.

19.15.34.14 G
The re-vegetation and reclamation obligations imposed by federal, state trust land or tribal agencies on lands managed by those agencies shall supersede these provisions and govern the obligations of any operator subject to those provisions, provided that the other requirements provide equal or better protection of fresh water, human health and the environment.

19.15.34.14 F
Reclamation of all disturbed areas no longer in use shall be considered complete when all ground surface disturbing activities at the site have been completed, and a uniform vegetative cover has been established that reflects a life-form ratio of plus or minus fifty percent (50%) of pre-disturbance levels and a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels, excluding noxious weeds.

SITING CRITERIA DEMONSTRATION

Distance to Groundwater

Figure 1, Figure 1a, Figure 2, Figure 2a, and the discussion presented below demonstrate that groundwater (fresh water, as defined by NMOCD Rules) at the location is greater than the required 50 feet below the proposed Rodney Robinson Air Gap Above-Ground Storage Tank Containment (Rodney Robinson AST). Specifically, the estimated depth to water is 167.6 feet.

Hydrogeology of Rodney Robinson Air Gap AST Containment

The proposed site for the Rodney Robinson AST is located approximately 28 miles southwest of Eunice, 29 miles northwest of Jal, and 27 miles east-northeast of Loving, New Mexico, almost in the middle of nowhere. It lies about 2 miles west of Antelope Ridge and about 11 miles due west of the northwest-southeast trending axis of the San Simon Swale. The area near the proposed AST containment is relatively flat with a surface covering of aeolian sand, which is generally underlain by a caliche layer. Below the caliche layer is likely the Ogallala Formation or Quaternary Older Alluvium (Qoa), which can be difficult to distinguish from the Ogallala Formation. According to the New Mexico State geologic map (seen on Figures 1 and 2a), the Rodney Robinson AST is in an area where the surface unit is Quaternary age eolian piedmont deposits (Qe/Qp).

A portion of Plate 1 from Ground-Water Report 6, which is a geologic map that shows elevation contours of the erosional surface of the red-beds (aka Triassic Dockum Group or Chinle Formation), is reproduced as Figure 2a. Figure 2a suggests that that the elevation of the top of the red-beds is about 3,600 feet above mean sea level. Because the ground surface elevation at the proposed AST is about 3750 feet, the thickness of the Ogallala or Older Alluvium is (3750-3600=) 150 feet. Plate 2 of GWR-6 (see Appendix Ground-Water Report 6 Plate 2) reports that in the area of the Rodney Robinson AST the source of groundwater is Triassic rocks. Figure 1 also shows USGS wells near to the proposed containment draw water from Triassic units (USGS-15262=Chinle Formation, USGS-15071=Santa Rosa Sandstone).

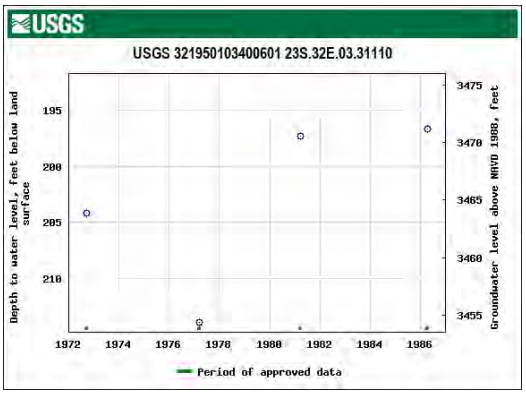
Depth to Water Data and Nearby Wells

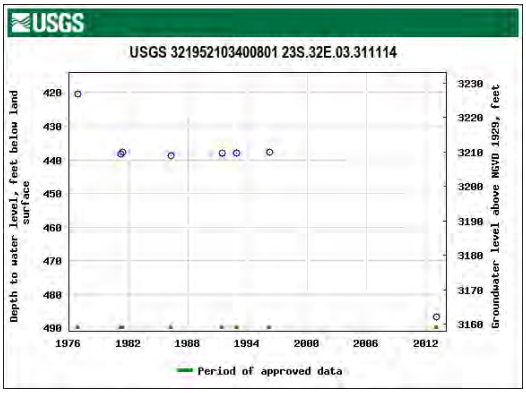
Figure 1 is a topographic map overlain by transparent geologic map of the state of New Mexico and associated legend (Figure 1a) that displays the following:

- The Rodney Robinson AST identified by a blue square labeled by a yellow callout box.
- Water wells from the USGS database as cyan, purple, and blue triangles. The colors indicate the principal water bearing-unit for each well: Ogallala, Chinle, and units that are Not Defined, respectively. The well number as defined in the R.T. Hicks Consultants database for USGS wells, recorded depth to water value, and date the water level measurement was recorded is displayed next to the corresponding well point.

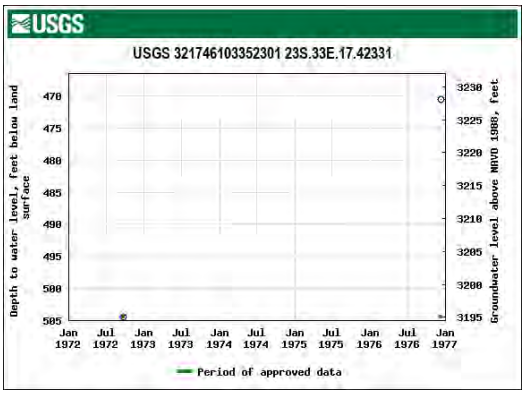
- Miscellaneous water wells from public and non-public databases that were identified by field inspection or other published documents are represented by yellow, blue, and green squares with black dots at the center. The colors correspond to the depth to water recorded in the RT Hicks database. The depth to water and date the depth to water value was recorded are also displayed.
- Water wells from the Office of the State Engineer WATERS database as light blue, light green, and dark blue circles with colored triangles that represent the depth to water. Well ID as documented in the OSE WATERS database, depth to water value, and the date the value was recorded.

USGS-15262 and USGS-15265 are the nearest mapped wells to the proposed containment, about 2 miles west. Well C-2349 is listed in the OSE database as near this location and we believe it is the same as one of the listed USGS wells. Our field survey found an active windmill and an abandoned casing 15 feet from the windmill (see Appendix *Site Photos*). Although two groundwater measuring points exist at this location, the depth to water in each is essentially identical and data suggest these two measuring points are USGS-15265 (aka C-2349). The location and elevation for USGS-15265 is a match for the "Clifton Well", which we believe is C-2349. USGS-15262 is reported at an elevation of 3668 or 15 feet higher than the Clifton well and USGS-15265. We found no evidence of a well near the Clifton well at or near the 3668 elevation. Additionally, the depth to water reported for USGS-15256 is 300 feet higher than our measurements or the past measurements by the USGS. Thus, we are unsure if USGS-15262 is properly located. The data for USGS-15262 (aka 3219…0601) is presented below next to the graph for USGS-15265 (aka 3219…0801).





Misc-99 and USGS-15071 were identified in 2013 and we found an active well that was not accessible for measurement and an open casing where we measured the depth to water. We are unsure of the veracity of the 2013 measurement, based upon data from other wells in the area. The area was fenced and locked during our 2020 site survey. We suggest that the most recent data reported by the USGS (depth to water = 470 feet) is correct.



Well C-3851 is 5 miles southwest of the proposed containment and has a high-quality lithologic log (see Appendix *Well Logs*). The data suggest the top of the Chinle is 120 feet below land surface and does not report any groundwater above this depth.

C-3582 is 4 miles east-southeast of the proposed containment and has a driller's log that is typical of most wells drilled with mud rotary. The uppermost red clay described is 80 feet below surface and the underlying sequence of red clay and sand is typical of the Chinle. This well log suggest shallow water is encountered at 18 feet below surface, which we find highly irregular. These two are the only well logs in the area of the proposed containment.

A series of geotechnical borings from the Oxy Red Tank Containment are in the Appendix *Well Logs*. The Oxy site is about 1.25 miles north of the proposed Rodney Robinson Containment. These logs show no evidence of groundwater to a depth of 85 feet. Also, in the Appendix is our log from the auger boring for the conductor pipe at Devon's North Thistle 1H, 2H, 3H pad (Misc. 390). This boring found dust dry cuttings from surface to a depth of 80 feet. These data also support our high degree of suspicion of the shallow water description in the log of the mud rotary drilled well C-3582.

Figure 2 is a topographic map overlain by a transparent geologic map of the state of New Mexico and a potentiometric surface map and the associated legend that displays the following:

- The Rodney Robinson AST identified by a blue square labeled by a yellow callout box.
- Water wells from the USGS database as cyan, purple, and blue triangles. The colors indicate the principal water bearing-unit for each well: Ogallala, Chinle, and units that are Not Defined, respectively. The well number as defined in the USGS database, recorded groundwater elevation value, and date the value was recorded is displayed next to the corresponding well point.
- Miscellaneous water wells from public and non-public databases that were identified by field inspection or other published documents are represented by yellow, blue,

and green squares with black dots at the center. The colors correspond to the depth to water recorded in the RT Hicks database. The groundwater elevation and date the ground water elevation value was recorded are also displayed near the representative point on the map.

- Isocontours of a potentiometric surface are generated by RT Hicks Consultants, Ltd. USGS and Miscellaneous wells and their groundwater elevation values were used to create the potentiometric surface.

Figure 2 shows that the elevation of the shallowest groundwater beneath the proposed containment is about 3200 feet ASL. Given the surface elevation of 3752, the depth to groundwater beneath the site is (3752-3200=) 552 feet.

Distance to Municipal Boundaries and Freshwater Fields

Figure 3 demonstrates that the area of interest is not within incorporated municipal boundaries or within defined municipal freshwater well fields covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended

- The closest municipalities are Jal, NM to the east-southeast or Loving, NM to the west-southwest, each is about 27 miles distant.
- The closest mapped well field is approximately 27 miles to the southeast and is owned by the City of Jal.

Distance to Subsurface Mines

Figure 4 and our general reconnaissance of the area demonstrate the absence of subsurface mines in the area.

- The nearest mapped surface mine is a closed caliche pit and lies approximately 1 mile to the northwest
- An unmapped active caliche pit appears to be about 1.3 miles due north.
- There are no subsurface mines in the area.

Distance to High or Critical Karst Areas

Figure 5 illustrates the Rodney Robinson Recycling Facility's absence of mapped areas of high or critical karst potential.

- The proposed location for the recycling facility is wholly contained within an area considered low karst potential by the Bureau of Land Management.
- The closest area mapped as High Karst Potential is about 12 miles to the west.
- Our field investigation found no evidence of unstable ground or karst features

Distance to 100-Year Floodplain

Figure 6 demonstrates the absence of 100-year flood plains with respect to the proposed location for the Rodney Robinson Recycling Facility.

- The nearest 100-year flood plain is near the potash tailings ponds about 17 miles due east of the proposed recycling facility.

Distance to Surface Water

Figure 7 and the site visit demonstrate the that the Rodney Robinson facility is outside of the setback distances for a continuously flowing watercourse or the next lower order tributary, lakebed, sinkhole, playa lake (measured from the ordinary high-water mark) or spring.

- The Rodney Robinson AST site is not within 300 feet of a continuously flowing watercourse, or within 200 feet of any other significant watercourse, lakebed, sinkhole, playa lake (as measured from the ordinary high-water mark), or spring.
- The closest surface water body is a lake/pond, which is a stock tank within a natural depression. This is approximately 4200 feet northwest.
- There are no mapped watercourses within a mile of the site and the site visit documents the lack of any watercourses within the setback distances.

Distance to Permanent Residences or Structures

Figure 8 demonstrates that the proposed site for the Rodney Robinson Recycling Facility is not within the setback distances of an occupied permanent residence, school, hospital, institution, church, or other structure at the time of the initial application.

- The only structures near the proposed site are the well pads and pipelines.

Distance to Non-Public Water Supply

Figures 1 and 7 demonstrate the Rodney Robinson location is not within the setback distances of a spring or freshwater well used for domestic or stock watering purposes, in existence at the time of initial application.

- Figure 1 shows the location of all area water wells. The nearest well is located approximately 2.3 miles to the west of the proposed site (C-2349 and USGS-15262, discussed above).
- No domestic water wells are located within 1,000 feet of the recycling area.
- No springs were identified in the area.
- The facility is not within 500 feet of a spring or freshwater well used for domestic or stock watering purposes, in existence at the time of initial application

Distance to Wetlands

Figure 9 demonstrates that the proposed site of the Rodney Robinson Recycling Facility is not within the 300-foot setback distance of a wetland.

- The nearest mapped wetland is the freshwater pond and stock tank mentioned above that is approximately 4200 feet to the northwest.

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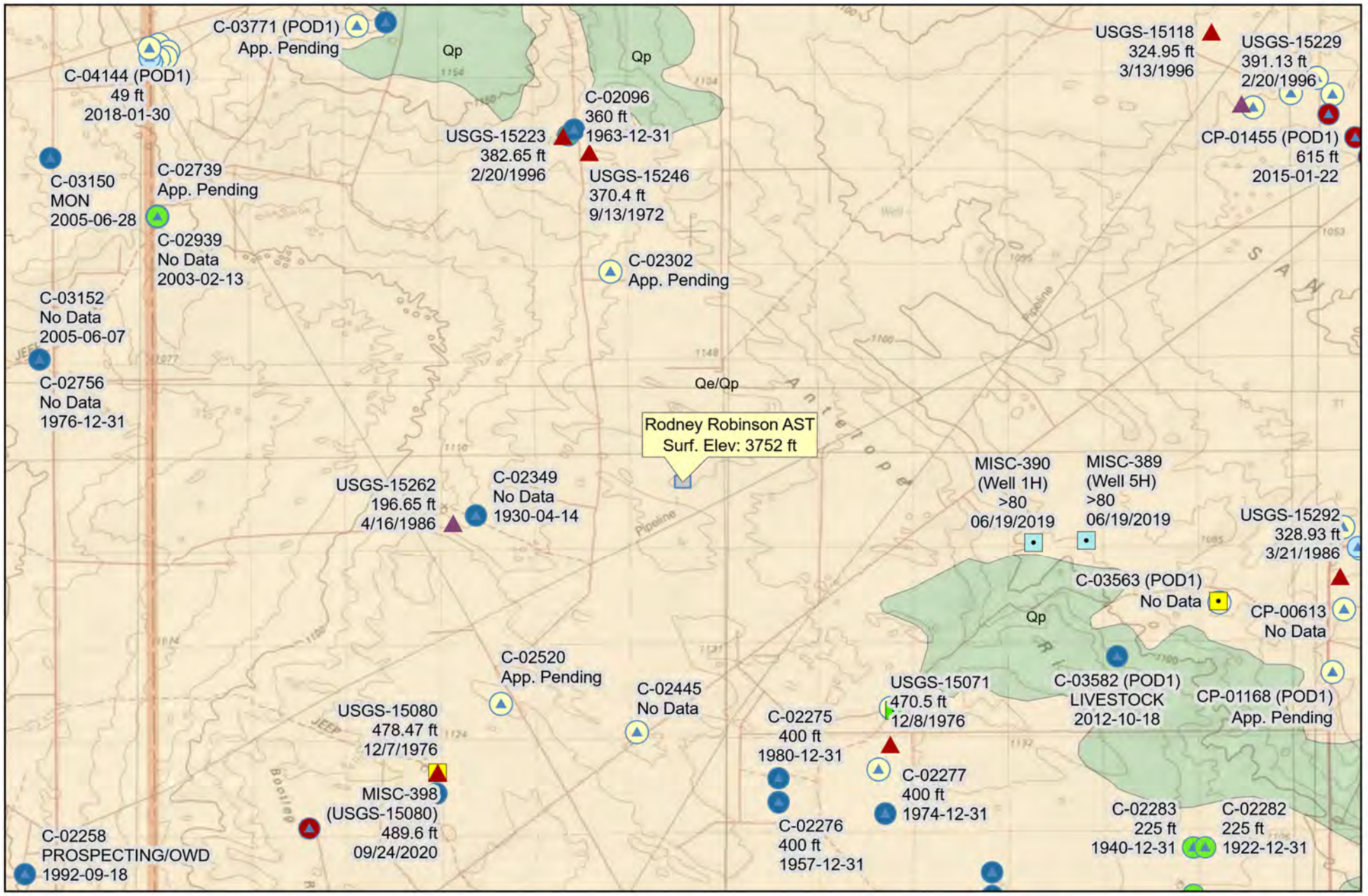

N
W E
S

0 1 2 Miles

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901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

Depth to Water with Geology

Figure 1

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

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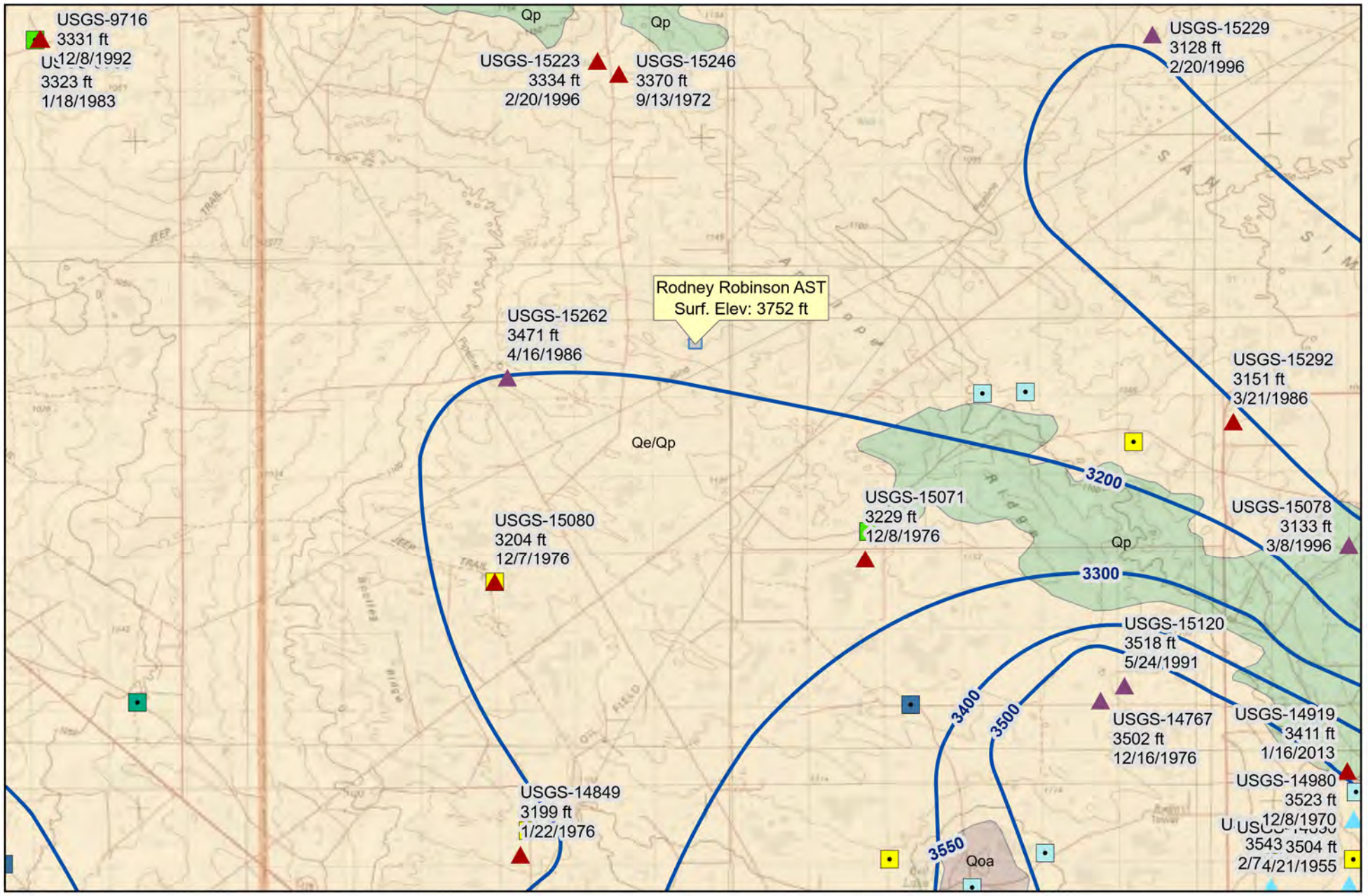

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Groundwater Elevation with Geology and Potentiometric Surface

Figure 2

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

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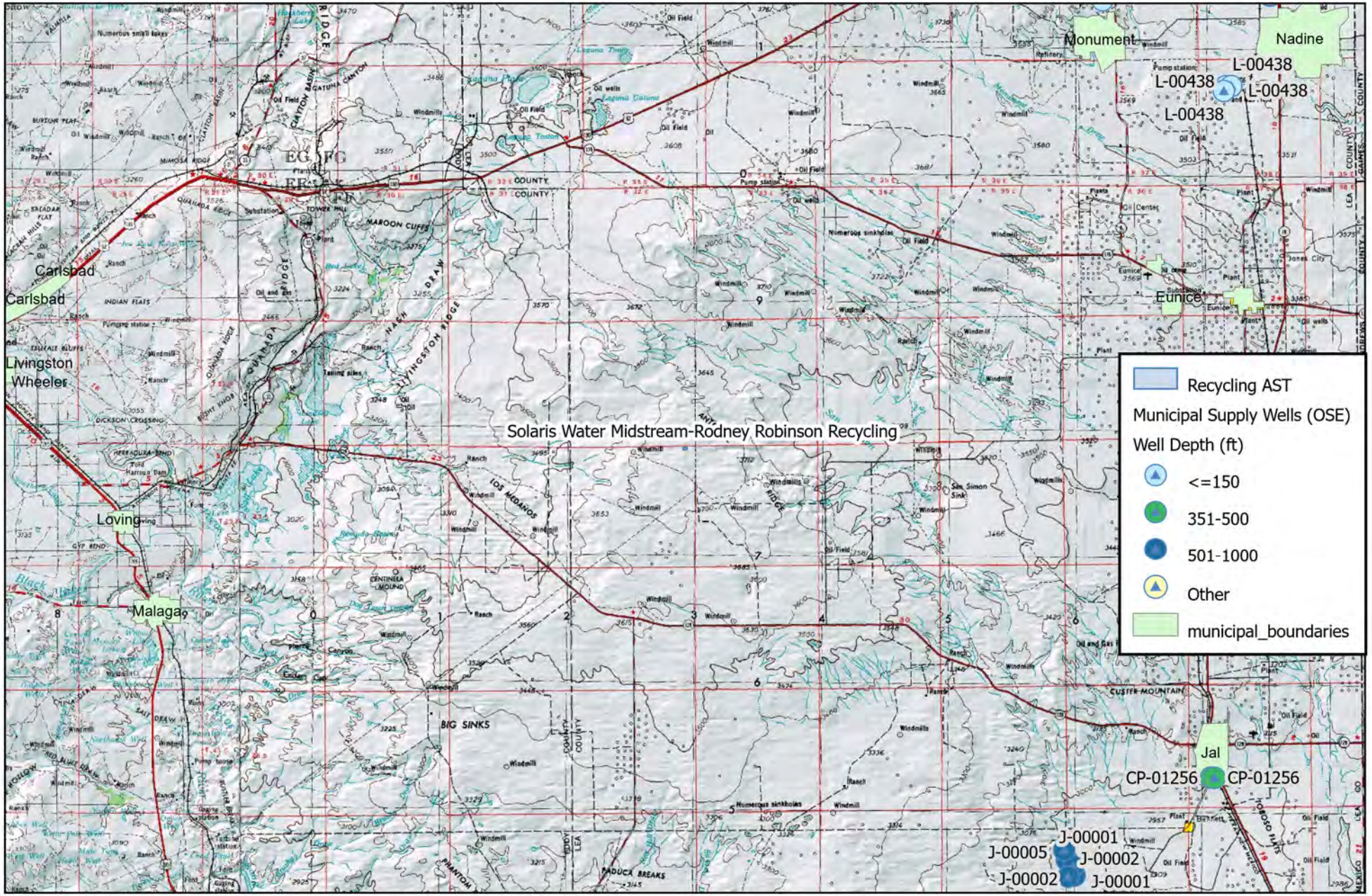

N W E S

0 5 10 Miles

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Well Fields and Municipal Supply Wells	Figure 3
Solaris Water Midstream- Rodney Robinson AST	Sept 2020

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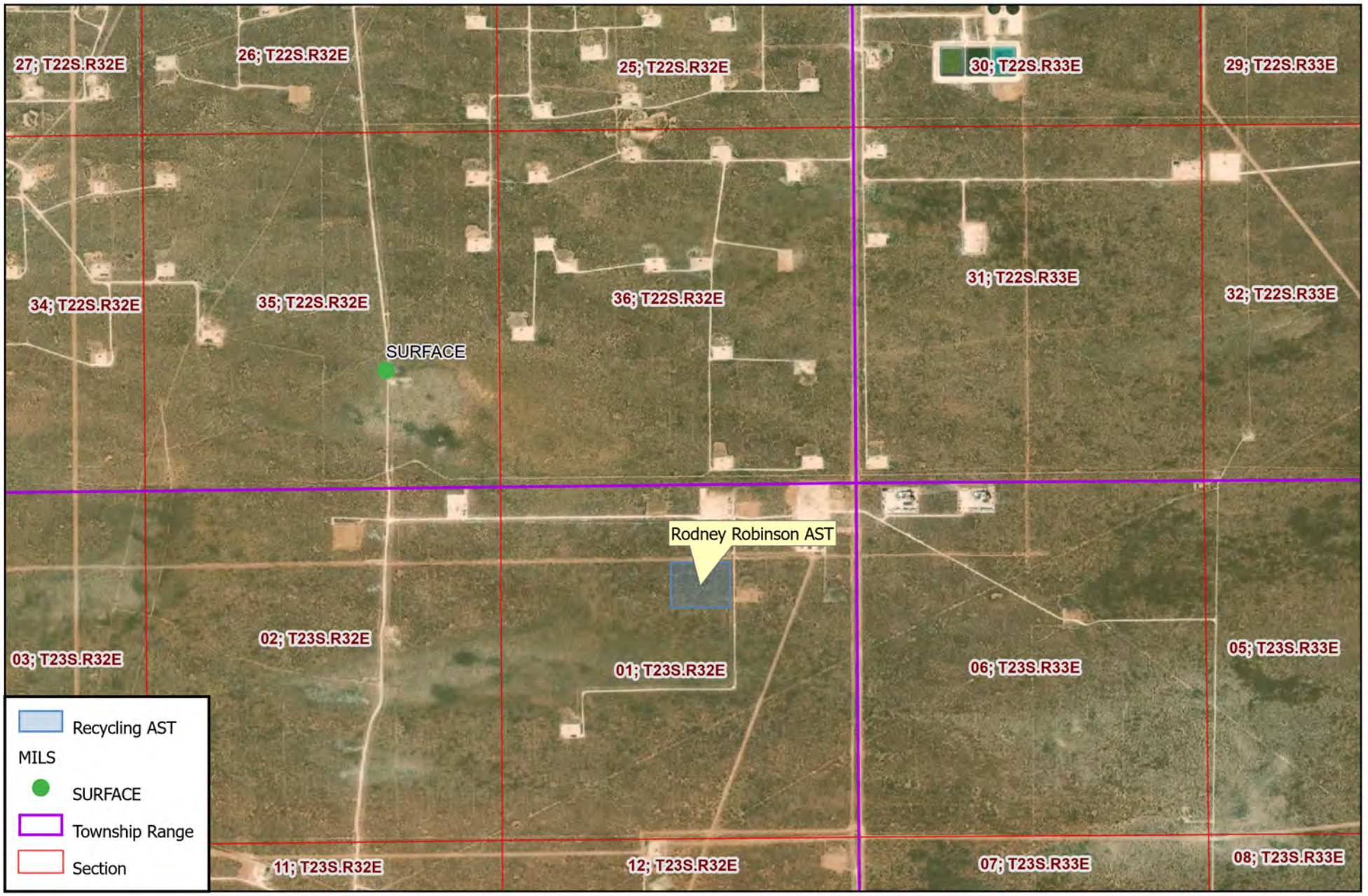

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Mines and Minerals	Figure 4
Solaris Water Midstream- Rodney Robinson AST	Sept 2020

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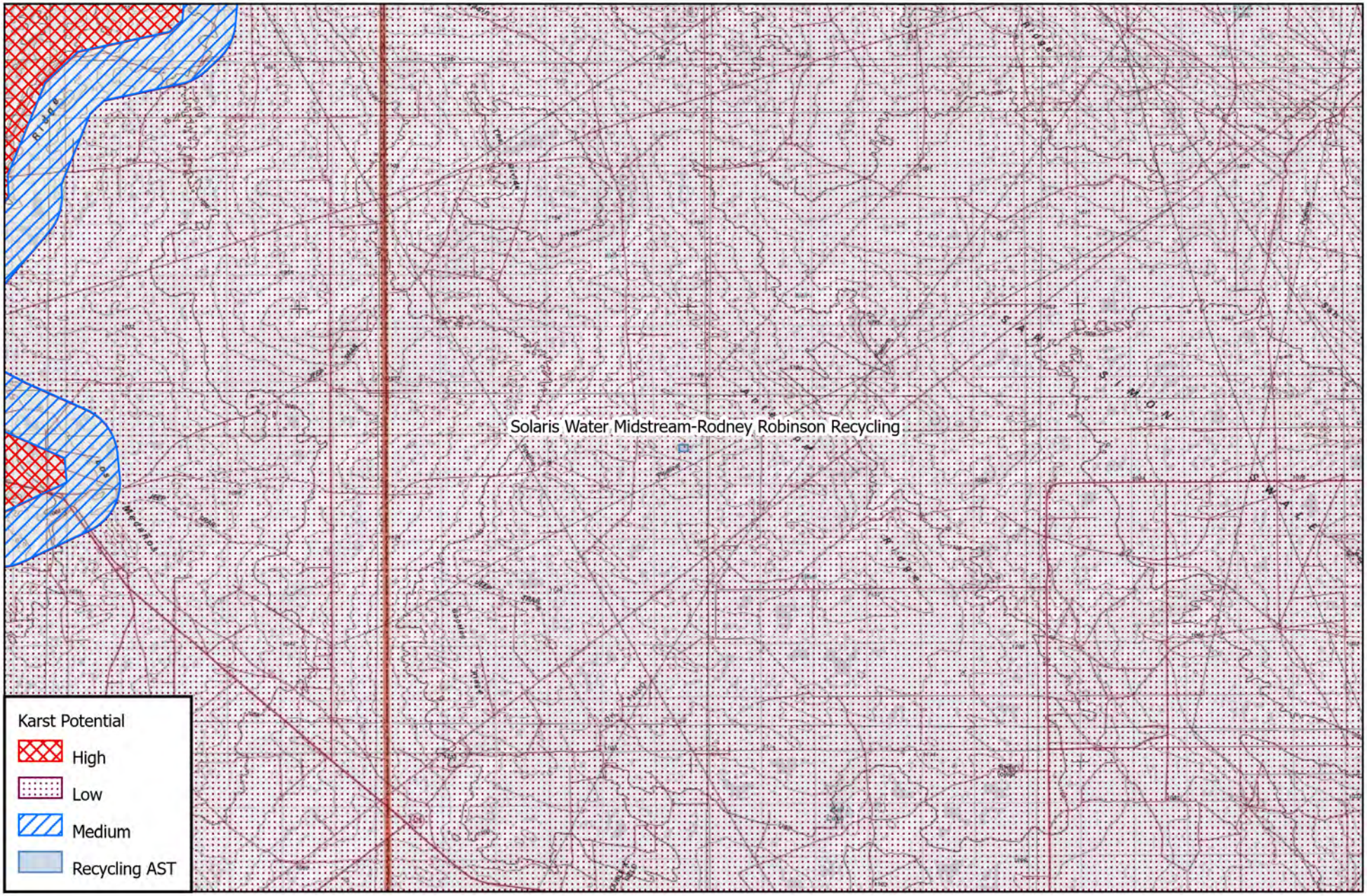

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Karst Potential

Figure 5

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

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FEMA Flood Hazards	Figure 6
Solaris Water Midstream- Rodney Robinson AST	Sept 2020

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Surface Water

Figure 7

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

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Nearby Structures

Figure 8

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

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Nearby Wetlands

Figure 9

Solaris Water Midstream- Rodney Robinson AST

Sept 2020

SITE PHOTOGRAPHS

Site Photographs

Figure 1 – Looking west along southern edge of proposed pad from southeast corner stake. Vegetation and surface is typical of area: Sand with generally flat with occasional, low dunes; Mesquite, Shinnery Oak, Yucca, small stands of native grasses

Figure 2 – View south to center of proposed location pad from center of north edge

Site Photographs

Figure 3 – View east from northeast corner of proposed pad showing pipeline right-of-way (east-west) and proximity to lease road (north-south)

Figure 4 – USGS-14813: water well is no longer present at site

Site Photographs

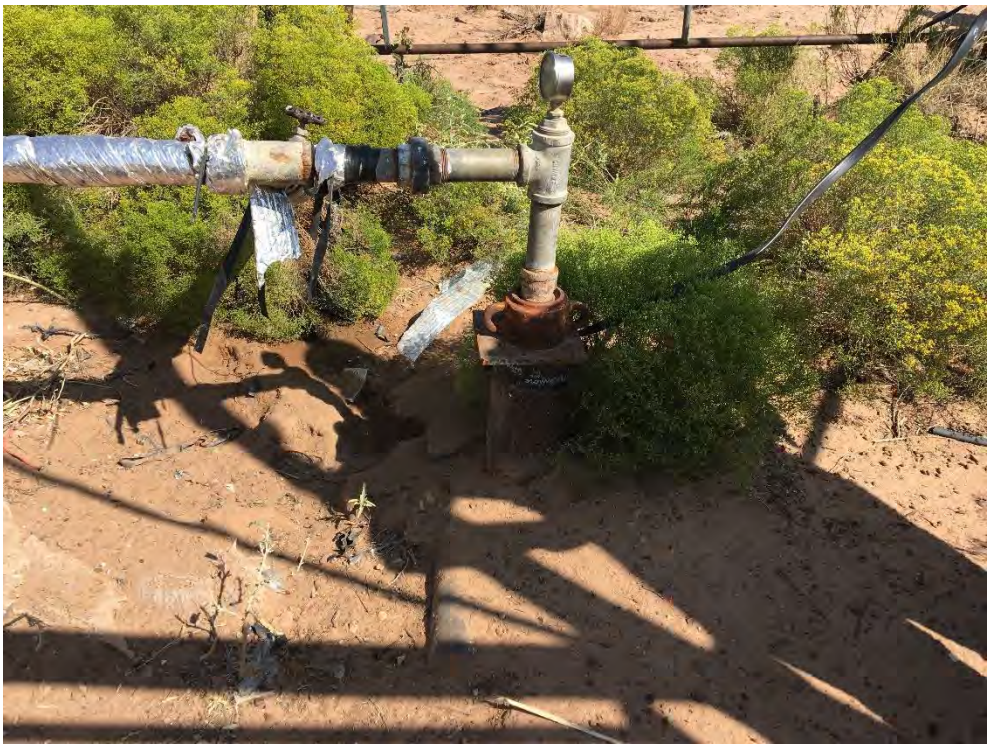


Figure 5 – Active windmill at cattle gathering corrals, USGS-15265

Figure 6 – USGS-15080 water well with pump; used for watering cattle; adjacent to tank battery

APPENDIX

LITHOLOGIC LOGS OF WELLS AND BORINGS

National Water Information System: Web Interface

Click to hideNews Bulletins

- Introducing The Next Generation of USGS Water Data for the Nation
- **NOTICE 09-08-2020: The NWIS Mapper is experiencing intermittent issues. Developers are looking into the problem. Thank you for your patience.**
- Full News

Groundwater levels for the Nation

Search Results -- 1 sites found

site_no list =

- 321952103400801

Minimum number of levels = 1

Save file of selected sites to local disk for future upload

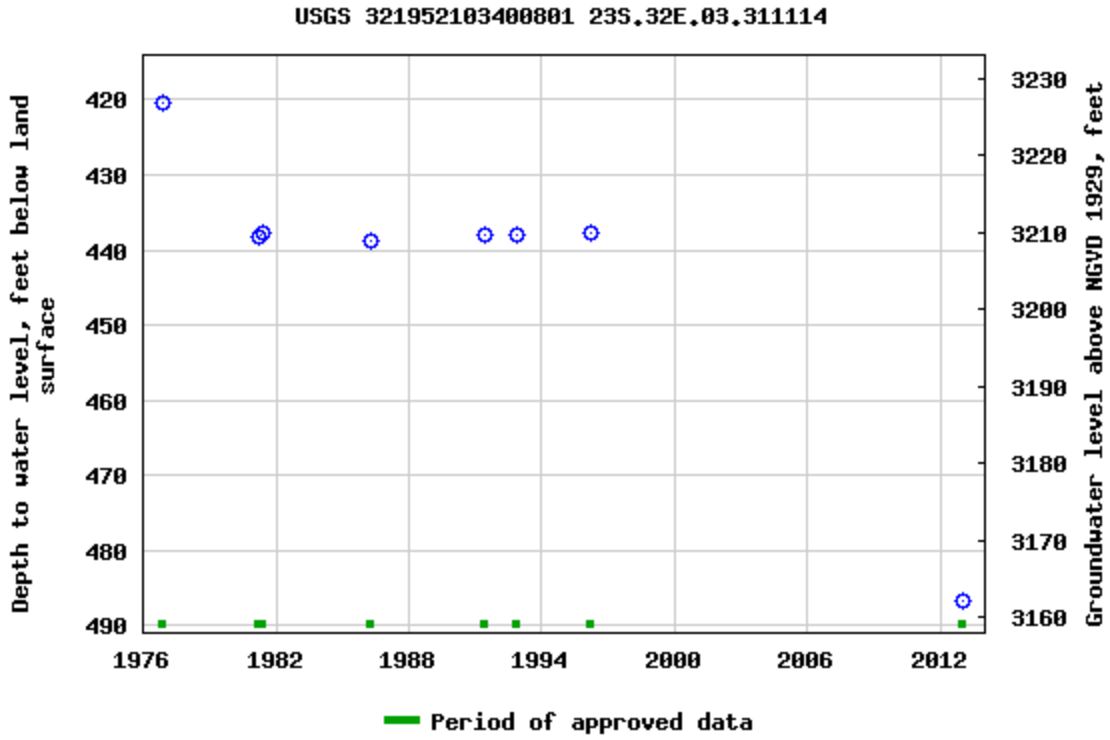
USGS 321952103400801 23S.32E.03.311114

Available data for this site Groundwater: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°19'59.2", Longitude 103°40'12.6" NAD83
Land-surface elevation 3,648.00 feet above NGVD29
The depth of the well is 630 feet below land surface.
This well is completed in the Santa Rosa Sandstone (231SNRS) local aquifer.

Output formats

Table of data
Tab-separated data
Graph of data
Reselect period



Breaks in the plot represent a gap of at least one year between field measurements.
Download a presentation-quality graph

Questions about sites/data?
Feedback on this web site
Automated retrievals
Help
Data Tips
Explanation of terms
Subscribe for system changes
News

Accessibility FOIA Privacy Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey
Title: Groundwater for USA: Water Levels
URL: https://nwis.waterdata.usgs.gov/nwis/gwlevels?

Page Contact Information: USGS Water Data Support Team
Page Last Modified: 2020-09-28 17:06:43 EDT
0.78 0.59 nadww01

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO

2012 NOV 21 A 10: 14

1. GENERAL AND WELL LOCATION

POD NUMBER (WELL NUMBER)	OSE FILE NUMBER(S)
C-03582	C03582
WELL OWNER NAME(S)	PHONE (OPTIONAL)
Bill Angel	575-369-6303
WELL OWNER MAILING ADDRESS	CITY / STATE / ZIP
PO Box 190	Lovington NM 88260

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	32	18	34.2	N
	LONGITUDE	103	32	57.0	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS

2. OPTIONAL

(2.5 ACRE)	(10 ACRE)	(40 ACRE)	(160 ACRE)	SECTION	TOWNSHIP	RANGE
¼	¼	¼	¼		☐ NORTH ☐ SOUTH	☐ EAST ☐ WEST

SUBDIVISION NAME	LOT NUMBER	BLOCK NUMBER	UNIT/TRACT

HYDROGRAPHIC SURVEY	MAP NUMBER	TRACT NUMBER

3. DRILLING INFORMATION

LICENSE NUMBER	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD1682	John Norris	Hungry Horse LLC

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
10-1-12	10-18-12	590	590	

COMPLETED WELL IS: ☐ ARTESIAN ☐ DRY HOLE ☒ SHALLOW (UNCONFINED) — STATIC WATER LEVEL IN COMPLETED WELL (FT):

DRILLING FLUID: ☐ AIR ☒ MUD ☐ ADDITIVES – SPECIFY:

DRILLING METHOD: ☒ ROTARY ☐ HAMMER ☐ CABLE TOOL ☐ OTHER – SPECIFY:

DEPTH (FT) FROM	DEPTH (FT) TO	BORE HOLE DIA. (IN)	CASING MATERIAL	CONNECTION TYPE (CASING)	INSIDE DIA. CASING (IN)	CASING WALL THICKNESS (IN)	SLOT SIZE (IN)
0	590	12"	PVC	glued	6"	3/8	7/8

4. WATER-BEARING STRATA

DEPTH (FT) FROM	DEPTH (FT) TO	THICKNESS (FT)	FORMATION DESCRIPTION OF PRINCIPAL WATER-BEARING STRATA (INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES)	YIELD (GPM)
18	65	47	Sand	UK
95	110	15	Sand	UK
230	236	6	Sand	UK
383	391	8	Sand	UK
410	416	6	Sand	UK

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA	TOTAL ESTIMATED WELL YIELD (GPM)
N/A	

FOR OSE INTERNAL USE — WELL RECORD & LOG (Version 6/9/08)

FILE NUMBER	C-3582	POD NUMBER		TRN NUMBER	515767
LOCATION	SHR	23S.33E.14.114			PAGE 1 OF 2

5. SEAL AND PUMP

TYPE OF PUMP: ☐ SUBMERSIBLE ☐ JET ☐ NO PUMP – WELL NOT EQUIPPED
☐ TURBINE ☐ CYLINDER ☐ OTHER – SPECIFY: unknown

ANNULAR SEAL AND GRAVEL PACK	DEPTH (FT) FROM	DEPTH (FT) TO	BORE HOLE DIA. (IN)	MATERIAL TYPE AND SIZE	AMOUNT (CUBIC FT)	METHOD OF PLACEMENT
	0	20	12	grout/cement	8	top

6. GEOLOGIC LOG OF WELL

DEPTH (FT) FROM	DEPTH (FT) TO	THICKNESS (FT)	COLOR AND TYPE OF MATERIAL ENCOUNTERED (INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES)	WATER BEARING?
0	7	7	topsoil	☐ YES ☒ NO
7	18	11	caliche	☐ YES ☒ NO
18	65	47	Sand	☒ YES ☐ NO
65	80	15	ROCK	☐ YES ☒ NO
80	95	15	Red clay	☒ YES ☐ NO
95	110	15	Sand	☒ YES ☐ NO
110	230	120	Red clay	☒ YES ☐ NO
230	236	6	Sand	☒ YES ☐ NO
236	310	74	Red clay	☒ YES ☐ NO
310	362	52	Sand clay	☒ YES ☐ NO
362	383	21	Red clay	☒ YES ☐ NO
383	391	8	Sand	☒ YES ☐ NO
391	410	19	Red clay	☒ YES ☐ NO
410	416	6	Sand	☒ YES ☐ NO
416	513	97	Red clay	☒ YES ☐ NO
513	520	104	Sand	☒ YES ☐ NO
520	590	70	Red clay	☒ YES ☐ NO

ATTACH ADDITIONAL PAGES AS NEEDED TO FULLY DESCRIBE THE GEOLOGIC LOG OF THE WELL

7. TEST & ADDITIONAL INFO

WELL TEST — METHOD: ☐ BAILER ☐ PUMP ☐ AIR LIFT ☐ OTHER – SPECIFY: N/A

TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

ADDITIONAL STATEMENTS OR EXPLANATIONS:

2012 NOV 21 A 10 — STATE ENGINEER OFFICE ROSWELL

8. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

SIGNATURE OF DRILLER — DATE: 11-19-12

FOR OSE INTERNAL USE — WELL RECORD & LOG (Version 6/9/08)

FILE NUMBER	C-3582	POD NUMBER		TRN NUMBER	518107
LOCATION	5TK	23S.33E.14.114			PAGE 2 OF 2

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

1. GENERAL AND WELL LOCATION

OSE POD NUMBER (WELL NUMBER)	OSE FILE NUMBER(S)
POD-1	C-3851
WELL OWNER NAME(S)	**PHONE (OPTIONAL)**
WIPP- Department of Energy Carlsbad Field Office	(575)234-7488
WELL OWNER MAILING ADDRESS	**CITY / STATE / ZIP**
PO Box 3090	Carlsbad / NM / 88221-3090

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	32	17	2.3	N
	LONGITUDE	103	41	42.3	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND

* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE

3.5 mi. east of Redd Rd. Section 20, Township 23s, Range 32e

2. DRILLING & CASING INFORMATION

LICENSE NUMBER	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1723	Randy Stewart	Stewart Brothers Drilling

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
8-19-15	10-2-15	1392	1405	1354

COMPLETED WELL IS: [x] ARTESIAN [ ] DRY HOLE [ ] SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT): 713

DRILLING FLUID: [ ] AIR [x] MUD ADDITIVES – SPECIFY:

DRILLING METHOD: [x] ROTARY [ ] HAMMER [ ] CABLE TOOL [ ] OTHER – SPECIFY:

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
+2	35	24	LCS	weld	14	.375	n/a
35	1354	12.250	Blank FRP	Threaded	5	.25	n/a
1354	1383	12.250	Slotted FRP	Threaded	5	.25	.070
1383	1393	12.250	Blank FRP	Threaded	5	.25	

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2015 NOV 10 PM 3:35

3. ANNULAR MATERIAL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	35	24	neat cement	61	tremie
35	1347	12.250	neat cement	1080	tremie
1347	1352	12.250	Gelacryl seal	3.25	tremie
1352	1353	12.250	Bentonite pellets	.35	tremie
1353	1383	12.250	6-9 Sand	19.60	tremie
1383	1389	12.250	Gelacryl seal	3.92	tremie
1389	1405	12.250	bentonite seal(.65 cu/ft)6-9 sand	9.80	tremie

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 10/29/15)

FILE NUMBER	C-3851	POD NUMBER	1	TRN NUMBER	564731
LOCATION	23S.32E.20.4.3.3			monitor	PAGE 1 OF 2

4. HYDROGEOLOGIC LOG OF WELL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	6	6	Pad material & brown sand	Y ✓N	
6	36	30	Caliche	Y ✓N	
36	120	84	Gatuna Sandstone	Y ✓N	
120	440	320	Chinle Sandstone	Y ✓N	
440	576	136	Santa Rosa Sandstone	Y ✓N	
576	1198	622	Dewey Lake Sandstone	Y ✓N	
1198	1228	30	Anhydrite	Y ✓N	
1228	1238	10	Mudstone	Y ✓N	
1238	1248	10	Anhydrite	Y ✓N	
1248	1265	17	Magenta Dolemite	Y ✓N	
1265	1332	67	Anhydrite	Y ✓N	
1332	1340	8	mudstone	Y ✓N	
1340	1354	14	Anhydrite	Y ✓N	
1354	1380	16	Culebra Dolemite	✓Y N	3.00
1380	1390	10	mudstone	Y ✓N	
1390	1405	15	Anhydrite	Y ✓N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☑ AIR LIFT ☐ BAILER ☐ OTHER – SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 3.00

STATE ENGINEER OFFICE ROSWELL, NEW MEXICO 2015 NOV 10 PM 3:35

5. TEST; RIG SUPERVISION

WELL TEST: TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION:

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Danny L White

6. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Danny White — Danny L. White — SIGNATURE OF DRILLER / PRINT SIGNEE NAME

10/31/15 — DATE

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/08/2012)

FILE NUMBER	C-3851	POD NUMBER	1	TRN NUMBER	564731	
LOCATION	23S.32E.20.4.3.3			monitor		PAGE 2 OF 2

Well Cuttings Log — Page 1 of 5

Hole ID: AEC-7R — Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R32E

Drill Date: 8-11-13 to 8-22-13	Drilling Method: Hollow-Stem/Air Rotary	Drill Make/Model: NA
Drill Co: Stewart Brothers Drilling Company	Hole Diameter: 11 Inch	Barrel Specs: NA
	Hole Depth: 891 Feet bgl	Drill Fluid: NA
	Hole Orientation: Vertical	Core Preserve: NA
Logged by: Brett Seal	Date: 9/23/14	Scale: NA

	Northing	Easting	Elevation
Survey Coordinate (Ft):			

Comments: Depths to unit contacts are derived from geophysical logs. Lithology comes from cuttings.

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description
C-1	0	Surficial Deposites			Mostly unconsolidated dune sands, with a few very poorly consolidated pebble sized cuttings. 5 YR 5/6 (yellowish red), well sorted rounded grains with high porosity
C-2	10	Mescalero			Sandstone, 7.5 YR 8/2 (pinkish white) moderately consolidated and well sorted. Consists of sedimentary grains supported by a caliche matrix. Highly effervescent when exposed to HCl.
C-3		Gatuña			Sandstone, 5 YR 8/3 (Pale pink), well consolidated, very well sorted silica grains, clast supported with a caliche matrix, highly effervescent when exposed to HCl, low porosity.
C-4	20 30	Santa Rosa			Sandstone, 2.5 YR 5/6 (reddish brown) well consolidated, very well sorted, calcic cement
C-5	40				Sandstone, 2.5 YR 4/4 (weak reddish brown), cuttings powdered, medium and fine rounded grains, very well sorted, calcareous cement, scarce mica flakes and iron oxides.
C-6	50				Sandstone, 2.5 YR 7/3 (pale reddish brown) two varieties of sandstone are present, First is very fine grained, well sorted, non-calcic with moderate porosity. The second is coarse sand sized grains exhibiting moderate sphericity and are sub-angular, well sorted with calcic cement and low porosity, clast supported. The coarse grained rock contains iron oxides and mica flakes while the fine grained does not. Description applies to 50' and 60' samples.
C-7	60 70				
C-8	80 90				Sandstone, 2.5 YR 6/4 (pale reddish brown), well sorted with coarse, sub-rounded, and sub-equant grains, clast supported with calcic cement and low porosity. Sparse mica flakes and more abundant iron oxides. Few fine grained cuttings from above.
C-9	100				Sandstone, same as above with no fine grained pieces.
C-11	110 120	Dewey Lake			Sample contains a lot of fall down contamination from the Santa Rosa above. New material: Sandstone, 5 YR 8/2 (pinkish white) very fine grained and very well consolidated with low porosity, calcic material with a few specs of iron ozides.
C-13	130 140 150				Sandstone, 2.5 YR 4/4 (weak reddish brown) two varieties present. First is coarse grained, equant, sub-angular, well sorted moderately consolidated and calcic, with iron oxides and moderate porosity. Second is a fine grained well sorted sandstone with low porosity and contains reduction spots, no calcic material. Minute amounts of fiberous gypsum.
C-15	160				Sandstone, two lithologies, 2.5 YR 3/4 (dusky red) very fine grained and well sorted, well consolidated, non-calcic. 2.5 YR 5/6 (red) medium sized well sorted grains, equant sub-rounded grains, well consolidated, non-calcic with iron oxides and reduction spots. Gypsum is present.

Lithology

Well Cuttings Log

Hole ID: AEC-7R

Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-16	170	Dewey Lake			Large increase in reduction material from above. Makes up 10-15% of material.	
C-18	180				Increase in the amount of Gypsum and a reduction in the amount of reduction material.	
	190					
C-20	200				Same as sample C-15 but with reduced Gypsum and reduction material.	
	210					
C-21	220				Sanstone, 7.5 YR 7/2 (Pinkish Gray) coarse grained, equant , sub-angular well sorted grains slightly calcic with iron oxides, well consolidated. No gypsum present.	
C-22					Sandstone, 2.5 YR 3/4 (dark reddish brown) very fine grained and well sorted, well consoildated with low porosity. Iron oxides are present along with minor amounts of reduction material and gypsum.	
	230					
C-23	240				Sandstone, 2.5 YR 4/3 (reddish brown) medium grained, well sorted, sub-angular grains, well consolidated with low porosidty. Sample is slightly calcic with iron oxides present. No gypsum or reduction material present.	
	250					
C-24	260				Sandstone, 2.5 YR 4/4 (reddish brown) fine grained, very well sorted with low porosity, moderately consolidated. Sample is slightly calcic with iron oxides and contains gypsum and reduction spots.	
	270					
C-25	280				Increase in gypsum.	
	290					
C-26	300				Same as above.	
	310					
C-27	320				Sandstone, 2.5 YR 4/4 (reddish brown) medium grained, well sorted and consolidated, sub-angular grains with low porosity. Iron oxides, sparse reduction material and minor amounts of gypsum presnt. Slightly calcic.	
	330					
C-28	340				Increase in gypsum and reduction material from C-27.	
	350					
C-29	360				Increase in gypsum and reduction material from C-28.	
	370					
C-30	380				Increase in gypsum and reduction material from C-29.	

Well Cuttings Log

Hole ID: AEC-7R

Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
	390	Dewey Lake				
C-31	400				Decrease in the amount of reduction material.	
	410					
C-32	420				Sandstone, 2.5 YR 4/3 (reddish brown) fine grained, very well sorted and consolidated with low porosity. Reduction spots, iron oxides and gypsum present. Sample is non-calcic.	
	430					
C-33	440				Large increase in reduction material and gypsum, and sample is calcic.	
	450					
C-34	460				No change	
	470					
C-35	480				Decrease in reduction material.	
	490					
C-36	500				No change.	
	510					
C-37	520				No Change.	
	530					
C-38	540				No Change.	
	550					
C-39	560				Sandstone, 2.5 YR 4/6 (red) medium grained, well sorted and consolidated, grains are equant and sub-rounded, porosity is low. Reduction spots, iron oxides and gypsum are present in the sample. Sample is calcic.	
	570					
C-40	580				No Change.	
	590					
C-41	600				Sandstone, 2.5 YR 4/4 (reddish brown) fine grained, very well sorted and consolidated with low porosity, reduction spots, iron oxides and gypsum are present. Material is non-calcic.	
	610					

Well Cuttings Log

Hole ID: AEC-7R

Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-42	620	Dewey Lake			No Change.	
	630					
C-43	640				No Change.	
	650					
C-45					Large amounts of gypsum.	
C-46B	660	Rustler	Forty-Niner	A-5	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity.	
	670					
C-46	680				Minor amounts of gypsum present.	
	690			M-4	No samples collected.	
C-49	700			A-4	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity and gypsum present.	
C-50	710				No change.	
C-52	720		Magenta		Dolomite, 2.5 YR 7/1 (light gray) microcrystaline, gypsum present.	
C-53	730				No Change.	
	740					
C-56	750		Tamarisk	A-3	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity and gypsum present.	
	760					
C-58	770				No gypsum.	
	780					
C-59	790				Anhydrite, 2.5 Y 5/1 (gray) to 2.5 Y 7/1 (light gray) fine crystalline structure with low porosity and gypsum present.	
	800					
C-60	810				Large increase in gypsum.	
C-61	820			M-3	Large amounts of anhydrite and dolomite fall down contamination with trace amounts of mudstone material. Gypsum present.	
C-62	830				Large amount of fall down contamination. Minor amounts of mudstone, 5 YR 5/4 (reddish brown) very fine grained and well sorted, well consolidated. Gypsum present.	

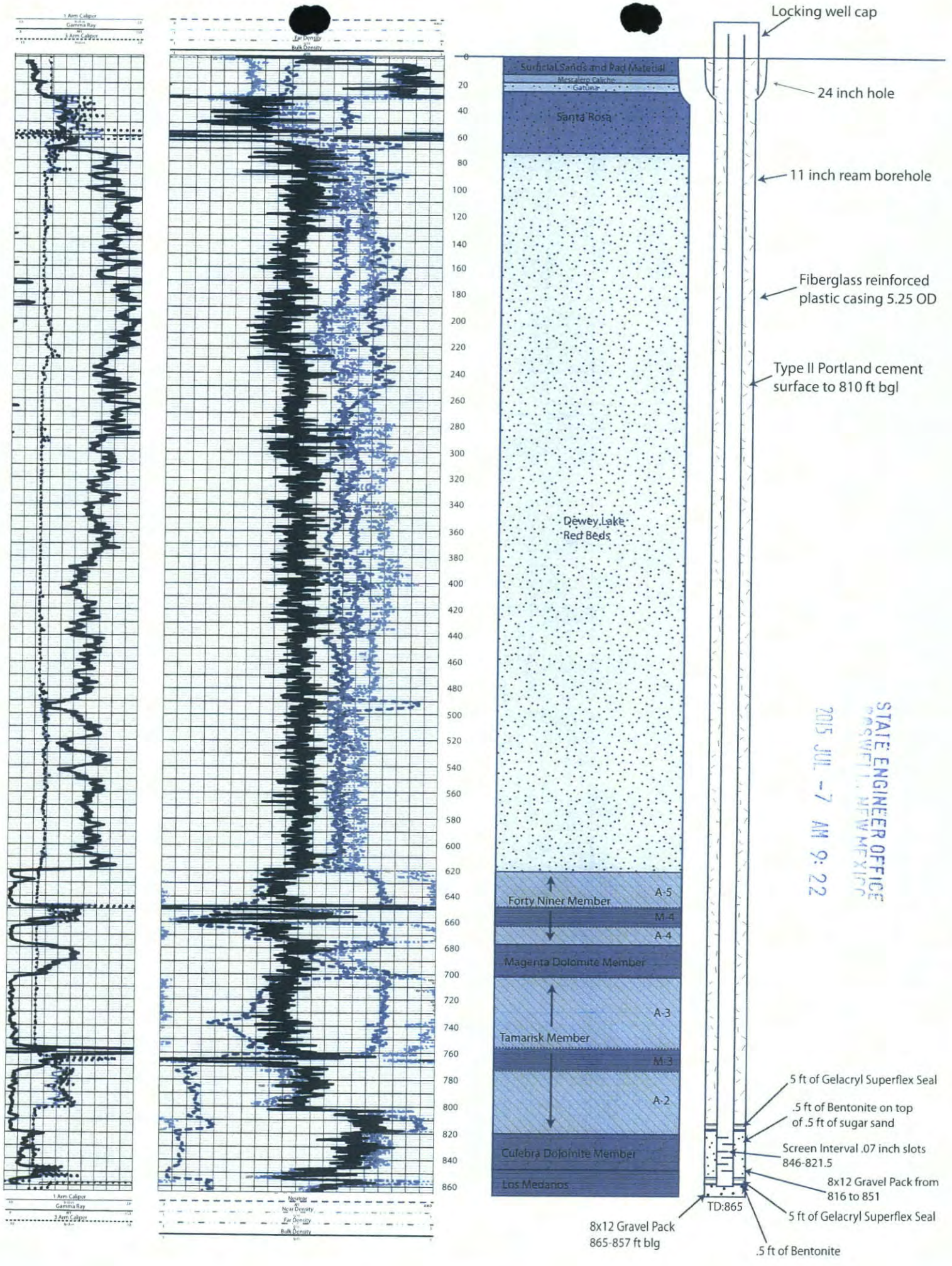
Well Cuttings Log

Page 5 of 5

Hole ID: AEC-7R

Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
	840	Rustler	Tamarisk	M-3		
C-66				A-2	Anhydrite, 2.5 YR 5/1 (reddish gray) to 7.5 Y 7/1 (light gray) fine crystalline structure with low porosity and gypsum present.	
C-67	850				No change.	
C-70	860		Culebra		Dolomite, 10 YR 7/1 (light gray) vuggy texture, microcrystaline matrix, large amount of gypsum.	
	870					
					End of Geophysical Log	
	880		Los Medaños			
	890					
	900					



New Mexico Office of the State Engineer

Point of Diversion Summary

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters)

Well Tag	POD Number	Q64	Q16	Q4	Sec	Twn	Rng	X	Y
	C 02349		2	3	03	23S	32E	625678	3578004*

x

Driller License: **Driller Company:**

Driller Name:

Drill Start Date:	04/14/1930	**Drill Finish Date:**	04/14/1930	**Plug Date:**	
Log File Date:		**PCW Rcv Date:**		**Source:**	
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	5 GPM
Casing Size:	8.00	**Depth Well:**	525 feet	**Depth Water:**	

x

***UTM location was derived from PLSS - see Help**

R. T. HICKS CONSULTANTS, LTD.
901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

Memorandum

Misc-390

From: Kristin Pope

Date: September 27, 2018

RE: Devon Energy, North Thistle 3-34 State Com 3H Conductor Pipe Log

Summary

1. Dust dry cuttings from the auger from ground surface to a depth of 65 feet
2. At 65 feet, the clay in the auger was moist
3. "Wet" cuttings were evident from 70-73 feet
4. After cessation of drilling for 45 minutes at the 73-foot depth, no saturated conditions were observed in the boring
5. From 73-80 feet, moisture content decreased with depth
6. Dust dry cuttings from the auger were observed at 80 feet below grade
7. The driller reported that the conductor pipes for 1H and 2H, which are 30 and 60 feet west of the 3H conductor pipe, did not detect any wet cuttings

The gray and red claystone encountered by the auger from 15-80 feet below grade are consistent with the Chinle/Dockum Formation. Discontinuous sandstone lenses of various thicknesses are observed in the Chinle/Dockum as are thicker, more extensive sandstones that can produce water for beneficial use. The lack of wet cuttings from adjacent borings, the thin "wet" horizon from 70-73 feet and the lack of saturated conditions after standing for 45 minutes is not indicative of groundwater for beneficial use.

Logging of a conductor pipe boring at the 4H, 5H and 6H boring is planned to further investigate the nature of the observed "wet" zone that may be about 60 feet below the bottom of the reserve pit.

Method Description

The location of the North Thistle 3-34 St. 1H, 2H, and 3H wells has a surface elevation of 3,596 feet ASL and is located approximately 26 miles northwest of the city of Jal in Lea County. According to the submitted C-144 temporary pit application the uppermost water-bearing zone was expected to be encountered within the upper units of the Chinle/Dockum Group, approximately 216 feet below the location or 3,380 feet ASL. To gather the most accurate groundwater data at the site, we logged the cuttings during the installation of the borehole for the conductor pipe at the 1H and 3H wells sites.

On September 21, 2018, I arrived on location to witness the drilling of the cellar of the 1H by Butch's Rat Hole & Anchor Service to a total depth of 8 feet using a track-mounted AF-125 auger rig. I inspected the cuttings with each trip out of the hole and the lithology of the cuttings consisted of fine, light-pink sand with caliche cobbles and boulders.

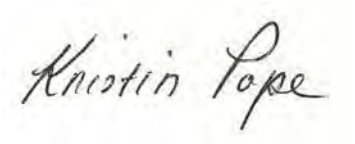
On September 22, 2018, I returned to the location at approximately 10:00 AM to find the rig drilling the conductor hole at the 3H well site. At the time of my arrival, the hole was advanced

to approximately 45 feet but the driller reported to me that the auger was in the same lithologic material since 15 feet BGS. From 45 feet to a total depth of 80 feet, I inspected the cuttings from each trip of the auger and logged the lithologic description and the presence or absence of moisture. Each trip advanced the hole approximately 2.0-2.5 feet of depth. Samples were collected from intervals in order to describe the lithology or to detect moisture. Inspection during drilling from 45 feet revealed dry cuttings. At 65 feet, moisture was observed in the clay. At 70-73 feet, the cuttings were described as "wet." During this time, the driller took a lunch break lasting approximately 45 minutes with the auger in this stratum. When drilling resumed, I observed no change in the degree of wetness of the cuttings, nor any standing water. At 73 feet, wetness dissipated and no longer described the cuttings as moisture continued decreasing with depth until 80 feet where I described cuttings as "dry."

The following lithological descriptions were observed and recorded:

45-65 feet	Mudstone, gray, slaty cleavage, dry *driller reports this material began at 15 ft*
65-70 feet	Medium clay, gray, globular-massive, ~10% pebbles & cobbles (gray, sub-rounded), moist
70-73 feet	Medium clay, red-brown, 15% pebbles (gray, angular), wet
73-80 feet	Clay, red, very fine, consolidated with platy structure, friable, moist
80-82 feet	Clay, gray, dry

The driller reported that during the drilling of the 1H conductor hole drilled earlier in the day, wet cuttings, as observed at 70-73 feet in the 3H, were not encountered. He said that if wetness was encountered in the 2H, which was to be drilled next, that the company would notify us. In subsequent communication, the driller indicated that no wet cuttings were evident.



Representative samples from each stratum encountered

Final TOOH: Dry, gray clay at 80 ft is visible at bottom half of auger

EXPLORATION RESULTS

Oxy Red Tank Recycling Facility - Section 30 T22S R33E

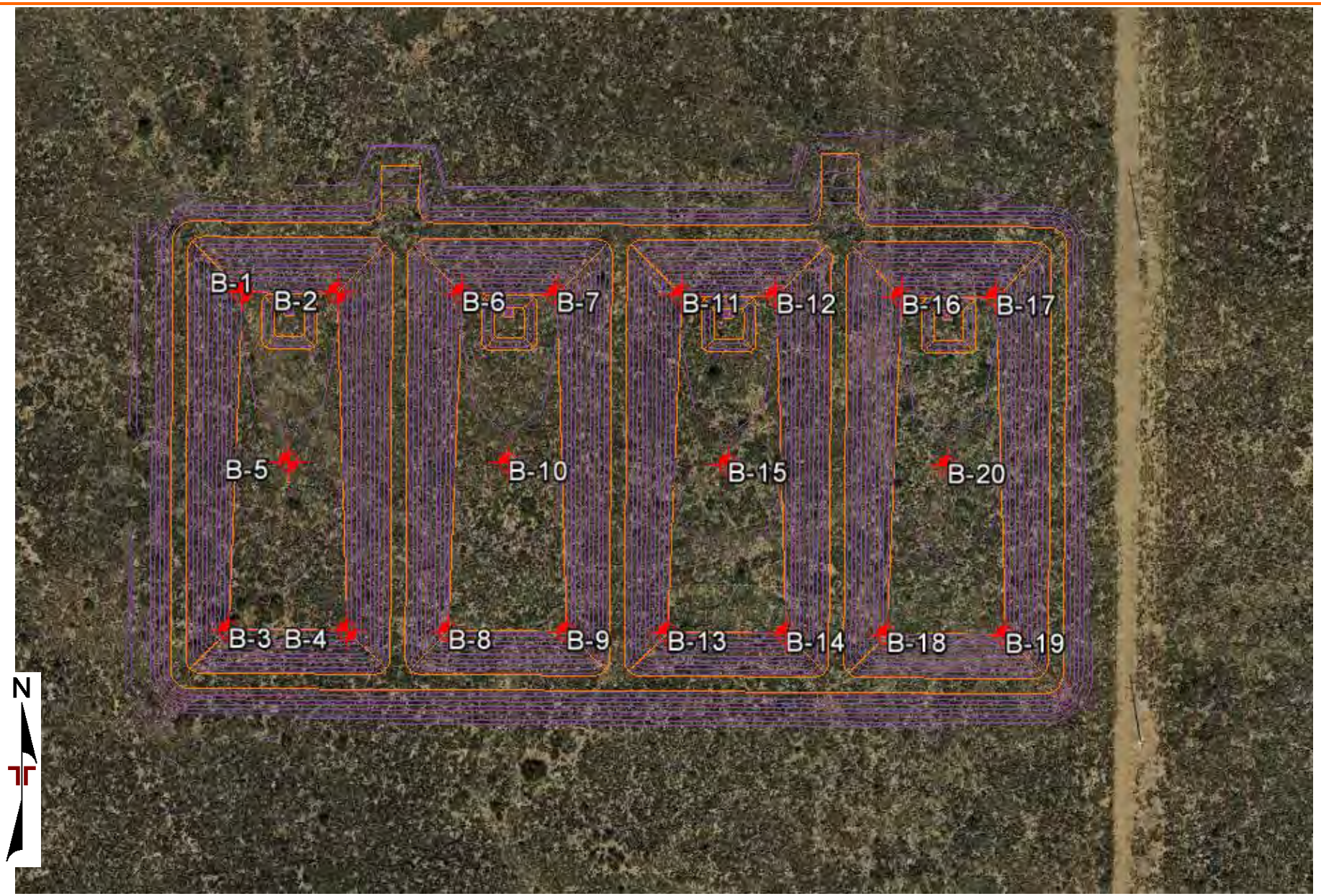


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. B-1

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6155°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT (SP-SM), brown to light brown, very loose to loose				2-1-2 N=3	1	NP	6
4.0	3744+/-	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, light brown to tan, medium dense	5			2-2-4 N=6			
		-very dense at 6'				3-8-17 N=25			
		-strongly cemented caliche materials encounterd below 6'	10			23-42-50/3"			
						50/5"			
			15			28-42-49 N=91			
			20			33-50/4"	5	NP	12
			25			18-26-27 N=53			
		-dense at 28.5'	30			14-26-23 N=49			
		-very dense at 33.5'	35			35-29-32 N=61			
		-dense at 38.5'	40			10-14-20 N=34			
		-very dense at 43.5'	45			31-22-40 N=62			
			50			50/5"			
		-dense at 53.5'	55			7-16-32 N=48			
		-very dense at 58.5'	60			10-19-33 N=52			
			65			31-50/4"			
			70			23-50/3"			
			75			20-43-50/4"			
80.0	3668+/-		80			25-42-50/4"			
		Boring Terminated at 80 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-17-2018 | Boring Completed: 03-19-2018

Drill Rig: CME 55 | Driller: Brian

Project No.: A4185061

BORING LOG NO. B-2

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6151°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0.0	3744+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
4.0		**SILTY SAND (SM)**, light brown to tan, very dense
		-dense at 6'
		-very dense at 8.5'
		-strongly cemented caliche materials encounterd below 8.5'
80.0	3668+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0			1-3-3 N=6			
5			1-3-6 N=9			
			50/4"			
10			17-21-23 N=44			
			32-33-50 N=83	8	33-24-9	43
15			50/5"			
20			38-50/5"			
25			30-38-48 N=86			
30			21-38-42 N=80			
35			50/2"	7	NP	34
40			20-27-35 N=62			
45			50/1"			
50			50/5"			
55			33-47-46 N=93			
60			30-42-50/2"			
65			18-36-50/1"			
70			30-50/2"			
75			37-50/5"			
80			50/1"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-19-2018 | Boring Completed: 03-20-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-3

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6155°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0.0	3741+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, very loose
4.0		**SILTY SAND (SM)**, light brown to tan, very dense **-strongly cemented caliche materials encounterd below 4'**
80.0	3665+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0		1-1-2 N=3			
5		3-4-6 N=10			
		10-30-50/5"			
10		39-50/5"			
		50/6"			
15		50/5"			
20		36-41-50 N=91	6	32-24-8	38
25		31-50/5"			
30		50/5"			
35		29-50/5"			
40		33-50	3	NP	29
45		22-43-50/1"			
50		17-30-50/5"			
55		45-50/3"			
60		31-50/5"			
65		50/5"			
70		50/6"			
75		16-50/5"			
80		50/2"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-26-2018 | Boring Completed: 03-27-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-4

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.615°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0	3741+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose to medium dense
4.0		
		SILTY SAND (SM), light brown, very dense **-strongly cemented caliche materials encounterd below 4'**
48.5	3696.5+/-	
		SANDY LEAN CLAY (CL), light brown to tan, hard
80.0	3665+/-	
		Boring Terminated at 80 Feet

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	1-2-2 N=4			
	4-5-8 N=13			
10	8-27-50/5"			
	30-50			
	27-50/4"			
15	40-50/4"			
20	29-33-36 N=69			
25	25-50/6"	6	NP	24
30	50/4"			
35	35-50/1"			
40	26-43-50/5"			
45	27-50/5"			
50	30-46-50/1"	6	26-12-14	54
55	50/5"			
60	50/5"			
65	50/6"			
70	42-50/1"			
75	50/1"			
80	50/0"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-25-2018 | Boring Completed: 03-26-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-5

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3581° Longitude: -103.6153°

Approximate Surface Elev: 3746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
		POORLY GRADED SAND WITH SILT (SP-SM), brown to light brown, loose
4.0	3742+/-	
		SILTY SAND (SM), light brown, very dense
		-strongly cemented caliche materials encounterd below 4'
80.0	3666+/-	
		Boring Terminated at 80 Feet

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	1-2-2 N=4	2	NP	6
	4-4-5 N=9			
10	9-23-50/4"			
	50/5"			
	50/2"			
15	30-50/5"			
20	37-50/5"			
25	26-37-42 N=79	4	NP	15
30	40-50/5"			
35	42-50/4"			
40	50/1"			
45	14-50/3"			
50	18-50			
55	50/1"			
60	50/3"			
65	50/5"			
70	50/2"			
75	50/3"			
80	50/1"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-23-2018 | Boring Completed: 03-23-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-6

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6145°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	3746+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose	1-3-4 N=7			
		CLAYEY SAND (SC), light brown, very dense **-strongly cemented caliche materials encounterd below 2'**	5-50/5"			
			50/1"			
			50/1"	9	29-18-11	48
			50/1"			
			50/1"			
			50			
			27-44-50/5"			
			28-44-50/5"			
			50/4"			
			31-50/5"			
			21-50/3"			
48.5	3699.5+/-	**SILTY SAND (SM)**, light brown to tan, very dense	24-41-46 N=87	3	NP	19
			16-30-50 N=80			
			50/4"			
			30-50/4"			
			50/3"			
			50/5"			
80.0	3668+/-		50/1"			
		Boring Terminated at 80 Feet				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-20-2018 | Boring Completed: 03-20-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-7

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6141°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0.0	3744+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, very loose
2.0		-dense at 2'
4.0		**SILTY SAND (SM)**, light brown to tan, very dense
		-strongly cemented caliche materials encounterd below 4'
80.0	3668+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0	1-1-2			
	N=3	5	NP	16
5	4-5-27			
	N=32			
	30-50/6"			
10	50/2"			
	24-45-50/1"			
15	38-50/5"			
20	50/5"			
25	46-50/5"			
30	30-42-50/5"	4	NP	18
35	39-47-50/1"			
40	43-50/5"			
45	50/4"			
50	32-46-50/2"			
55	41-50/5"			
60	25-50/4"			
65	50/5"			
70	18-50/2"			
75	50/3"			
80	50/1"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-23-2018 | Boring Completed: 03-23-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-8

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6146°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0.0	3745+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
		-very dense at 2'
		-strongly cemented caliche materials encounterd below 2'
6.0	3739+/-	**SILTY SAND (SM)**, light brown to tan, very dense
80.0	3665+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		1-2-3 N=5			
		3-44-40 N=84	6	NP	32
10		24-30-38 N=68			
		50/4"			
		50/5"			
15		35-50/5"			
20		20-25-30 N=55	6	NP	20
25		50/6"			
30		36-50/5"			
35		50/6"			
40		41-50/4"			
45		29-50/2"			
50		30-50/3"			
55		50/5"			
60		50/0"			
65		50/0"			
70		50/1"			
75		50/2"			
80		50/1"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-27-2018 | Boring Completed: 03-27-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-9

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6141°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
2.0	3743+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
		SILTY SAND (SM), light brown to tan, very dense
		-strongly cemented caliche materials encounterd below 2'
80.0	3665+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	1-2-5 N=7	7	NP	23
	7-11-50/5"			
	50/0"			
	50/1"			
10	35-39-35 N=74			
15	37-50/5"			
20	31-50/5"			
25	20-50/6"			
30	50/6"			
35	21-27-30 N=57			
40	10-25-50/5"	2	NP	17
45	8-50/6"			
50	50/5"			
55	39-50/3"			
60	50/2"			
65	50/5"			
70	39-50/3"			
75	50/0"			
80	50/2"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-28-2018 | Boring Completed: 03-28-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-10

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3581° Longitude: -103.6143°

Approximate Surface Elev: 3746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	3744+/-	1-2-2	2	NP	6
		N=4			
		4-7-50/2"			
		50/0"			
		50/1"			
		50/2"			
		39-40-50/5"	7	NP	24
		38-50/5"			
		30-50/4"			
		43-50/5"			
		37-50/3"			
		50/3"			
		44-50/2"			
		50/5"			
		41-50/5"			
		50/3"			
		50/1"			
		50/0"			
		50/4"			
80.0	3666+/-	50/2"			

POORLY GRADED SAND WITH SILT (SP-SM), brown to light brown, loose

SILTY SAND (SM), light brown, very dense

-strongly cemented caliche materials encounterd below 2'

Boring Terminated at 80 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-24-2018 | Boring Completed: 03-24-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-11

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6136°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	3746+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose		2-2-4 N=6	1	NP	5
		SILTY SAND (SM), light brown, very dense	5	24-50/5"			
		-strongly cemented caliche materials encounterd below 2'		42-50/4"			
				50/5"			
			10	50/4"			
			15	32-50/5"			
			20	50/5"			
			25	50/5"			
			30	50/4"			
			35	50/5"			
			40	26-50/4"			
			45	20-38-43 N=81	3	NP	17
			50	18-50/6"			
			55	20-50/1"			
			60	30-50/4"			
			65	16-30-50/4"			
68.9	3679+/-			50/5"			
		Boring Terminated at 68.9 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-22-2018 | Boring Completed: 03-22-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-12

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6132°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT (SP-SM), brown to light brown, loose		1-2-3			
4.0	3744+/-	**-strongly cemented caliche materials encounterd below 2'**		N=5			
		SILTY SAND (SM), light brown to tan, very dense	5	19-50/5"			
				50/4"			
				50/6"			
			10	32-32-35 N=67	10	34-27-7	46
			15	31-50/5"			
			20	50/5"			
			25	50/4"			
			30	50/6"			
			35	50/5"			
			40	50/3"			
			45	50/5"			
			50	24-34-50/4"	4	NP	27
			55	50/4"			
			60	35-50/4"			
			65	50/3"			
69.4	3678.5+/-			25-50/5"			
		Boring Terminated at 69.4 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-22-2018 | Boring Completed: 03-22-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-13

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6136°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	3743+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose	2-2-3 N=5			
		CLAYEY SAND (SC), brown to light brown, very dense **-strongly cemented caliche materials encounterd below 2'**	50/5"			
			50/5"			
			38-50/4"			
			22-32-39 N=71	7	24-16-8	41
13.5	3731.5+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown, very dense	50/5"			
			20-28-35 N=63			
			17-24-30 N=54			
			50/4"			
			19-28-33 N=61			
			16-27-34 N=61			
			22-26-38 N=64	2	NP	9
			36-50/5"			
			50/5"			
			50/4"			
			50/5"			
68.7	3676.5+/-					
		Boring Terminated at 68.7 Feet	50/3"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-28-2018 | Boring Completed: 03-28-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-14

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6131°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0	3745+/-	**CLAYEY SAND (SC)**, brown to light brown, loose to medium dense
		-very dense at 4'
		-strongly cemented caliche materials encounterd below 4'
8.5	3736.5+/-	**SILTY SAND (SM)**, light brown to tan, very dense
80.0	3665+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0		1-3-2 N=5			
5		8-9-11 N=20			
		50/5"	8	30-20-10	44
10		11-19-32 N=51			
		14-29-33 N=62			
15		50/5"			
20		30-45-50/5"			
25		37-48-50/5"			
30		17-29-36 N=65			
35		19-31-40 N=71			
40		23-29-42 N=71			
45		26-32-44 N=76			
50		31-38-44 N=82			
55		37-47-50/5"	3	NP	16
60		50/4"			
65		50/5"			
70		50/5"			
75		50/4"			
80		50/6"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-27-2018 | Boring Completed: 03-27-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-15

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3581° Longitude: -103.6134°

Approximate Surface Elev: 3746 (Ft.) +/-

DEPTH		ELEVATION (Ft.)
2.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose	3744+/-
	SILTY SAND (SM), light brown to tan, very dense **-strongly cemented caliche materials encounterd below 2'**	
80.0		3666+/-
	Boring Terminated at 80 Feet	

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0	2-2-3 N=5	1	NP	5
5	4-35-50/1"			
	18-30-50 N=80			
10	38-50/1"			
	50/5"			
15	50/6"			
20	18-50/6"			
25	20-36-50/6"	5	NP	29
30	23-45-50/4"			
35	23-38-44 N=82			
40	50/4"			
45	23-40-50/1"			
50	30-44-50/4"			
55	29-50/1"			
60	50/5"			
65	20-50/4"			
70	40-50/1"			
75	50/2"			
80	50/5"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-25-2018 | Boring Completed: 03-25-2018

Drill Rig: D-80 | Driller: Mike

Project No.: A4185061

BORING LOG NO. B-16

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6126°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
2.0	3746+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
		SILTY SAND WITH GRAVEL (SM), light brown to tan, very dense
		-strongly cemented caliche materials encounterd below 2'
80.0	3668+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	2-2-6 N=8			
	50/5"	5	NP	32
10	26-33-35 N=68			
	28-32-37 N=69			
15	31-38-42 N=80			
	50/6"			
20	50/4"			
25	50/5"			
30	42-50/4"			
35	50/5"			
40	18-36-47 N=83	4	NP	17
45	24-41-50/5"			
50	16-50/5"			
55	50/5"			
60	50/2"			
65	50/6"			
70	50/4"			
75	50/4"			
80	50/5"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-21-2018 | Boring Completed: 03-21-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-17

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3587° Longitude: -103.6122°

Approximate Surface Elev: 3748 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0.0	3744+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose to medium dense
4.0		**SILTY SAND (SM)**, light brown to tan, very dense **-strongly cemented caliche materials encounterd below 4'**
80.0	3668+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	1-2-2 N=4			
	8-9-9 N=18			
10	22-33-39 N=72			
	27-38-45 N=83			
15	27-38-45 N=83	9	43-27-16	37
	21-35-39 N=74			
20	50/5"			
25	50/4"			
30	50/4"			
35	50/5"			
40	21-41-50/5"	4	NP	14
45	40-50/4"			
50	37-50/5"			
55	43-50/4"			
60	36-50/5"			
65	32-50/5"			
70	44-50/4"			
75	47-50/4"			
80	45-50/5"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-20-2018 | Boring Completed: 03-20-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-18

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6127°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION
2.0	3743+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
		SILTY SAND (SM), light brown to tan, very dense **-strongly cemented caliche materials encounterd below 2'**
68.8	3676+/-	***Boring Terminated at 68.8 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0		2-3-3 N=6	3	NP	11
5		50/5"			
		50/3"			
		28-50/-1"			
10		50/4"			
15		50/5"			
20		50/5"			
25		30-50/5"			
30		33-50/5"			
35		22-35-50/5"	1	NP	7
40		23-32-50/5"			
45		28-34-50/4"			
50		40-50/4"			
55		50/4"			
60		50/5"			
65		50/5"			
		50/4"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-25-2018 | Boring Completed: 03-25-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-19

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3575° Longitude: -103.6122°

Approximate Surface Elev: 3745 (Ft.) +/-

DEPTH		ELEVATION (Ft.)
2.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose	3743+/-
	SILTY SAND (SM), light brown to tan, very dense **-strongly cemented caliche materials encounterd below 2'**	
80.0		3665+/-
	Boring Terminated at 80 Feet	

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0		1-2-3 N=5	1	NP	7
5		50/2"			
		50/6"			
		21-50/4"			
10		50/6"			
15		50/5"			
20		50/5"			
25		32-50/5"			
30		28-45-50/4"	4	NP	17
35		32-48-50/4"			
40		37-40-50/5"			
45		36-50/5"			
50		39-50/4"			
55		43-50/5"			
60		40-50/5"			
65		50/5"			
70		50/5"			
75		50/5"			
80		50/2"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-24-2018 | Boring Completed: 03-24-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

BORING LOG NO. B-20

PROJECT: Detention Pond Station

CLIENT: Topographic Land Surveyors
Fort Worth, TX

SITE: 12 Miles S of NM-176 on Delaware Basin Rd.
Lea County, NM

LOCATION See Exploration Plan

Latitude: 32.3581° Longitude: -103.6124°

Approximate Surface Elev: 3746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
2.0	3744+/-	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, loose
		SILTY SAND (SM), light brown to tan, very dense
		-strongly cemented caliche materials encounterd below 2'
80.0	3666+/-	***Boring Terminated at 80 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		2-3-5 N=8			
		50/2"			
		33-50/5"			
		50/5"			
10		50/4"			
15		50/5"			
20		50/4"			
25		41-50/5"			
30		21-35-50/5"	4	NP	17
35		26-38-50/4"			
40		27-36-42 N=78			
45		38-42-50/4"			
50		39-50/5"			
55		44-50/6"	2	NP	15
60		24-50/2"			
65		30-50/4"			
70		50/4"			
75		50/5"			
80		50/4"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations are approximate

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 03-23-2018 | Boring Completed: 03-24-2018

Drill Rig: CME 55 | Driller: Bobby

Project No.: A4185061

Variances for Alternative Testing Methods

Request for OCD Approval of Alternative Test Methods to Analyze Concentrations of TPH and Chloride

The prescriptive mandates of the Rule that are the subject of this request are the following subsections of NMAC 19.15.17.13 [emphasis added], 19.15.34.14 and 19.15.29. 12 D

> **19.15.17.13 CLOSURE AND SITE RECLAMATION REQUIREMENTS:**
> **D.(5)** The operator shall collect, at a minimum, a five point composite of the contents of the temporary pit or drying pad/tank associated with a closed-loop system to demonstrate that, after the waste is solidified or stabilized with soil or other non-waste material at a ratio of no more than 3:1 soil or other non-waste material to waste, the concentration of any contaminant in the stabilized waste is not higher than the parameters listed in Table II of 19.15.17.13 NMAC.

The referenced Table II, which is reproduced in part below, notes the Method with asterisk signifying: "*Or other test methods approved by the division".

Table II
Closure Criteria for Burial Trenches and Waste Left in Place in Temporary Pits

Depth below bottom of pit to groundwater less than 10,000 mg/l TDS	Constituent	Method*	Limit**
25-50 feet	Chloride	EPA Method 300.0	20,000 mg/kg
	TPH	EPA SW-846 Method 418.1	100 mg/kg

> **19.15.34.14 CLOSURE AND SITE RECLAMATION REQUIREMENTS FOR RECYCLING CONTAINMENTS:**
> **C.** The operator shall test the soils beneath the containment for contamination with a five-point composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I below.
> **(1)** If any contaminant concentration is higher than the parameters listed in Table I, the division may require additional delineation upon review of the results and the operator must receive approval before proceeding with closure.

The referenced Table I, which is reproduced in part below, notes the Method with asterisk signifying: "*Or other test methods approved by the division".

Table I
Closure Criteria for Recycling Containments

Depth below bottom of containment to groundwater less than 10,000 mg/l TDS	Constituent	Method*	Limit**
51 feet - 100 feet	Chloride	EPA 300.0	10,000 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	2,500 mg/kg

After sampling solids of more than 50 drilling pits in the Permian Basin, we have observed and reported to OCD on numerous occasions significant problems with non-petroleum drilling additives (e.g. starch) interfering with the laboratory method 418.1. It is not surprising that in many instances we found no correlation between the laboratory results using 418.1 and the results using Method 8015.

We request approval of Method 8015 (GRO + DRO + MRO) for Method 418.1.

> **19.15.29.12 D. CLOSURE REQUIREMENTS.** The responsible party must take the following action for any major or minor release containing liquids.
> **(1)** The responsible party must test the remediated areas for contamination with representative five-point composite samples from the walls and base, and individual grab samples from any wet or discolored areas. The samples must be analyzed for the constituents listed in Table I of 19.15.29.12 NMAC or constituents from other applicable remediation standards.

The referenced Table I, is reproduced in part below.

Table I
Closure Criteria for Soils Impacted by a Release

Minimum depth below any point within the horizontal boundary of the release to ground water less than 10,000 mg/l TDS	Constituent	Method*	Limit**
≤ 50 feet	Chloride***	EPA 300.0 or SM4500 Cl B	600 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	100 mg/kg
	BTEX	EPA SW-846 Method 8021B or 8260B	50 mg/kg
	Benzene	EPA SW-846 Method 8021B or 8260B	10 mg/kg

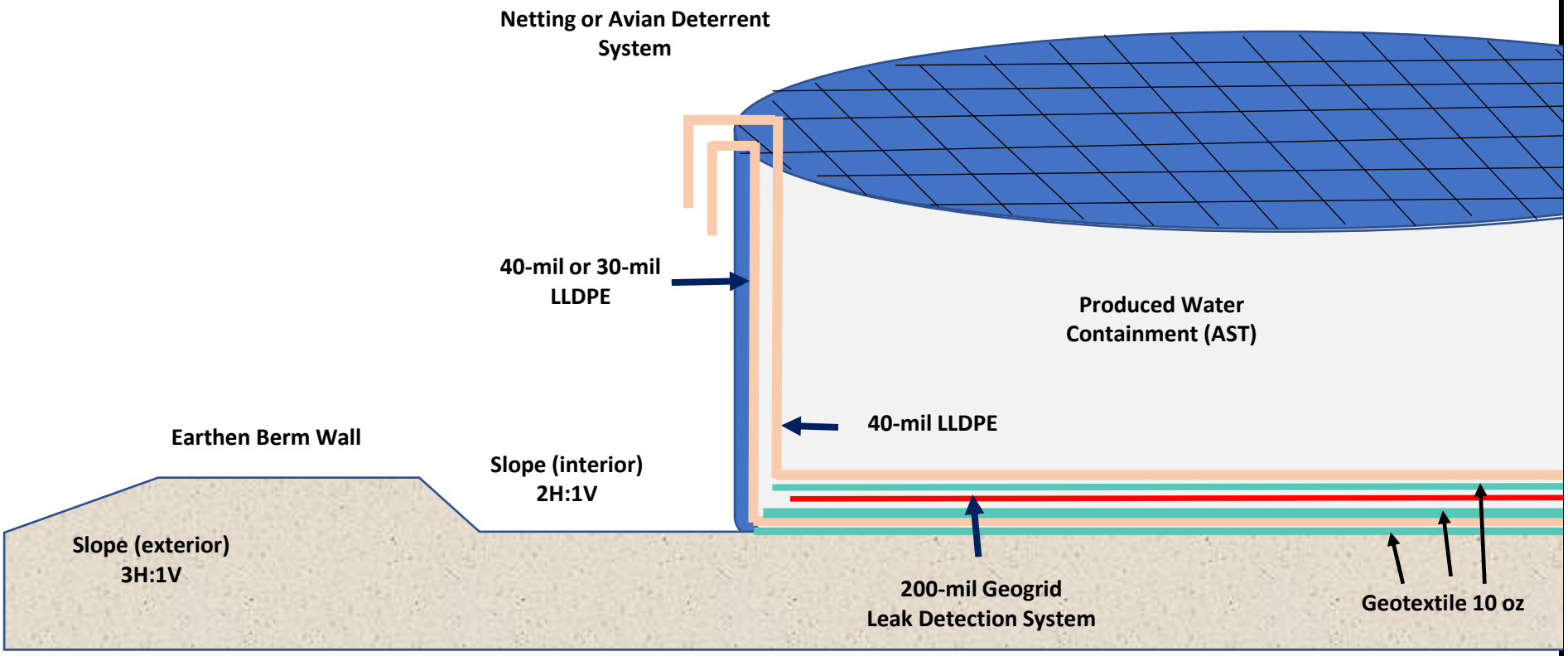
We request approval of EPA 300.0 or SM4500 for the analysis of chloride.

Demonstration that OCD Approval Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

The purpose of TPH analyses in the Pit Rule is to measure total petroleum hydrocarbons not all non-polar compounds, such as starch or cellulose that can interfere with Method 418.1. While Method 418.1 may provide some useful data for transportation of crude oil or condensate spills to disposal, the addition of non-polar organic materials in drilling fluids, especially for horizontal wells, renders Method 418.1 highly problematic to determine compliance with the Rule. Using Method 8015 for TPH (GRO+DRO+MRO) provides a better measurement of what we believe the Commission intended operators to measure.

In hearings before the Oil Conservation Commission technical arguments were presented regarding the use of SM4500 in lieu of EPA 300.00 for chloride analysis for Rule 29. The Division and the Commission agreed that these two methods provide equal or better protection of fresh water, public health and the environment.

Variances for Above Ground Steel Tank Modular Recycling Storage Containment Liners



Description of Leak Detection System

- 200-mil geogrid drainage layer lies between the primary and secondary liner
- Geotextile between the geogrid and the liners
- 2- to 3-inch deep sump excavated within the compacted caliche pad as a collection point for any seepage
- A ¾-inch aqua braid line runs from the collection sump between the liners and beneath the geogrid drainage system to the outside of the AST
- The leak detection pipe is fastened to the exterior of the AST and terminates at ground level.
- Every week, a portable self-priming peristaltic pump connects to the leak detection system.
- The self-priming pump discharges into a ¾" aqua braid line, through a turbine meter, and back into the AST, on top of the primary liner
- If fluid is detected, it is tested for conductance to determine the origin of the water (e.g. produced water or condensation)

R.T. Hicks Consultants Albuquerque, NM	**Design Sketch**	**Plate 1**
	Solaris Water Midstream - Telluride Air Gap AST	**May-20**

STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR 40 MIL NON-REINFORCED LLDPE GEOMEMBRANE AS AN ALTERNATIVE PRIMARY AND 30 MIL NON-REINFORCED AS ALTERNATIVE SECONDARY LINER FOR MODULAR STEEL AST CONTAINMENT

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of 19.15.34.12

NMAC 19.15.34.12 A DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

(4) All primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. *All primary liners shall be 30-mil flexible PVC, 45-mil LLDPE string reinforced or 60-mil HDPE liners. Secondary liners shall be 30-mil LLDPE string reinforced or equivalent with a hydraulic conductivity no greater than 1 x 10-9 cm/sec. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.*

The applicant proposes one layer of 40-mil LLDPE non-reinforced as a primary liner and a secondary liner comprised of one layer of 30-mil LLDPE non-reinforced material

Rule 34 did not consider Above Ground Steel Storage Tanks that employ liners as a primary and secondary containment method.

This material is more readily available than the prescribed liners in the Rule and provides superior flexibility and conformity characteristics. Due to the vertical steel walls, 60-mil HDPE, 45 or 30-mil LLDPE string reinforced liners and 30-mil PCV liners are not sufficiently flexible for use in these modular containments.

All liners will have a hydraulic conductivity no greater than 1 x 10 -9 cm/sec and meet or exceed EPA SW-846 method 9090A.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

The following technical documents provide supportive data to demonstrate that this liner system *(with integrated leak detection system)* provides equal or better protection of fresh water, public health and the environment by providing the requisite containment and protection. Attached is a technical comparison of the proposed material is compared to what is advised through Rule 34. A second memorandum provides clarification that the engineering requirements for site preparation, which ensures functionality of the liner system, is crosscutting to varied locations/sites within the Permian Basin. Liner specifications are also included in submission.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Technical Memorandum: 40-mil LLDPE as Alternative Primary with 30-mil LLDPE as Alternative Secondary Liner System for Modular Steel AST Recycling Containment

NMAC 19.15.34.12 A (4)

In consideration of the liner application for modular AST impoundments, size and depth of the AST, design details for modular tanks as well as estimated length of at least five years of service time, it is my professional opinion that a 40 mil LLDPE (non-reinforced) and a 30 mil LLDPE (non-reinforced) geomembrane system will provide the requisite barrier against produced water loss as an alternative primary and secondary liner system. *The two proposed liners, 40 mil LLDPE as Primary liner and 30 mil LLDPE Secondary liner, will function equal to or better than 45 mil String Reinforced LLDPE, 30 mil PVC, or 60 mil HDPE liners as a primary liner and 30 mil LLDPE string reinforced as a secondary liner system. Additionally, this two-layer system with integrated leak detection system, will provide requisite protection for the environment that is equal to or better than the above primary and secondary liner systems referenced in OCD rule 34.* The following are discussion points that will exhibit the attributes of a 40 mil/30 mil LLDPE lining system:

The nature and formulation of LLDPE resin is very similar to HDPE. The major difference is that LLDPE is lower density, lower crystallinity (more flexible and less chemical resistant). However, LLDPE will resist aging and degradation and remain intact for many years in exposed conditions. The LLDPE resin is virtually the same for non-reinforced 30 or 40 mil LLDPE and string reinforced 30 or 45 mil LLDPE geomembranes and both will provide requisite containment and be equally protective for this application, enduring UV and chemical degradation in the produced water environment.

Flexibility Requirements. Non-reinforced LLDPE geomembranes are less stiff and far more flexible than string reinforced geomembranes as well as 60 mil HDPE and in this regard are preferred for installations in vertical wall tanks such as this proposed installation. LLDPE provides a very flexible sheet that enables it to be fabricated into large panels, folded for shipping and installed on vertical walls transitioned to flat bottom. Non-reinforced LLDPE sheet will conform better than a string reinforced LLDPE to the tank dimensions under hydrostatic loading and will exhibit less wrinkling and creasing during and after installation.

Thermal Fusion Seaming Requirements. Thermal seaming and QC seam test requirements for geomembranes are product specific and usually prescribed by the sheet manufacturer. Both dual wedge and single wedge thermal fusion welding is commonly used on LLDPE and QC testing by air channel (ASTM D 5820) or High Pressure Air Lance (ASTM D 4437) is fully acceptable and recognized as industry standards. In this regard, either non-reinforced LLDPE or string-reinforced LLDPE will be acceptable as far as QC and thermal fusion seaming methods are concerned.

Potential for Leakage through the Primary and Secondary Liners. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media between the primary and secondary LLDPE geomembranes at the base of the AST in this application provides immediate drainage to a low point or outside the Modular AST Impoundment and thus no hydrostatic head or driving gradient is available to push leakage water through a hole in the Secondary LLDPE liner .

Leakage through any Primary geomembrane is driven by size of hole and depth and will be detected by the increase of water in the drainage system and the volume being pumped out of the secondary containment. In this regard and for this variance, the Primary consists of 40 mil LLDPE geomembrane which will perform equal to or better than a single layer of string reinforced LLDPE for potential leakage. Thus, if a leak occurs through the top layer, it will be effectively contained by the second layer of 30 mil LLDPE geomembrane. If required, location of holes in the Primary can be found by Electrical Leak Location Survey (ELLS) using a towed electrode (ASTM D 7007). Holes found can then be repaired and thus water seepage into the leakage collection and drainage system will be kept to a minimum. Dependent on OCR requirements for Action Leakage Rate (ALR), the leakage volumes may only be monitored. For example, a typical ALR is < 20 gpad whereas a rapid and large leak (RLL) may be > 100 gpad.
Most states specify maximum ALR values for waste and process water impoundments usually in the range of 100 to 500 gpad. However, New Mexico does not specify an ALR for waste or process water impoundments (GRI Paper No. 15).

LLDPE (and string reinforced LLDPE) can be prefabricated into large panels and thus both types offer the following for Containment:

- Prefabrication in factory-controlled conditions into very large panels (up to 30,000 sf) results in ease of installation, less thermal fusion field seams and less on site QC and CQA. (It should be noted that HDPE cannot be prefabricated into panels and requires considerably more on-site welding and QC).

- Large prefabricated panels will provide better control of thermal fusion welding in a factory environment that will improve the liner system integrity for the long term. Ease of installation of large prefabricated custom size panels results in a greater reduction of installation time and associated installation and QC costs

- The Non-reinforced LLDPE geomembrane provides superior lay flat characteristics and conformability which allows for more intimate contact with the underlying soil, geonet, or geotextile and tank walls as well as overlying materials thus providing better flow characteristics for drainage of water. String reinforced LLDPE exhibits more wrinkling and when overlaid or in contact with a geonet drain, wrinkles tend to form pockets and dams affecting drainage of any leakage water to the exterior of the Modular AST Impoundment.

- Both types of LLDPE geomembrane are easily repaired using the same thermal fusion bonding method without the need for special surface grinding preparation for extrusion welding as is typically used in repair of HDPE geomembranes. However, string reinforced LLDPE requires that all cut edges with exposed scrim must be encapsulated with extrusion bead. No encapsulation is required on non-reinforced LLDPE.

In summary, it is my professional opinion that the liner system of 40 mil non-reinforced LLDPE geomembrane as Primary liner and 30 mil non reinforced LLDPE Secondary liner, with integrated leak detection system, will provide protection that is equal to or better than 45 mil string reinforced LLDPE, 30 mil PVC, 60 mil HDPE (primary liner) and 35 mil LLDPEr (secondary liner) and meets requirements as defined by the rule as an alternative liner system (resistance to UV and chemical exposure and required hydraulic conductivity). Additionally, this liner system will provide a superior installation in the AST environment and function better than liners referenced in the OCD rule and will provide the requisite protection of fresh water, public health and the environment for at least 5 years in the produced water recycling environment.

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

Geosynthetic Research Institute (GRI) Published Standards and Papers 2018

ASTM Standards 2018

Attachments:

R. K. Frobel C.V.

STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR 40 MIL NON-REINFORCED LLDPE GEOMEMBRANE AS AN ALTERNATIVE PRIMARY AND SECONDARY LINER FOR MODULAR STEEL AST CONTAINMENT

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of 19.15.34.12

NMAC 19.15.34.12 A DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

(4) All primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. *All primary liners shall be 30-mil flexible PVC, 45-mil LLDPE string reinforced or 60-mil HDPE liners. Secondary liners shall be 30-mil LLDPE string reinforced or equivalent with a hydraulic conductivity no greater than 1 x 10-9 cm/sec*. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

The applicant proposes one layer of 40-mil LLDPE as a primary liner and a secondary liner comprised of one layer of 40-mil LLDPE material.

Rule 34 did not consider Above Ground Steel Storage Tanks that employ liners as a primary and secondary containment method.

This material is more readily available than the prescribed liners in the Rule and provides superior flexibility and conformity characteristics. Due to the vertical steel walls, 60-mil HDPE, 45 or 30-mil LLDPE string reinforced liners and 30-mil PCV liners are not sufficiently flexible for use in these modular containments.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

The following technical documents provide supportive data to demonstrate equal or better protection of fresh water, public health and the environment by providing the requisite containment and protection. Technical comparison of the proposed material is compared to what is advised through Rule 34 is discussed. A second memorandum provides clarification that the engineering requirements for site preparation, which ensures functionality of the liner system, is crosscutting to varied locations within the Permian Basin. Stamped plans from design engineer confirm applicability of this liner system to this specific site.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Technical Memorandum: 40-mil LLDPE as Alternative Primary/Secondary Liner System for Modular Steel AST Recycling Containment

NMAC 19.15.34.12 A (4)

In consideration of the Primary lining application (modular AST impoundment), size of the AST and depth, design details for modular tanks as well as estimated length of up to five years of service time, it is my professional opinion that a 40 mil LLDPE geomembrane will provide the requisite barrier against processed water loss. It should be noted that the 40 mil LLDPE exceeds the OCD mandate for a Secondary lining system. *The two proposed 40 mil LLDPE liners will function equal to or better than 45 mil String Reinforced LLDPE, 30 mil PVC, or 60 mil HDPE liners as a primary liner and 30 mil LLDPE string reinforced as a secondary liner system. Additionally, the 40 mil LLDPE in a two-layer system will provide requisite protection for the environment that is equal to or better than the above primary and secondary liner systems referenced in OCD rule 34.* The following are discussion points that will exhibit the attributes of a 40 mil LLDPE lining system:

The nature and formulation of LLDPE resin is very similar to HDPE. The major difference is that LLDPE is lower density, lower crystallinity (more flexible and less chemical resistant). However, LLDPE will resist aging and degradation and remain intact for many years in exposed conditions. The LLDPE resin is virtually the same for non-reinforced 40 mil LLDPE and string reinforced 45 mil LLDPE geomembranes and both will provide requisite containment and be equally protective for this application.

Flexibility Requirements. Non-reinforced LLDPE geomembranes are less stiff and far more flexible than string reinforced geomembranes as well as 60 mil HDPE and in this regard are preferred for installations in vertical wall tanks such as this proposed installation. LLDPE provides a very flexible sheet that enables it to be fabricated into large panels, folded for shipping and installed on vertical walls transitioned to flat bottom. Non-reinforced LLDPE sheet will conform better than a string reinforced LLDPE to the tank dimensions under hydrostatic loading and will exhibit less wrinkling and creasing during and after installation.

Thermal Fusion Seaming Requirements. Thermal seaming and QC seam test requirements for geomembranes are product specific and usually prescribed by the sheet manufacturer. Both dual wedge and single wedge thermal fusion welding is commonly used on LLDPE and QC testing by air channel (ASTM D 5820) or High Pressure Air Lance (ASTM D 4437) is fully acceptable and recognized as industry standards. In this regard, either non-reinforced LLDPE or string-reinforced LLDPE will be acceptable as far as QC and thermal fusion seaming methods are concerned.

Potential for Leakage through the Primary and Secondary Liners. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media between the primary and secondary LLDPE

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geomembranes at the base of the AST in this application provides immediate drainage to a low point or outside the Modular AST Impoundment and thus no hydrostatic head or driving gradient is available to push leakage water through a hole in the Secondary LLDPE liner .

Leakage through any Primary geomembrane is driven by size of hole and depth and will be detected by the increase of water in the drainage system and the volume being pumped out of the secondary containment. In this regard and for this variance, the Primary consists of 40 mil LLDPE geomembrane which will perform equal to or better than a single layer of string reinforced LLDPE for potential leakage. Thus, if a leak occurs through the top layer, it will be effectively contained by the second layer of 40 mil LLDPE geomembrane. If required, location of holes in the Primary can be found by Electrical Leak Location Survey (ELLS) using a towed electrode (ASTM D 7007). Holes found can then be repaired and thus water seepage into the leakage collection and drainage system will be kept to a minimum. Dependent on OCR requirements for Action Leakage Rate (ALR), the leakage volumes may only be monitored. For example, a typical ALR is < 20 gpad whereas a rapid and large leak (RLL) may be > 100 gpad.
Most states specify maximum ALR values for waste and process water impoundments usually in the range of 100 to 500 gpad. However, New Mexico does not specify an ALR for waste or process water impoundments (GRI Paper No. 15).

Both non-reinforced LLDPE and string reinforced LLDPE can be prefabricated into large panels and thus both types offer the following for Containment:

- Prefabrication in factory-controlled conditions into very large panels (up to 30,000 sf) results in ease of installation, less thermal fusion field seams and less on site QC and CQA. (It should be noted that HDPE cannot be prefabricated into panels and requires considerably more on-site welding and QC).

- Large prefabricated panels will provide better control of thermal fusion welding in a factory environment that will improve the liner system integrity for the long term. Ease of installation of large prefabricated custom size panels results in a greater reduction of installation time and associated installation and QC costs

- The Non-reinforced LLDPE geomembrane provides superior lay flat characteristics and conformability which allows for more intimate contact with the underlying soil, geonet, or geotextile and tank walls as well as overlying materials thus providing better flow characteristics for drainage of water. String reinforced LLDPE exhibits more wrinkling and when overlaid or in contact with a geonet drain, wrinkles tend to form pockets and dams affecting drainage of any leakage water to the exterior of the Modular AST Impoundment.

- Both types of LLDPE geomembrane are easily repaired using the same thermal fusion bonding method without the need for special surface grinding/preparation for extrusion welding as is typically used in repair of HDPE geomembranes.

However, string reinforced LLDPE requires that all cut edges with exposed scrim must be encapsulated with extrusion bead. No encapsulation is required on non-reinforced LLDPE.

In summary, it is my professional opinion that the two layers of 40 mil non-reinforced LLDPE geomembranes will provide a Primary/Secondary liner system that is equal to or better than 45 mil string reinforced LLDPE, 30 mil PVC, 60 mil HDPE (primary liner) and 35 mil LLDPEr (secondary liner). Additionally, the two layers of 40 mil LLDPE will provide a superior installation and function better than liners referenced in the OCD rule. The two layers of 40 mil non- reinforced LLDPE will provide the requisite protection of fresh water, public health and the environment for at least 5 years in the frack water environment.

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

Geosynthetic Research Institute (GRI) Published Standards and Papers 2018

ASTM Standards 2018

Attachments:

R. K. Frobel C.V.

Slope and Anchor Variance Request for Above Ground Steel Tank Modular Recycling Storage Containments

STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR SLOPE AND ANCHOR FOR MODULAR STEEL AST CONTAINMENT

Statement Explaining Why the Applicant Seeks a Variance

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of NMAC 19.15.34.12.

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT:

A. An operator shall design and construct a recycling containment in accordance with the following specifications.

(2) A recycling containment shall have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear. Geotextile is required under the liner when needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity. *The operator shall construct the containment in a levee with an inside grade no steeper than two horizontal feet to one vertical foot (2H:1V). The levee shall have an outside grade no steeper than three horizontal feet to one vertical foot (3H:1V).* The top of the levee shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance.

(3) Each recycling containment shall incorporate, at a minimum, a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions. *The edges of all liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep*.

The applicant requests a variance to prescribed slope and anchor in the setting of above ground modular steel containments.

With respect to storage of produced water for use in lieu of fresh water, Rule 34 is written for earthen, lined pits, not free-standing modular impoundments that employ liners as their primary fluid containment system. A modular impoundment consists of a professionally designed steel tank ring with vertical walls. There is no slope to consider as the segmental steel sections are set vertical.

There is no anchor trench as envisioned by the Rule, liners are anchored to the top of the steel walls with clips, no anchor trench is required.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

The following technical memorandum provides supportive data to demonstrate equal or better protection of fresh water, public health and the environment by providing the requisite containment and protection.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Technical Memorandum: Slope and Anchor Trench Variance for Above Ground Steel Modular Containments

NMAC 19.15.34.12 A (2), (3)

Side Slope

The design of soil side slope (inclination) is a geotechnical engineering design consideration. Liquid impoundments such as fresh water or process water containments are usually built within an excavation or with raised earthen embankments. For a liquid impoundment with an exposed liner system, the slope soils and construction dictate slope inclination and very detailed slope stability analysis may be required to determine if slope failure within the embankment will occur once loaded with impounded water. Slope failure may also occur during construction or when the impoundment is empty. A maximum slope is usually specified and is dependent on soil type and cohesive strength, saturated or unsaturated conditions, etc. Detailed analysis for slope stability can be found in "Designing with Geosynthetics" by R.M Koerner as well as many geotechnical books.

A modular impoundment, on the other hand, consists of a professionally designed steel tank ring with vertical walls. *There is no slope to consider as the segmental steel sections are set vertical.* Design of steel tanks, in regard to hydrostatic loading, wind loading, seismic loads, etc. are thoroughly referenced with detailed procedures in the design code - American Petroleum Institute (API) 650-98 "Welded Steel Tanks for Oil Storage". *There are no requirements for maximum slope inclination other than perhaps 90 degrees or vertical wall.*

Anchor Trench

All earthen impoundments with a geomembrane lining system require some form of top of slope anchor, the most common of which is an excavated and backfilled anchor trench usually set back at least 3 ft from the top of slope. Again, there are detailed procedures for anchor trench design in "Designing with Geosynthetics" by R.M Koerner.

A Modular Impoundment requires mechanical anchoring of the geomembrane at the top of the vertical steel wall using standard liner clips that prevent the geomembrane or geomembrane layers from slipping down the side wall. These are detailed in the Tank Installation Manual. *There are no requirements for an "anchor trench" as this is not an in-ground impoundment.*

In summary, based on the design and specifications of a modular steel impoundment, there is no requirement for a maximum interior slope angle of 2H:1V due to the fact that this impoundment is a steel tank with vertical walls. Additionally, there is no requirement for an anchor trench as the geomembrane is attached to the top of the Modular Impoundment vertical walls with large steel clips. This provides the requisite protection of fresh water, public health and the environment for many years.

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If you have any questions on the above technical memorandum or require further information, give me a call at 303-679-0285 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

American Petroleum Institute (API) 650-98 "Welded Steel Tanks for Oil Storage"

Koerner, R.M., 2005 "Designing With Geosynthetics" Prentice Hall Publishers

Attachments:

R. K. Frobel C.V.

Freeboard Variance Request for Above Ground Steel Tank Modular Recycling Storage Containments

STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR FREEBOARD FOR MODULAR STEEL AST CONTAINMENT

Statement Explaining Why the Applicant Seeks a Variance

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of NMAC 19.15.34.13

> **19.15.34.13 OPERATIONAL REQUIREMENTS FOR RECYCLING CONTAINMENTS:**
> **B.** The operator shall maintain and operate a recycling containment in accordance with the following requirements.
> **(2)** The operator *shall maintain at least three feet of freeboard at each containment*.

The applicant requests variance to allow for a freeboard of 2 feet as opposed to the prescribed 3 feet in the setting of an above ground steel tank modular system.

Rule 34 did not take into consideration above ground steel tank modular containment systems. With respect to lined earthen impoundments that may hold 25-acre feet of produced water, a 3-foot freeboard stipulation makes sense. For example, wave action and other factors could focus stress on the upper portion of the levee or the liner system in these large impoundments. The smaller diameter steel tank (modular impoundment) does not share the same characteristics as these large earthen pits.
We believe 3-feet of freeboard is not necessary – especially during active hydraulic stimulation of wells when maximum storage volume provides the highest value. Moreover, meeting the 3-foot freeboard requirement at all times significantly reduces the storage capacity of a single modular impoundment – negatively impacting the economics of using produced water in lieu of fresh water for E&P activities.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

The attached technical memorandum by Ron Frobel, PE, describes how the proposed 2-foot freeboard limit in the permit application for the modular impoundment provides the same protection afforded by the 3-foot freeboard mandate for a large earthen pit. The attached equations and supporting email from Mr. Jason Henderson, PE, shows that a 2-foot freeboard limit on the steel impoundment meets the manufacturer's design criteria.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Freeboard Requirements for Above Ground Steel Tank Modular Recycling Storage Containments

NMAC 19.15.34.13 B (2)

Liquid impoundments such as fresh water or process water containments are usually built within an excavation or with raised earthen embankments. For a liquid impoundment with an exposed liner system, the slope soils and construction dictate slope inclination and very detailed slope stability analysis may be required to determine if slope failure within the embankment will occur once loaded with impounded water. Freeboard or the vertical height between the maximum water surface elevation and the top of slope is important for earthen impoundments. Specified freeboard requirements take into consideration high precipitation events and prevent wave run-up on slopes that result in over-topping and potential saturation of embankments. This is particularly important on large earthen impoundments. Detailed design considerations including freeboard requirements for lined earthen impoundments can be found in "Designing with Geosynthetics" by R.M Koerner as well as other publications on reservoir design.

A modular impoundment, on the other hand, consists of a professionally designed steel tank ring with vertical walls. There is no slope to consider as the segmental steel sections are set vertical. Design of steel tanks as regards hydrostatic loading, wind loading, seismic loads, etc. are thoroughly referenced with detailed procedures in the design code - American Petroleum Institute (API) 650-98 "Welded Steel Tanks for Oil Storage". *There are requirements for operational freeboard to prevent over-topping but due to the relatively small surface area and fetch of cylindrical tanks, wave heights are much less than large earthen impoundments. Thus, freeboard is usually within the range of 0.5 to 2 ft.* I have reviewed the Tank Design Calculation Summary and regarding the structural stability of the tank walls, a freeboard of 0.5 ft was assumed. Thus, the variance request of 2.0 ft for a Modular Impoundment is well within the Tank Design requirements.

In summary, it is my professional opinion that the design freeboard of 2.0 ft will provide requisite storage volume and prevent overtopping due to wind and wave action, potential seismic events and high precipitation.

If you have any questions on the above technical memorandum or require further information, give me a call at 303-679-0285 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

COLORADO REGISTERED RONALD KENNETH FROBEL 15742 PROFESSIONAL ENGINEER

References:

NMAC 19.15.34.13 OPERATIONAL REQUIREMENTS FOR RECYCLING CONTAINMENTS

American Petroleum Institute (API) 650-98 “Welded Steel Tanks for Oil Storage”

Koerner, R.M., 2005 “Designing With Geosynthetics” Prentice Hall Publishers

Attachments:

R. K. Frobel C.V.

The modular impoundment is designed for use with fluids that are 8.34 pounds/gallon (62.4 pounds per cubic foot) or lighter. Exceeding this specification for fluid weight at full tank capacity (12') could lead to failure at the connection plate(s).

Assuming a freeboard of 0.5 ft (minimum modular impoundment freeboard requirement) the Hyrdo Pressure (p) of water is 718 pounds per square foot (psf), where

$$p = Design\ Density\ X\ Height$$

$$= 62.4\ PCF * 11.5\ ft$$

$$(design\ density = 8.34\ \frac{lb}{gal}\ X\ 7.48\ \frac{ft^3}{gal})$$

The density of the conditioned produced water is 9.3 pounds/gallon. Assuming a freeboard of 3-ft (19.15.17.12.F(3) NMAC) , the Hyrdo Pressure (p) of conditioned produced water is 626 psf, where

$$p = Design\ Density\ X\ Height$$

$$= 69.64\ PCF * 9\ ft$$

$$(design\ density = 9.3\ \frac{lb}{gal}\ X\ 7.48\ \frac{ft^3}{gal})$$

Using conditioned produced water with the Pit Rule freeboard requirements of 3-feet results in a Hydro Pressure 92 psf less than the engineered design.

The operator asks the District Division to allow for a 2-foot freeboard, which yields a Hydro Pressure (p) of 696.4 psf, where

$$p = Design\ Density\ X\ Height$$

$$= 69.64\ PCF * 10\ ft$$

$$(design\ density = 9.3\ \frac{lb}{gal}\ X\ 7.48\ \frac{ft^3}{gal})$$

Applicability of Variances for Modular AST Containments in the Permian Basin of New Mexico

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Technical Memorandum: Applicability of Variances for Modular AST Containments in the Permian Basin of New Mexico

NMAC 19.15.34.12 A (2)

I have reviewed the most recent historical variances for AST Containments in the document titled "Variances for C-147 Registration Packages Permian Basin of New Mexico" (January 2020) and examined the applicable design drawings and permits for the following modular AST containments located in the Permian Basin of New Mexico.

- C-147 Registration Package for Myox Above Ground Storage Tank Section 32, T25S, R28E, Eddy County (January 20, 2020)
- C-147 Registration Package for Fez Recycling Containment and Recycling Facility Area (100+ acres) Section 8, T25-S, R35-E, Lea County, Volume 2 – Above-Ground Storage Tank Containments
- Hackberry 16 Recycling Containments and Recycling Facility Section 16, T19S, R31E, Eddy County

Locations of the modular containments range from west of the Pecos River to slightly west of Jal, NM. All locations exhibit different surface and subsurface geology, different topography and are of various sizes and volumes. *However, in regard to structural integrity of the base soils that support the AST and in particular the geomembrane containment system, the specification requirements are the same*. The foundation soils must be roller compacted smooth and free of loose aggregate over ½ inch. Compaction characteristics must meet or exceed 95% of Standard Proctor Density in accordance with ASTM D 698. This specification requirement is specific and causes the general or earthworks contractor to meet this standard regardless of the site- specific geology or topography. Provided that the design drawings and associated specifications call out the minimum requirements for subsoils compaction (i.e., 95% Standard Proctor Density – ASTM D 698), the design engineer or owners representative will carry out soils testing on the foundation materials to provide certainty to the AST containment owner that the earthworks contractor has met these obligations.

Thus, provided that the contractor meets the minimum specified requirements for foundation soils preparation and density, the location, geology or depth to groundwater will make no difference in regard to geomembrane liner equivalency as demonstrated by the AST variances presented in this volume and are considered valid for meeting NMOCD Rule 34 requirements for all locations within the Permian Basin of New Mexico.

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

ASTM Standards 2019

RONALD K. FROBEL, MSCE, P.E.

CIVIL ENGINEERING
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EXPERT WITNESS
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FIRM: R. K. FROBEL & ASSOCIATES
Consulting Civil / Geosynthetics Engineers

TITLE: Principal and Owner

PROFESSIONAL AFFILIATIONS:

American Society for Testing and Materials (ASTM) -
Founding member of Committee D 35 on Geosynthetics
Chairman ASTM D35 Subcommittee on Geomembranes 1985-2000
ASTM Award of Merit Recipient/ASTM Fellow - 1992
ASTM D18 Soil and Rock - Special Service Award - 2000
Transportation Research Board (TRB) of The National Academies
Appointed Member A2K07 Geosynthetics 2000 - 2003
National Society of Professional Engineers (NSPE) - Member
American Society of Civil Engineers (ASCE) - Member
Colorado Section - ASCE - Member
International Society of Soil Mechanics and Foundation Engineers
(ISSMFE) - Member
International Geosynthetics Society (IGS) - Member
North American Geosynthetics Society (NAGS) - Member
International Standards Organization (ISO) - Member TC 221
Team Leader - USA Delegation Geosynthetics 1985 - 2001
European Committee for Standardization (CEN) - USA Observer
EPA Advisory Committee on Geosynthetics (Past Member)
Association of State Dam Safety Officials (ASDSO) – Member
U. S. Committee on Irrigation and Drainage (USCID) - Member
Technical Advisory Committee - Geosynthetics Magazine
Editorial Board - Geotextiles and Geomembranes Journal
Fabricated Geomembrane Institute (FGI) – Board of Directors
Co-Chairman International Conference on Geomembranes
Co-Chairman ASTM Symposium on Impermeable Barriers
U.S. Naval Reserve Officer (Inactive)
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ACADEMIC BACKGROUND:

University of Arizona: M.S. - Civil Engineering - 1975
University of Arizona: B. S. - Civil Engineering – 1969
Wentworth Institute of Technology: A.S. Architecture – 1966

PROFESSIONAL EXPERIENCE:

R. K. Frobel & Associates - Consulting Engineers
Evergreen, Colorado, Principal and Owner, 1988 - Present

Chemie Linz AG and Polyfelt Ges.m.b.H., Linz, Austria
U. S. Technical Manager Geosynthetics, 1985 - 1988

U.S. Bureau of Reclamation, Engineering and Research Center
Denver, Colorado, Technical Specialist in Construction Materials Research and Application, 1978 - 1985

Water Resources Research Center (WRRC), University of Arizona
Tucson, AZ, Associate Research Engineer, 1975 - 1978

Engineering Experiment Station, University of Arizona
Tucson, AZ, Research Assistant, 1974 - 1975

United States Navy, Commissioned Naval Officer, 1970 - 1973

REPRESENTATIVE EXPERIENCE:

R.K. Frobel & Associates: Civil engineering firm specializing in the fields of geotechnical, geo-environmental and geosynthetics. Expertise is provided to full service civil/geotechnical engineering firms, federal agencies, municipalities or owners on a direct contract, joint venture or sub-consultant basis. Responsibilities are primarily devoted to specialized technical assistance in design and application for foreign and domestic projects such as the following:
Forensics investigations into geotechnical and geosynthetics failures; providing expert report and testimony on failure analysis; providing design and peer review on landfill lining and cover system design, mine waste reclamation, water treatment facilities, hydro-technical canal, dam, reservoir and mining projects, floating reservoir covers; oil and gas waste containment; design of manufacturers technical literature and manuals; development and presentation of technical seminars; new product development and testing; MQA/CQA program design and implementation.

Polyfelt Ges.m.b.H., Linz, Austria and Denver Colorado: As U.S. technical manager, primary responsibilities included technical development for the Polyfelt line of geosynthetics for the U.S. civil engineering market as well as worldwide applications.

U.S. Bureau of Reclamation, Denver, Colorado: As technical specialist, responsibilities included directing laboratory research, design and development investigations into geosynthetics and construction materials for use on large western water projects such as dams, canals, power plants and other civil structures. Included were material research, selection and testing, specification writing, large scale pilot test programs, MQA/CQA program design and supervision of site installations. Prime author or contributor to several USBR technical publications incorporating geosynthetics.

University of Arizona, Tucson, Arizona: As research engineer at the Water Resources Research Center, responsibilities included research, design and development of engineering materials and methods for use in construction of major water projects including potable water reservoirs, canals and distribution systems. Prime author or contributor to several WRRC technical publications.

Northeast Utilities, Hartford, Connecticut: As field engineer for construction at Northeast Utilities, responsibilities included liason for many construction projects including additions to power plants, construction of substations, erection of fuel oil pipelines and fuel oil storage tanks. Responsibilities also included detailed review, inspection and reporting on numerous construction projects.

U.S. Navy: Commissioned Naval Officer – Nuclear Program

PUBLICATIONS: Over 85 published articles, papers and books.

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