

April 2021

Volume 1
C-147 Registration Package for Pintail
Above-Ground Storage Tank
Section 9, T26S, R32E, Lea County



Existing pad for Dominator AST view is southwest.

Prepared for:
Solaris 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

April 5, 2021

Mr. Mike Bratcher
NMOCD - District 2, Supervisor
811 S. First St.
Artesia, NM 88210
Via E-Mail

Ms. Victoria Venegas
NMOCD - District 2
811 S. First St.
Artesia, NM 88210
Via E-Mail

RE: Solaris Water Midstream, Pintail AST Containment Permit
Section 9, T26S, R32E, Lea County
C-147 Volume 1 and Volume 2

Dear Mr. Bratcher and Ms. Venegas:

On behalf of Solaris Water Midstream, R.T. Hicks Consultants is pleased submit a permit for the above-referenced project. The current schedule calls for commencing to fill the AST Containment as early as June 1, 2021. Please note that the siting criteria demonstration evaluates

- the area of the proposed AST Containment
- a 10-acre area southwest of the AST location for a forthcoming registration of an in-ground containment and
- a large area the includes the two containments described above for a potential future registration of an in-ground containment.

Both Volumes will be transmitted to OCD via the OCD.Online portal.

Volume 1 contains:

- C-147 form signed by the operator,
- AST Operations and Closure Plans (verbatim from the approved Zia Hills AST Containments),
- Siting Criteria Demonstration.

Hicks Consultants affirms that:

- The location meets all siting criteria in the Rule and the location meets the specified setback criteria,
- We conducted a foot survey to check that all setback criteria are met,
- The Operation and Maintenance Plan and Closure Plan are consistent with the Rule and previously approved by OCD.

Volume 2 contains information specific to the design and construction of the proposed AST and variance requests to cause the AST to conform to Rule 34. Specifically, you will find:

- Engineering drawings for the proposed 40,000 bbl. AST Containment are fully consistent with plans previously approved by OCD,

April 5, 2021

Page 2

- The Design/Construction Plan verbatim from the approved Zia Hills AST Containment
- The manual for AST set up from New Wave Energy Services
- Variances for AST Storage Containments – all of which have been approved by OCD previously.

In compliance with 19.15.34.10 of the Rule, this submission is copied to BLM Carlsbad who is the representative of the owner of the surface upon which the containments will be constructed (i.e., the United States).

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

Sincerely,
R.T. Hicks Consultants

A handwritten signature in black ink, appearing to read "Randall T. Hicks". The signature is stylized and cursive.

Randall T. Hicks PG
Principal

Copy: Solaris Water Midstream
BLM Carlsbad

R. T. HICKS CONSULTANTS, LTD.

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PINTAIL ABOVE-GROUND STORAGE TANK

Financial Assurance Cost Estimate

Total estimated cost for closure, reclamation, and restoration of the facility (AST, fencing, etc.) pursuant to Rule 34 is **\$49,500** based upon the work elements in the spreadsheet (below). We used the same estimate as the recently approved cost estimate for Rodney Robinson AST Containment. Reclamation and restoration of the air gap pad is generally required by BLM for construction on Federal surface and funds for this reclamation are included below. Items shown with "0" units are costs recommended by BLM but are not required in a closure cost estimate for compliance with Rule 34. The estimate was generated by Solaris with input from Hicks Consultants and is equivalent to contractor bids for other AST containments.

ITEM NO.	ITEM DESCRIPTION	UNITS	QTY	UNIT PRICE	TOTAL Rule 34 Cost
	Pintail AST Containment				
1	Site Containment	0	1	\$1,000.00	\$0.00
2	Removal of AST and Liner Disposal	1	1	\$30,000.00	\$30,000.00
3	Removal of Weir Tanks	0	5	\$500.00	\$0.00
4	Removal of Chemical Trailer	0	1	\$50.00	\$0.00
5	Removal of Filter Pods	0	1	\$200.00	\$0.00
6	Removal of pumps, generators, light towers	0	4	\$200.00	\$0.00
8	Clean Pumps, piping and equipment	0	1	\$1,500.00	\$0.00
9	Remove Pumps, piping, and equipment	0	3	\$1,500.00	\$0.00
11	Assess soil for impacts	1	1	\$2,500.00	\$2,500.00
12	Re-grade and Reclaim Site	1	1	\$16,000.00	\$16,000.00
13	Misc. disposal and removal of fencing and cattle guards	1	1	\$1,000.00	\$1,000.00
	<u>Facility Decommision and Reclaim Site Subtotal:</u>				\$49,500.00
	CONSTRUCTION BID ESTIMATE TOTAL				

Appendix Site Photographs



Figure 1- View west showing NE corner of BLM leased area for operations relating to the pipeline air gap. CR-1 and air gap of pipeline shown in background.



Figure 2- South center of 300 x 350-foot BLM lease that will become work area for pipeline air gap. The Pintail AST Containment will be set up on the air gap work area pad.



Figure 3- View south from center of BLM lease area showing location of future Pintail Containment #2 (in-ground storage).



Figure 4- View NW from SE corner of BLM lease. Note caliche on surface and nearby caliche pits document subsurface caliche.

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): Pintail 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: G Section: 9 Township: 26S Range: 32E County: Lea
Surface Owner: Federal State Private Tribal Trust or Indian Allotment

2.
 Recycling Facility:
Location of (if applicable): Latitude: 32.06103 N Longitude: 103.67500 W 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: 32.06103 N Longitude: 103.67500 W approx. (NAD83)
 For multiple or additional recycling containments, attach design and location information of each containment
 Lined Liner type: Thickness See Attachment Plate 1 LLDPE HDPE PVC Other _____
 String-Reinforced
Liner Seams: Welded Factory Other Volume: See Attachment Plate 1 Dimensions _____
 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 \$ _\$33,500 _____ (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.

Variations:

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 Variations

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.

<u>General siting</u>	
<u>Ground water is less than 50 feet below the bottom of the Recycling Containment.</u> NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells FIGURES 1-2	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> NA
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Minerals Division FIGURE 4	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Within a 100-year floodplain. FEMA map FIGURE 6	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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: 4/2/2021

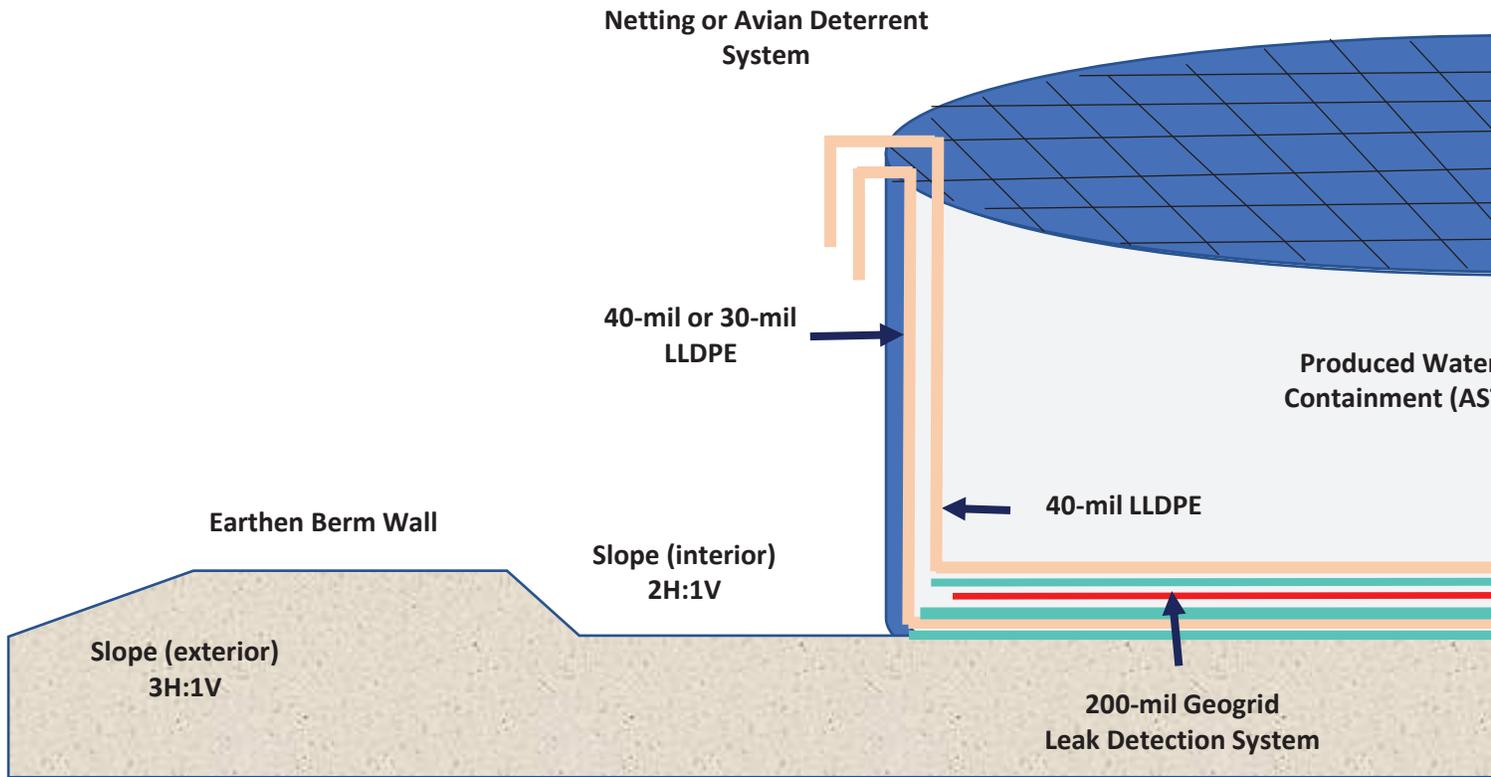
e-mail address todd.carpenter@solarismidstream.com Telephone: 432-413-0918

11.

OCD Representative Signature: _____ Approval Date: _____

Title: _____ OCD Permit Number: _____

- OCD Conditions _____
- Additional OCD Conditions on Attachment _____



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 3/4-inch aqua braid line runs from the collection sump between the liners and beneath the geogrid drainage system to the outside
- 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 3/4" 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.e. produced water or condensation)

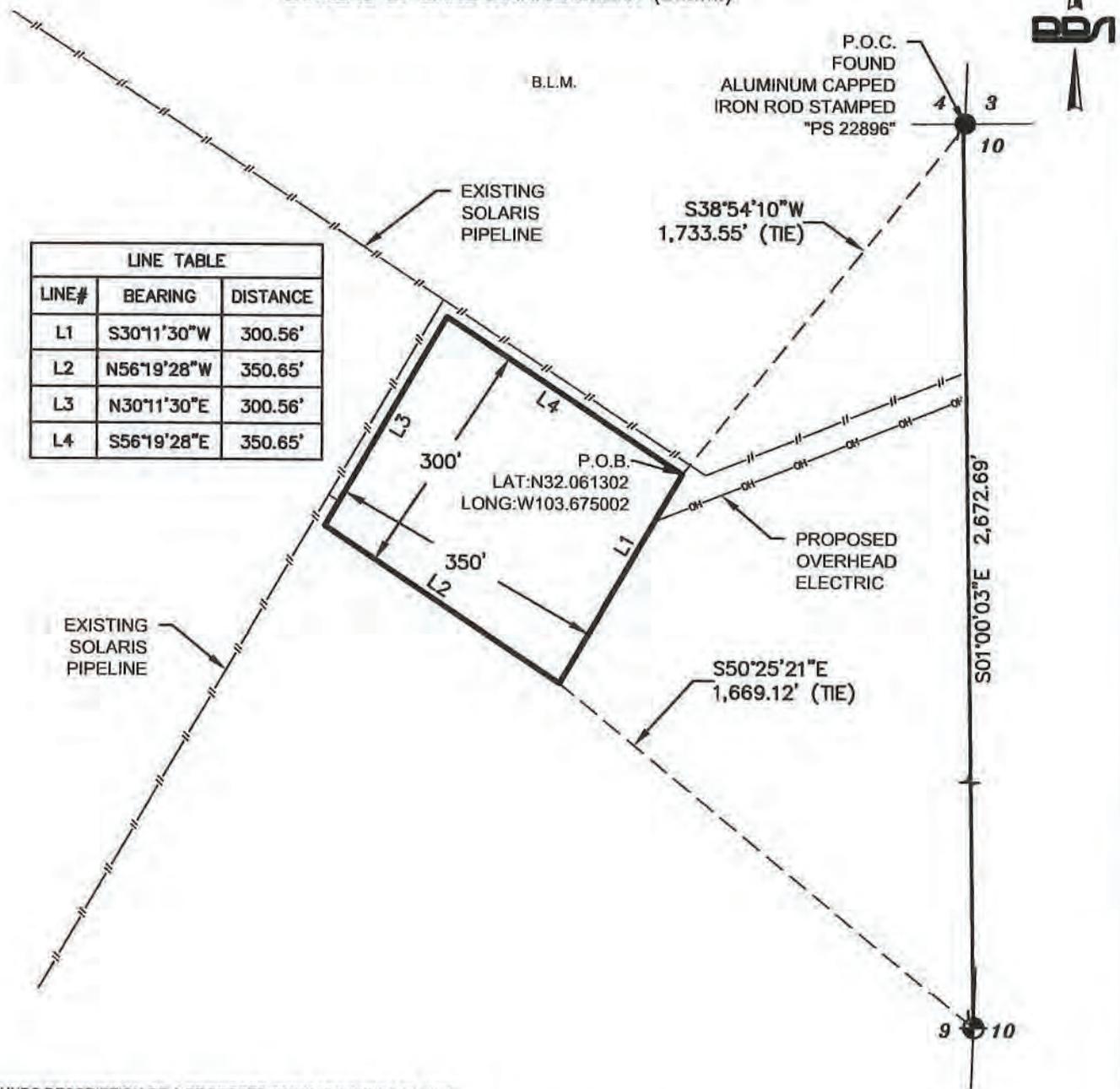
**R.T. Hicks Consultants
Albuquerque, NM**

Design Sketch

Solaris Water Midstream - 40,000 bbl Pintail AST

**SURVEY FOR CONTAINMENT AND
RECYCLING FACILITY**

EXHIBIT A
 SECTION 9, TOWNSHIP 26 SOUTH, RANGE 32 EAST, N.M.P.M.
 LEA COUNTY, NEW MEXICO
 BUREAU OF LAND MANAGEMENT (B.L.M.)



LINE TABLE		
LINE#	BEARING	DISTANCE
L1	S30°11'30"W	300.56'
L2	N56°19'28"W	350.65'
L3	N30°11'30"E	300.56'
L4	S56°19'28"E	350.65'

A METES AND BOUNDS DESCRIPTION OF A PROPOSED 300' X 350' SURFACE SITE

BEING A 2.41 ACRE TRACT OF LAND SITUATED IN SECTION 9, TOWNSHIP 26 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 NORTHEAST CORNER OF SAID SECTION 9 BEING A FOUND ALUMINUM CAPPED IRON ROD STAMPED "PS 22896", THENCE SOUTH 38°54'10" WEST, 1,733.55 FEET TO THE POINT OF BEGINNING BEING A YELLOW CAPPED IRON ROD STAMPED "NM PS 24876"; THENCE SOUTH 30°11'30" WEST, 300.56 FEET TO A YELLOW CAPPED IRON ROD STAMPED "NM PS 24876", FROM WHICH THE EAST QUARTER CORNER OF SAID SECTION 9, BEING A FOUND BRASS CAP MONUMENT STAMPED "U.S. GENERAL LAND OFFICE SURVEY", BEARS SOUTH 50°25'21" EAST, 1,669.12 FEET; THENCE NORTH 56°19'28" WEST, 350.65 FEET TO A YELLOW CAPPED IRON ROD STAMPED "NM PS 24876"; THENCE NORTH 30°11'30" EAST, 300.56 FEET TO A YELLOW CAPPED IRON ROD STAMPED "NM PS 24876"; THENCE SOUTH 56°19'28" EAST, 350.65 FEET TO THE POINT OF BEGINNING, AND CONTAINING 2.14 ACRES (105,194 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.

NOTES:

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

LEGEND:

- = DENOTES (C/L) EASEMENT
- = DENOTES FOUND CORNER AS NOTED
- = DENOTES FOUND BRASS CAP MONUMENT STAMPED "U.S. GENERAL LAND OFFICE SURVEY"

EASEMENT TABLE		
SURFACE SITE	105,194 S.F.	2.41 AC.

**O&M PLAN
CLOSURE PLAN**

Operations and Maintenance Plan Above Ground Tank Containment (AST)

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 through the submission of a modified C-147.
- 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.
- The operator will address all releases from the recycling and re-use of produced water 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 as 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.
- 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.
- 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

19.15.34.10 B

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

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.

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.

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.

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.

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.

Operations and Maintenance Plan Above Ground Tank Containment (AST)

- 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.
 - 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.
 - 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.
 - 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.

19.15.34.13 B

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

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.

(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.

Operations and Maintenance Plan Above Ground Tank Containment (AST)

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.

Operations and Maintenance Plan Above Ground Tank Containment (AST)

- 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.

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.

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.

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

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.

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.

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.

Solaris Water Midstream, LLC.

Inspection Form

Date: _____

Dominator AST

(weekly inspection when fluids are present, monthly otherwise)

Tank ID: _____

Fluid Level: _____

Tank contents: _____

Inspection Task	Results		Remarks, Observations, and/or Remedial Actions
Visible Oil on Surface	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe Action	
<i>An absorbent boom or similar device is located on site to remove visible oil from surface.</i>			
At least 2 ft of freeboard	<input type="checkbox"/> Yes	<input type="checkbox"/> No, Measure Freeboard	
Evidence of surface water run-on	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
<i>Check for excessive erosion of perimeter berms.</i>			
Birds or wildlife in net or screen	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
<i>Within 30 days of discovery, report dead birds or wildlife to the appropriate agency (USFWS, NMDGF) and to NMOCD District II.</i>			
Damage to netting or screen	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
Rupture of Liner	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
<i>If rupture is above fluid level, repair within 48 hours. If below fluid level, remove fluid above within 48 hours, notify NMOCD District II, and repair.</i>			
Clips or clamps properly securing liner	<input type="checkbox"/> Yes	<input type="checkbox"/> No, Describe	
If low level, enough liner slack on panel wall	<input type="checkbox"/> Yes	<input type="checkbox"/> No, Describe	
Uneven gaps between panels	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	

Solaris Water Midstream, LLC.

Signs of tank settlement	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
Erosion of soil surrounding tank (10 ft radius)	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
Running water on the ground	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
Unusual ponding of fluid inside berm	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
<i>Field test (pH, Cl-, conductance, etc.) ponded fluid and compare to fluid in tank. If tank is determined as the source, locate and repair rupture within 48 hours. Notify NMOCD District II and repair.</i>			
Rust or corrosion on panels, stairs, or hardware	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	
Damage to any hardware	<input type="checkbox"/> None Observed	<input type="checkbox"/> Yes, Describe	

Additional Observations or Actions:

Inspected by: _____

Closure Plan Above Ground Tank Containment (AST)

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.

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 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.

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.

Closure Plan Above Ground Tank Containment (AST)

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.

GENERAL SITING CRITERIA DEMONSTRATION AND SITE SPECIFIC GROUNDWATER DATA

<u>Siting Criteria for Recycling Containment</u>	
<i>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.</i>	
General siting	
<p>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</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> NA
<p>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</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> NA
<p>Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Minerals Division FIGURE 4</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; topographic map FIGURE 5</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>Within a 100-year floodplain. FEMA map FIGURE 6</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>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</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>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</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>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</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<p>Within 500 feet of a wetland. FIGURE 9 - US Fish and Wildlife Wetland Identification map; topographic map; visual inspection (certification) of the proposed site</p>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

SITING CRITERIA (19.15.34.11 NMAC SOLARIS WATER MIDSTREAM – PINTAIL SITE CONTAINMENT

Distance to Groundwater

Figure 1 and 1a, Figure 2, their associated legends, 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 Pintail recycling containments that compose the Pintail Site. Specifically, the estimated depth to water is greater than 100 feet.

Hydrogeology of Pintail Site Containment

The proposed site for the Pintail Recycling Facility and the associated three containments is located approximately 28.5 miles southwest of Jal, New Mexico and 29.3 miles southeast of Loving, New Mexico. It lies 1.7 miles to the southwest of the Paduca Breaks and Red Hills. The area near the proposed site is relatively flat with a surface covering of loose sand with vegetation consisting of rabbit brush, native grasses, and some mesquite. Caliche underlies the thin sand surface. According to the New Mexico State Geologic Map (Figures 1 and 2), the Pintail Site is in an area where the surface unit is Quaternary-age older alluvium (Qoa).

As shown in the eastern portion of Figures 1 and 2, the upper Chinle Formation, T(r)cu, crops out at an elevation of 3250 above mean sea level and the Ogallala Formation is mapped east of the Chinle outcrop and 4.6 miles east of the Pintail site. Nearest the site, there are two wells, USGS-9515 and -9501, that reportedly draw water from the Rustler Formation and Santa Rosa Formation, respectively. These data indicate groundwater in the area is Triassic in age and lies greater than 200 feet below the surface.

The lithologic logs of nearby borings show red sand/clay at depths of 15-50 feet. These data combined with the nearby mapped outcrop of upper Chinle permits a conclusion that the Ogallala is not present in the area and the contact between the alluvium and Triassic bedrock is less than 50 feet.

Depth to Water Data and Nearby Wells

Figures 1 and the associated legend are topographic maps overlain by a transparent geologic map of the state of New Mexico that display the following:

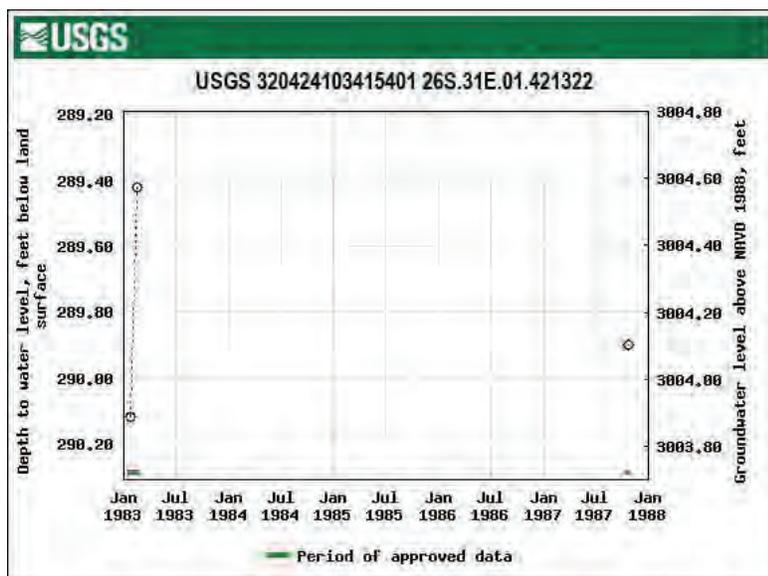
- A blue hatched rectangle, which represents the footprint of the Pintail Site.
- Water wells from the USGS database as green, cyan, purple, red, and blue triangles. These colors indicate the principal water-bearing unit for each well: Alluvium/Bolsom, Ogallala, Chinle, Santa Rosa, and Rustler, respectively. The well number as defined in the database, recorded depth to water value, and date the water level was measured is displayed next to the corresponding well point.
- Miscellaneous water wells from public and non-public databases were identified by field inspection or other published documents are represented by yellow, cyan, and green squares with black dots in the center. The colors correspond to the depth to water. The water level measurement and the date the measurement was recorded are displayed next to the corresponding well points.
- Water wells from the Office of the State Engineer's WATERS database as light blue, light green, dark green, and dark blue circles with colored triangles in the center. These symbols indicate the depth to water measured in the well. Well ID as

SITING CRITERIA (19.15.34.11 NMAC) SOLARIS WATER MIDSTREAM – PINTAIL SITE CONTAINMENT

documented in the WATERS database, depth to water value, and the date the value was recorded is displayed next to the corresponding well point.

A number of OSE wells in the area surrounding the Pintail site have water level measurements as recent as 2018. These measurements (typically measured by drillers soon after well completion) and well logs associated with the wells (See Well Logs Appendix), help confirm the depth to water in the area is greater than the required 100 feet. C-4209 is 2.58 miles to the northwest of the site and was drilled in 2018. The depth to water at the time of drilling was 155 feet. The water-bearing unit in this well is a red sand, which would imply this unit is likely a part of the Santa Rosa Formation. C-4256 is 3.03 miles northwest of the site and was also drilled in 2018. The depth to water at the time of the drilling was 330 feet. The water-bearing unit in this well is a red and blue siltstone with gravel stringers, which indicates this unit belongs to either the Rustler (magenta dolomite member) or the Santa Rosa Formation.

USGS-9501 is 1.7 miles to the northwest of the Pintail site. The most recent water level measurement is from late 1987 is approximately 280.9 feet, and the earliest measurement from early 1983 shows a water level of 290.10 feet. Over the 5-year time period on the graph below (USGS 320424...401), there is a 0.7-foot change, which indicates a stable water level in this well.



USGS-14294 is 4.7 miles to the northeast of the Pintail site (below, USGS 320449...101). The most recent water level measurement is approximately 189.8 feet below the surface and was taken in early 1986. The only other measurement is from 1981 and was recorded as approximately 191.2 feet below the surface. The total change in depth to water over 5 years is 1.4 feet. This indicates a relatively stable water level in this well.

SITING CRITERIA (19.15.34.11 NMAC)
SOLARIS WATER MIDSTREAM – PINTAIL SITE CONTAINMENT

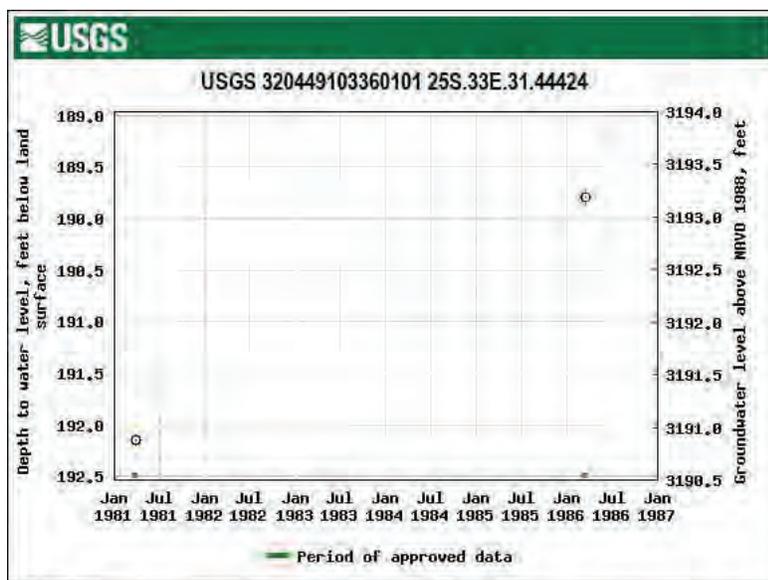


Figure 2 is a topographic map overlain by a transparent geologic map of the state of New Mexico and a potentiometric surface map and associated legend that displays the following:

- The Pintail site as a blue hatched box.
- Water wells from the USGS database as green, cyan, purple, red, and blue triangles. These colors indicate the principal water-bearing unit for each well: Alluvium/Bolsom, Ogallala, Chinle, Santa Rosa, and Rustler, respectively. The well number as defined in the database, recorded groundwater elevation value, and date the water elevation was measured is displayed next to the corresponding well point.
- Miscellaneous water wells from public and non-public databases were identified by field inspection or other published documents are represented by yellow, cyan, and green squares with black dots in the center. The colors correspond to the groundwater elevation. The water elevation measurement and the date the measurement was recorded are displayed next to the corresponding well points.

We used the USGS and MISC data to generate the potentiometric surface map. As indicated earlier, the geology and water level data demonstrate that wells in the area draw water from the Rustler or Santa Rosa formations. The water table elevations shown on Figure 2 are anchored by data showing that the elevation of the potentiometric surface beneath the Pintail Site is about 3020 feet ASL.

- We conclude with a high degree of scientific certainty that the depth to the groundwater surface is (3245-3020=) 225 feet.
- *Assuming the deepest containment is 25 feet below natural grade, the distance between the bottom of the containment and the groundwater surface is 200 feet.*

SITING CRITERIA (19.15.34.11 NMAC SOLARIS WATER MIDSTREAM – PINTAIL SITE CONTAINMENT

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 nearest freshwater well field is 21.1 miles to the southeast and is owned by the City of Jal.
- The nearest municipality is the City of Jal, which is 28 miles northeast of the site.

Distance to Subsurface Mines

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

- The Pintail site is not in an area where subsurface mines exist.
- The nearest surface mine is mapped in the MILS database .25 miles to the southwest. However, we believe this point represents what appears to be two gravel exploration pits mapped on the topo map on either side of the point from the MILS database. If these two gravel pits were used, examination of historical Google images suggest they may have been small borrow pits associated with the construction of County Road #1.
- An active gravel pit lies northwest of the Pintail Site.

Distance to High or Critical Karst Areas

Figure 5 illustrates the Pintail Site absence of mapped areas of high or critical karst potential.

- The Pintail site is not located within high or critical karst potential areas.
- Our field investigation saw no evidence of karst features such as sinkholes.

Distance to 100-Year Floodplain

Figure 6 demonstrates the absence of 100-year flood plains with respect to the proposed location for the Pintail site.

- The nearest 100- year flood plain is 2.96 miles due northwest of the site.

Distance to Surface Water

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

- The nearest surface water feature is an intermittent stream that is located 1.32 miles due east.
- We observed no watercourses that meet the Rule 35 definition near the site.

SITING CRITERIA (19.15.34.11 NMAC SOLARIS WATER MIDSTREAM – PINTAIL SITE CONTAINMENT

Distance to Permanent Residences or Structures

Figure 8 demonstrates that the proposed site for the Pintail Site 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 Pintail 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, C-04209, is located approximately 2.57 miles to the northwest of the proposed site.
- No domestic water wells are located within 1,000 feet of the recycling area.
- No springs were identified in the area.
- The site 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.

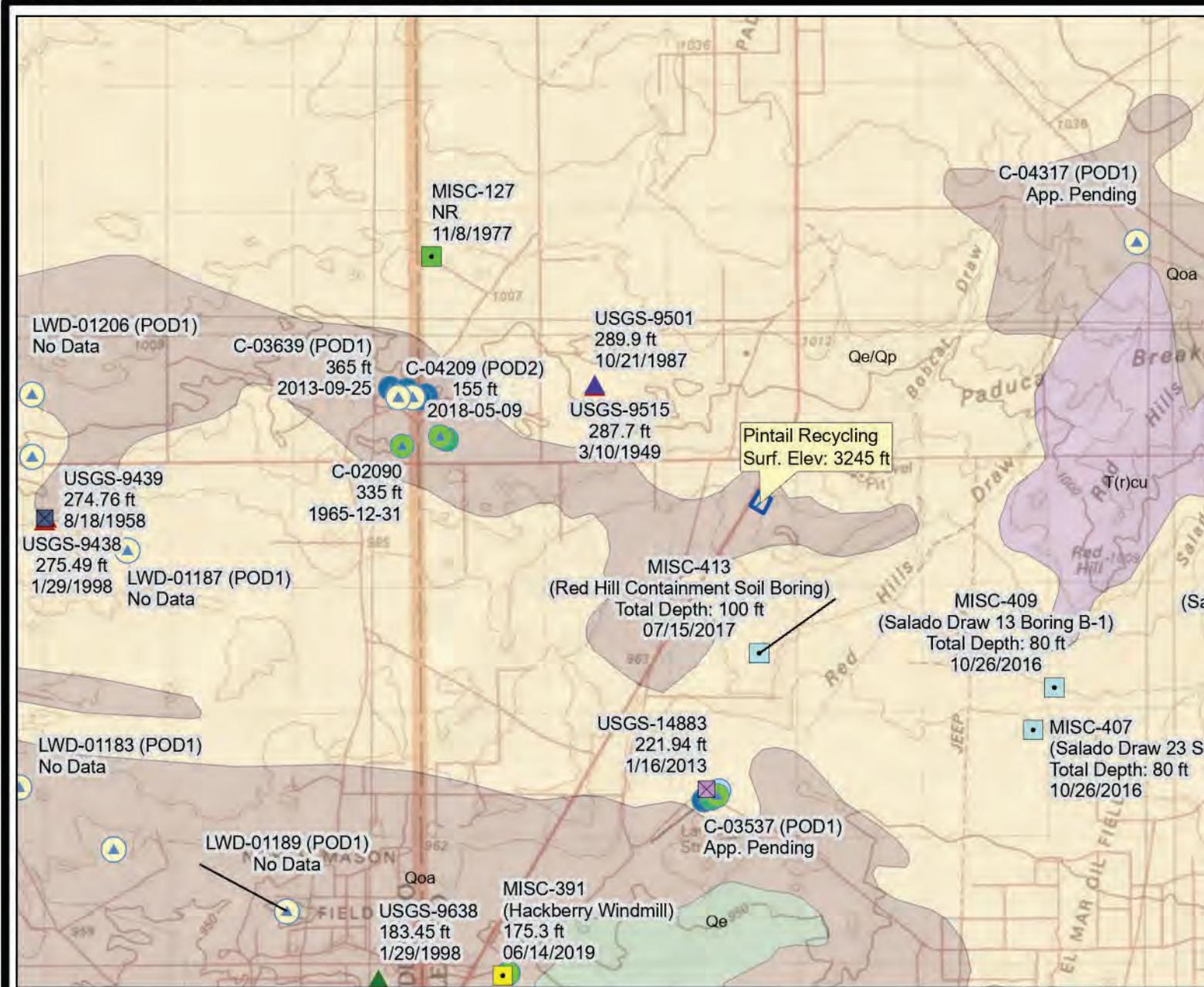
Distance to Wetlands

Figure 9 demonstrates that the proposed site of the Pintail site is not within the 300-foot setback distance of a wetland.

- The nearest mapped wetland is a freshwater pond that is .43 miles to the northwest. It is labeled as palustrine, and upon inspection of aerial photographs it was found to be an existing containment pond.

Figures

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0 2,640 5,280
US Feet

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

Depth to Water and Geology
Solaris Water Midstream – Pintail Rec

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 Recycling Containment Area	Misc. Water Wells (Well ID, DTW)	NM Geology
USGS Gauging Station (DTW, Date)	Well Depth (ft)	 Qe, Quaternary-Eolian Deposits, Qe, Quaternary-
 Alluvium/Bolsom	 No Data	 Qe/Qp, Quaternary-Eolian Piedmont Deposits
 Ogallala	 <= 150	 Qoa, Quaternary-Older Alluvial Deposits, Qoa, Q
 Chinle	 151 - 350	 T(r)cu, Triassic-Upper Chinle Group, T(r)cu, Triass
 231DCKM, Site had been pumped recently,	OSE Water Wells (DTW/Date)	 To, Tertiary-Ogallala Formation, To, Tertiary-Ogal
 Santa Rosa	Well Depth (ft)	
 Santa Rosa, Site was being pumped.	 <=150	
 Rustler	 151-350	
	 351-500	
	 501-1000	
	 Other	

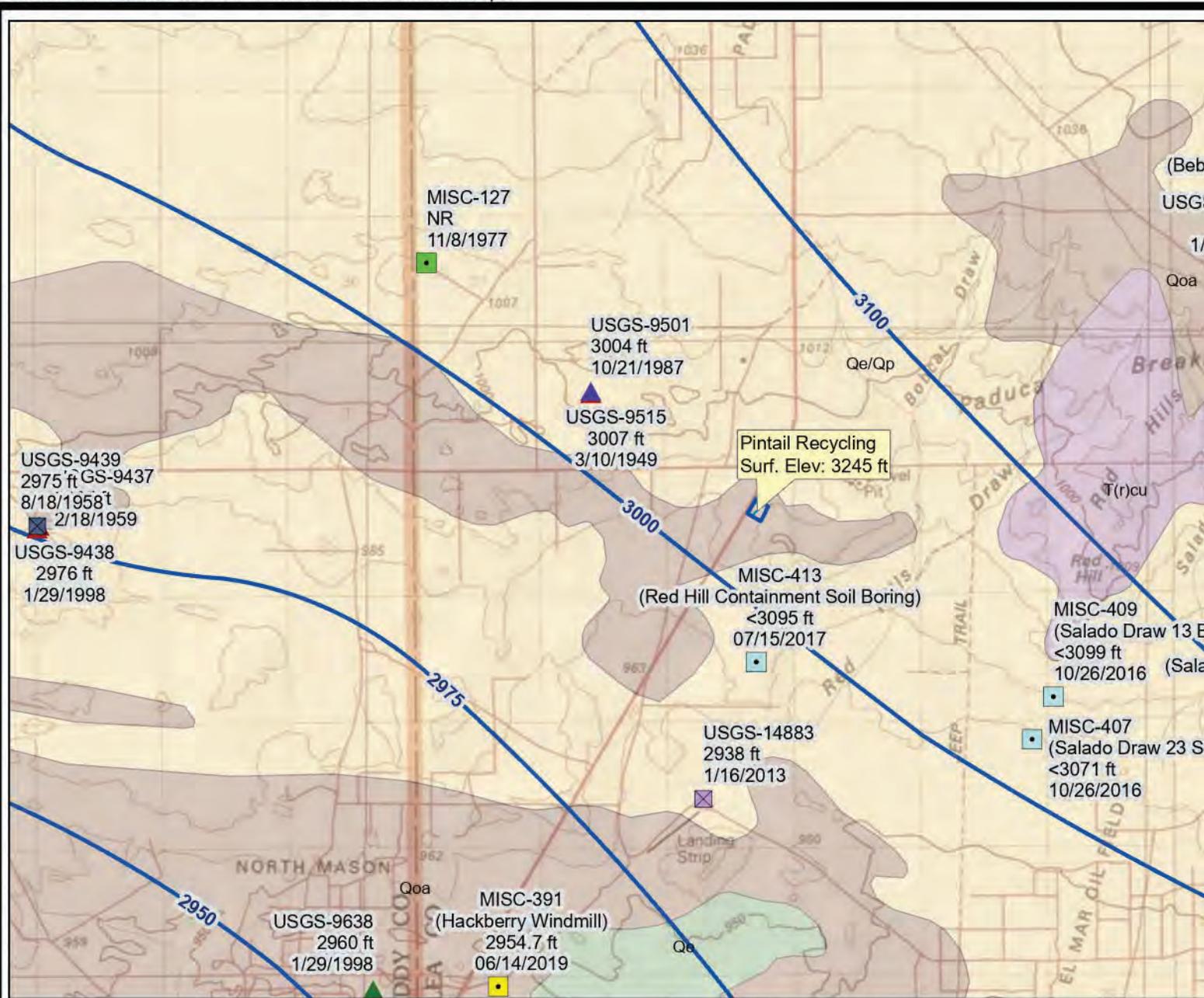


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Depth to Water and Geology Legend
Solaris Water Midstream – Pintail Rec

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Groundwater Elevation, Geology
 and Potentiometric Surface
 Solaris Water Midstream – Pintail Rec

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 Recycling Containment Area	Misc. Water Wells (GW Elev, Date)	NM Geology
USGS Gauging Station (GW Elev, Date)	Well Depth (ft)	 Qe, Quaternary-Eolian Deposits, Qe, Quaternary
 Alluvium/Bolsom	 No Data	 Qe/Qp, Quaternary-Eolian Piedmont Deposits
 Ogallala	 ≤ 150	 Qoa, Quaternary-Older Alluvial Deposits, Qoa, Q
 Chinle	 151 - 350	 T(r)cu, Triassic-Upper Chinle Group, T(r)cu, Triass
 231DCKM, Site had been pumped recently.	Potentiometric Surface (ft msl)	 To, Tertiary-Ogallala Formation, To, Tertiary-Oga
 Santa Rosa	 Isocontour	
 Santa Rosa, Site was being pumped.		
 Rustler		

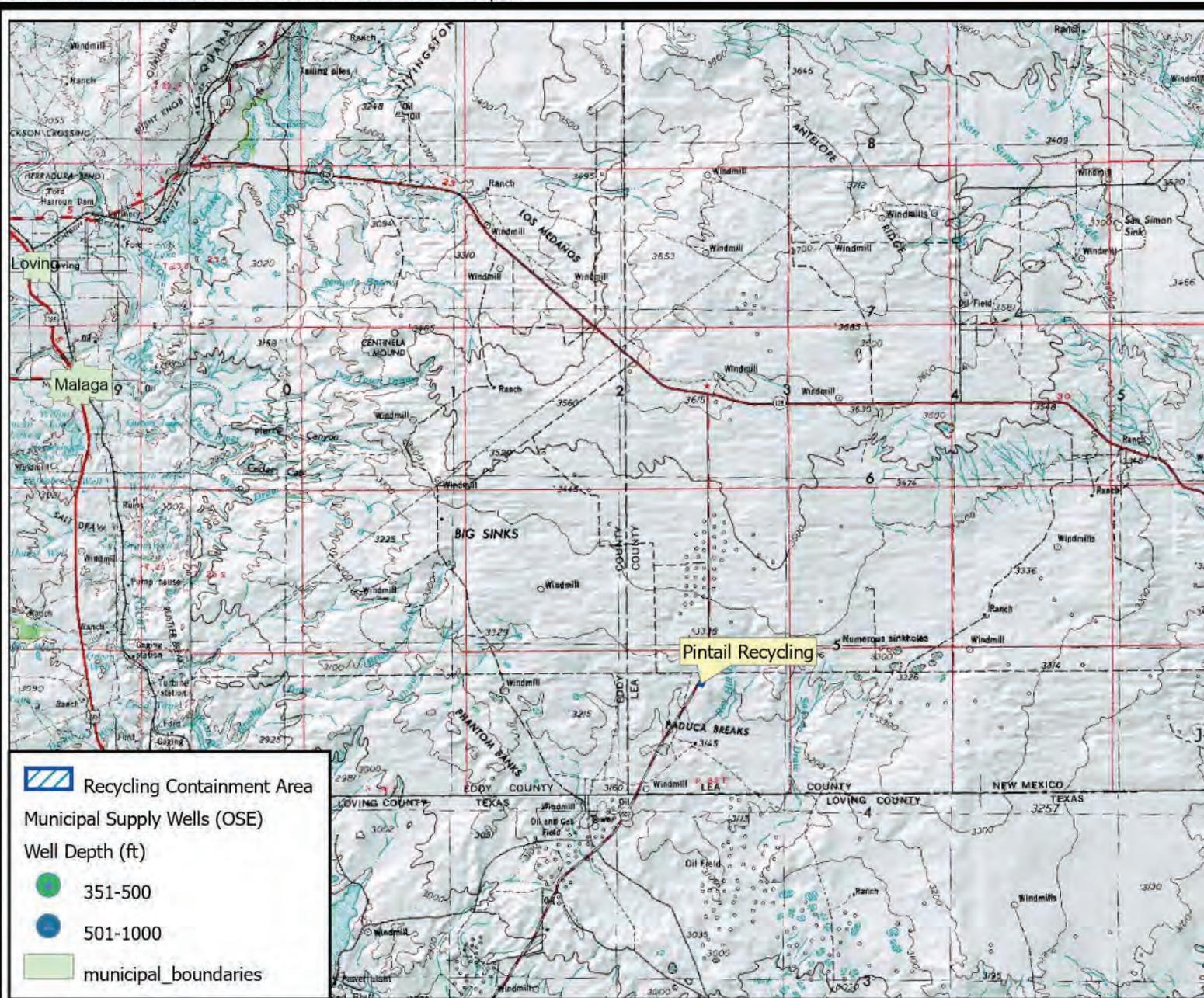


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Groundwater Elevation, Geology
and Potentiometric Surface Legend
Solaris Water Midstream – Pintail Rec

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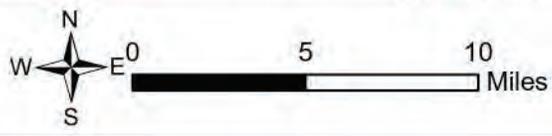
 Recycling Containment Area

Municipal Supply Wells (OSE)

Well Depth (ft)

-  351-500
-  501-1000

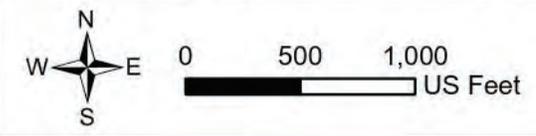
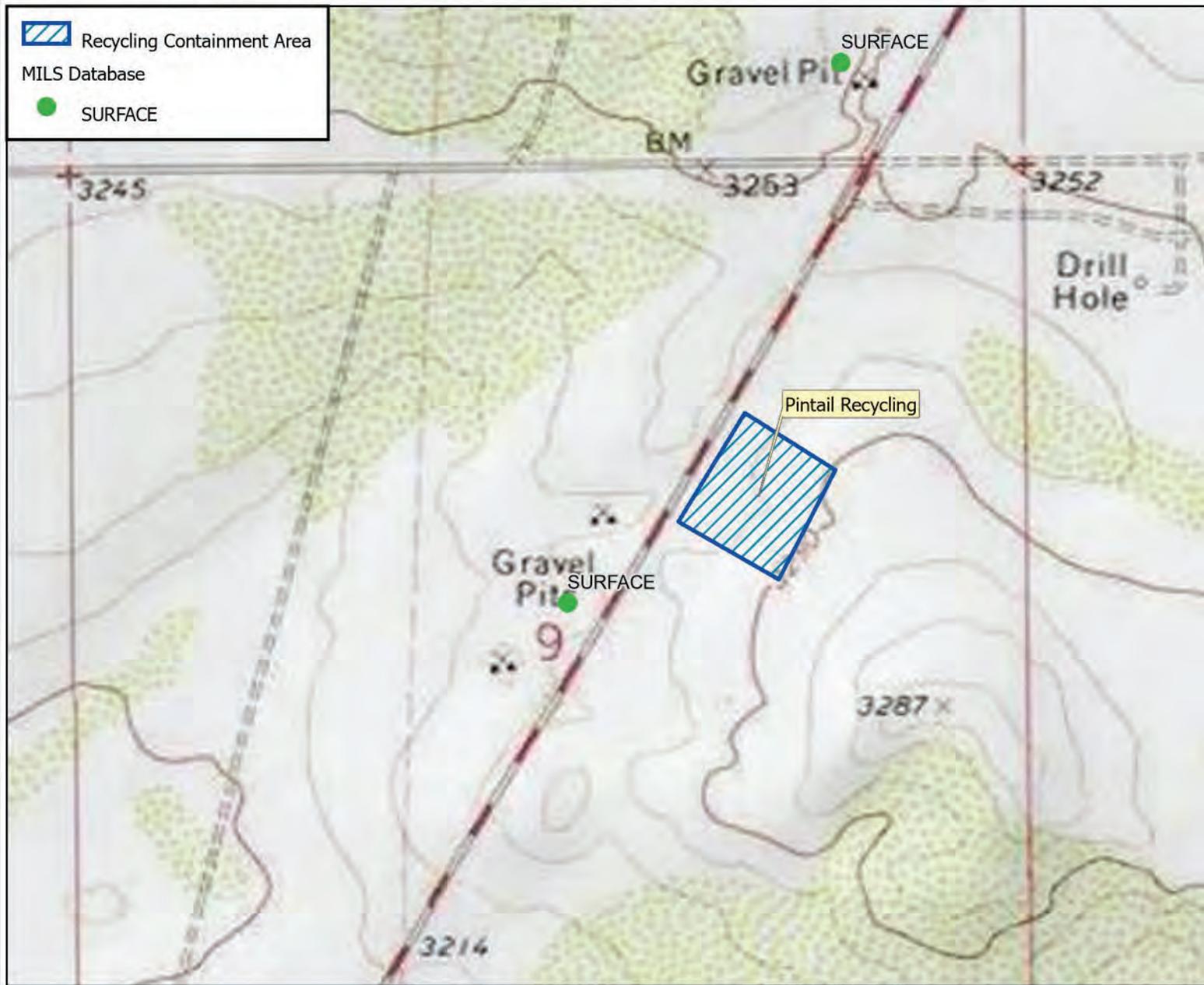
 municipal boundaries



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Well Fields and Municipal Well Sup
 Solaris Water Midstream – Pintail Rec

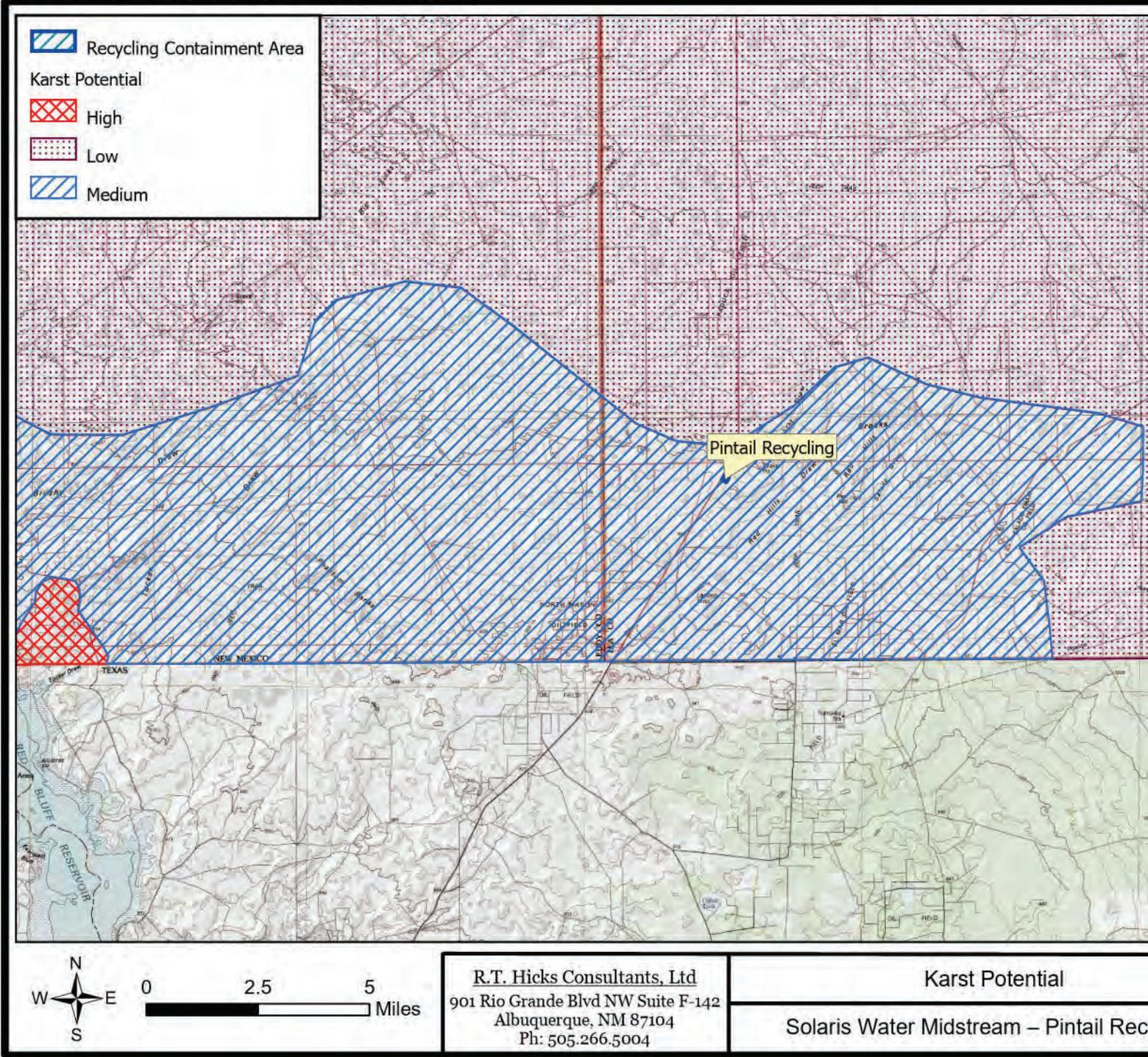
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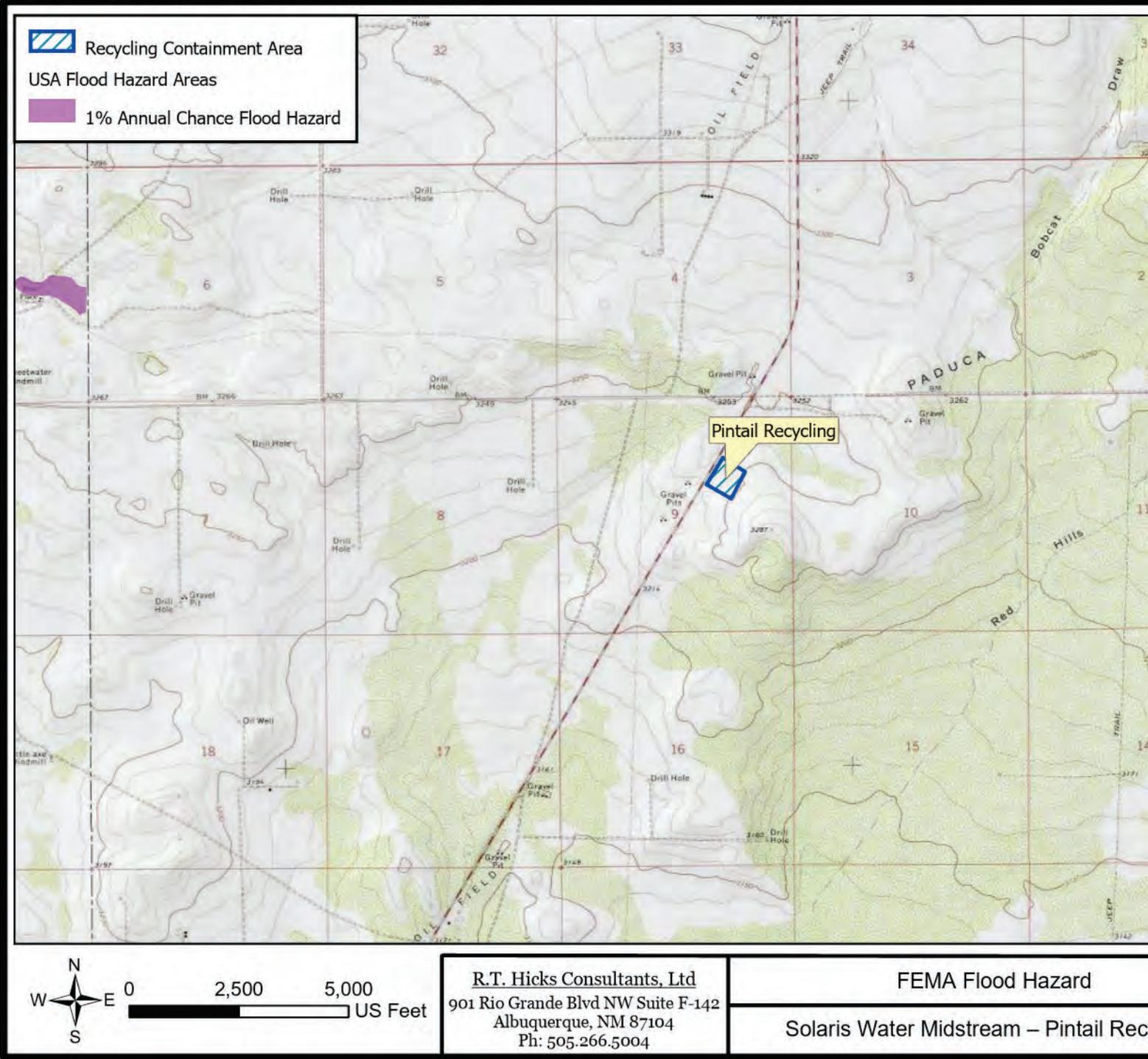
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Mines and Minerals
Solaris Water Midstream – Pintail Rec

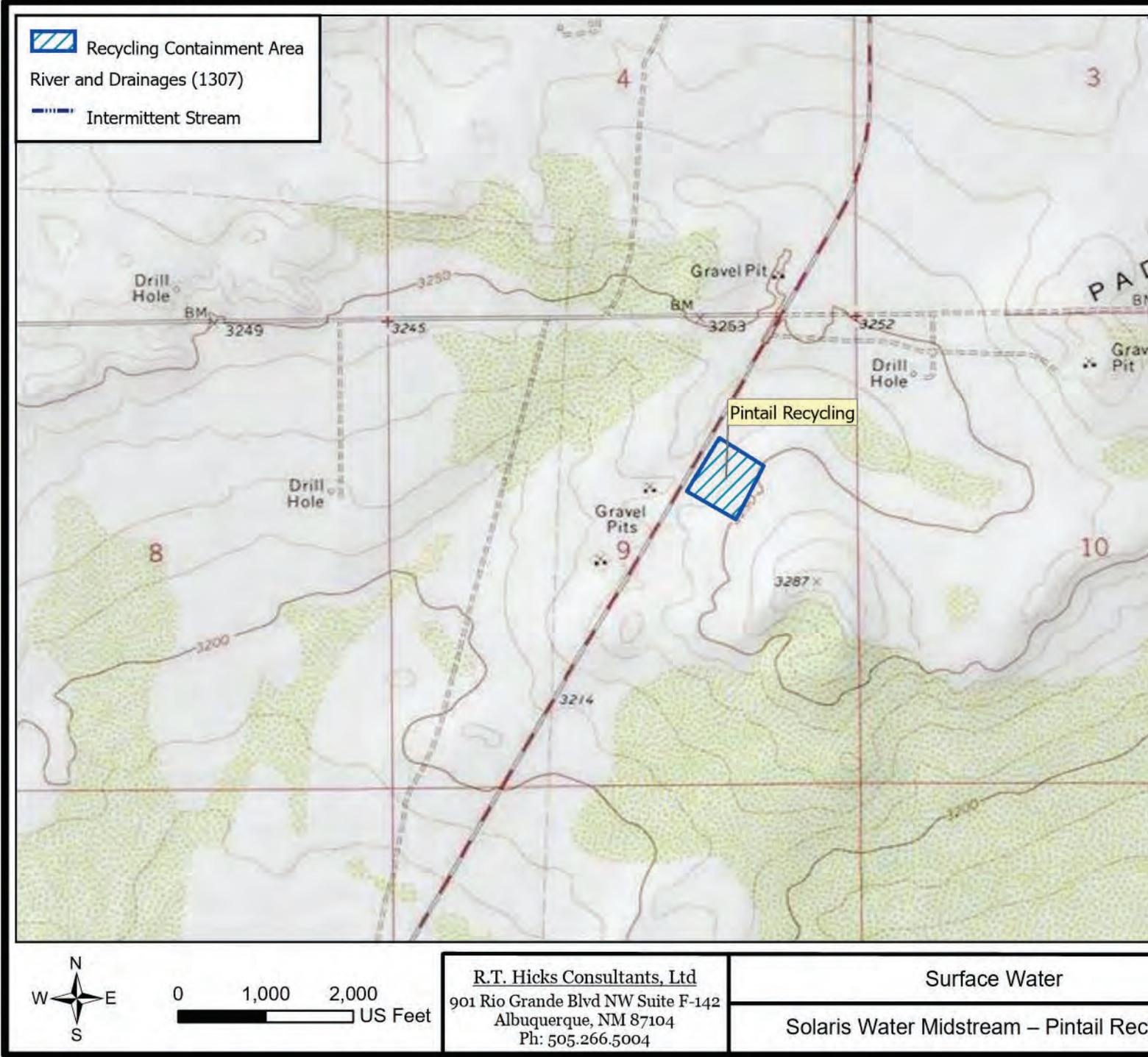
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Pintail Recycling



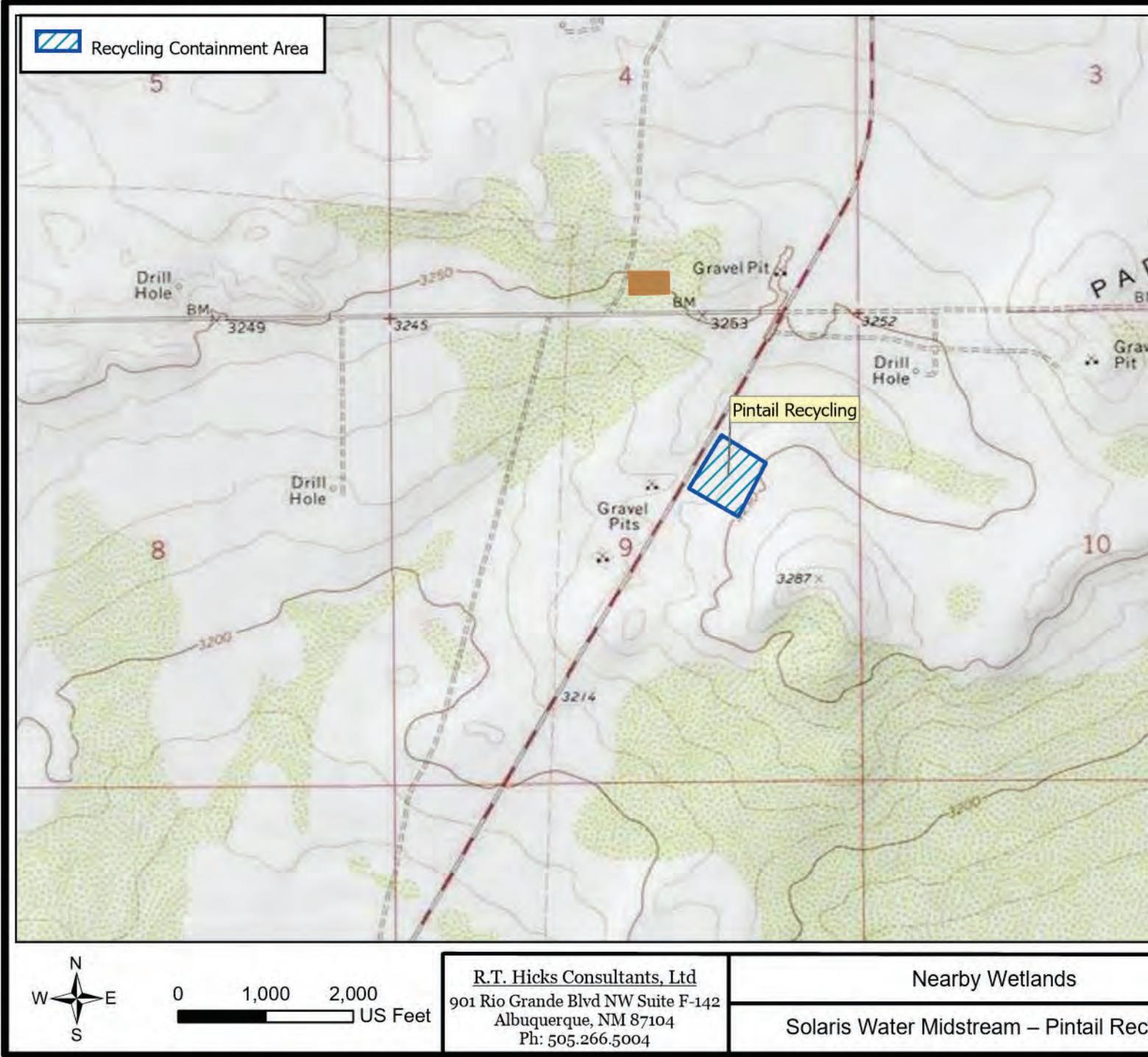
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Nearby Structures

Solaris Water Midstream – Pintail Rec

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Nearby Wetlands
Solaris Water Midstream – Pintail Rec

WELL LOGS APPENDIX



THE DRILLING PROFESSIONALS

Soil Boring Log

Client	Phoenix Environmental LLC
Contractor	HCI Drilling
Date Completed	07/15/2017
Location	Red Hills West 21
Soil Boring Number	SB-1
Lithology	
0' – 11'	Caliche – White
11' – 12'	Sandstone – Pink
50' – 100'	Red Clay
GPS Coordinates	32.042248, 103.676538

Copies: Email (Phoenix Env)

HCI DRILLING / P.O. BOX 96 / WOLFFORTH, TX 79382-0096
806.866.4026 / HCIDRILL.COM

Salado Draw Containment & Recycling Facility | **MOC**

Figure 2: Soil Boring Log



THE DRILLING PROFESSIONALS

Soil Boring Log

Client	Phoenix Environmental LLC
Contractor	HCI Drilling
Date Completed	07/09/2107
Location	Jal, NM
Soil Boring Number	SB-1
Lithology	
0' – 20'	Caliche with Sand
20' – 50'	Caliche with Sandstone
50' – 100'	Red Clay with Sandstone Stringers

Copies: Email (Phoenix Env)

HCI DRILLING / P.O. BOX 96 / WOLFFORTH, TX 79382-0096
806.866.4026 / HCIDRILL.COM



Tetra Tech Inc.
 4000 N. Big Spring, Suite 401
 Midland, TX, 79705
 Telephone: 432-682-4559
 Fax: 432-682-3946

BOREHOLE ID: B-1
 PAGE 1 OF 2

CLIENT Chevron PROJECT NAME Salado Draw Section 23 Frac Pond
 PROJECT NUMBER 212C-MD-00649 PROJECT LOCATION Lea County, New Mexico

DATE(S) OF EXCAVATION: **10/26/2016** GROUND ELEVATION: **N/** METHOD: **HSA/Air Rotary**
 CONSULTANT: **Tetra Tech, Inc.** A LATITUDE: **32.033156N** LOGGED BY: **James Kennedy**
 DRILLING CONTRACTOR: **Yellow Jacket** LONGITUDE: **103.639194W** DRILLED BY: **Jason**
 Notes: **No groundwater encountered**

DEPTH (ft)	SAMPLE TYPE	N Value	GRAPHIC LOG	MATERIAL DESCRIPTION
0				
	SS	1		Very Loose, Brown, Fine to Medium Grained SAND with Silt, Dry, with some roots
	SS	8		
3.5				Dense to Very Dense, Reddish Brown to Pink, Silty Fine to Medium Grained SAND , Calcareous, with Limestone Fragments, Dry
	SS	41		
5				
	SS	50/5"		
10	SS	50/1"		
	SS	50/2"		
15				
20	SS	50/2"		
25	SS	50/2"		
30	SS	50/3"		
35	SS	50/1"		
40	SS	50/1"		

BOREHOLE/TP/WELL - VECTOR SALADO - FRAC POND.GPJ LAB SUMMARY.GDT 11/28/16

(Continued Next Page)



Tetra Tech Inc.
 4000 N. Big Spring, Suite 401
 Midland, TX, 79705
 Telephone: 432-682-4559
 Fax: 432-682-3946

BOREHOLE ID: B-1
 PAGE 2 OF 2

CLIENT Chevron PROJECT NAME Salado Draw Section 23 Frac Pond
 PROJECT NUMBER 212C-MD-00649 PROJECT LOCATION Lea County, New Mexico

DEPTH (ft)	SAMPLE TYPE	N Value	GRAPHIC LOG	MATERIAL DESCRIPTION
40				
45				
50	SS	50/0"		Dense to Very Dense, Reddish Brown to Pink, Silty Fine to Medium Grained SAND , Calcareous, with Limestone Fragments, Dry (<i>continued</i>)
55				
60				
65				
70				
75				
80				Borehole terminated at 80.0 feet.

BOREHOLE/TP/WELL - VECTOR SALADO - FRAC POND.GPJ LAB SUMMARY.GDT 11/28/16



Tetra Tech Inc.
 4000 N. Big Spring, Suite 401
 Midland, TX, 79705
 Telephone: 432-682-4559
 Fax: 432-682-3946

BOREHOLE ID: B-1
 PAGE 1 OF 2

CLIENT Chevron PROJECT NAME Salado Draw Section 13 Frac Pond
 PROJECT NUMBER 212C-MD-00649 PROJECT LOCATION Lea County, New Mexico

DATE(S) OF EXCAVATION: **10/26/2016** GROUND ELEVATION: **N/A** METHOD: **HSA/Air Rotary**
 CONSULTANT: **Tetra Tech, Inc.** LATITUDE: **32.038060N** LOGGED BY: **James Kennedy**
 DRILLING CONTRACTOR: **Yellow Jacket** LONGITUDE: **103.636220W** DRILLED BY: **Jason**
 Notes: **No groundwater encountered**

DEPTH (ft)	SAMPLE TYPE	N Value	GRAPHIC LOG	MATERIAL DESCRIPTION
0				
	SS	1		Very Loose, Brown, Fine to Medium Grained SAND with Silt, Dry, with some roots
	SS	8		
3.5				Dense to Very Dense, Reddish Brown to Pink, Silty Fine to Medium Grained SAND , Calcareous, with Limestone Fragments, Dry
	SS	41		
5				
	SS	50/5"		
10	SS	50/1"		
15	SS	50/2"		
20	SS	50/2"		
25	SS	50/2"		
30	SS	50/3"		
35	SS	50/1"		
40	SS	50/1"		

BOREHOLE/TP/WELL - VECTOR SALADO - FRAC POND.GPJ LAB SUMMARY.GDT 11/28/16

(Continued Next Page)



Tetra Tech Inc.
 4000 N. Big Spring, Suite 401
 Midland, TX, 79705
 Telephone: 432-682-4559
 Fax: 432-682-3946

BOREHOLE ID: B-1
 PAGE 2 OF 2

CLIENT Chevron PROJECT NAME Salado Draw Section 13 Frac Pond
 PROJECT NUMBER 212C-MD-00649 PROJECT LOCATION Lea County, New Mexico

DEPTH (ft)	SAMPLE TYPE	N Value	GRAPHIC LOG	MATERIAL DESCRIPTION
40				
45				
50	SS	50/0"		Dense to Very Dense, Reddish Brown to Pink, Silty Fine to Medium Grained SAND , Calcareous, with Limestone Fragments, Dry (<i>continued</i>)
55				
60				
65				
70				
75				
80				Borehole terminated at 80.0 feet.

BOREHOLE/TP/WELL - VECTOR SALADO - FRAC POND.GPJ LAB SUMMARY.GDT 11/28/16

April 2021

Volume 2

C-147 Registration Package for Pintail AST Containment & Recycling Facility Section 9, T25-S, R32-E, Lea County

**Engineering Drawings and Liner Specifications
Design/Construction Plan
New Wave Manual
Variances for AST Storage Containments
Applicability of Engineering Variances to Variety of
Site Conditions in Permian Basin**

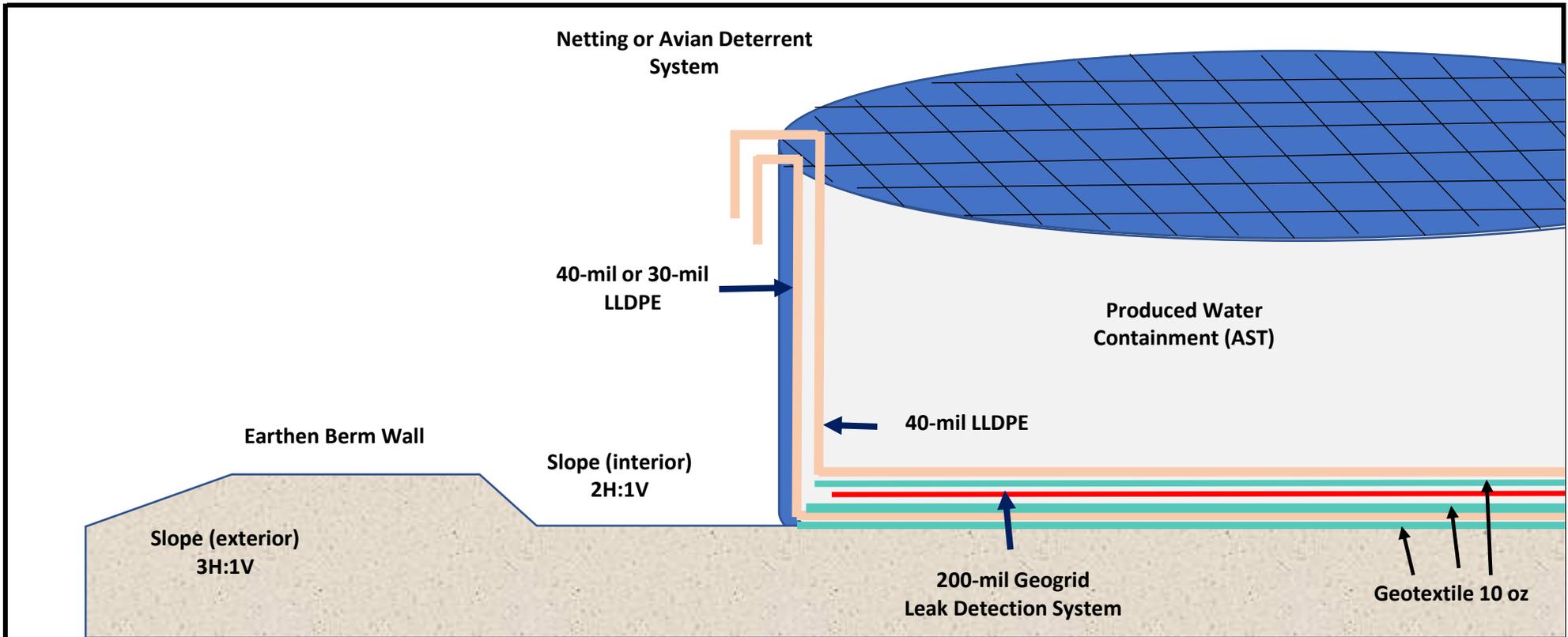


Aerial view showing in-ground containments designed by Magrym Consulting and permitted by Hicks Consultants. Also shown are two 60,000 bbl above-ground storage tank containments permitted by Hicks Consultants. Photograph by permission from Magrym Consulting.

**Prepared for:
Solaris Water Midstream
Houston, Texas**

**Prepared by:
R.T. Hicks Consultants, Ltd.
901 Rio Grande NW, Ste F-142
Albuquerque, New Mexico 87104**

RECYCLING CONTAINMENT DESIGN DRAWINGS

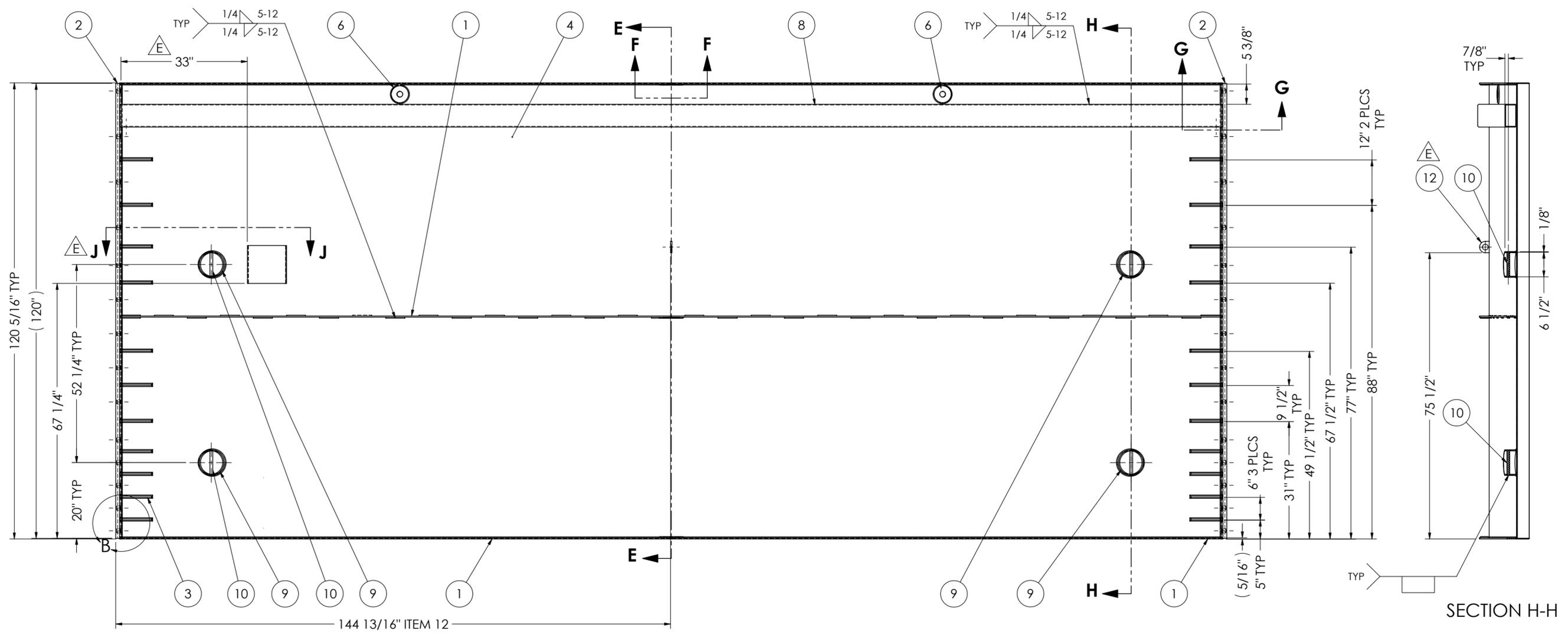
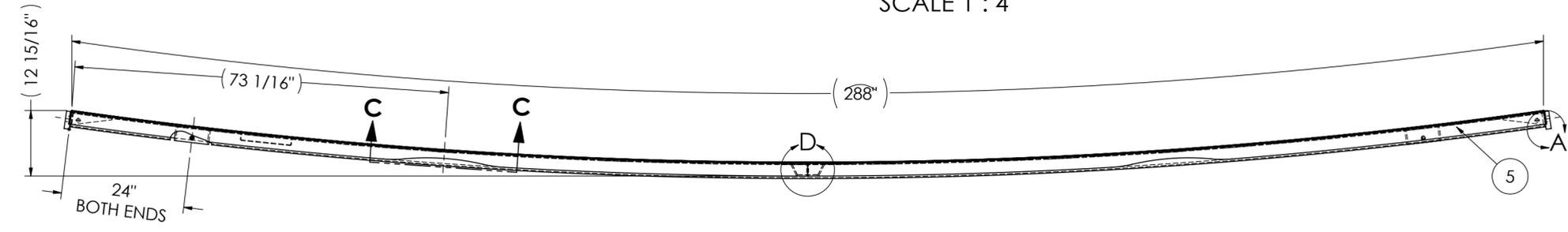
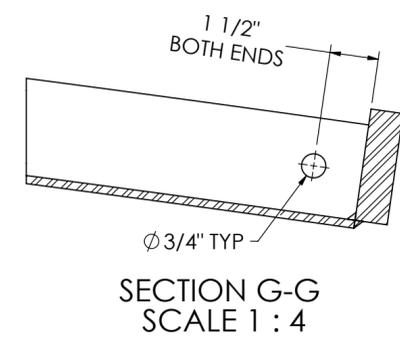
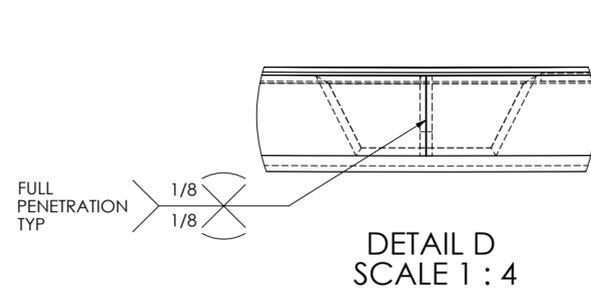


Description of Leak Detection System

- 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 3/4-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 3/4" 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.e. produced water or condensation)

R.T. Hicks Consultants Albuquerque, NM	Design Sketch	Plate 1
	Solaris Water Midstream - Pintail AST	Mar-21

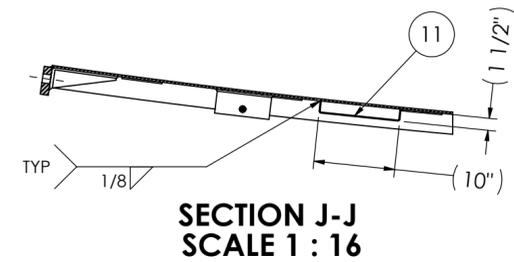
ITEM	PART NUMBER	DESCRIPTION	LENGTH	QTY.
1	-	PLATE, 5/16 G40.21-44W	-	4
2	-	PLATE, 1 G40.21-44W	-	2
3	-	PLATE, 3/8 G40.21-44W	-	22
4	-	PLATE, 1/4 G40.21-44W	10' X 24'	1
5	-	PLATE, 5/16 G40.21-44W	-	2
6	-	PLATE, 1/4 G40.21-44W	-	2
7	-	PLATE, 1/4 G40.21-44W	-	3
8	-	HSS, 6 X 3 X .188W G40.21-50W	288"	1
9	-	PIPE, 6 SCH40 .280W A106B	3"	4
10	-	ROUND BAR, 3/4 HR 40.21-44W	6 1/2"	4
11	600505	BRACKET, IDENTIFICATION PLATE	-	1
12	600178	LUG, ROUND HEAD	-	1



- NOTES:
- TO BE WELDED WITH 7018-1 ELECTRODE OR FLUX-CORE EQUIVALENT
 - DETAIL "A", DETAIL "B", & SECTION C-C, SECTION E-E, SECTION F-F ON SHT 2 OF 3
 - ITEM DETAILS ON SHT 3 OF 3

REV	DESCRIPTION	ECN #	DATE	APPR
E	ITEM 11 WAS 600480; 33 WAS 18-5/8; 52-1/4 WAS 89-1/4; ADDED ITEM 12		10/1/2014	GQH
D	ADDED ITEMS 9-11; INSERTED NEW BOM; ADDED DRAIN HOLES TO ITEM 8		9/11/2014	GQH
	ADDED SECTION G-G & H-H; ADDED DETAIL 10; ADDED IDENTIFICATION PLATE		9/11/2014	GQH
0	ISSUED FOR MANUFACTURE			

REVISIONS



UNLESS OTHERWISE SPECIFIED:

1. REMOVE BURRS AND SHARP EDGES.

2. INSIDE CORNER RADIUS = 0.031"

3. CHAMFER SIZE = 0.030" X 45°

4. CONCENTRICITY = 0.002" TIR

5. MACHINE FINISH = 125µin rms

6. INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5

DIMENSIONS ARE IN INCHES

TOLERANCES:

FRACTIONAL: ±1/16

ANGULAR: ±0.5°

DECIMAL: ±0.030

X.XX ±0.010

X.XXX ±0.005

DO NOT SCALE DRAWING

NAME	DATE	MATERIAL:
MODELLED	CDH 28AUG12	MILD STEEL
DRAWN	CDH 28AUG12	FINISH/CONDITION:
CHECKED	GQH 29AUG12	SPECIFICATION:
ENG APPR.	GQH 29AUG12	API 650
CONTACT	cholte@holtedesign.com	WEIGHT:
		3189.90 lbs

CUSTOMER:
NEW WAVE ENERGY SERVICES LTD.

PROJECT/MODEL:
CONTAINMENT RING

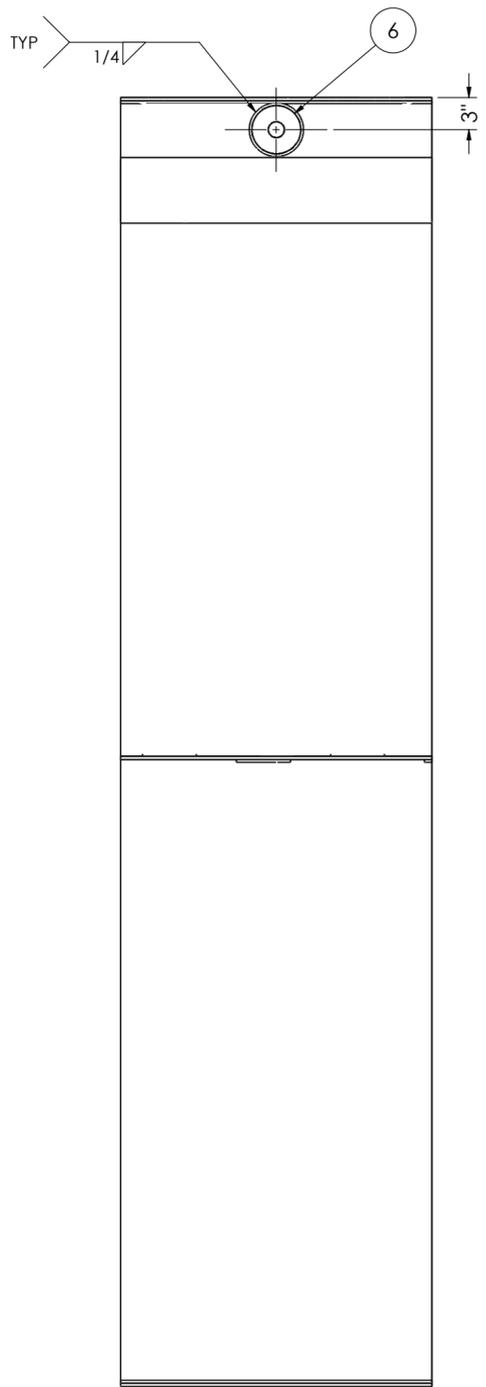
HOLTE DESIGN INC.

- Mechanical Design
- 3D Conceptual Layouts
- Manufacturing Drawings
- Graphical Illustrations
- Sales Brochures

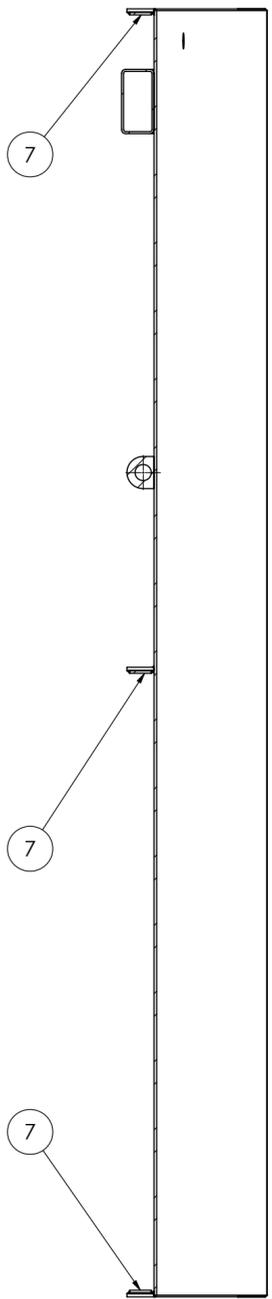
TITLE:
CONTAINMENT RING, 10' X 24' - 40000 BBL - 6300 CUBIC METERS WLDMT

SIZE: C DWG. NO. 600144 REV E

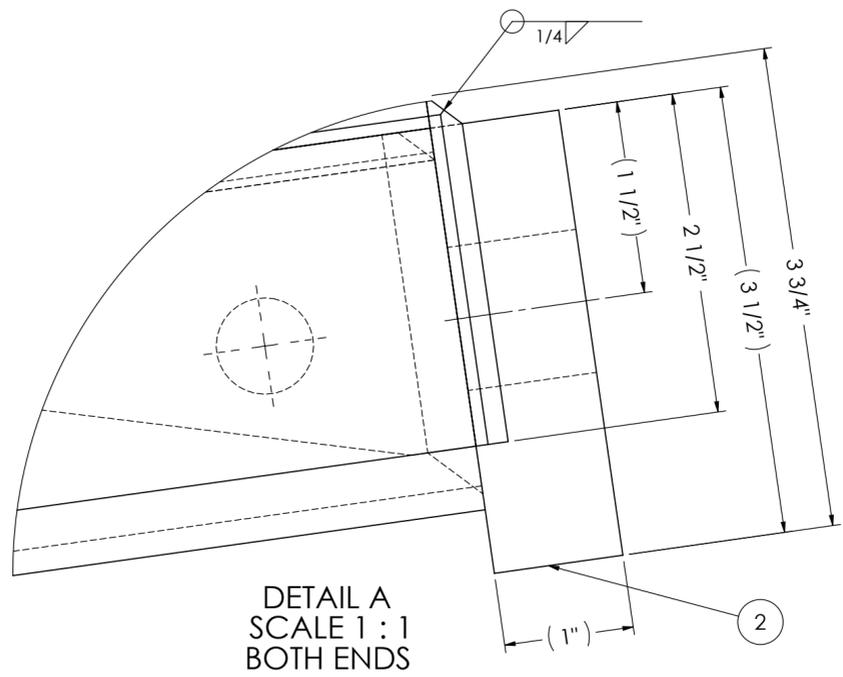
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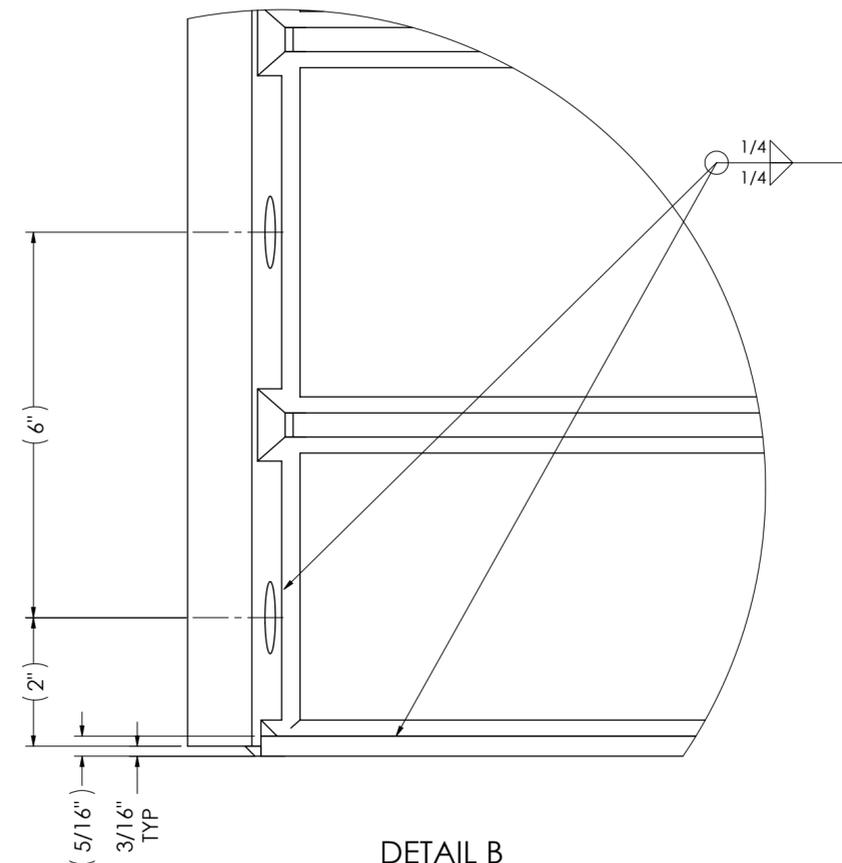
SECTION C-C
2 PLCS



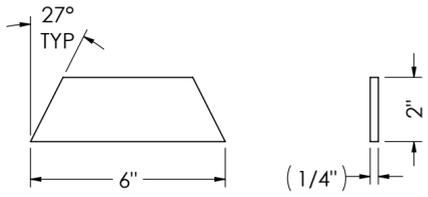
SECTION E-E



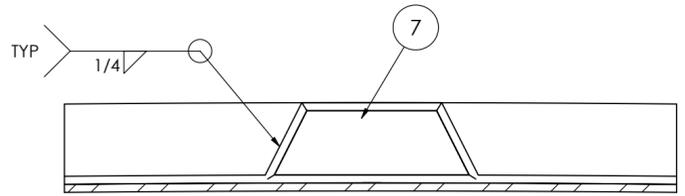
DETAIL A
SCALE 1 : 1
BOTH ENDS



DETAIL B
SCALE 1 : 2
BOTH ENDS

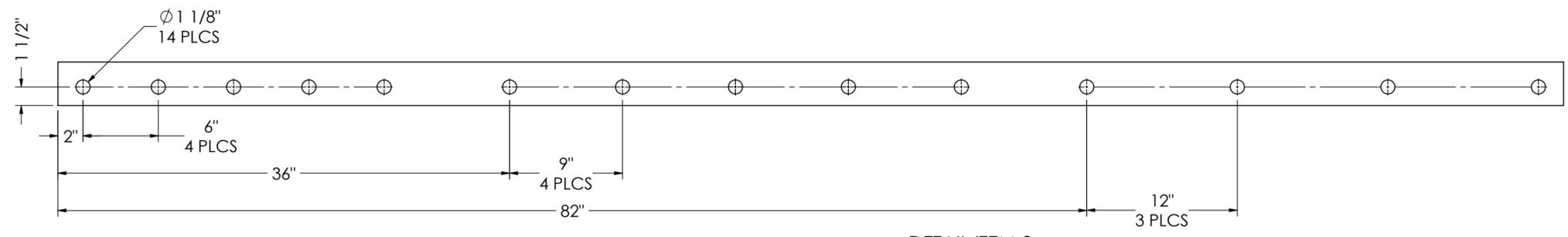


DETAIL ITEM 7
SCALE 1 : 4

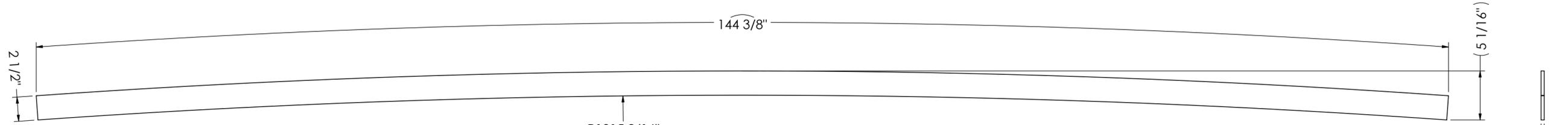


SECTION F-F
SCALE 1 : 4

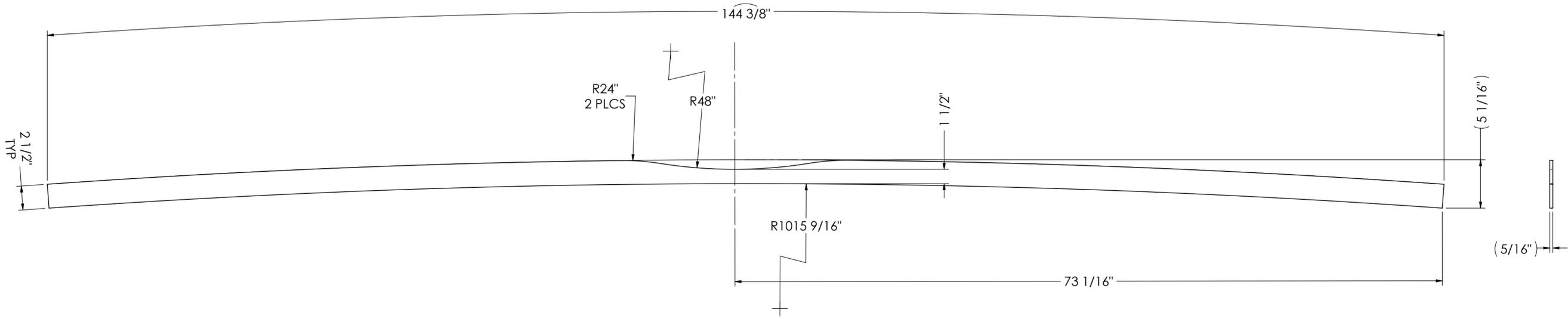
UNLESS OTHERWISE SPECIFIED: 1. REMOVE BURRS AND SHARP EDGES. DIMENSIONS ARE IN INCHES 2. INSIDE CORNER RADIUS = 0.031" TOLERANCES: 3. CHAMFER SIZE = 0.030" x 45° FRACTIONAL: 1/16 4. CONCENTRICITY = 0.002" TIR ANGULAR: ±0.5° 5. MACHINE FINISH = 125µin min. XX +0.030 6. INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5 X.XX ±0.010 X.XXX ±0.005				CUSTOMER: NEW WAVE ENERGY SERVICES LTD.		 <ul style="list-style-type: none"> - Mechanical Design - 3D Conceptual Layouts - Manufacturing Drawings - Graphical Illustrations - Sales Brochures 	
DO NOT SCALE DRAWING		PROJECT/MODEL: CONTAINMENT RING		TITLE: CONTAINMENT RING, 10' X 24' - 40000 BBL - 6300 CUBIC METERS WLDMT			
MODELLED	CDH	DATE	28AUG12	MATERIAL: MILD STEEL		PROPRIETARY AND CONFIDENTIAL	
DRAWN	CDH	DATE	28AUG12	FINISH/CONDITION:		INFORMATION CONTAINED IN THIS DRAWING IS PROPRIETARY AND CONFIDENTIAL AND SHALL REMAIN THE SOLE PROPERTY OF AREA HOLTE DESIGN INC. THIS DOCUMENT SHALL NOT BE USED, COPIED OR REPRODUCED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN PERMISSION OF HOLTE DESIGN INC. ALL PRINTS SHALL BE RETURNED UPON JOB COMPLETION UNLESS OTHERWISE SPECIFIED IN WRITING BY HOLTE DESIGN INC.	
CHECKED	GQH	DATE	29AUG12	SPECIFICATION: API 650		SIZE	DWG. NO.
ENG APPR.	GQH	DATE	29AUG12	WEIGHT: 3189.90 lbs		C	600144
CONTACT	cholte@holtedesign.com					REV	E
						SCALE: 1:12 SHEET 2/3	



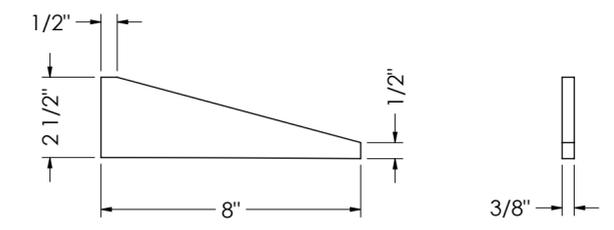
DETAIL ITEM 2
SCALE 1:8



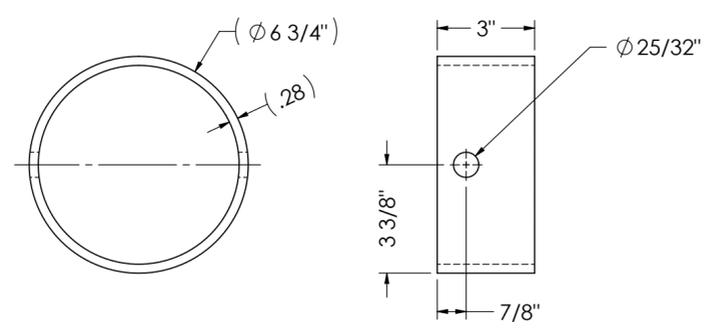
DETAIL ITEM 1
SCALE 1:8



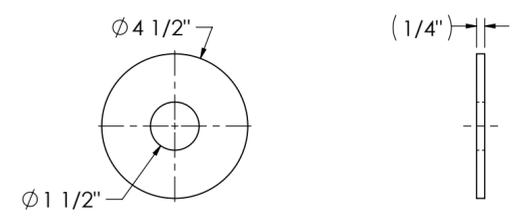
DETAIL ITEM 5
SCALE 1:12



DETAIL ITEM 3
SCALE 1:4



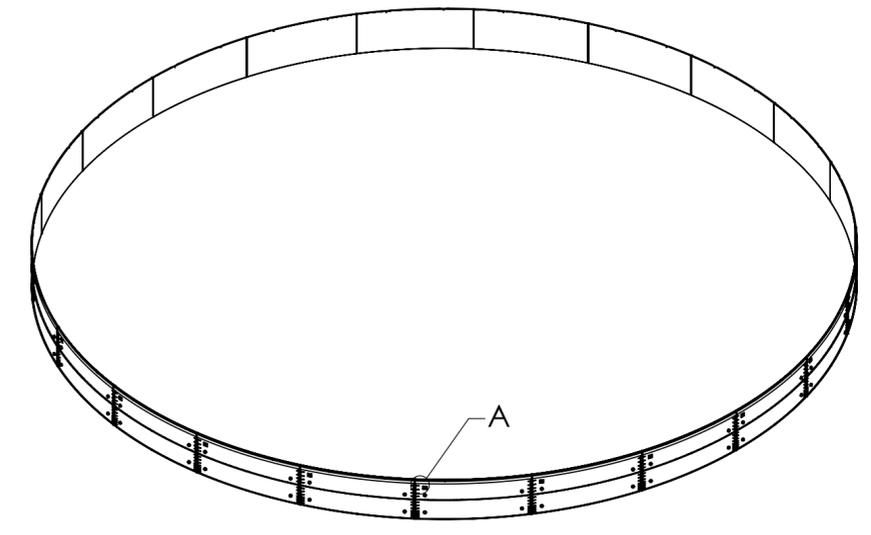
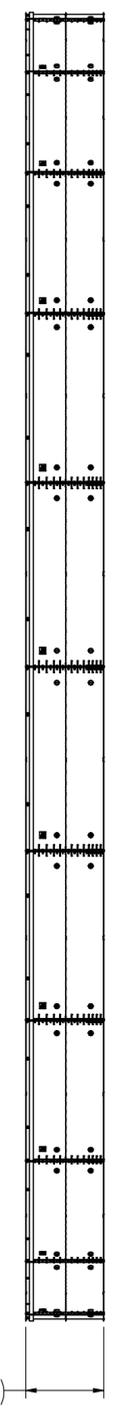
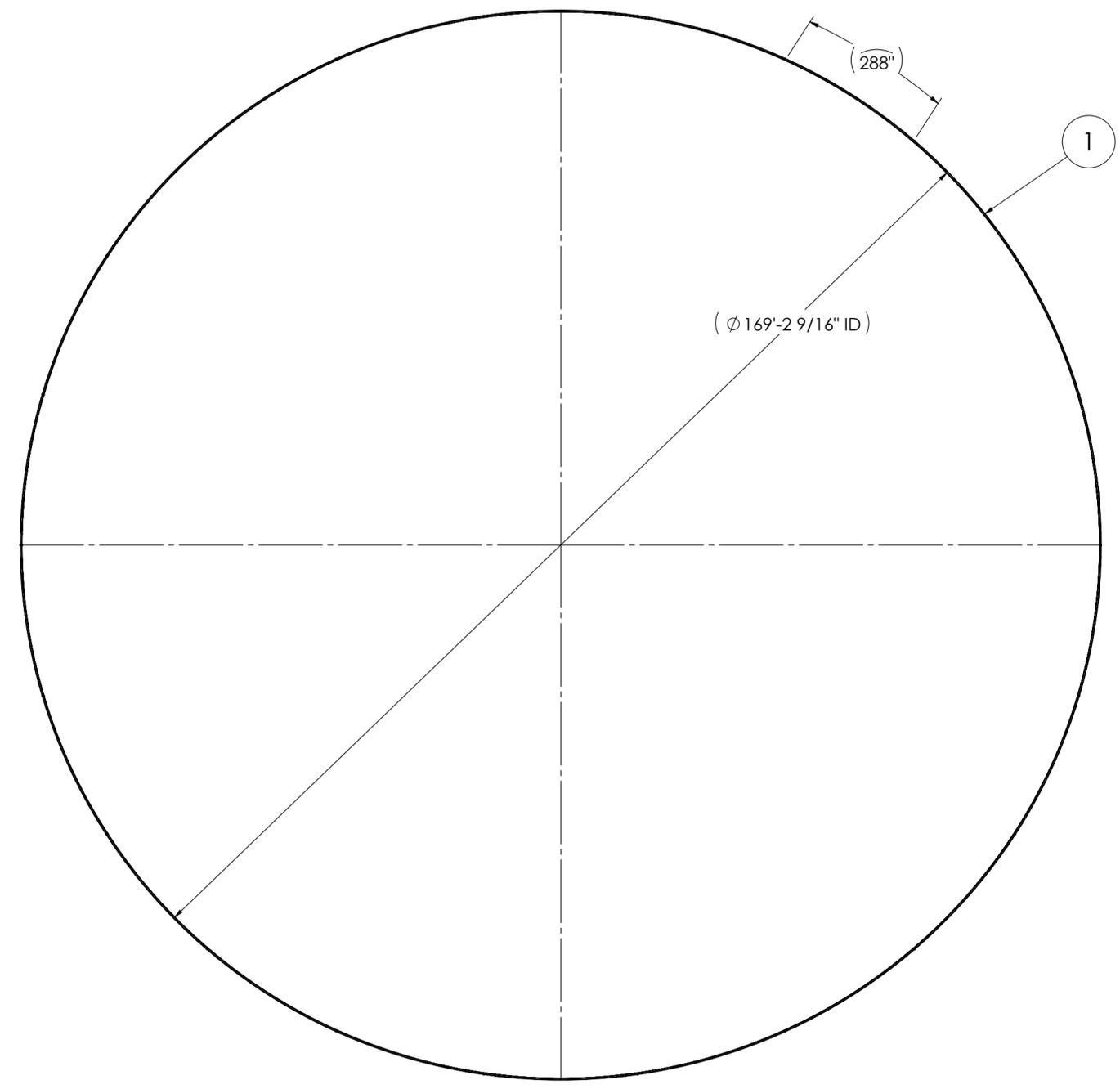
DETAIL ITEM 9
SCALE 1:4



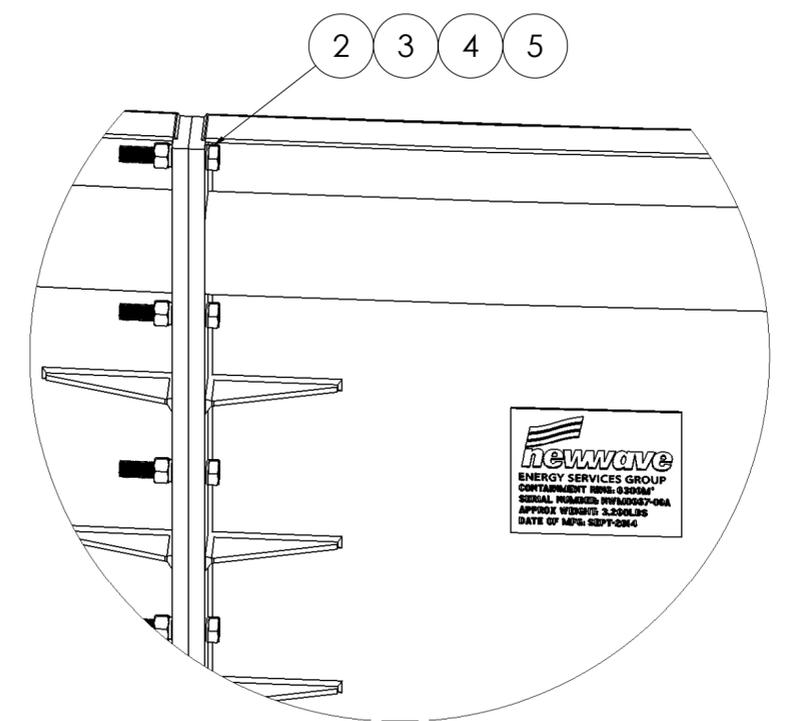
DETAIL ITEM 6
SCALE 1:4

UNLESS OTHERWISE SPECIFIED:				CUSTOMER: NEW WAVE ENERGY SERVICES LTD.		HOLTE DESIGN INC. - Mechanical Design - 3D Conceptual Layouts - Manufacturing Drawings - Graphical Illustrations - Sales Brochures	
DO NOT SCALE DRAWING				PROJECT/MODEL: CONTAINMENT RING			
1. REMOVE BURRS AND SHARP EDGES.	DIMENSIONS ARE IN INCHES		TOLERANCES: ±1/16		TITLE: CONTAINMENT RING, 10' X 24' - 40000 BBL - 6300 CUBIC METERS WLDMT		
2. INSIDE CORNER RADI = 0.031"	FRACTIONAL: ±1/16		ANGULAR: ±0.5°		SIZE C DWG. NO. 600144 REV E		
3. CHAMFER SIZE = 0.030" x 45°	CONCENTRICITY = 0.002" TIR		MACHINE FINISH = 125µin max		SCALE: 1:12 SHEET 3/3		
4. INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5	PER: ASME Y14.5		WEIGHT: 3189.90 lbs		PROPRIETARY AND CONFIDENTIAL		
5. MACHINE FINISH = 125µin max	CONTACT: cholte@holtedesign.com		INFORMATION CONTAINED IN THIS DRAWING IS PROPRIETARY AND CONFIDENTIAL AND SHALL REMAIN THE SOLE PROPERTY OF AREA HOLTE DESIGN INC. THIS DOCUMENT SHALL NOT BE USED, COPIED OR REPRODUCED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN PERMISSION OF HOLTE DESIGN INC. ALL PRINTS SHALL BE RETURNED UPON JOB COMPLETION UNLESS OTHERWISE SPECIFIED IN WRITING BY HOLTE DESIGN INC.				
6. INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5	DATE: 28AUG12		DATE: 28AUG12				
	DATE: 29AUG12		DATE: 29AUG12				
	DATE: 29AUG12						

ITEM	PART NUMBER	DESCRIPTION	QTY
1	600144	CONTAINMENT RING, 10' X 24' - 40000 BBL - 6300 CUBIC METERS WLDMT	22
2	800113	CAP SCREW, HEX 1-8 UNC X 4 GRADE 8	308
3	800156	WASHER, FLAT 1 GRADE 8	616
4	800166	WASHER, LOCK 1 GRADE 8	308
5	800146	NUT, HEX 1 GRADE 8	308



ISOMETRIC VIEW
SCALE 1:280



DETAIL A
SCALE 1 : 8

NOTES:
1. CAP SCREW, HEX 1-8 UNC GRADE 8 , TORQUE TO 400 LBS/FT

REV	DESCRIPTION	ECO #	DATE	APPR
0	ISSUED FOR MANUFACTURE			
REVISIONS				

UNLESS OTHERWISE SPECIFIED: 1. REMOVE BURRS AND SHARP EDGES. 2. INSIDE CORNER RADIUS = 0.031" 3. CHAMFER SIZE = 0.030" x 45° 4. CONCENTRICITY = 0.002" TIR 5. MACHINE FINISH = 125µin. rms 6. INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5			DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL: ±1/16 ANGULAR: ±0.5° X.X ±0.030 X.XX ±0.010 X.XXX ±0.005		CUSTOMER: NEW WAVE ENERGY SERVICES LTD.			- Mechanical Design - 3D Conceptual Layouts - Manufacturing Drawings - Graphical Illustrations - Sales Brochures
DO NOT SCALE DRAWING			MATERIAL: MID STEEL FINISH/CONDITION: -		PROJECT/MODEL: CONTAINMENT RING			
MODELLED: CDH 28AUG12 DRAWN: CDH 28AUG12 CHECKED: GQH 29AUG12 ENG APPR: GQH 29AUG12 CONTACT: cholte@holtedesign.com	SPECIFICATION: API 650		WEIGHT: 14084114 lbs		PROPRIETARY AND CONFIDENTIAL <small>INFORMATION CONTAINED IN THIS DRAWING IS PROPRIETARY AND CONFIDENTIAL AND SHALL REMAIN THE SOLE PROPERTY OF AREA HOLTE DESIGN INC. THIS DOCUMENT SHALL NOT BE USED, COPIED OR REPRODUCED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN PERMISSION OF HOLTE DESIGN INC. ALL PRINTS SHALL BE RETURNED UPON JOB COMPLETION UNLESS OTHERWISE SPECIFIED IN WRITING BY HOLTE DESIGN INC.</small>		SIZE: C DWG. NO.: 600143 SCALE: 1:200	REV: 0 SHEET 1/1



Cantech Oilfield Equipment Ltd.

April 30, 2015

Our Ref: CT-C022

New Wave Energy Services Group

#1955, 140 - 4th Ave, SW

Calgary, Alberta

Canada, T2P 3N3

Water Container Ring 600143 (600144 individual panels)

To whom it may concern:

This letter certifies that the above water container ring (600143) is engineered by Cantech Oilfield Equipment Ltd with the following specification

- Maximum Capacity: 40,000 BBL (6,300 cubic meter)
- Fluid Specific Density: 1,200 kg/m³ maximum
- Design Safety Factor: 2.5 minimum

The ring consists of 22 individual panels (600144). Each individual panel is identical and made of G40.21-44W steel plates. The flange connections are MPI inspected. Individual panels are bolted together by using 1"-8UNC Grade 8 bolt with specified 400ft-lbs tightening torque.

Sincerely,

George Hu, P.Eng.
Cantech Oilfield Equipment Ltd
Permit Number: P10445

TECHNICAL REPORT

BY CanTech Oil



Simulation of 10FT40000BBL

Date: September 16, 2012
 Study name: Stress and Displacement
 Analysis type: Static

Table of Contents

Description..... 1
 Model Information 2
 Study Properties 2
 Units 3
 Material Properties 3
 Loads and Fixtures..... 4
 Mesh Information 5
 Study Results 6
 Local Stress Concentration Max 7

Description

One panel study of the 10FT40000BBL frame stress and displacement evaluation



Cantech Oilfield Equipment Ltd.

July 15, 2015

Our Ref: CT-C029

New Wave Energy Services Group

#1955, 140 - 4th Ave, SW
Calgary, Alberta
Canada, T2P 3N3

Ground Support Requirement and Design Safety Factor of New Wave Water Tank

To whom it may concern:

All New Wave Tanks are engineered with a minimum design safety factor of 2.5 when the specific gravity of a fluid contained is 1.20 kg/m³.

The flanged connections with 1" Gr. 8 bolts between individual panels are stronger than panel itself. The unlevelled ground support will not affect the design safety factor provided that the grade is within 10" over 100ft span. Uneven ground support will not affect the design safety factor of the tank as long as the gap between the bottom flange of the tank and the ground does not exceed 2" in order to prevent liners from being stretched and extruded over the gap.

When the specific gravity of the fluid differ from 1.2 kg/m³, the design safety factor can be calculated as follows:

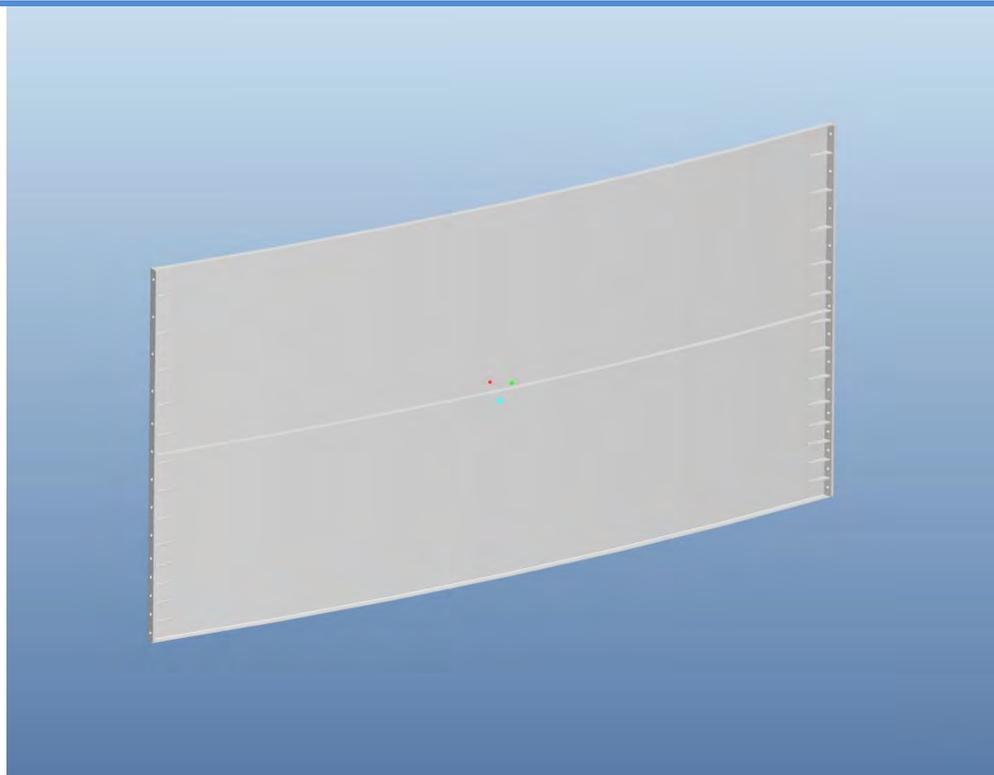
Achieved minimum safety factor = $2.5 \times 1.2 / \text{fluid specific gravity}$

For example, when the specific gravity is 1.25, the achieved minimum design safety factor will be $2.5 \times 1.2 / 1.25 = 2.4$.

Sincerely,

George Hu, P.Eng.
Cantech Oilfield Equipment Ltd
Permit Number: P10445

Model Information



Model name: FEA model
Current Configuration: Default

Solid Bodies			
	Treated As	Volumetric Properties	
	Solid Body	Mass:2656.05 lb Volume:9425.53 in ³ Density:0.281793 lb/in ³ Weight:2654.25 lbf	

Study Properties

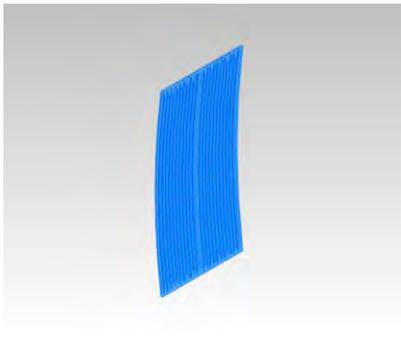
Study name	Study 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SolidWorks Flow Simulation	Off
Solver type	FFEPlus

Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SolidWorks document (C:\Users\Ning\Desktop\10FT_40000BBL_22Panel\Bonded Connection)

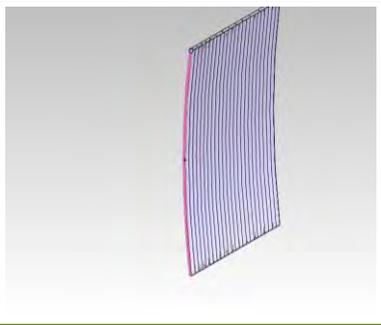
Units

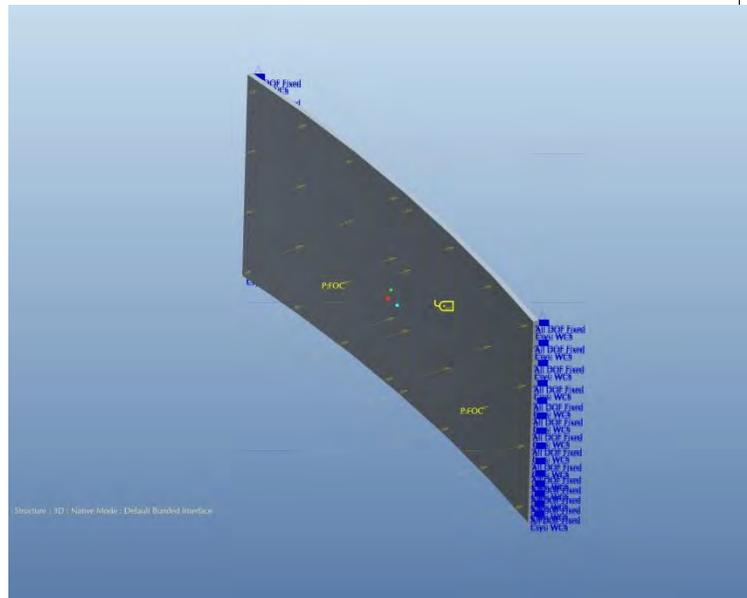
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

Material Properties

Model Reference	Properties	Components
	Name: 44 W Model type: Linear Elastic Isotropic Default failure criterion: Max von Mises Stress Yield strength: 44000 PSI Tensile strength: 65000PSI Elastic modulus: 2.1e+011 N/m ² Poisson's ratio: 0.28 Mass density: 7800 kg/m ³ Shear modulus: 7.9e+010 N/m ² Thermal expansion coefficient: 1.3e-005 /Kelvin	Solid Body (Steel2)(FEA) (Linear Elastic Isotropic) (Max von Mises Stress) 2.20594e+008 N/m ² 3.99826e+008 N/m ² 2.1e+011 N/m ² 0.28 7800 kg/m ³ 7.9e+010 N/m ² 1.3e-005 /Kelvin
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Circular Symmetry-1	See Load Image	Entities: 28 places of the mounting holes
Reference Geometry-1		Entities: 1 vertex(s) Reference: Face< 1 > Type: Use reference geometry Translation: ---, ---, 0 Units: mm

Load name	Load Image	Load Details
Pressure-1		Entities: 1 face(s) Type: Normal to selected face Value: A function of $P = \rho gh$ where P density kg/m^3 , g gravity m/s^2 , h depth m Units: N/m^2

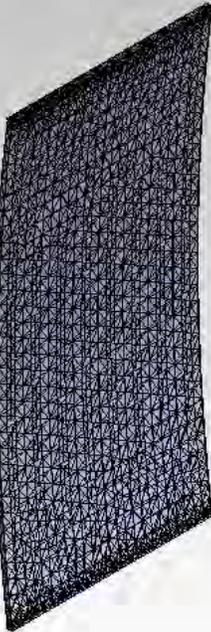
Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Curvature based mesh
Jacobian points	4 Points
Maximum element size	7.54748 in
Minimum element size	1.5095 in
Mesh Quality	High

Mesh Information - Details

Total Nodes	20520
Total Elements	9824
Maximum Aspect Ratio	164.85
% of elements with Aspect Ratio < 3	13.5
% of elements with Aspect Ratio > 10	64
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:05
Computer name:	HP-PC

Model name: FEA model
 Study name: Study 1
 Mesh type: Solid mesh



Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	14.73 psi	161900 psi
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm	26.1 mm

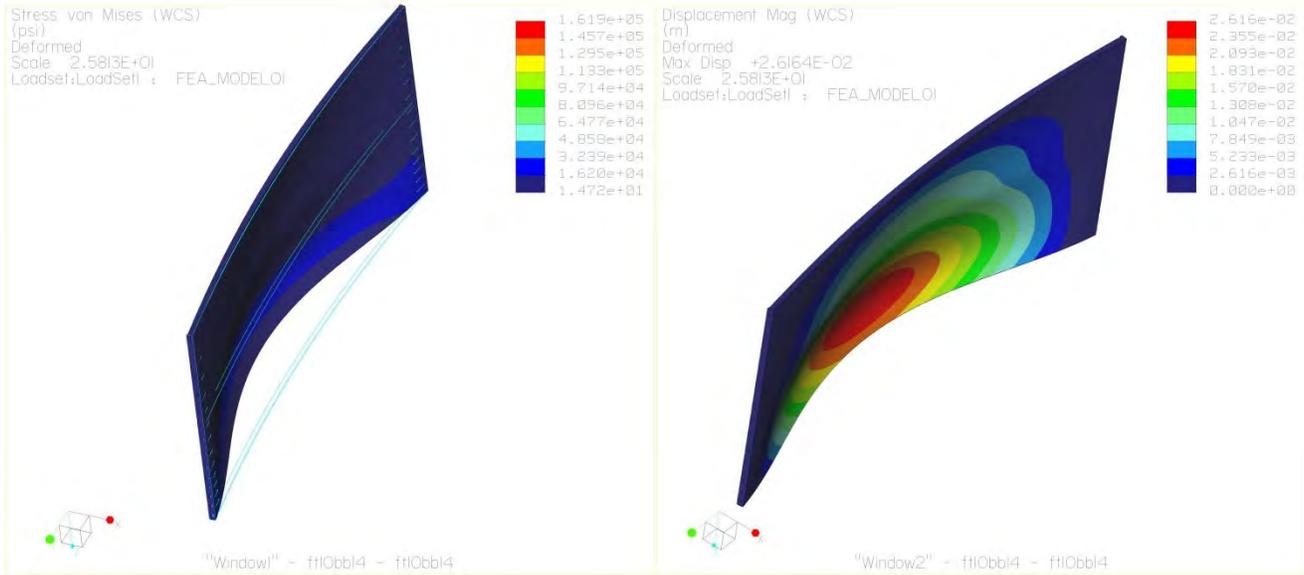
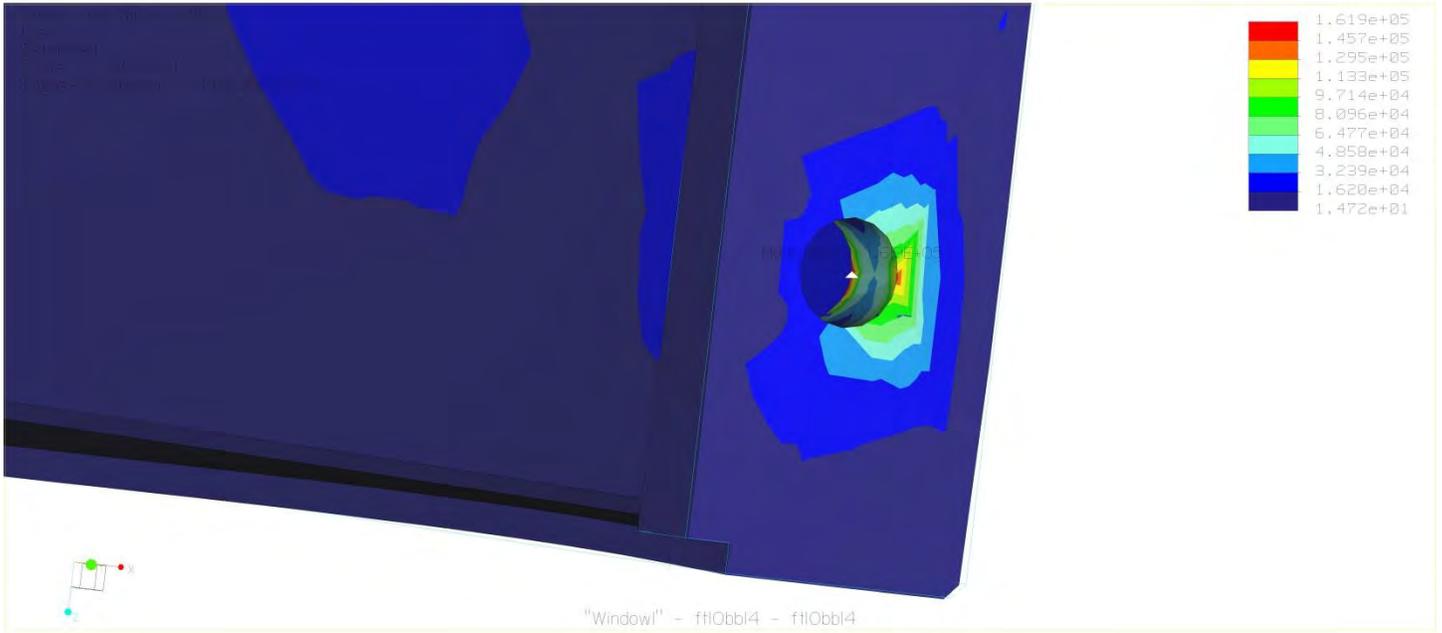


Image-1

Local Stress Concentration Max





US 866-375-9749
CAN 800-841-0836

Above Ground Tank Liner Systems - Geomembrane

1. Product Description

High capacity above ground tank liner systems are increasingly being used by the upstream oil & gas sector for containment of drilling fluids associated with hydraulic fracturing operations. Layfield is recognized as a leading manufacturer and fabricator of above ground storage liner systems in North America and internationally. Our Enviro Liner series of geomembranes are highly durable and flexible materials designed to contain the combination of brine fluids and chemicals used in the fracking process. A rapidly growing trend is the use of above ground engineered water storage systems designed to hold large volumes of water. As an example, many tank systems in the market can store from 750,000 to 2,000,000 gallons of frac fluids. Layfield provides one piece prefabricated liners designed for quick installation with no seaming required on site.

2. Technical Data

Materials information is on page 2.

3. Installation

Surface preparation is the key to a successful tank lining installation. When setting up a new tank on the ground, the prepared surface should be uniform, well compacted, and free of sharp rock fragments or stones. In a new frac tank installation (such as a storage tank used in hydraulic fracturing), we usually recommend that a non-woven geotextile be placed on the ground as the first step. Then the outline of the frac tank wall should be marked on the geotextile with spray paint. The liner is placed at the center of the marked geotextile before tank assembly starts. Then the tank is assembled. Once the tank is finished, the liner is unfolded, pulled up over the walls, and secured to the perimeter. Larger tanks, retrofits, and tanks that are field fabricated normally require additional installation details and would be quoted separately. Please contact your Layfield representative for additional details.



4. Availability and Cost

Available from Layfield or distributors. Call
425-254-1075 Pacific time
780-453-6731 Mountain time, or
905-761-9123 Eastern time

5. Warranty

Products sold will meet Layfield's published specifications. Any extended warranty required by the buyer must be negotiated at the time of order. Extended warranties may be available on this product and may be at extra cost. Full warranty details are available from Layfield.

6. Maintenance

Geomembranes should be inspected at least once per year for damage, stress, or any other detrimental condition. The entire containment area should be visually inspected annually. Layfield provides geomembrane maintenance services on request.

7. Filing Systems

9.

18 Oct 2016		Enviro Liner® 1000 Properties			
Style	ASTM	EL 1020	EL 1030	EL 1040N	EL 1040
Thickness	D5199	20 mil 0.5 mm	30 mil 0.75 mm	36 mil 0.91 mm	40 mil 1.0 mm
Density (Typical)	D792	0.93	0.93	0.93	0.93
Tensile Strength at Break	D6693	76 ppi 13 N/mm	114 ppi 20 N/mm	136 ppi 24 N/mm	152 ppi 27 N/mm
Elongation	D6693	800%	800%	700%	800%
Tear Resistance	D1004	11 lbs 49 N	16 lbs 70 N	19 lbs 84 N	22 lbs 100 N
Puncture Resistance	D4833	28 lbs 120 N	42 lbs 190 N	54 lbs 240 N	56 lbs 250 N
Carbon Black Content	D6370	≥ 2.0%	≥ 2.0%	2.0%	≥ 2.0%
High Pressure OIT	D5885	400 min	400 min	N/A	400 min
Low Temperature Impact Resistance	D746	-69°F -56°C	-69°F -56°C	-40°F -40°C	-69°F -56°C
Service Temperatures	Max Continuous Use	140°F 60°C	140°F 60°C	140°F 60°C	140°F 60°C



www.LayfieldContainment.com
Containment@layfieldgroup.com

From: Gilbert Serrano <Gilbert.Serrano@layfieldgroup.com>
Sent: Thursday, March 25, 2021 12:15 PM
To: r@rthicksconsult.com
Cc: Jan Nichols <Jan.Nichols@layfieldgroup.com>
Subject: RE: PE-Stamped Demonstration of Equivalency of LLDPE and Enviro Liner - needed if the proposed AST will use Enviro Liner rather than 40-mil LLDPE (primary) and 30-mil LLDPE (secondary)

Hi Randy,

We fully confirm that EL1040 is in fact a LLDPE based geomembrane.

Best regards,

Gil Serrano



Gil Serrano | Engineering Business Manager | Geosynthetics

10038 Marathon Parkway | Lakeside, CA 92040

phone: (619) 771.6227 | mobile: (619) 509.6471 | www.layfieldgroup.com



New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

Title	Frac Tank Set Up SWP-Tanks-05
Description of Task	Frac Tanks are installed to hold large amounts of liquids for use by our clients.
Applicable Laws and Regulations	Alberta: OHS Act, Regulation and Code BC: OHS Act, Regulation and Code
PPE and Protective Controls	Hard Hat, CSA Approved Footwear, Safety Glasses/Goggles, Hi Visibility outerwear, Hearing Protection (ear plugs or ear muffs), H2S Monitor (if required), Cut Resistant Protective Gloves. Training, Procedure, Programs & Policies, Inspections, Regulations, Pre-Job Meetings.
Required Training:	<i>Formal:</i> WHMIS, H2S Alive, CSO, First Aid/CPR, TDG <i>Informal:</i> New Wave Orientation, Customer Orientation, Safe Working Procedures, Policies, Codes of Practice, On the Job Training, Competency Assessments, Mentoring
Supervisor Responsibilities	Supervisors are responsible to facilitate and/or provide proper instruction to their workers on site and make sure equipment/tool owner manuals are available on site.
Job Steps	<ol style="list-style-type: none"> 1. Hold a Pre-Job safety meeting before beginning this operation. This will include a review of procedures, hazard assessments, hand signals while performing lifts, emergency response procedures, and roles & responsibilities. Include everyone on site (workers, contractors, equipment operators, etc.). 2. Ensure everyone on site is experienced, trained and competent to perform their task (ex. Equipment operators). 3. Using the transit/laser level ensure that the grade of the site for the tank install is within acceptable specifications. 4. Mark the center of tank per location as appointed by client, keeping in mind that sufficient room is needed on the backsides of the tank for the hoe to pull liner. 5. Remove all debris including but not limited to: sticks, rocks or any foreign material capable of puncturing liner. Watch your footing and be mindful of slip/trip/fall hazards. 6. Mark the center of the tank by digging a shallow hole or using a disc and then measure 4 ways from center and mark with spray paint to reference the size of geo and the size of the liner per the size of the tank. 7. After examining the unroll instructions as marked on the geotextile proceed to unroll the geo. 8. Unfold the geo ensuring that it is square and equal on all four sides per the spray paint marks previously put on the outside of the tank.

1

*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.



New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

9. Finding the center of the tank using the hole dug or disc, mark the center of the tank with spray paint and then using a paint stick, mark the circumference of the tank per tank measurements set out in the measurement guide lines.
10. Using the liner bar and picker/excavator/hoe unroll the liner in the same fashion as the geo textile ensuring that the QC manual is removed from the outside of the roll.
11. While rolling out the liner (suspended load) do not put any body part under the suspended load without complete confirmation from the operator that the task is fully stopped, and all movements of equipment have been suspended. While loads are in motion, workers must never be under them.
12. Fold the liner towards the center from 8 points until the outside tank lines on the geo are exposed and in a neat and tidy fashion to ensure a uniform pull of the liner when the tank is erected.
13. While manually pulling the geo and liner, ensure proper communication is established between the crew and everyone pulls together on command. Ensure entire crew has a proper grip on the geo or liner, proper stance for balance and no excess force is used to pull either the geo or liner. Be mindful of slip/trip/fall hazards while pulling the geo and/or liner.
14. Mark the center of the tank again by finding the hole or disc by using spray paint and write the outside panel measurement on the floor of the liner with spray paint.
15. Ensure there is always minimal foot traffic on the surface of the liners. The liner is extremely slippery (especially when wet – rain, snow, ice). If a worker needs to walk on the liner, caution needs to be taken. Take slow small shuffling steps (like a penguin) and keep hands out of pockets for balance.
16. From the center point measure to the inside of both ends of the first panel and set in place with the picker and support one end with the A-arm or hoe. Use the hoe/picker to stabilize 7-8 panels before removing (first skid emptied).
17. While placing all the panels with the picker, workers must take extreme caution and must never go under a suspended load.
18. Skids holding the panels occasionally need to be moved and/or relocated. Only straps approved for towing/pulling can be used. Inspect straps prior to use.
19. Trim excess geo, ensuring there is approximately 18-24' left on the outside of the tank to allow settling.
20. The excess geo that is trimmed off, must be put to the inside of the circumference mark on the geo to be used later to pack into the corner where the tank and geo meet.

2

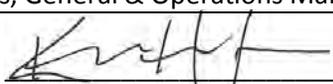
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New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

	<ol style="list-style-type: none"> 21. Continue setting panels ensuring that each panel is measured from the center until the last 4 panels are ready to be set. The last 4 measurements of panels must be measured from panel to panel as set out in the measurement guidelines. 22. Refer to the Safe Work Procedure on Electric Torque Guns for torquing procedure. Ensure the portable generator used to power the torque gun is placed downwind and/or position yourself so that the exhaust is away from your breathing zone. 23. Once the walls are in place, fold the liner out and secure with clamps and airplane cable. 24. While pulling the liner over the erected tank walls, ensure hoe/picker operator is familiar with the task and constant communication is established (radios). Watch for pinch points while putting the liner into the thumb of the hoe/picker. 25. Ensure that no excess liner is cut off until all the clamps and cable are secure. 26. Remove all excess liner in a neat and straight fashion using a tank ring support as a guideline ensuring that there is 18" below the airplane cable. 27. Install the suctions and equipment per the customer's request. 28. Remove all excess liner and secure on location in a hidden spot to be disposed of later. 29. Walk around the complete tank and check to make sure there is no tools, excess bolts or garbage left over. 30. Ensure all bolts and airplane cable are installed correctly. 31. Supervisor to check 3-4 bolts on every seam with the manual torque wrench while ensuring that the threads are fully exposed from the nut. 32. Ensure that all paperwork is reviewed with and signed by the client. 33. Tank Supervisor and Electric Torque Gun Operator must walk around the tank visually ensuring the bolts are torqued and then both must sign off on the Tank Installation Checklist. 34. Tank Supervisor and Liner Puller must sign off on the Liner Installation Form.
Created By	Workers, General & Operations Managers, Safety Department
Manager Approval	 _____ Karmen Hodgson – Tanks General Manager

3

*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.



New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

Title	Bolt Up of Piping and Assemblies	SWP-Tanks-02
Description of Task	Equipment is prepared and requires fabrication before being used.	
Applicable Laws and Regulations	Alberta: OHS Act, Regulation and Code BC: OHS Act, Regulation and Code	
PPE and Protective Controls	Hard Hat, CSA Approved Footwear, Safety Glasses/Goggles, Hi Visibility outerwear, Hearing Protection (ear plugs or ear muffs), H2S Monitor (if required), Protective Gloves. Training, Procedure, Programs & Policies, Inspections, Regulations, Pre-Job Meetings.	
Required Training:	<i>Formal:</i> WHMIS, H2S Alive, CSO, First Aid/CPR, TDG <i>Informal:</i> New Wave Orientation, Customer Orientation, Safe Working Procedures, Policies, Codes of Practice, On the Job Training, Competency Assessments, Mentoring	
Supervisor Responsibilities	Supervisors are responsible to facilitate and/or provide proper instruction to their workers on site and make sure equipment/tool owner manuals are available on site.	
Job Steps	<ol style="list-style-type: none"> 1. All personnel involved in this task must attend a pre-job safety meeting. This will include role designation, review of procedures and hazard assessment/identification. Establish emergency response roles and procedures. 2. Obtain all applicable permits. Only certified/trained personnel can operate lifting equipment (crane, picker, etc.) 3. Ensure potential hazards are identified within the work area. 4. Communicate with all personnel involved of potential hazards. 5. Always watch for pinch points. 6. If using lifting devices, ensure operators are properly trained and all lifting equipment is inspected before use. Communicate with everyone involved the hand signals to be used and who will be giving them. 7. Ensure that all flange and sealing surfaces are cleaned before assembly. 8. Ensure proper gaskets and bolting materials are used. 9. Ensure that the flange alignment is accurate. 10. Ensure that bolting is tightened evenly around flange perimeters. 11. Ensure stud threads protrude thru stud nut at least one full thread. 12. Ensure that all welded threaded connections (i.e. TOL's) have had a thread chaser used on the threads prior to assembly. 	

1

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New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

	<p>13. Ensure that proper thread dope and Teflon tape is used on all threaded connections.</p> <p>14. Perform post job clean up after task is completed.</p>
Created By	Workers, General & Operations Managers, Safety Department
Manager Approval	 _____ Karmen Hodgson – Tanks General Manager

INTERNATIONAL HAND SIGNALS:

 Main Hoist	 Auxiliary Hoist	 Hoist Load	 Hoist Load Slowly	 Stop
 Raise Boom	 Raise Boom & Lower Load	 Lower Load	 Lower Load Slowly	 Emergency Stop
 Lower Boom	 Lower Boom & Raise Load	 Swing Boom	 Swing Boom Slowly	 Travel (mobile eqpt)
 Retract Boom 2 hands	 Retract Boom 1 hand	 Extend Boom 2 hands	 Extend Boom 1 hand	 Dog Everything

2

*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.



New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

Title	Setting Up a Bird Net SWP-Tanks-07
Description of Task	This task consists of employees building and placing a bird net over top of a tank.
Applicable Laws and Regulations	Alberta: OHS Act, Regulation and Code BC: OHS Act, Regulation and Code
PPE and Protective Controls	Hard Hat, CSA Approved Footwear, Safety Glasses, Fire Resistant Coveralls, Hi Visibility outerwear, Hearing Protection (ear plugs or ear muffs), H2S Monitor (if required), Protective Gloves. Training, Procedure, Programs & Policies, Inspections, Regulations, Pre-Job Meetings, Body Placing and Spacing, Use proper lifting and pulling techniques.
Required Training:	<i>Formal:</i> WHMIS, H2S Alive, CSO, First Aid/CPR, TDG <i>Informal:</i> New Wave Orientation, Customer Orientation, Safe Working Procedures, Policies, Codes of Practice, On the Job Training, Competency Assessments, Mentoring
Supervisor Responsibilities	Supervisors are responsible to facilitate and/or provide proper instruction to their workers on site and make sure equipment/tool owner manuals are available on site.
Job Steps	<ol style="list-style-type: none"> 1. All personnel involved in this task must attend a pre-job safety meeting. This will include role designation, review of procedures and hazard assessment/identification. Establish emergency response roles and procedures. 2. Construct bird net stands. Use proper lifting techniques and watch for pinch points. 3. Ensure all stands have 8 support legs. 4. Attach bolts in specified holes in stand. 5. Ensure all rubber mats on bases are secure and free of debris. 6. Set upright to required height and secure with bolts. 7. Mark out tank floor to indicate where bird net stands will sit. 8. Place the bird net stands with a picker on to the marks on the tank floor. (Picker may need to be moved to reach all marks). Never go under a suspended load. Always maintain eye contact and have constant communication with picker operator. 9. Around the outside of the tank, mark 8 equal points.

1

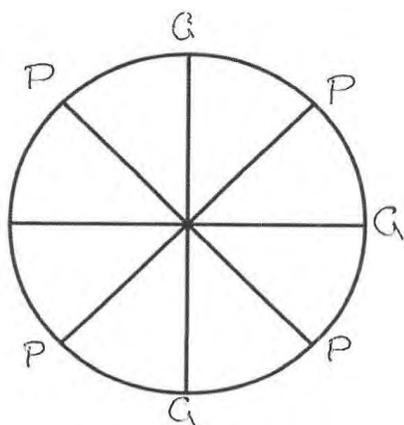
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New Wave Energy Services

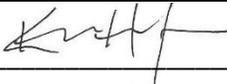
Health, Safety and Environmental Manual

Safe Work Procedure – Tanks



10. Mark every second one with a G (for green) and the remainder with a P (for pink). (Green= centre of edge of net. Pink= corner of net. The net is square).
11. Place bird net still in box next to a "G" and open box. DO NOT cut white string.
12. Place end of net over top of tank and pull net to the opposite side of the tank.
13. Ensure net does not get caught on bird net stands.
14. Open up net and secure 2' down on outside of tank. Denoted by green ribbon. On all 4 "G" marks.
15. Lift net over bird net stands using extendable pole.
16. Secure corner of bird net to letter "P"s pulling tight.
17. Work round tank securing bird net to ring clamps. Watch slip/trip/fall hazards.
18. Work around the tank a second time pulling net tight.
19. Use rope to secure net on every seam of tank.
20. Tie up all spare netting on the floor.

2

Created By	Workers, General & Operations Managers, Safety Department
Manager Approval	 _____ Karmen Hodgson – Tanks General Manager

*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.

New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

Title	Setting Up a Rescue Platform SWP-Tanks-08
Description of Task	Setting up and assembling a rescue platform.
Applicable Laws and Regulations	Alberta: OHS Act, Regulation and Code BC: OHS Act, Regulation and Code
PPE and Protective Controls	Hard Hat, CSA Approved Footwear, Safety Glasses/Goggles, Fire Resistant Coveralls, Hi Visibility outerwear, Hearing Protection (ear plugs or ear muffs), H2S Monitor (if required), Protective Gloves, Full Body Harness, Lanyard Training, Procedure, Programs & Policies, Inspections, Regulations, Pre-Job Meetings, Body Placing and Spacing, Use proper lifting and pulling techniques.
Required Training:	<i>Formal:</i> WHMIS, H2S Alive, CSO, First Aid/CPR, TDG, Crane/picker/Rigging certification, Fall Protection certification. <i>Informal:</i> New Wave Orientation, Customer Orientation, Safe Working Procedures, Policies, Codes of Practice, On the Job Training, Competency Assessments, Mentoring
Supervisor Responsibilities	Supervisors are responsible to facilitate and/or provide proper instruction to their workers on site and make sure equipment/tool owner manuals are available on site.
Job Steps	<p>Note: This platform is a prototype platform and may change or be amended by New Wave site supervisor or client representative, all revisions must be approved by New Wave safety advisor.</p> <ol style="list-style-type: none"> 1. All personnel involved in this task must attend a pre-job safety meeting. This will include role designation, review of procedures and hazard assessment/identification. Establish emergency response roles and procedures. 2. Ensure level compact ground where rescue platform will be set. 3. Place rig mat along tank where platform will be placed. 4. While rescue platform is in collapsed position remove pins 1&2 colored white from frame to free structure so it can be raised to standing position. Watch for pinch points. (NOTE: do not remove any other pins than the ones mentioned above.) 5. Inspect slings and clevises. Hook up slings and clevises to four lifting lugs located on handrails, raise platform to fully erected position with telehandler or picker. Ensure employees are free from the area and do not allow anyone to go under a suspended load. 6. Once platform is raised, insert pins 3 & 4 color white into holes. Be sure that safety keeper is in place on each pin. Watch for pinch points. 7. Once platform is fully pinned, have your New Wave site supervisor inspect platform. Once site supervisor has approved that all pins are in place, you can don safety harness and double lanyard and proceed up platform to unhook slings from telehandler or picker. 100% tie off is mandatory when climbing this platform.

1

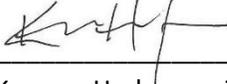
*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.



New Wave Energy Services

Health, Safety and Environmental Manual

Safe Work Procedure – Tanks

	8. Use picker and ladders to install supports for the safety jib and insert pins marked 5 & 6 colored white. 9. Use telehandler or picker to place/hang rescue jib crane into jib crane pocket. (NOTE: rescue jib crane is marked "A") 10. Use ladder winch marked "B" to lower ladder into tank. 11. Before operation, New Wave site supervisor must inspect rescue platform.
Created By	Workers, General & Operations Managers, Safety Department
Manager Approval	 _____ Karmen Hodgson – Tanks General Manager

*The information in this Safe Work Procedure does not take precedence over applicable government legislation, with which all workers should be familiar.



Design and Construction Plan Above Ground Tank (AST) Containments

General

Examination of the engineering drawings and the SOP for set-up (Engineering Drawings, Liner Specifications, Set Up) plus the history of solid performance of these AST Containments demonstrates that the AST Containment is designed and will be assembled to ensure the confinement of produced water, to prevent releases and to prevent overtopping due to wave action or rainfall. As the AST Containments are generally less than 190 feet in diameter, wave action is not a meaningful consideration.

These AST Containments are constructed of 12-foot high steel panels, are netted (netting no larger than 1.5 inch per square per BLM COA) ~~and employ the Mega Blaster Pro avian deterrent system~~ to prevent ingress of migratory birds. AST Containments will be enclosed by a 4-strand barbed wire fence or better. Thus, complies with the Rule to fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair.

The operator shall post an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in conspicuous places surrounding the containment. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township and range, and emergency telephone numbers.

Site Preparation

Foundation for AST Containment

Preparation of the soils on site is required to form a dependable base for the AST Containment in accordance with NMAC 19.15.34 and the SOP and is the responsibility of the operating company. If the location of the AST Containment is on an existing pad, the operator has stripped and stockpiled the topsoil for use as the final cover or fill at the time of closure. If the pad is new construction, the operator will strip and stockpile the soil for reclamation upon cessation of site activities.

19.15.34.12 A

(1) The operator shall design and construct a recycling containment to ensure the confinement of produced water, to prevent releases and to prevent overtopping due to wave action or rainfall.

19.15.34.12 D

(1) The operator shall fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.

19.15.34.12 C

Signs. The operator shall post an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in a conspicuous place on the fence surrounding the containment. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township and range, and emergency telephone numbers.

19.15.34.12 B

Stockpiling of topsoil. Prior to constructing containment, the operator shall strip and stockpile the topsoil for use as the final cover or fill at the time of closure.

Design and Construction Plan Above Ground Tank (AST) Containments

The foundation soils must be roller compacted. Compaction characteristics must meet or exceed 95% of Standard Proctor Density in accordance with ASTM D 698 or modified Proctor Test (ASTM Standard D1557).

Examination of the SOP shows that the AST Containment contractor will conform to the following mandates of the Rule:

- the AST Containment will have a properly constructed compacted earth foundation and interior slopes (vertical steel) 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 will be placed under the liner where needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity.
- If the AST containment is within a levee, the inside grade is no steeper than two horizontal feet to one vertical foot (2H: 1V) and the outside grade no steeper than three horizontal feet to one vertical foot (3H: 1V). The vertical steel walls of the AST Containment are the subject of a *variance included in Volume 3* of this submission. OCD.

The Operator will ensure that at a point of discharge into or suction from the recycling containment, the liner is protected from excessive hydrostatic force or mechanical damage and external discharge or suction lines shall not penetrate the liner.

Liner and Leak Detection Materials

The liner and geotextile specifications show that 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 *an equivalent liner [to that stated in Rule 34] and are pursuant to a requested variance*. The liner system is presented in an earlier section of this submission.

All secondary liners shall be *an equivalent liner [to that stated in Rule 34] approved by OCD pursuant to a*

19.15.34.12 A

(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.

19.15.34.12 A

(6) At a point of discharge into or suction from the recycling containment, the operator shall insure that the liner is protected from excessive hydrostatic force or mechanical damage. External discharge or suction lines shall not penetrate the liner.

19.15.34.12 A

(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

Design and Construction Plan Above Ground Tank (AST) Containments

variance. The liner system is presented in an earlier section of this submission.

Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

Variance request for liner system (two 40 mil LLDPE for primary and secondary liners) included in Volume 3.

The AST Containment will have a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet to facilitate drainage.

Install Secondary Liner, Leak Detection System and Secondary Containment

All AST containments holding produced water will have a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions. The rule states that the edges of all secondary liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep. The lack of an anchor trench with an AST Containment *is pursuant to a requested variance.*

The AST Containment Contractor will cause the recycling containment will have a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection (see attached drawing).

The presence of the secondary containment levee ~~or pre-fabricated secondary containment~~ meets the OCD Rule mandate that a recycling containment shall design the containment to prevent run-on of surface water. The containment shall be surrounded by a berm, ditch or other diversion to prevent run-on of surface water.

AST Containment Setup

As with the secondary liner, AST Containment contractor will minimize liner seams and orient them up and down, as much as possible, not across, a slope.

hydraulic conductivity no greater than 1×10^{-9} cm/sec. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

19.15.34.12 A

(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.

19.15.34.12 A

(7) The operator of a recycling containment shall place a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet or two feet of compacted soil with a saturated hydraulic conductivity of 1×10^{-5} cm/sec or greater to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection.

19.15.34.12 A

(8) The operator of a recycling containment shall design the containment to prevent run-on of surface water. The containment shall be surrounded by a berm, ditch or other diversion to prevent run-on of surface water.

Design and Construction Plan Above Ground Tank (AST) Containments

Factory welded seams shall be used where possible. AST Containment contractor will employ field seams in geosynthetic material that are thermally seamed. Prior to field seaming, AST Containment contractor shall overlap liners four to six inches and minimize the number of field seams and corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the AST Containment bottom. Qualified personnel shall perform field welding and testing.

Fluid Injection/Withdrawal Flow Diverter

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.

19.15.34.12 A

(5) The operator of a recycling containment shall minimize liner seams and orient them up and down, not across, a slope of the levee. Factory welded seams shall be used where possible. The operator shall ensure field seams in geosynthetic material are thermally seamed. Prior to field seaming, the operator shall overlap liners four to six inches. The operator shall minimize the number of field seams and corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the slope's toe. Qualified personnel shall perform field welding and testing.

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.

March 2020

**Variations and/or Equivalency Demonstrations for
Above Ground Steel Tank Modular Recycling
Storage Containments (AST) Primary and
Secondary Liners**

***40-mil Non-reinforced LLDPE Liner as Alternate
Primary and 30-mil Non-reinforced LLDPE as Secondary
Liner for Above Ground Steel Tank Modular Recycling
Storage Containments***

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 1×10^{-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 1×10^{-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.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

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.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

- Both types of LLDPE geomembrane are easily repaired using the same thermal fusion bonding method without the need for special surface grading 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,

RK 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 1×10^{-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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Consulting Engineers

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.

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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 rife. 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 CV

***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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Consulting Engineers

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,

RK 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

References:

NMAC 19.15.34.13 OPERATIONAL REQUIREMENTS FOR RECYCLING CONTAINMENTS



R.K. FROBEL & ASSOCIATES
Consulting Engineers

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 Hydro Pressure (p) of water is 718 pounds per square foot (psf), where

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 62.4 \text{ PCF} \times 11.5 \text{ ft} \\
 (\text{design density} &= 8.34 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

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 Hydro Pressure (p) of conditioned produced water is 626 psf, where

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 69.64 \text{ PCF} \times 9 \text{ ft} \\
 (\text{design density} &= 9.3 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

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

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 69.64 \text{ PCF} \times 10 \text{ ft} \\
 (\text{design density} &= 9.3 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

January 2020

***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

R.K. FROBEL & ASSOCIATES
Consulting Engineers

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
GEOSYNTHETICS
EXPERT WITNESS
FORENSICS**

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
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Co-Chairman International Conference on Geomembranes
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U.S. Naval Reserve Officer (Inactive)
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Mine Safety Health Administration (MSHA) Certified

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

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**PROFESSIONAL
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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.

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Page 3

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.

CONTACT DETAILS:

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Additional VARIANCE FOR RECYCLING STORAGE CONTAINMENTS (Inground and AST)

- **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.

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District IV
 1220 S. St Francis Dr., Santa Fe, NM 87505
 Phone:(505) 476-3470 Fax:(505) 476-3462

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

CONDITIONS

Action 22912

CONDITIONS OF APPROVAL

Operator:	SOLARIS WATER MIDSTREAM, LLC	907 Tradewinds Blvd, Suite B	Midland, TX79706	OGRID:	371643	Action Number:	22912	Action Type:	C-147L
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OCD Reviewer	Condition
vvenegas	NMOCD has reviewed the recycling containment permit application and related documents, submitted by [371643] SOLARIS WATER MIDSTREAM, LLC on April 5, 2021 for the proposed Pintail Above-Ground Storage Tank at Unit Letter H, Section 09, Township 26S, Range 32E in Lea County, New Mexico. The form C-147 and related documents for the proposed Pintail Above-Ground Storage Tank is approved with conditions of approval.