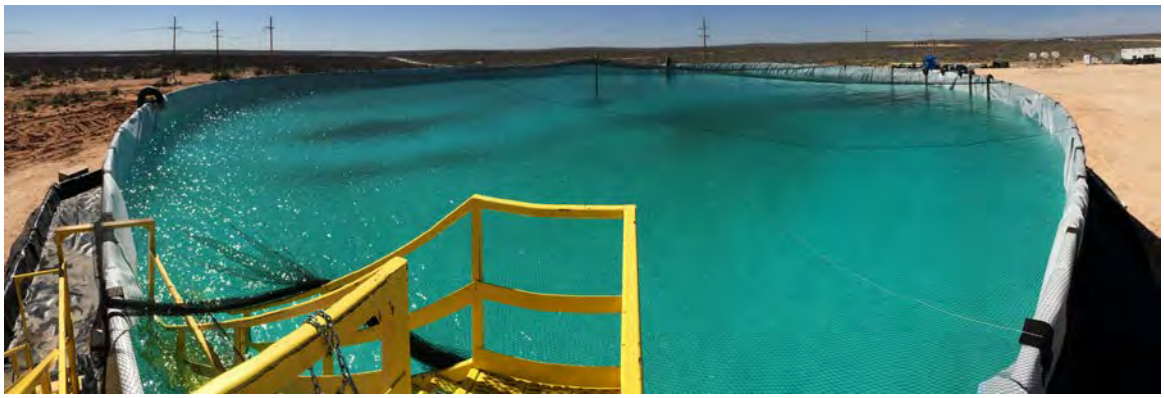
April 2015

C-147 Registration Package for Rattlesnake (AST #1) and Ragin Cajun (AST #2) Containments Section 13 T26S R34E Lea County NM.



View south showing AST Containment at Rattlesnake 13 Federal 1H well pad.

Prepared for
Devon Energy
Oklahoma City, OK
and
Complete Energy Services
Oklahoma City, OK

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

R. T. HICKS CONSULTANTS, LTD.

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April 3, 2015

Dr. Tomas Oberding
NMOCD District 1
1625 French Drive
Hobbs, NM 88240
Via E-Mail

RE: Devon Energy Rattlesnake/Ragin Cajun Recycling Facility and Containment
C-147 Registration Package

Dear Dr. Oberding:

Enclosed is a fully assembled C-147 registration for a recycling facility and containment located at the Rattlesnake 13 Federal 1H production pad in Section 13, T17S R27E and an associated containment located at the Ragin Cajun 13 Federal 1H pad in that same section. This submission re-packages the OCD-approved MWFM pit under Rule 17 as a containment and recycling facility under Rule 35.

We are pleased to report that recycling of produced water began on April 2.

The differences between the approved Part 17 permit and this registration are:

1. This transmittal letter
2. The C-144 is deleted and replaced by a new C-147 Form
3. One attachment is no longer relevant and has been deleted: Wells with approved APDs
4. The setback criteria for nearby churches, hospitals, etc. was changed from 300 feet to 1000 feet in the text
5. We added new photographs to Appendix A (Site Inspection) to show the ASTs set up and operational.

Because the original permit is an OCD-approved document, we did not change any references in the original text relating to the MWFM pit or form C-144. Thus, OCD can readily compare the registration package to the permit and see that it is verbatim.

I believe the attached registration is complete and meets all of the criteria for approval under NMOCD Rules. Please let us know if you need any additional information or clarification regarding the application. Note the surface owner is copied on this transmission.

Sincerely,
R.T. Hicks Consultants

Randall Hicks

Copy: Lime Rock Resources
Indra Dahal, BLM Carlsbad (surface owner)

Variance Requests

R.T. Hicks Consultants, Ltd.
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Variance Requests (19.15.17.15)

The applicant (Devon Energy) asks the Division District for the approval of the variances listed below. We conclude that the variance requests provide equal or better protection of fresh water, public health and the environment.

Fencing 19.15.17.11.D

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 19.15.17.11.

D. Fencing.

(1)The operator shall fence or enclose a pit or below-grade tank in a manner that deters unauthorized access and shall maintain the fences in good repair. Fences are not required if there is an adequate surrounding perimeter fence that prevents unauthorized access to the well site or facility, including the pit or below-grade tank. During drilling or workover operations, the operator is not required to fence the edge of the pit adjacent to the drilling or workover rig.

And

(3) The operator shall fence any other pit or below-grade tank to exclude livestock with a four foot fence that has at least four strands of barbed wire evenly spaced in the interval between one foot and four feet above ground level.

The Pit Rule is obviously written for earthen, lined pits and below grade tanks, not free-standing modular impoundments. The modular impoundment meets the prescriptive mandates in the first sentence of D(1): “”The operator shall fence or enclose a pit or below-grade tank in a manner that deters unauthorized access…”.

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

The 12-foot tall steel tank clearly deters unauthorized access. This same 12-foot high steel wall of the tank excludes livestock and wildlife. The applicant concludes the 12-foot high steel walls provide equal or better protection as fencing.

Slopes & Anchor Trench [NMAC 19.15.11.J(2) & (3)]

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 19.15.17.11.

> J: Multi-well fluid management pits. The operator shall design and construct a multi-well fluid management pit in accordance with the following requirements.
>
> > (1)…
> >
> > (2) The pit 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 where needed to reduce localized stress-strain or protuberances that may otherwise compromise the liner's integrity. The operator shall construct a multi-well fluid management pit so that the slopes are 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 levee's top shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance. The appropriate division district office may approve an alternative to the slope requirement if the operator demonstrates that it can construct and operate the pit in a manner that provides equivalent or better protection to fresh water, public health and the environment.
> >
> > (3) Each multi-well fluid management pit shall contain, 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.

With respect to storage of produced water for use in lieu of fresh water, the Pit Rule is written for earthen, lined pits, not free-standing modular impoundments. The modular impoundments meet the prescriptive mandates in the first sentence – there will no sharp edges, rocks or debris on the vertical steel walls or on the prepared foundation for the liner(s).

The vertical steel walls do not meet the slope requirement and three is no anchor trench as envisioned by the Rule. The vertical steel walls also apply to the secondary containment system onto which the secondary liner will be fastened. Therefore a variance is required.

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

The attached document, which is written by a Professional Engineer, demonstrates that the steel tank walls and the underlying prepared foundation provide the structural stability that is equivalent to that of an earthen pit constructed in compliance to the mandates of the Pit Rule. The attached letter relies upon the specifications for the liner material and the tank itself.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Mr. Randall Hicks, PG
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November 20, 2014

RE: Technical Memorandum
Slopes and Anchor Trench Variance
NMAC 19.15.11.J(2) & (3)
Devon Energy MWFM Modular Impoundment

Dear Mr. Hicks:

At your request, I have reviewed the suitability of application of 40 mil LLDPE geomembrane as an alternative Primary and Secondary liner for the Devon Energy Multi-Well Fluid Management (MWFM) Modular Impoundment. In consideration of liners in traditional pits, the NMOCD rules require a maximum 2H:1V slope and anchorage at the top of slope in soil backfill anchor trench. I have also reviewed your C-144 Supplemental Information Report, Modular Tank Drawing, Design and Siting characteristics as well as applicable correspondence. In consideration of the LLDPE Primary and Secondary lining system application (Modular Impoundment), size of impoundments and depth, design details for modular tanks as well as the fact that this is an above ground storage tank (not constructed in an excavated or raised embankment pit), it is my professional opinion that the 40 mil LLDPE geomembranes will provide the requisite barrier against potential processed water loss and will function within the vertical walls of the Modular Impoundment the same as or better than an in-ground pit with slopes. The following are discussion points that will exhibit the positive attributes of a Modular Impoundment System:

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 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 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, it is my professional opinion that two 40 mil LLDPE geomembranes installed within the vertical walls of a Modular Impoundment will provide the requisite protection of fresh water, public health and the environment for many years and especially for the estimated one year life of the Devon Energy MWFM Modular Impoundment. In particular, 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.

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:

C-144 Supplemental Information
Devon Energy Modular Impoundment
Prepared by R. T. Hicks Consultants Ltd.

NMOCD Recycling Rule, Title 19, Chapter 15 – Produced Water, Drilling Fluids and Liquid Waste 2014 – Section 19.15

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.

Liner [NMAC 19.15.11.J(4)]

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 19.15.17.11.J:

> (4) The primary (upper) liner and secondary (lower) liner shall be geomembrane liners. The geomembrane liner shall consist of 30- mil flexible PVC or 60-mil HDPE liner, or an equivalent liner material that the division's district office approves. The geomembrane liner shall have a hydraulic conductivity no greater than 1 x 10-9 cm/sec. The geomembrane liner shall be composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. Liner compatibility shall comply with EPA SW- 846 Method 9090A or subsequent relevant publication.
>
> (5) The operator shall minimize liner seams ... The operator shall ensure field seams in geosynthetic material are thermally seamed (hot wedge) with a double track weld to create an air pocket for non-destructive air channel testing. The operator shall test a seam by establishing an air pressure between 33 and 37 psi in the pocket and monitoring that the pressure does not change by more than one percent during five minute after the pressure source is shut off from the pocket…

With respect to the material of the primary liner, the applicant proposes two (2) 40-mil LLDPE liners and a secondary liner comprised of one (1) layer of 40-mil LLDPE material.

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

The attached letter from Mr. Ron Frobel concludes that the proposed primary liner system for the modular containments will provide equal protection of fresh water, public health and the environment as the primary liner system specified for an earthen pit (60-mil HDPE or 30-mil PVC). His letter states that the characteristics of the modular impoundment combined with the relatively short life-span of the project (less than 2 years) make the double-liner system of 40-mil LLDPE a better choice from an economic and environmental perspective than 60-mil HDPE or 30-mil PVC.

With respect to the secondary liner system, OCD has already approved 30-mil LLDPE for earthen pit storage systems – based upon data and arguments presented in previous submissions of Mr. Frobel. This variance request to use 40-mil LLDPE as the secondary liner for the modular impoundment system relies on some of the same arguments presented earlier, but also considers the nature of this secondary liner being exposed to some UV radiation and possibly some construction traffic. Again, Mr. Frobel concludes that the nature of the proposed secondary containment system and the less than 2-year lifespan of the project make the proposed secondary liner system a better choice from an economic and environmental perspective than 60-mil HDPE or 30-mil PVC.

Because of how the Pit Rule is written, Mr. Frobel has elected to compare and contrast the characteristics of 30-mil PVC with 40-mil LLDPE as a liner material the proposed modular containment structure. The data and arguments in Mr. Frobel's letter clearly demonstrate that the proposed variance provides better protection of fresh water, public health and the environment than the specified 30-mil PVC material.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Mr. Randall Hicks, PG
R.T. Hicks Consultants Ltd.
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November 18, 2014

RE: Technical Memorandum
LLDPE as Alternative Primary Liner System
Devon Energy MWFM Modular Impoundment

Dear Mr. Hicks:

At your request, I have investigated the suitability of application for 40 mil LLDPE non-reinforced geomembrane as an alternative Primary liner in the Devon Energy Modular Impoundment. I have reviewed your C-144 Supplemental Information Report, Modular Tank Drawing, Design and Siting characteristics as well as applicable correspondence. In consideration of the Primary lining system application (modular impoundment), size of the impoundment and depth, design details for modular tanks as well as estimated length of up to two years of service time, it is my professional opinion that 40 mil LLDPE geomembrane will provide the requisite barrier against processed water loss. The two 40 mil LLDPE liners will function equal to or better than 60 mil HDPE or 30 mil PVC as a primary liner system. The reader is referred to the Technical Memorandum regarding the Secondary Liner for discussion points on PVC. 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. Although the lifetime of LLDPE in covered conditions (i.e., secondary liner) will be somewhat reduced with respect to HDPE, a secondary liner of LLDPE will outlast an exposed HDPE liner. In fact, according to the Geosynthetic Research Institute (GRI) study on lifetime prediction (GRI Paper No. 6), the half life of HDPE (GRI GM 13) exposed is > 36 years and the half-life of LLDPE (GRI GM 17) exposed is approximately 36 years (the Devon Energy Modular Impoundment life span is expected to be only 1 year maximum). It is understood that in order to ensure compliance of materials, 60 mil HDPE must meet or exceed GRI GM 13. Likewise, the primary or secondary liner must meet or exceed GRI GM 17 for non-reinforced LLDPE. Adhering to the minimum requirements of the GRI Specifications, 40 mil LLDPE when used as a primary liner in the Devon Modular Impoundment will be equally as protective as a 60 mil HDPE liner.

Flexibility Requirements. LLDPE geomembranes are less stiff and far more flexible than HDPE and in this regard are preferred for installations in vertical wall tanks such as the Devon Modular Impoundment. 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. LLDPE will conform to the tank dimensions under hydrostatic loading.

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, there should be no exception or recommended practice for seaming and QC testing in the OCD rules. This would be fully covered in comprehensive specifications for both the Primary and Secondary geomembranes that would be reviewed by OCD.

Potential for Leakage through the Primary Liners. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media provides immediate drainage to a low point or outside the Modular Impoundment and thus no hydrostatic head or driving gradient is available to push leakage water through a hole. In this regard, secondary geomembrane materials can be (and usually are) much less robust in both thickness and polymer type.

Leakage through any Primary geomembrane is driven by size of hole and depth and will be detected by the increase of waste 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 2 layers of 40 mil LLDPE geomembrane which will out perform a single layer of HDPE for potential leakage. Thus, if a leak occurs through the top layer, it will be effectively contained by the second layer. 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 Secondary 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 water impoundments usually in the range of 100 to 500 gpad. However, New Mexico does not specify any ALR for waste water impoundments (GRI Paper No. 15).

HDPE can not be prefabricated into large panels and thus LLDPE offers the following for Primary Liner 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.

- Large prefabricated panels of LLDPE will provide better control of thermal fusion welding in a factory environment that will improve the liner system integrity for the long term.

- The LLDPE geomembrane provides superior lay flat characteristics and conformability which allows for more intimate contact with the underlying soil, geonet or geotextile as well as overlying materials thus providing better flow characteristics for drainage of water. HDPE exhibits extreme 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 Impoundment.

- Ease of installation of large prefabricated custom size panels results in a greater reduction of installation time and associated installation and QC costs.

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

In summary, it is my professional opinion that the double 40 mil LLDPE geomembranes will provide a Primary liner system that is equal to or better than a single 60 mil HDPE liner or a single 30 mil PVC liner and will provide the requisite protection of fresh water, public health and the environment for many years and especially for the estimated two year life of the Devon Energy Modular Impoundment.

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:

C-144 Supplemental Information
Devon Energy Modular Impoundment
Prepared by R. T. Hicks Consultants Ltd.

Geosynthetic Research Institute (GRI) Published Standards and Papers 2013

ASTM Standards 2013

Attachments:

R. K. Frobel C. V.

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Consulting Engineers

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November 18, 2014

RE: Technical Memorandum
LLDPE as Alternative Secondary Liner System
Devon Energy MWFM Modular Impoundment

Dear Mr. Hicks:

At your request, I have reviewed the suitability of application of a 40 mil LLDPE geomembrane as an alternative secondary liner for the Devon Energy Multi-Well Fluid Management (MWFM) Modular Impoundment. I have reviewed your C-144 Supplemental Information Report, Modular Tank Drawing, Design and Siting characteristics as well as applicable correspondence. In consideration of the Secondary lining system application (Modular Impoundment), size of impoundments and depth, design details for modular tanks as well as estimated length of service time of less than two years, it is my professional opinion that the 40 mil LLDPE geomembrane will provide the requisite barrier against potential processed water loss and will function far better than 30 mil PVC as a secondary liner system, especially in consideration of the secondary lining exposed conditions beyond the tank walls. The following are discussion points that will exhibit the attributes of a 40 mil LLDPE secondary lining system:

LLDPE Base Polymer. As discussed in previous technical memorandums, the LLDPE resin is similar to HDPE with the major difference noted that LLDPE exhibits lower density, lower crystallinity (more flexible and less chemical resistant) and better thermal fusion weld capability.. LLDPE resin will resist aging and degradation and remain intact for many years in exposed conditions. The Geosynthetic Research Institute (GRI) study on lifetime prediction (GRI Paper No. 6), shows that the half life of HDPE (GRI GM 13) exposed is > 36 years and the half-life of LLDPE (GRI GM 17) exposed is also approximately 36 years (the Devon Energy Modular Impoundment life span is expected to be only 2 years maximum). It is understood that in order to ensure compliance of materials, the primary geomembrane to be used in the pits must meet or exceed GRI Specification Requirements and in this case should meet or exceed GRI GM 17 for non-reinforced LLDPE. Adhering to the minimum requirements of the GRI Specifications, 40 mil LLDPE when used as an alternate secondary liner will be far superior to an exposed 30 mil PVC. It should be noted that PVC geomembranes are not addressed in GRI specifications.

PVC Base Polymer. PVC base resin is formulated with a number of components including oils, plasticizers, fillers and carbon black. The polymer structure is relatively amorphous and low in crystallinity and thus more permeable than the semi-crystalline

LLDPE structure. PVC must include plasticizers to make the sheet flexible and the plasticizers tend to leach out of the PVC polymer over time making the sheet stiff and very difficult to repair. Plasticizer migration is accelerated in exposed conditions by heat and UV/ozone attack. Thus PVC geomembranes are always designed with soil cover to protect the polymer from premature degradation. PVC geomembranes have been observed to deteriorate in exposed conditions in less than 2 years. The Devon Energy Modular Impoundment requires that the secondary liner be exposed beyond the tank walls.

Durability of Geomembranes is directily affected by exposure conditions. Buried or covered geomembranes are not affected by the same degradation mechanisms (UV, Ozone, Chemical, Stress, Temperature, etc) as are fully exposed geomembranes. In this regard, the PVC lining material is much less robust when fully exposed to the elements than LLDPE. PVC geomembranes are required to be covered by other geosynthetics or earth materials to prevent exposure to UV, heat and oxidation. In particular, PVC geomembrane materials will degrade due to the extraction of plasticizers which is accelerated by UV and heat exposure. LLDPE geomembranes do not have extractable resin components that would degrade the base polymer when subjected to fully exposed conditions.

Thermal FusionSeaming 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, there should be no exception or recommended practice for seaming and QC testing in the OCD rules. This would be fully covered in comprehensive specifications for both the Primary and Secondary geomembranes that would be reviewed by OCD.

Potential for Leakage through the Primary Liner. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media on top of the LLDPE secondary provides immediate drainage to outside the tank walls and thus no hydrostatic head or driving gradient is available to push leakage water through a hole in the secondary lining system. If required, location of holes in the Secondary due to construction can be found by Electrical Leak Location Survey (ELLS) using a water lance (ASTM D 7002). Holes found can then be repaired prior to placement of the Primary lining and thus any potential water seepage will be kept to a minimum..

Chemical Attack. Chemical attack to polymeric geomembranes is directly a function of exposure time as well as crystallinity. For short term exposure to process water of less than 2 years, the LLDPE geomembrane when used as a primary or secondary liner will provide a chemically resistant liner that can be QC tested to reduce potential defects or holes. Due to extractable components of PVC and less chemically resistant nature of the polymer (more amorphous and low crystallinity), PVC will not provide the requisite chemical resistant barrier in exposed conditions.

Geomembrane Installation. In consideration of the MWFM Modular Impoundment and associated construction and installation of liners in tanks, the following installation attributes of LLDPE should be considered:

- LLDPE is light in unit weight and thus will allow for factory pre-fabrication of large panels in excess of 30,000 sf for 40 mil material. This allows for a one panel installation in many Modular Impoundments.
- LLDPE provides a very dimensionally stable sheet in temperature extremes which results in far less field wrinkles and waves during and after installation. Non reinforced PVC is not as dimensionally stable.
- The LLDPE geomembrane is easily repaired using the same thermal fusion bonding method without the need for special surface preparation or cleaning. PVC, when oxidized and exhibiting loss of plasticizer is very difficult to repair and repair is usually by chemical fusion methods that are not as reliable as thermal fusion methods.
- Due to the semi-crystalline polymer structure and flexibility, the LLDPE geomembrane will provide superior installation and operation resistance to mechanical damage and is especially resistant to tear propagation, puncture and abrasion. 30 mil PVC does not exhibit the same strength requirements necessary when exposed to the elements and potential construction traffic on the tank exterior.
- LLDPE does not require a cover system to protect it from exposure to the elements whereas PVC geomembranes should be protected from direct exposure to the elements.
- LLDPE is available in a textured sheet which will provide greater base stability and resistance to sliding during and after construction of the Modular Impoundment

In summary, it is my professional opinion that a 40 mil LLDPE geomembrane will provide a short term (less than 2 years) secondary liner system that is superior to 30 mil PVC and will provide the requisite protection of fresh water, public health and the environment for many years and especially for the estimated one year life of the Devon Energy MWFM Modular Impoundment..

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:

C-144 Supplemental Information
Devon Energy Modular Impoundment
Prepared by R. T. Hicks Consultants Ltd.

NMOCD Recycling Rule, Title 19, Chapter 15 – Produced Water, Drilling Fluids and Liquid Waste 2014 – Section 19.15

Geosynthetic Research Institute (GRI) Published Standards and Papers 2013

ASTM Standards 2013

Attachments:

R. K. Frobel C.V.

Leak Detection [NMAC 19.15.17.J(8)]

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 19.15.17.11.J:

> (8) The operator shall place a leak detection system between the upper and lower geomembrane liners that consists of two feet of compacted soil with a saturated hydraulic conductivity of 1 x 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. The operator may install alternative methods that the appropriate division's district office approves.

With respect to the leak detection system, the current standard of care for leak detection is synthetic drainage material (not compacted soil), similar to the 200-mil GSE Hypernet which is proposed in this application. The Hypernet is easier to install and is less expensive than the prescribed method of the Rule. This request was recently approved by OCD for several MWFM pits (lined earthen pits).

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

With respect to the use of the 200-mil Hypernet drainage system in lieu of 2-feet of compacted soil, we believe the table below that contrasts the two systems provides ample demonstration.

Geonet Hypernet	**Compacted Soil**
Installation does not put strain on secondary liner	Equipment and compaction can stress secondary liner
Hydraulic conductivity is homogeneous and isotropic	Hydraulic conductivity can vary based upon the nature of the compaction and percent fines in a given load of placed soil
Fluid transmissivity is 2×10^{-3} m^2/sec	Mandated transmissivity is 6×10^{-8} m^2/sec
Settling after loading/unloading pit with fluid should be minimal	Settling after loading/unloading pit with fluid could be measureable, creating liner strain and changes in flow patterns to the detection system

Freeboard [NMAC 19.15.17.F(3)]

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 19.15.17.11.F:

> **F.** Multi-well fluid management pits. An operator shall maintain and operate a multi-well fluid management pit in accordance with the following additional requirements.
> **(3)** The operator shall maintain at least three feet of freeboard for the pit.

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 fully netted, 158-foot diameter steel tank (modular impoundment) does not share the same characteristics as these large earthen pits and we believe 3-feet of freeboard is not necessary. Moreover, meeting the 3-foot freeboard requirement 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 letter from Mr. Frobel 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

Mr. Randall Hicks, PG
R.T. Hicks Consultants Ltd.
901 Rio Grande Boulevard
Suite F-142
Albuquerque, New Mexico 87104

November 20, 2014

RE: Technical Memorandum
Freeboard Variance
NMAC 19.15.17.F(3)
Devon Energy MWFM Modular Impoundment

Dear Mr. Hicks:

At your request, I have reviewed the suitability of application of 40 mil LLDPE geomembrane as an alternative Primary and Secondary liner for the Devon Energy Multi-Well Fluid Management (MWFM) Modular Impoundment. In consideration of liners in traditional pits, the NMOCD rules require a freeboard of at least 3.0 ft. I have also reviewed your C-144 Supplemental Information Report, Modular Tank Drawing, Design and Siting characteristics as well as applicable correspondence. In consideration of the LLDPE Primary and Secondary lining system application (Modular Impoundment), size of impoundments and depth, design details for modular tanks as well as the fact that this is an above ground storage tank (not constructed in an excavated or raised embankment pit), it is my professional opinion that the 40 mil LLDPE geomembranes will provide the requisite barrier against potential processed water loss and will function within the vertical walls of the Modular Impoundment with a 2.0 ft freeboard the same as or better than an in-ground pit with slopes and a 3.0 ft freeboard requirement. The following are discussion points a Modular Impoundment System:

Freeboard Requirements

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 as regards 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 two 40 mil LLDPE geomembranes installed within the vertical walls of a Modular Impoundment will provide the requisite protection of fresh water, public health and the environment for many years and especially for the estimated two year life of the Devon Energy MWFM Modular Impoundment. In particular, 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:

C-144 Supplemental Information
Devon Energy Modular Impoundment
Prepared by R. T. Hicks Consultants Ltd.

NMOCD Recycling Rule, Title 19, Chapter 15 – Produced Water, Drilling Fluids and Liquid Waste 2014 – Section 19.15

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

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

Attachments:

R. K. Frobel C.V.

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

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

$$p = Design\ Denisty\ X\ Height$$
$$= 62.4\ PCF * 11.5\ ft$$

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

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

$$p = Design\ Denisty\ X\ Height$$
$$= 69.64\ PCF * 9\ ft$$

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

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

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

$$p = Design\ Denisty\ X\ Height$$
$$= 69.64\ PCF * 10\ ft$$

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

Andrew Parker

From: Henderson, Jason E. <Jason.Henderson@CES-FluidMgmt.com>
Sent: Monday, November 17, 2014 11:58 AM
To: 'Andrew Parker (andrew@rthicksconsult.com)'; ''Randall Hicks' (r@rthicksconsult.com)'
Subject: CES - Frac Tanks New Mexico
Attachments: Engineering Calculations - Pool Tanks.pdf; SKMBT_C55013021610260.pdf; SKMBT_C55013021807050.pdf

Randall,

These are the Pinnacle specs. If you look at the engineering calculations, provided the State requests this information, you will see the following:

Hydro Pressure, p = Design Density * H = 62.4 PCF * 11.5 = 718 psf – Which is the water density based on 8.34 lb/gal * 7.48 ft^3/gal
Since the state restricts me to 3 feet of freeboard then my Hydro Pressure on produced water is as follow:
9.3 lbs/Gal * 7.48 Ft^3/gal * 9ft = 626 psf which is 92psf less than this engineer's design thus I can use this tank for produced water under the conditions the state requires.

I could actually fill this tank to 10.3 feet with 9.3 lbs/gal produced water without comprising the engineer's design constraints. (9.3 lbs/Gal * 7.48 Ft^3/Gal *10.3 Ft = 715.51psf which is less that tank design max load of 718 psf)

Thank You,

Jason Henderson, P.E.
Director, Water and Disposal Solutions
Complete Energy Services Water Transfer & Treatment
Fluid Management Division
4727 Gaillardia Parkway, Suite 250 | Oklahoma City, OK | 73142
Direct: (405) 748-2221 | Mobile: (405) 365-0952 | Fax: (405) 748-2202
Email: jhenderson@CES-fluidmgmt.com

C-147
Site Specific Information for Containments

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

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 March 31, 2015

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: _Devon Energy Production Company, L.P. _____(For multiple operators attach page with information) OGRID #:___6137_____

Address: __333 W. Sheridan, Oklahoma City, OK 73102-8260_____

Facility or well name (include API# if associated with a well): _Rattlesnake/Ragin Cajun Recycling Facility API# Not Applicable_____

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

U/L or Qtr/Qtr _____ Section ____13____ Township ____26S____ Range ____34E____ County: __Lea_____

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

2.

☒ **Recycling Facility:**

Location of recycling facility (if applicable): Latitude ___32.03755 _____ Longitude ___-103.42747 _____ NAD: ☐1927 ☒ 1983

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 __ see attached _____ Longitude __see attached _____ NAD: ☐1927 ☐ 1983

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

☒ Lined ☒ Liner type: Thickness _two 30_mil (Primary) one 40-mil (Secondary) ☒ LLDPE ☐ HDPE ☐ PVC ☐ Other __

☒ String-Reinforced

Liner Seams: ☐ Welded ☒ Factory ☐ Other _____ Volume: _41,000 each_ bbl Dimensions: __diameter 157 ft, height 12 ft __

☐ 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 $_____ **(work on these facilities cannot commence until bonding amounts are approved)**

☐ Attach closure cost estimate and documentation on how the closure cost was calculated.

5.

Fencing:

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

☒ Alternate. Please specify___See previously-approved variance _____

6.

Signs:

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

☒ Signed in compliance with 19.15.16.8 NMAC

7.

Variances:

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

Check the below box only if a variance is requested:

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

If a Variance is requested, it must be approved prior to implementation.

8.

Siting Criteria for Recycling Containment

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

General siting

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

9.
Recycling Facility and/or Containment Checklist:
Instructions: Each of the following items must be attached to the application. Indicate, by a check mark in the box, that the documents are attached.

- ☒ Design Plan - based upon the appropriate requirements. *Appendices B-H*
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements. *Appendix B*
- ☒ Closure Plan - based upon the appropriate requirements. *Appendix B*
- ☒ 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): Josh Bruening Title: Engineer

Signature: [signature] Date: April 2, 2015

e-mail address: josh.bruening@dvn.com Telephone: 405-501-3236

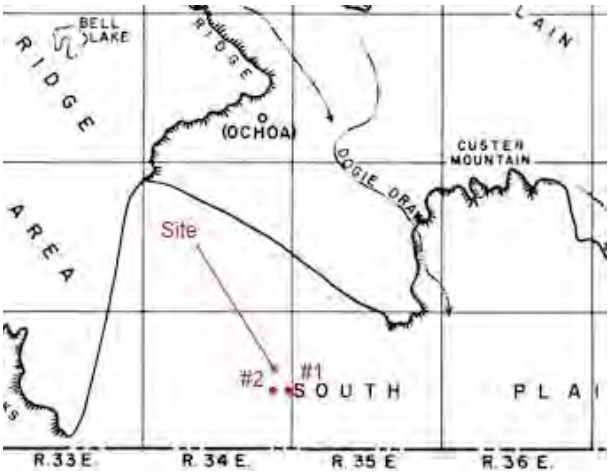
11.
OCD Representative Signature: _____ **Approval Date:** _____

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

☐ OCD Conditions _____
☐ Additional OCD Conditions on Attachment

Siting Criteria (19.15.17.10 NMAC)

Geologic Setting of the Regional Fresh-Water Bearing Formations



The modular impoundment is located within the central portion of the South Plain, which is part of the Pecos Valley Physiographic Province. Regionally, the San South Plain drains to the south, then to the east via Cheyenne Draw, and to the south via Monument Draw, ultimately to the Pecos River, located approximately fifty miles to the south-southeast of the sites. In New Mexico the South Plain lies to the southeast of the Grama Ridge Area and south of the Eunice Plain. It extends into Texas where it is referred to as the Toyah Basin. Because a thick layer of sand covers the South Plain the topography is irregular with no integrated drainage extending across the area from the higher elevations to the north and east.

Groundwater within the South Plain is found only in Mesozoic and Cenozoic Era rocks that were deposited since approximately 235 million years ago. The oldest of these are the Triassic age Dockum Group. They consist of conglomerates, cross-bedded sandstones, claystones, and siltstones that were deposited in a continental fluvial environment over the evaporites of the late Permian Ochoan Series, which had filled the Delaware Basin by that time.

Any Jurassic or Cretaceous age rocks that were deposited above the Triassic have subsequently been removed by erosion leaving an irregular surface upon which the Cenozoic rocks were deposited. Cenozoic Era rocks in the area consist of the Tertiary age Ogallala Formation and Quaternary age eolian and piedmont deposits. The Ogallala Formation consists of terrestrial sediments (sand with some clay, silt and gravel) and a thin layer Quaternary age sands blanket the Ogallala across most of the area.

The Ogallala and associated alluvium groundwater is present in the South Plain only in localized areas where the geometry of the underlying Triassic rocks provide containment for precipitation in the immediate area. Regional groundwater production within the South Plain occurs only from the Triassic age Santa Rosa aquifer.

Distance to Groundwater

Figure 1, Figure 2, and the discussion presented below demonstrates that groundwater (fresh water as defined by NMOCD Rules) at the location is greater than 100 feet beneath the modular impoundment.

Figure 1 is an area geologic base map that depicts regional topography (metric contour units) and includes the water wells located nearest to the proposed modular impoundment site for which information is available, regardless of how comprehensive or useful. It also shows:

1. The location of the proposed modular impoundment as a purple hexagon.
2. Water wells from the USGS database as color-coded triangles that indicated the producing aquifer (see Legend).
3. Water wells from the New Mexico Office of the State Engineer (OSE) database as a small blue triangle inside a colored circle that indicates the well depth (see Legend). Please note, OSE wells are often miss-located in the WATERS database as older wells are plotted in the center of the quarter, quarter, quarter, of the Section Township and Range. Topographic maps and/or aerial photographs verified all but four of the specific OSE well locations included on this map.
4. Water wells, which are not documented in the public databases but were identified by field inspection or other published reports are shown as a dot inside a color-coded (depth) square.
5. Depth to water and gauging dates from the most recent and reliable measurement for each well is provided adjacent to the well symbol. It should be noted that in most cases the depth to water provided by the OSE database are from drillers log notes estimated at the time of completion, rather than actual field measurements.

Figure 2 is a regional topographic base map (metric contour units) that depicts the potentiometric surface contours of the Triassic aquifer from Ground-Water Report 6 (GWR-6) *Geology and Ground-Water Conditions in Southern Lea County, New Mexico* by Alexander Nicholson and Alfred Clebsch (1961). The potentiometric contours are labeled in feet above sea level (ASL). Figure 2 also shows:

1. The location of the proposed modular impoundment as a purple hexagon.
2. Groundwater elevations and gauging dates from the most recent available static water level measurement for each well.

Site Geology

The modular impoundment is located on an outcrop of Quaternary Age eolian and piedmont deposits (Qe/Qp on Figure 1). These fine-grained sands and clays, along with the Quaternary piedmont deposits and Quaternary lacustrine/playa deposits (Qp and Qpl on Figure 1), are present as a thin covering of the underlying eroded Tertiary or Triassic age rocks. Based on information from GWR-6 and the elevation of the site (3,240 feet ASL), the Triassic age rocks are present approximately 65 feet below the surface.

The surface drainage is generally to the south at the modular impoundment location, however the area is covered by low stabilized sand dunes and no continuously flowing or any other significant watercourses are present.

Water Table Elevation

Fifteen water wells were identified in the area surrounding the modular impoundment site, but only two are located within a 5-mile radius (see Figure 1). A summary of the available water well data, with respect to groundwater elevation, is provided on the table below. The primary data for eleven of the wells is from the OSE Waters database. Information from two wells was obtained only by site inspection (no water level data) and the data from one well each was obtained from the USGS and Texas Water Development Board (TWDB) databases. As stated earlier, the groundwater elevations provided for the OSE wells are likely based on driller log notes rather than measurements made under static conditions. Where information from Open File Report No. 95 (OFR-95) or GWR-6 is available it was included with the OSE data on the table.

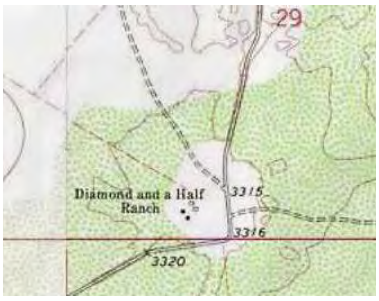
Well Numbers (see Map)	Well Location						Well Source Information							Groundwater Elevation Data						Gauging Date
	Township (south)	Range (east)	Section	Quarter Section OSE protocol (64,	16,	4)	NM-OSE Database	USGS Database	Open File Rpt. 95	GW Report No. 6	USGS Topo Sheet	Aerial Photograph	Field Verification	Surface Elevation (published)	Surface Elevation (Topo Sheet)	Well Total Depth (published)	Depth to Water (published)	Groundwater Elev. (published)	Groundwater Elev. (using topo elev.)	
C 02315	25	34	15	2	4	2	✓			✓	✓	–	--	3,335	3,324	168	164.9	3,170	3,159	7/23/54
C 02299	25	34	24	4	4	2	✓					–	--		3,339	350	300		3,039	12/31/49
C 02316	25	34	29	3	4	3	✓					–	--		3,317	100	50		3,267	6/30/1880
C 02296	25	35	18	1	3	2	✓				✓	–	--		3,361	300	230		3,131	12/31/49
C 02298	25	35	21	2	2	1	✓		✓	✓	✓	–	--	3,230	3,228	250	166.38	3,064	3,062	12/9/70
USGS-368	25	35	21	2	2	1	✓	✓			✓	–	--	3,228	3,228	275	166.71	3,061	3,061	2/29/96
C 02295	26	33	12	2	2	4	✓					–	--		3,348	250	200		3,148	12/31/49
C 02291	26	34	6	1	1	2	✓					–	--		3,318	220	160		3,158	12/31/49
C 02292	26	34	6	3	1	2	✓		✓	✓	✓	–	--	3,330	3,319	360	141.9	3,188	3,177	7/23/54
Misc-231	26	34	26	1	1	1					✓	✓	✓		3,216					
J 00005	26	35	13	2	2	2	✓		✓	✓	✓	–	--	2,990	2,982	601	228.63	2,761	2,753	5/28/70
Misc-232	26	35	19	4	2	2					✓	✓	✓		3,176					
J 00001	26	36	18	1	1	3	✓			✓	✓	–	--	2,981	2,978	559	253	2,728	2,725	9/8/90
J 00002	26	36	19	3	3	2	✓			✓	✓	–	--	2,950	2,945	700	216.0	2,734	2,729	9/8/80
Misc-233	31.974167°N / -103.342778°W						Loving Co., TX				✓	–	--	3,027	3,027	5095	--	--		3/29/90

✓ Indicates well was verified, (blank) indicates well not verified, and -- indicates no attempt to verify

Initially, an attempt was made to identify each well using USGS topographic maps. The surface elevation of each well identified on the topographic maps was compared to the published surface elevation, if available. Wells that could not be verified using maps were searched for using current and historic satellite photographs in an effort to identify windmills, tanks, or roads associated with the well. The following comments should be noted from Figure 1 and the table:

- Well USGS-368 and C-02298 are separate water wells, but they located in close proximity to each other.

- Well C-02316 is believed to be producing from a localized saturated alluvium zone that exists within a surface depression that likely reflects a depression in the underlying Triassic rocks. The groundwater depth at this well is not consistent with the regional aquifer.



- Misc-231 was observed from a distance during the site inspection but driving access to the well was not readily possible from the east.

- Two water wells were located at the Misc-232 location; both were converted from windmills to submersible pump and casing access to determine depth to groundwater was not possible on the day of inspection.

Hydrogeology

GWR-6 indicates that Ogallala groundwater is not present as a regional aquifer in the area surrounding the proposed modular impoundment location. The only water well in the mapping

area identified as an Ogallala or Alluvium producer is C-02316, located approximately 6.0 miles to the northwest. As stated above, this well is believed to produce from a localized alluvium aquifer.

Based on the potentiometric surface maps published in GWR-6 (shown in Figure 2), the groundwater elevation at the proposed Tank #1 site is approximately 2,960 ASL. With a surface elevation of 3,235 feet ASL the depth to groundwater below the surface at Tank #1 should be approximately 273 feet. The groundwater elevation at the proposed Tank #2 site is approximately 2980 ASL. With a surface elevation of 3,240 feet ASL the depth to groundwater below the surface at Tank #2 should be approximately 260 feet.

Distance to Surface Water

Figure 3 and the site visit demonstrates that the location is not within 300 feet of a continuously flowing watercourse, or any other significant watercourse, or within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). No continuously flowing watercourses exist within 300 feet of the location. The nearest surface drainage feature (un-named intermittent stream identified on the USGS quadrangle map) is located 1.6 miles to the east of Tank #1 and 1.5 miles west of Tank #2.

Distance to Permanent Residence or Structures

Figure 4 and the site visit demonstrates that the location is not within ~~300~~ 1000 feet from a permanent residence, school, hospital, institution, church, or other structure in existence at the time of initial application.

- Site visit performed by Mr. Littlejohn, P.G. on October 20, 2014.

Distance to Non-Public Water Supply

Figures 1 and 3 demonstrate that the location is not within 500 horizontal feet of a private, domestic fresh water well or spring that less than five households use for domestic or stock watering purposes, or within 1000 horizontal feet of any other fresh water well or spring, in existence at the time of initial application.

- Figure 1 shows the locations of all area water wells; the nearest fresh water well is located 1.2 miles to the southeast of Tank #1 and 1.8 miles southwest of Tank #2. There are no known domestic water wells located within the mapping area.
- Figure 3 shows that no springs are identified within the mapping area.

Distance to Municipal Boundaries and Fresh Water Fields

Figure 5 demonstrates that the location is not within incorporated municipal boundaries or defined municipal fresh water well fields covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended.

- The closest municipality is Jal, NM approximately 15 miles to the east-northeast.
- The closest public well field is located approximately 64 miles to the west.

Distance to Wetlands

Figure 6 demonstrates the location is not within 500 feet of wetlands.

- The nearest designated wetlands is a “Freshwater Pond” located 2.3 miles to the southeast of Tank #1 and 2.6 miles west of Tank #2.

Distance to Subsurface Mines

Figure 7 and our general reconnaissance of the area demonstrate that the nearest mines are caliche pits.

- The nearest caliche pit is located approximately 1.2 miles to the southwest.

Distance to High or Critical Karst Areas

Figure 8 shows the location of the modular impoundment with respect BLM Karst areas

- The proposed modular impoundments are located within a "low" potential karst area.
- The nearest "medium" potential karst area is located approximately 6 miles to the west.
- We saw no evidence of unstable ground near the proposed modular impoundment locations during the site inspection.

Mr. Littlejohn, P.G. conducted the field survey and concluded that the ground is stable.

Distance to 100-Year Floodplain

Figure 9 demonstrates that the location is within an area that has not yet been mapped by the Federal Emergency Management Agency with respect to the Flood Insurance Rate 100-Year Floodplain.

- Areas that are not mapped are designated as "Undetermined Flood Hazard" and are generally considered minimal flood risk.
- Our field inspection and examination of the topography permit a conclusion that the location is not within any floodplain.

Site Specific Information Figures

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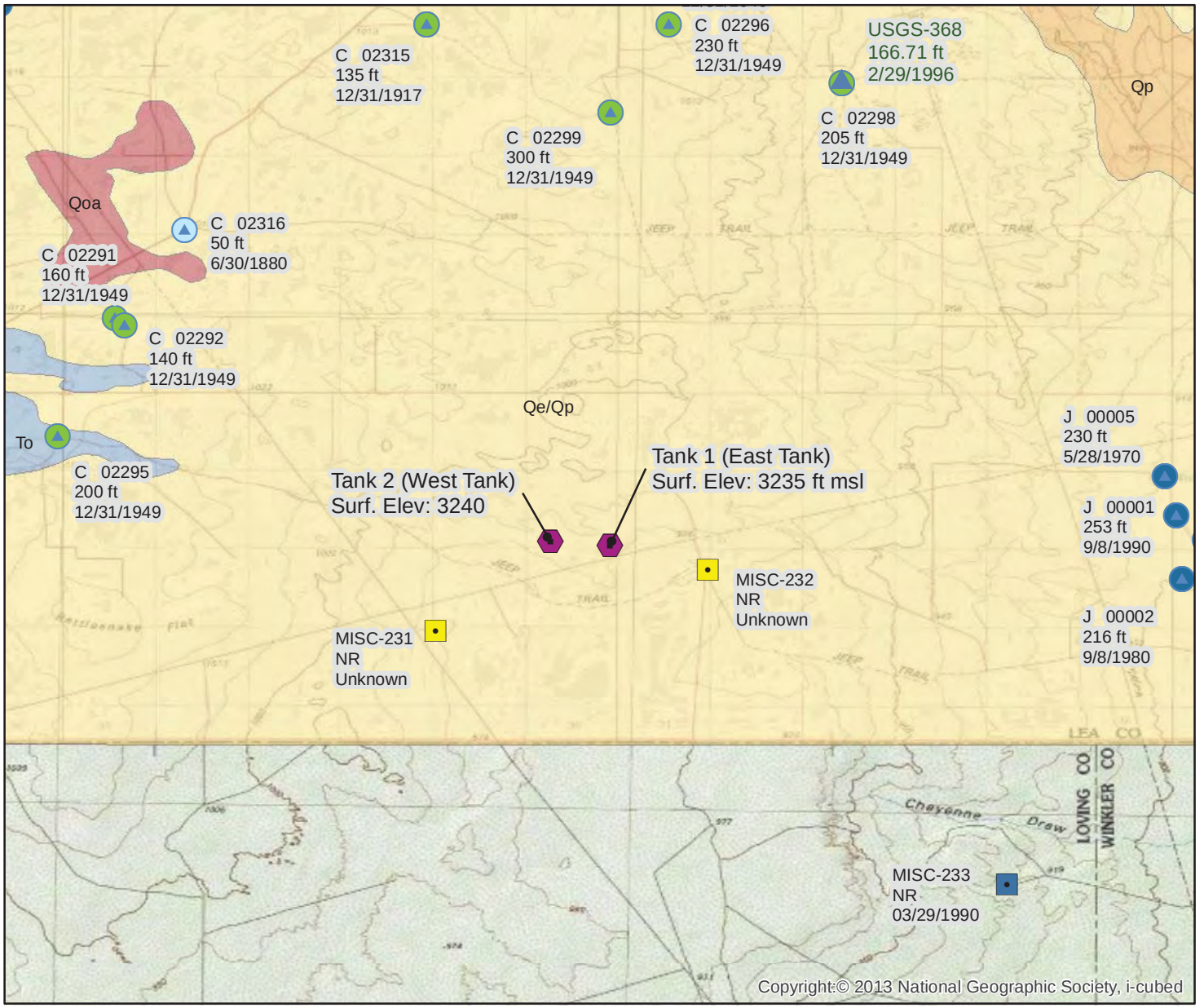

Legend

Modular Impoundment

OSE Water Wells (DTW, Date)

Well Depth (ft)

- <= 150
- 151 - 350
- 501 - 1000

USGS Gauging Station (DTW, Date)

Aquifer Code, Well Status

- Santa Rosa

Misc Water Wells (DTW, Date)

Well Depth (ft)

- -99.0
- 500.1 - 6000.0

NM Geology

Map Unit, Description

- Qe/Qp, Quaternary-Eolian Piedmont Deposits
- Qoa, Quaternary-Older Alluvial Deposits
- Qp, Quaternary-Piedmont Alluvial Deposits
- To, Tertiary-Ogallala Formation

N W E S

0 1 2 Miles

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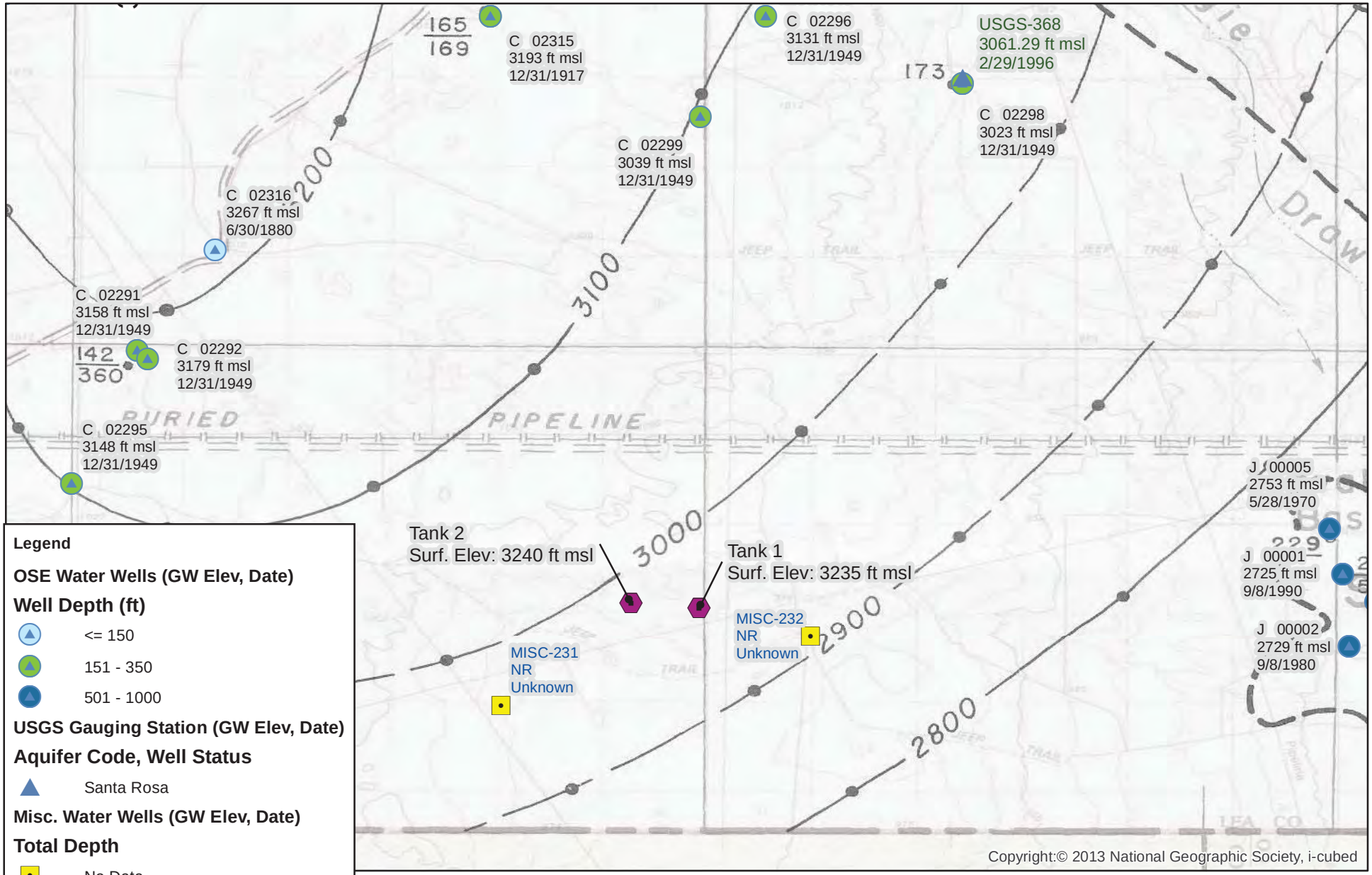
Ph: 505.266.5004

Depth To Water and Geology

Figure 1

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



Map Source: Ground Water Map of Southern Lea County (Nicholson & Clebsch, 1954)

0 1 2 Miles

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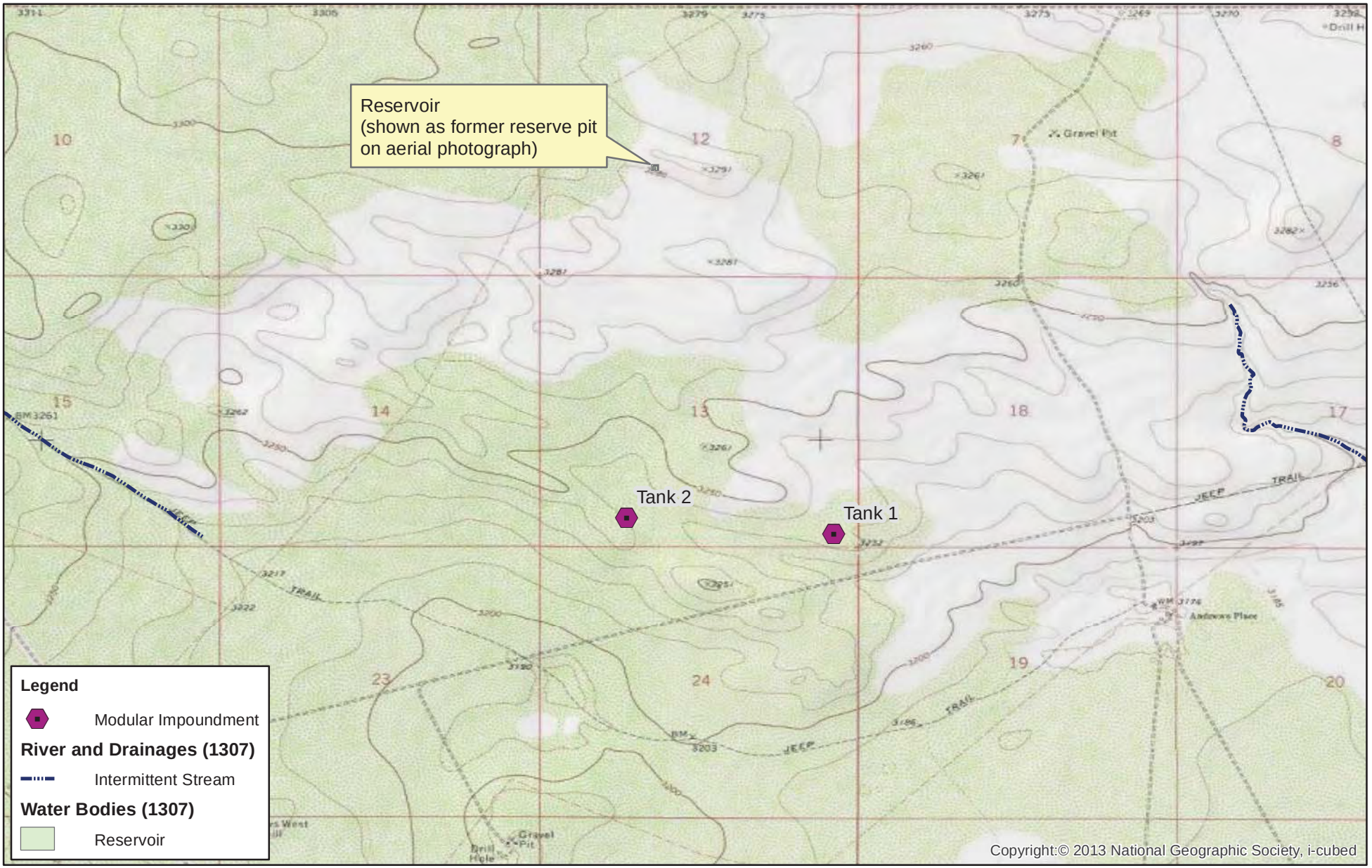
Groundwater Elevation at Nearby Water Wells

Figure 2

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



N
W E
S

0 0.25 0.5 Miles

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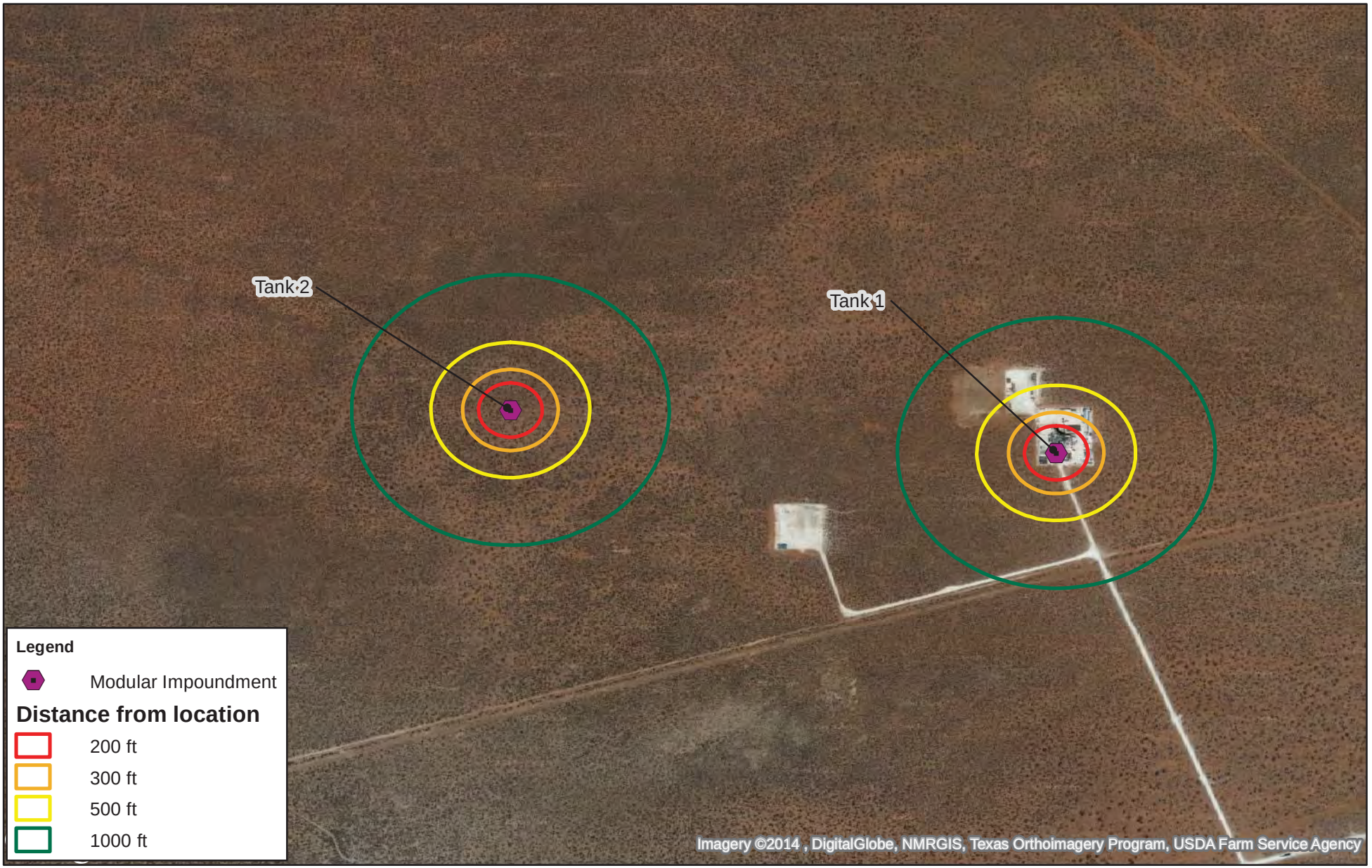
Surface Water and Topography

Figure 3

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



(aerial image c.2014)

N
W
E
S

0 500 1,000
Feet

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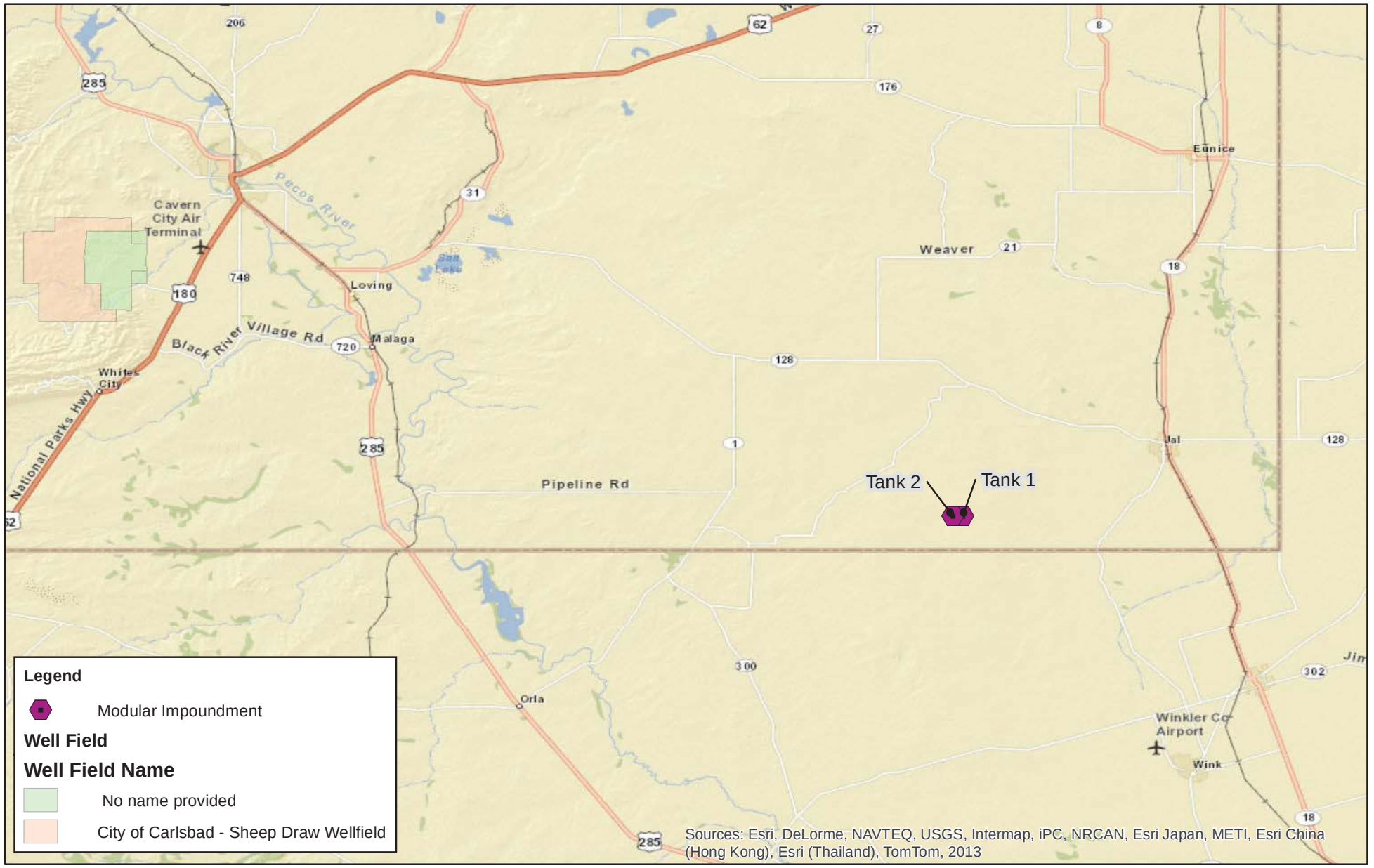
Nearby Structures

Figure 4

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



N W E S

0 5 10 Miles

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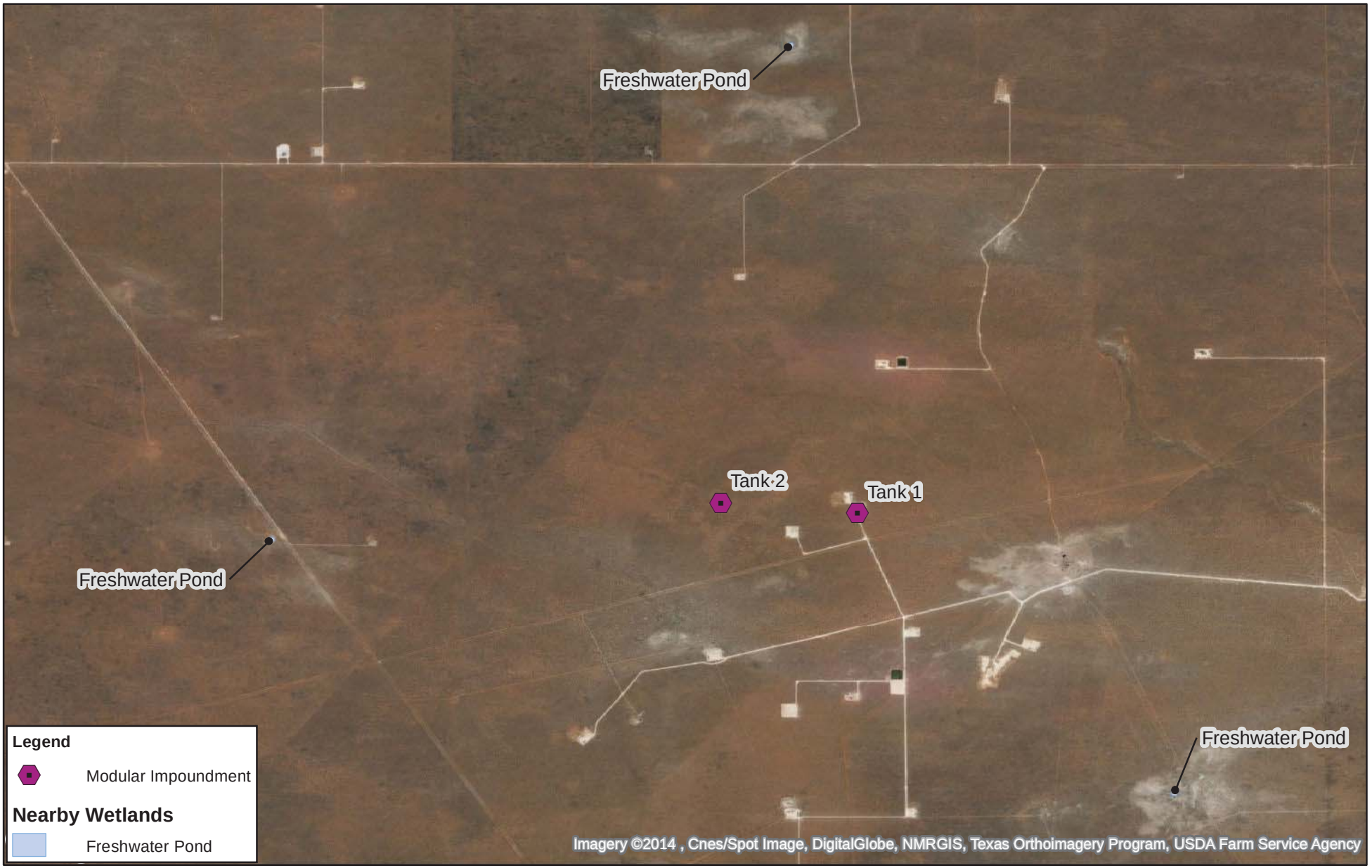
Nearby Municipalities and Well Fields

Figure 5

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



N
W E
S

0 0.5 1 Miles

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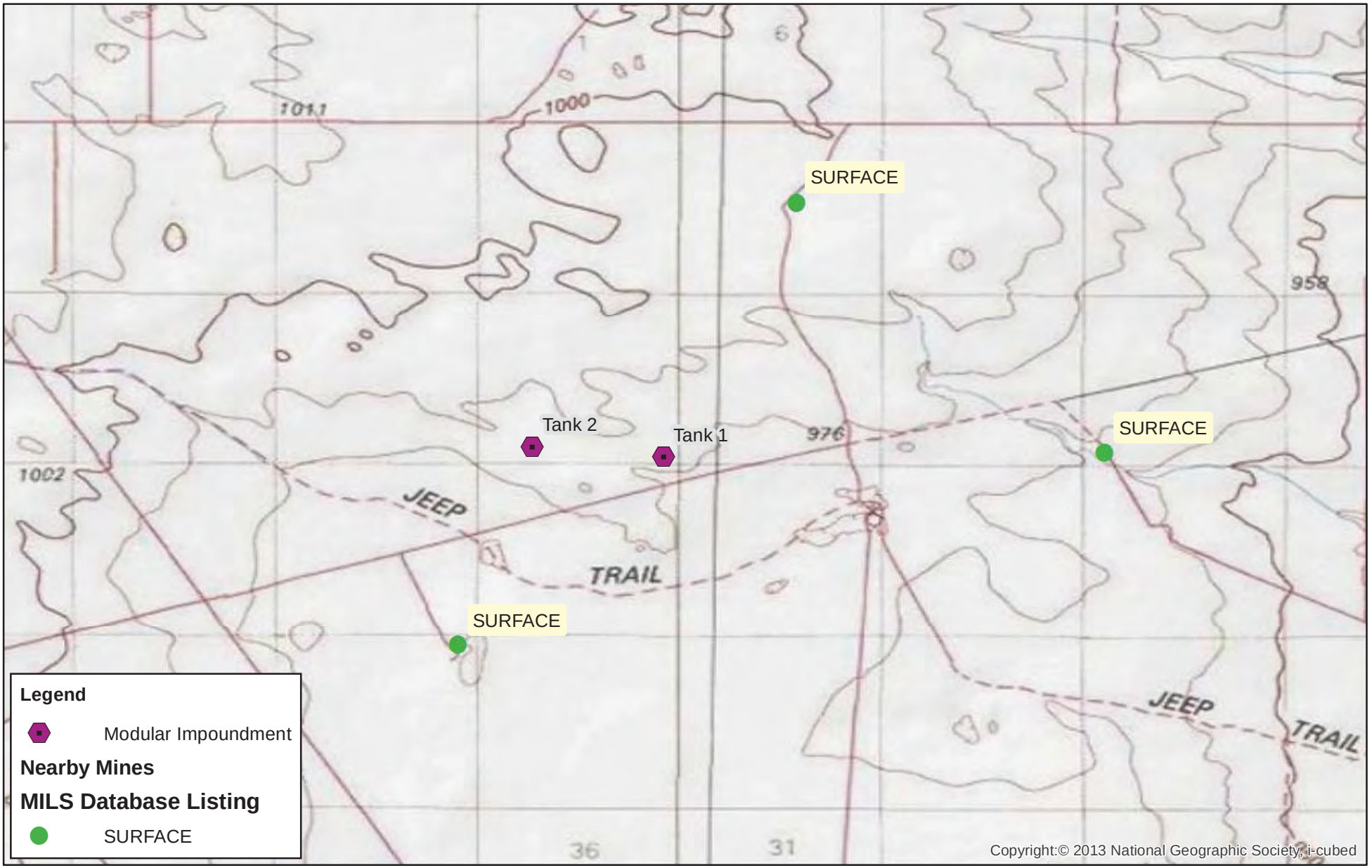
Nearby Wetlands

Figure 6

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



N
W E
S

0 0.5 1 Miles

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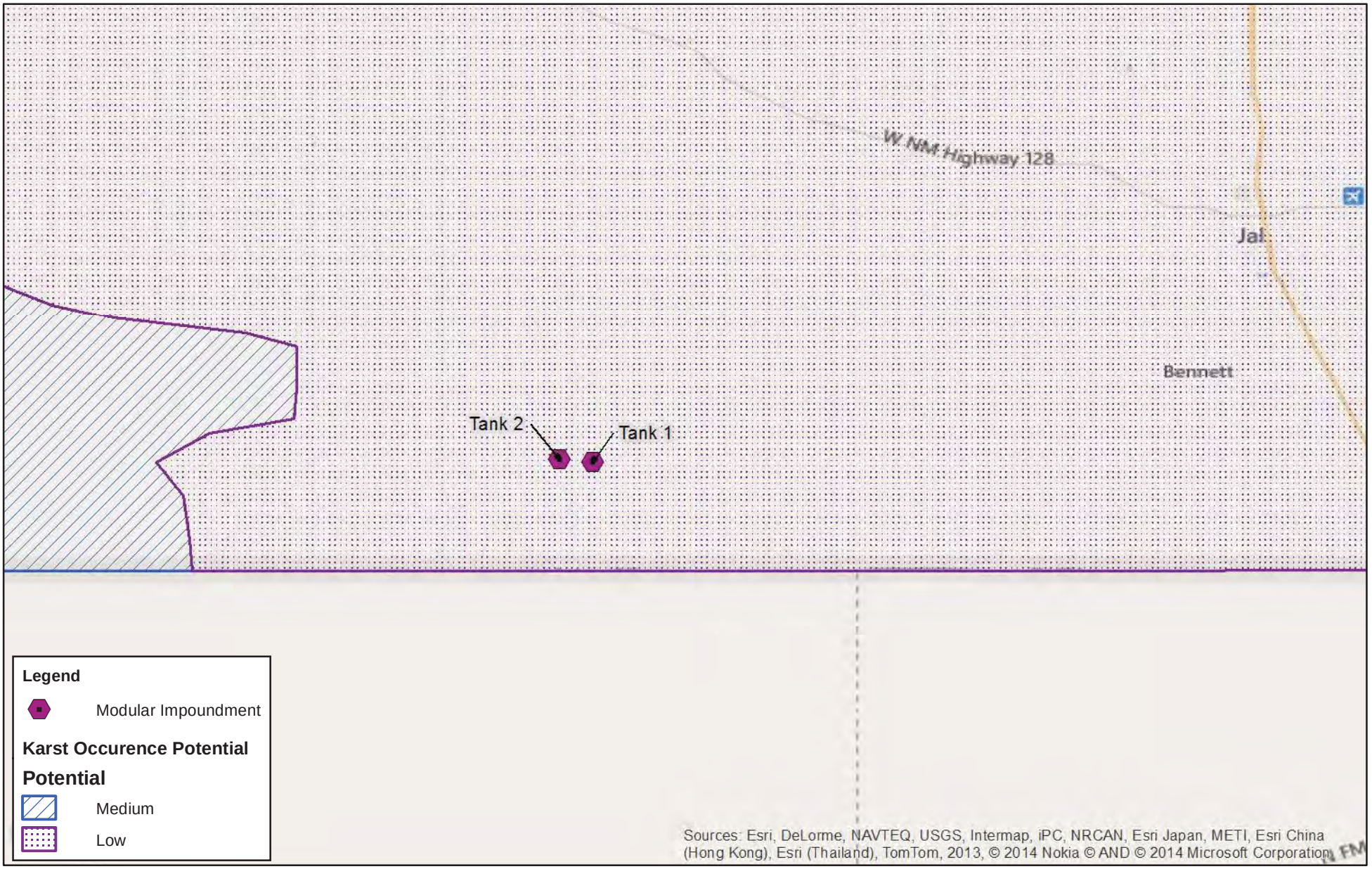
Albuquerque, NM 87104
Ph: 505.266.5004

Nearby Mines and Minerals

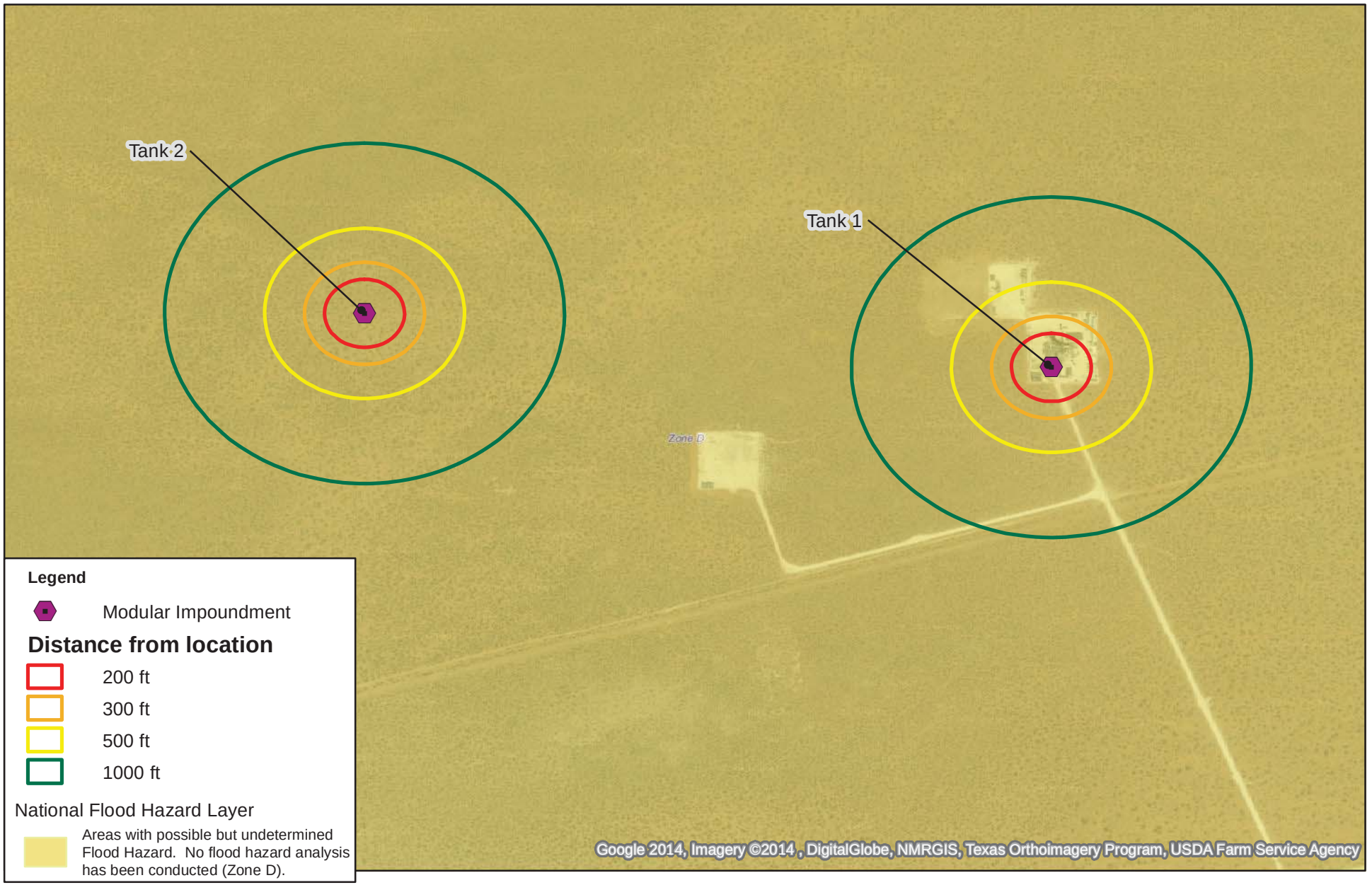
Figure 7

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Karst Potential	Figure 8
	Devon Energy Production, LP MWFM Modular Impoundment	October 2014



Legend

Modular Impoundment

Distance from location

- 200 ft
- 300 ft
- 500 ft
- 1000 ft

National Flood Hazard Layer

Areas with possible but undetermined Flood Hazard. No flood hazard analysis has been conducted (Zone D).

FEMA Source: https://hazards.fema.gov/gis/nfhl/services/public/NFHLWMS/MapServer/WMSServer

N W E S

0 500 1,000 Feet

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FEMA Flood Map

Figure 9

Devon Energy Production, LP
MWFM Modular Impoundment

October 2014

Site Specific Information Plates

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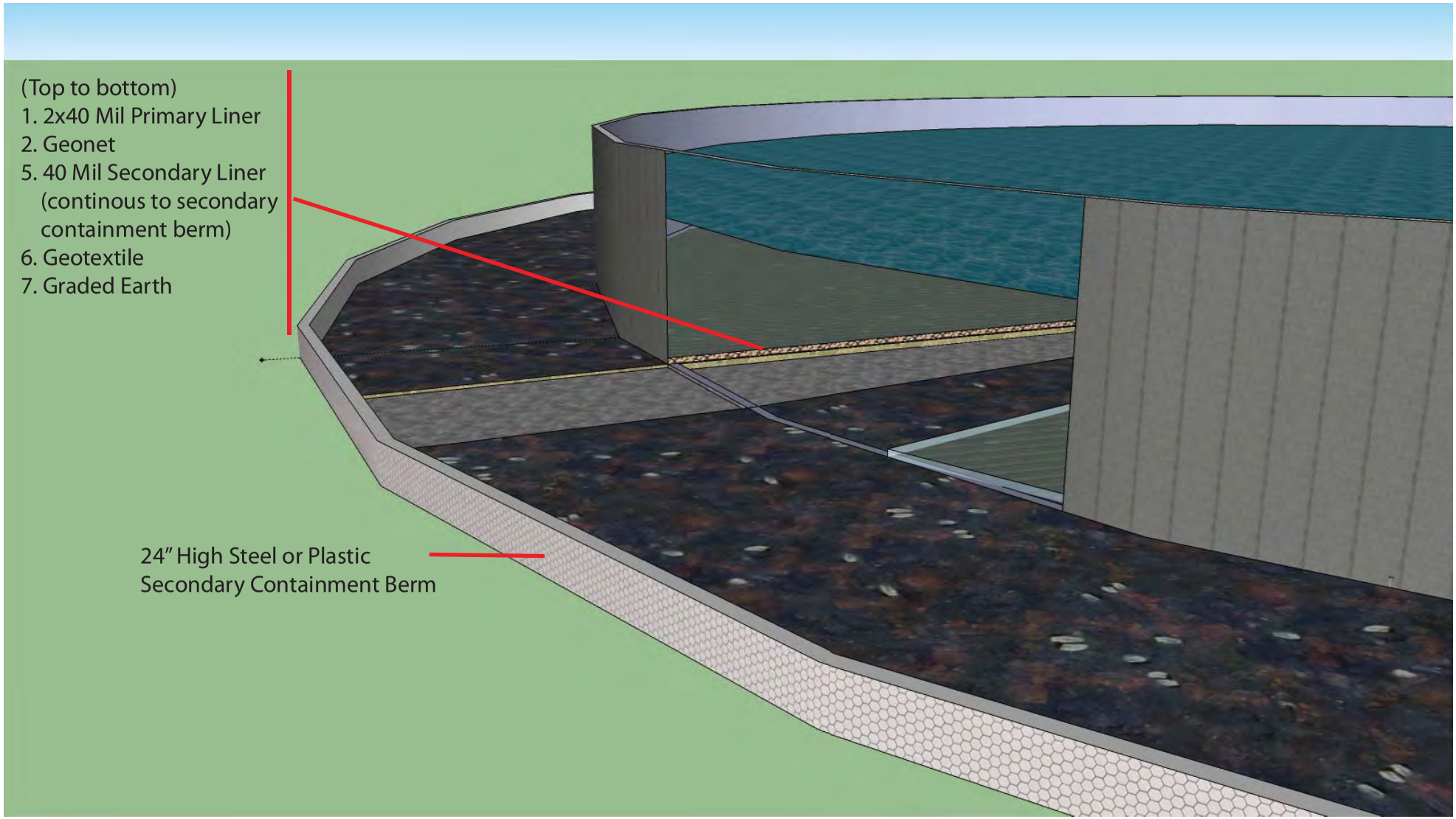

Source: R.T. Hicks Consultants, Ltd

R.T. HICKS CONSULTANTS, LTD.
910 Rio Grande Blvd Suite F-142 Albuquerque, NM 87104
505.266.5004

Modular Impoundment Schematic

Devon Energy MWFM Pit

Plate 1

November 2014

Appendix A

Site Inspection Photographs

& Survey Information

R.T. Hicks Consultants, Ltd.
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Albuquerque, NM 87104

District I
1625 N. French Dr., Hobbs, NM 88240
Phone: (575) 393-6161 Fax: (575) 393-0720
District II
811 S. First St., Artesia, NM 88210
Phone: (575) 748-1283 Fax: (575) 748-9720
District III
1000 Rio Brazos Road, Aztec, NM 87410
Phone: (505) 334-6178 Fax: (505) 334-6170
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505
Phone: (505) 476-3460 Fax: (505) 476-3462

HOBBS OCD
JAN 09 2013
RECEIVED

State of New Mexico
Energy, Minerals & Natural Resources Department
OIL CONSERVATION DIVISION
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-102
Revised August 1, 2011
Submit one copy to appropriate District Office

☐ AMENDED REPORT

dm

WELL LOCATION AND ACREAGE DEDICATION PLAT

1 API Number	2 Pool Code	3 Pool Name
30-025-40912	97597	Jabina Delaware; ~~Brushy Canyon~~ Southwest

4 Property Code	5 Property Name	6 Well Number
39621	RATTLESNAKE ~~UNIT~~ "~~13~~"-"~~12~~" FED Com	~~1H~~ OK

7 OGRID No.	8 Operator Name	9 Elevation
6137	DEVON ENERGY PRODUCTION COMPANY, L.P.	3232.2

10 Surface Location

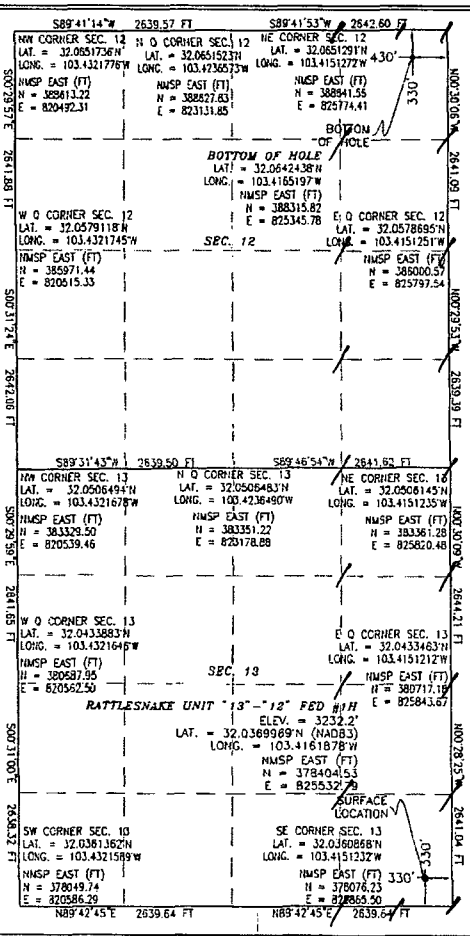
UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
P	13	26 S	34 E		330	SOUTH	330	EAST	LEA

11 Bottom Hole Location If Different From Surface

UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
A	12	26 S	34 E		330	NORTH	430	EAST	LEA

12 Dedicated Acres	13 Joint or Infill	14 Consolidation Code	15 Order No.
320			

No allowable will be assigned to this completion until all interests have been consolidated or a non-standard unit has been approved by the division.



17 OPERATOR CERTIFICATION

I hereby certify that the information contained herein is true and complete to the best of my knowledge and belief, and that this organization either owns a working interest or unleased mineral interest in the land including the proposed bottom hole location or has a right to drill this well at this location pursuant to a contract with an owner of such a mineral or working interest, or to a voluntary pooling agreement or a compulsory pooling order heretofore entered by the division.

7/10/2012
Signature Date

Patti Riechers
Printed Name

Patti Riechers

E-mail Address

patti.riechers@dvn.com

18 SURVEYOR CERTIFICATION

I hereby certify that the well location shown on this plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my belief.

JUNE 14, 2012
Date of Survey

Signature and Seal of Professional Surveyor

Certificate Number FILIMON F. JARAMILLO, PLS 12797

SURVEY NO. 1110

EG 1-10-2013

District I
1625 N. French Dr., Hobbs, NM 88240
Phone: (575) 393-6161 Fax: (575) 393-0720
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State of New Mexico
Energy, Minerals & Natural Resources Department
OIL CONSERVATION DIVISION
1220 South St. Francis Dr.
Santa Fe, NM 87505

HOBBS OCD
AUG 12 2014
RECEIVED

Form C-102
Revised August 1, 2011
Submit one copy to appropriate District Office

☐ AMENDED REPORT

WELL LOCATION AND ACREAGE DEDICATION PLAT

[1] API Number	[2] Pool Code	[3] Pool Name
30-025-41259	97597	Jabalina; Delaware

[4] Property Code	[5] Property Name	[6] Well Number
40007	RAGIN CAJUN "13" FEDERAL	1H

[7] OGRID No.	[8] Operator Name	[9] Elevation
6137	DEVON ENERGY PRODUCTION COMPANY, L.P.	3244.7

[10] Surface Location

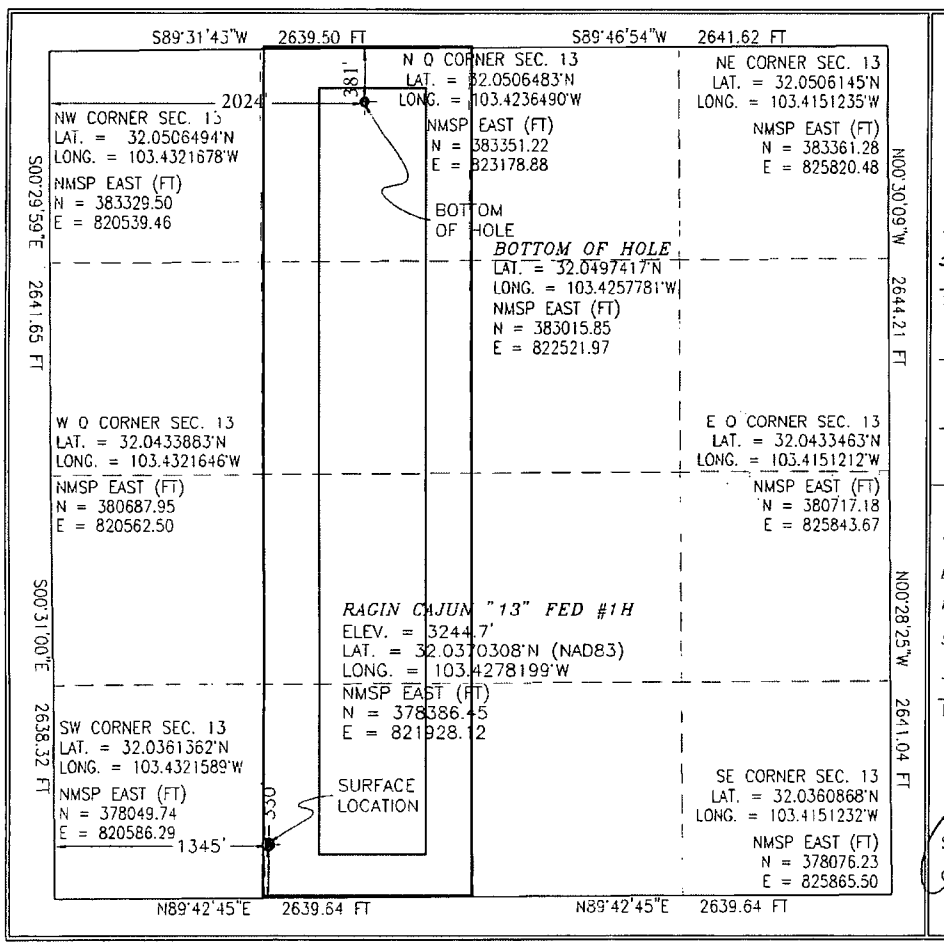
UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
N	13	26 S	34 E		330	SOUTH	1345	WEST	LEA

[11] Bottom Hole Location If Different From Surface

UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
C	13	26 S	34 E		~~381~~ 323	NORTH	~~2024~~ 1957	WEST	LEA

[12] Dedicated Acres	[13] Joint or Infill	[14] Consolidation Code	[15] Order No.
160			

No allowable will be assigned to this completion until all interests have been consolidated or a non-standard unit has been approved by the division.



[17] OPERATOR CERTIFICATION

I hereby certify that the information contained herein is true and complete to the best of my knowledge and belief, and that this organization either owns a working interest or unleased mineral interest in the land including the proposed bottom hole location or has a right to drill this well at this location pursuant to a contract with an owner of such a mineral or working interest, or to a voluntary pooling agreement or a compulsory pooling order heretofore entered by the division.

Megan Moravec — 8/8/2014
Signature — Date

Megan Moravec, Regulatory Analyst
Printed Name

Megan.Moravec@dvn.com
E-mail Address

[18] SURVEYOR CERTIFICATION

I hereby certify that the well location shown on this plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my belief.

JULY 19, 2012
Date of Survey

Signature and Seal of Professional Surveyor:
FIDEL F. JARAMILLO
NEW MEXICO
REGISTERED LAND SURVEYOR

Certificate Number: FIDEL F. JARAMILLO, PLS 12797
SURVEY NO. 1173

PP: 330' FSL & 1345' FWL, Sec 13, T26S, R34E

Project Area: ☐
Producing Area: ☐

SEP 10 2014

View south across existing well pad

View southeast from edge of well pad showing native vegetation

Poorly stitched view north of recycling facility at Rattlesnake production pad.

View southeast of Rattlesnake AST showing lined secondary containment system.

Panoramic view of Rattlesnake AST filled with fresh water for hydrostatic testing.

View southwest of Ragin Cajun AST

Lay flat hoses to transport produced water between ASTs. These same style of hoses will be used to transport produced water to hydraulic stimulation of individual wells.

Photograph of 40-mil secondary liner (bottom), 200-mil geogrid drainage system with attached geotextile beneath and over the grid. This leak detection system extends about 4-feet beyond the walls of the AST.

Appendix B
Generic Plans for Temporary MWFM Pits

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Albuquerque, NM 87104

Design and Construction Plan (19.15.17.11 NMAC)

The modular impoundment system is constructed from A-36 carbon steel wall sheets (1/4" thickness) and is engineered to withstand the hydrostatic pressures exerted downwards and outwards by the weight of the fluid when full. The wall sheets are connected with A-36 carbon steel connecting plates (1-1/4" thickness). The wall sheets are connected to the connecting plates with pins. The double 40 mil LLDPE primary liner is then clamped to the top of these walls leaving an extra liner material hanging outside of the modular impoundment to provide a safety margin. The operation and set-up procedure as provided by the manufacture is documented in Appendix C. Appendix D contains the modular impoundment's engineered drawings and specifications. Plate 1 shows a schematic of the modular impoundment's primary liner, secondary liner, geotextiles, geonet and secondary containment placement.

Prior to installation, the production pad will be prepared to make it smooth and free of rocks. A minimum of 10 oz. per square foot nonwoven geotextile material from SKAPS Industries (product GT110; see Appendix E for specifications) shall be placed between the production pad and the liner of the modular impoundment to prevent liner rupture or tear from the underlying pad.

The modular impoundment capacity is 42,000 barrels (bbls). The modular impoundment will be constructed according to manufacturer's specifications as described in the below section titled *"Design and Construction"*. The modular impoundment is engineered to prevent contamination of fresh water and protect public health and the environment.

Stockpiling of topsoil

The modular impoundment shall be constructed on an existing production pad at Rattlesnake 13 12 Federal Com 1H. No additional surface disturbance shall occur. After modular impoundment closure, the production pad will remain in-place until proper abandonment of the production well.

Signs

The operator shall post an upright sign not less than 12 inches by 24 inches with lettering not less than two inches in height on the fence at the entrance(s) to the pit. 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.

Fencing

As described in below section titled *"Design and Construction"*, the modular impoundment is constructed with 12-foot high steel walls. In lieu of fencing to prevent unauthorized access and exclude entry of livestock, the modular impoundment's steel 12-foot high walls will be used as an alternative to fencing. The operator concludes that the 12-foot high steel walls are superior to fencing.

Liner

The primary liner will consist of two 40-mil LLDPE geomembrane liners (see Appendix F for specifications). These two liners acting as the primary liner will extend up the steel walls and overhang the top approximately 2-feet. The secondary liner will consist of a 40 mil liner. The secondary liner will be placed underneath the modular tank and extend out 20-feet to the secondary containment berms.

The geomembrane liners are composed of an impervious, synthetic material that is resistant to petroleum hydrocarbons, salts and acidic and alkaline solutions. The liner material is resistant to ultraviolet light. Liner compatibility complies with EPA SW-846 method 9090A or equivalent as specified in Appendix F.

A 10 oz. per square foot nonwoven geotextile will be placed between the production pad and the secondary liner, at inner joints pinch-points, and where a liner could either have direct contact with the wall sheets or become pinched between walls and/or the walls and the ground, including the clamps holding the liner to the top of the modular impoundment.

The operator will minimize liner seams and orient them up and down, vertically across the wall sheets, when possible. The operator will use factory welded seams where possible. Prior to field seaming, the operator will overlap liners four to six inches and orient seams vertical, up and down the wall sheets.

Engineered fill and draw line mounts are provided with the modular impoundment. The mounts protect the liner from fluid force or mechanical damage at any point of discharge into or suction from the modular impoundment.

Leak detection

The secondary 40-mil LLDPE geomembrane liner will be installed below the modular impoundment - extending 20 feet from the steel walls and creating an impermeable seal with the secondary containment berm. The secondary liner will go over the containment berm and anchor to the exterior berm wall. A geonet drainage mat (see Appendix G for specifications) will be installed between the primary and secondary liner for leak detection. The geonet will extend past the steel walls by a few feet. The modular impoundment will rest on top of the geonet. Leak detection will be monitored within the secondary containment. See Plate 1 for schematic.

Secondary Containment

Plastic containment berms (see Appendix H for specifications) will be placed 20-feet from the steel wall sheets (see schematic on Plate 1). The berms of the secondary containment will be 24” in height. As discussed above, the 40-mil secondary liner will be placed underneath the modular impoundment- creating an impermeable barrier between the modular impoundment and the underlying soil. The secondary liner will go up and over the containment berm and anchor to the containment berm’s exterior wall. A nonwoven geotextile material will be placed between the production pad and the secondary liner to prevent liner rupture or tear from the underlying pad. Leaks in the primary liner will be detected within the secondary containment 20-foot buffer between the steel walls and the secondary containment berm.

The secondary containment berm around the modular impoundment will also prevent surface water run-on/off associated with the modular impoundment.

Operational Plan (19.15.17.12)

General Specifications

The operator will maintain and operate the modular impoundment according to manufacturer's operating manual and as described below.

The operator will maintain and operate the modular impoundment 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. Solids, other than blow-sand, are not expected to accumulate in the modular impoundment.

The operator will not discharge into or store any hazardous waste in the modular impoundment other than produced water used for well stimulation.

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 (19.15.29 NMAC) within this same 48 hours of the discovery and repair the damage or replace the liner.

The operator will install and use a pick up/discharge tubes, as shown in the modular impoundment's engineered drawings (Appendix D), in order to prevent damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes during injection or withdrawal of liquids.

The operator will inspect and remove, as necessary, surface water run-on accumulated in the secondary containment. No surface water run-on is expected due to the 24-inch high secondary containment berms.

The operator will only discharge conditioned produced water or fresh into the modular impoundment.

The operator will verify that no oil is on the modular impoundment surface. If oil is observed, the oil shall be removed using an absorbent boom or other device and properly disposed at an approved facility.

The operator will maintain the modular impoundment free of miscellaneous solid waste or debris.

The operator will maintain at least 2-feet of freeboard in the modular impoundment, except under extenuating circumstances, which will be noted on the inspection log as described below.

Thus, at no time will the volume of fluid in the modular impoundment exceed 35,973 barrels; the capacity of safe use of the modular impoundment for conditioned produced water assuming 1.7 feet of freeboard.

The operator will remove all free fluids from the modular impoundment within 60 days from the date the release of the workover/stimulation rig associated with the last well stimulated. The operator will note the date of this release upon Form C-105 or C-103 upon well completion. The operator may request an extension up to two months from the division district office as long as this additional time does not exceed the modular impoundment life span.

Monitor, Inspection, and Reporting

Between well stimulations, the modular impoundment will contain enough produced water to hold down the liner. Weekly inspections shall occur when there is 1-foot depth or more of produced water in the modular impoundment. Monthly inspections shall occur when there is less than 1-foot depth of produced water in the modular impoundment. An inspection log will be maintained by the operator.

Monitoring and Inspection Checklist:

- Visually inspect the liner. If a liner's integrity is compromised, or if any penetration of the liner occurs above the water surface, then the operator will notify the appropriate Division district office within 48 hours (phone or email).
- Inspect the system for injection or withdrawal of liquids from the modular impoundment and document that the design prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes is working appropriately (see Design and Construction Plan for data relating to this equipment).
- Inspect the modular impoundment water surface for visible oil.
- Measure the freeboard.
- Inspect the secondary containment berm around the modular impoundment to check for erosion and collection of surface water run-on.
- Measure H2S concentrations on the down-wind side of the modular impoundment when produced water is present
- Inspect the secondary containment for evidence of damage and monitor for leakage.
- Inspect the netting for damage or failure. If netting is jeopardized, repair of the netting shall occur within 48 hours.

Closure Plan (19.15.17.13)

The modular impoundment is 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 not commence closure without first obtaining approval of the closure plan submitted with the C-144 application.

Closure Notice

The operator will notify the NMOCD 48-hours prior to closure activities. To allow for review time and site inspection, the operator will notify the Division's District office at least 30 days prior to cessation of operations and provide a proposed schedule for closure. The operator will close the modular impoundment within 60 days of cessation of operation of the modular impoundment in accordance with the proposed closure plan.

At least 72 hours, but not more than one week, prior to any closure activities, the operator will notify the surface owner (Bureau of Land Management) by certified mail, return receipt requested. This notice will include the project name and location description.

Excavation and Removal Closure Plan – Protocols and Procedures

1. If re-use of any residual fluids in the modular impound is not possible, the fluids will be sent to disposal at a division-approved facility.

2. The operator will remove all solid modular impoundment contents and transfer those materials to the following division-approved facility:
   Disposal Facility Name: R360 Permit Number NM 01-0006

3. If possible, modular impoundment geomembrane textiles and liners that exhibit good integrity may be recycled for use as an underliner of tank batteries or other use as approved by OCD.

4. Disassemble the modular impoundment infrastructure according to manufacturer's recommendations

5. After the disassemble of the modular impoundment and removal of the contents and liners, soils beneath the modular impoundment will be tested as follows
   a. Collect a five-point (minimum) composite from beneath the modular impoundment liner to include any obviously stained or wet soils, or any other evidence of impact from the modular impoundment for laboratory analyses for the constituents listed in Table I of 19.15.17.13 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.

If all constituents' concentrations are less than or equal to the parameters listed in Table I, then the operator will proceed to reclaim the surface to pre-existing conditions.

Closure Documentation

Within 60 days of closure completion, the operator will submit a closure report to the District Division, with necessary attachments to document all closure activities are complete, including sampling results.

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 approved closure plan.

Reclamation and Re-vegetation

The operator will reclaim the surface to safe and stable pre-existing conditions that existed prior to the construction of the modular impoundment. Pre-existing conditions is a caliche well pad that supports active oil and gas operations.

For all areas disturbed by the closure process that will not be used for production operations or future drilling, the operator will

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

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 surface grading work element of reclamation is complete.

Appendix C
Pinnacle Operations Manual

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

Pinnacle Manufacturing, LLC

Pool Tank

Operations Manual

Contents

1. Overview

Congratulations on the purchase of your pool tank from Pinnacle Manufacturing, LLC. The tanks are fully engineered and designed to enable customers to store large volumes of fluids for fracking, construction, environmental or waste water operations *(see* Section 2, Designed Fluid Weight). The tanks are not intended to replace mobile storage tanks but will significantly reduce the number of tanks used in traditional applications. The pool tank saves time in setup and fuel costs in transporting to/from the site, as well as diminishing the environmental impact by reducing truck traffic and leaks associated with connecting multiple tanks on the tank battery.

Setting up the pool tank is a quick and straightforward exercise. Once a location is selected and the site prepared by grading and compacting the surface, underlayment pads are traditionally used as the base for the tank walls. Many operators mark the pad with an outline of the diameter of the tank(s) to allow the setup crew to see where the wall sections need to be placed easily. Trenches are also often dug at this time to capture fluids associated with any minor leaks in the tank liners. Temporary supports are used to hold up the first several panels until enough of the tank is built to allow it to support itself.

Panels are held together using connecting plates that are 'pinned' together with the supplied hardware. The telehandler mast attachment can manipulate the panels in most cases to allow the pins to drop in place easily, making pin installation a snap.

Many customers start hanging the liner next (once temporary supports are removed) using the included liner clamps. Three (3) liner clamps are used for every panel of the pool tank. They are installed at the top of the panels around the perimeter of the tank, except where the draw line(s) will be installed. The heavy weight of the draw lines and accessories require that they be set directly on the top of the panel.

Standard components included with the kits include:

- One (1) entry / observation stair and platform
- One (1) exit ladder
- Liner clamps (number varies with tank size)
- Felt retainers

Optional accessories include:

- Panel manipulator plate (telehandler mast attachment)
- Temporary support legs
- 4" fill pipes
- 4" recirculation lines with three-tier nozzles
- 8" external draw line

2. Specifications

Tanks are offered in three primary configurations, but several other sizes are engineered and ready for
production. Specifications for the three primary tanks are as follows:

- 10,000/24,000 and 42,000 bbl. capacities available
- 13 to 26 modular panels-12' tall by ~20' long weighing approximately 5,100 lbs.
- Engineered overlapping connection plates, 6-pin system
- 1-1/4 connection plates with pins
- One (1) entry / observation stair and platform
- One (1) exit ladder
- Liner clamps (number varies with tank size)
- Felt retainers
- SP-6 Commercial Blast
- External and internal paint, customer color choice

Optional accessories include:

- Panel manipulator plate (telehandler mast attachment) For use with minimum 10,000 lb. rated telehandler such as Lull, CAT, or JLG
- 4" fill pipes
- 4" recirculation lines with three-tier nozzles
- 8" external draw line
- Six (6) 4" temporary panel supports
- Additional entry/exit ladder(s)

Materials:

- All pool tanks are constructed with:
  - A-36 carbon steel wall sheets (1/4" thickness)
  - ASTM A500 grade B 4"x4" and 3”x3” exterior tubing (1/4" thickness)
  - A-36 connecting plates (1-1/4" thickness)

Designed Fluid Weight

All pool tanks are designed for use with fluids that are 62.4 pounds per cubic foot or lighter. Exceeding this specification for fluid weight at full tank capacity (11.5') could lead to a major structural failure at the connection plate(s).

3. Storing and Transporting Panels

Panels for the pool tank are designed to form a circle, the diameter of which will hold the stated capacity when filled to 11.5 feet. Each panel has its own unique 'curvature' that when fully assembled forms a perfect circle. As such, panels should never be swapped, modified or used in any other manner than the original design. The panels are not interchangeable (from one size to another) and cannot be used to form larger or smaller diameter pools.

The benefit of this design is that panels are stackable, limited only by height restrictions on US highways (13' 6") or by the maximum height of the telehandler on the yard. In most cases, the panels associated with the most popular BPTs (10,000, 24,000 and 40,000 bbl.) may be transported on three flatbed trucks by stacking up to six panels on each trailer.

4. Site Preparation

Site preparation to install a pool tank is largely driven by the diameter of the tanks. Following is a table showing diameters for the various sizes offered by Pinnacle Manufacturing. Insure that the site is cleared of debris and flat.

- 10,000 Barrels: 80' diameter
- 24,000 Barrels: 121' diameter
- 42,000 Barrels: 158' diameter

The site for a pool tank must be level with a 30' buffer (e.g., more than the diameter of the tank) to allow sufficient room to move the telehandler installing the panels. The site must be leveled to install the tank. The flat ground surface must be prepared to withstand 3000 pounds per square foot net soil pressure. While not mandatory, it is best to compact the pool tank site to minimize settling once filled.

Customers should ensure the surface is smooth enough to lay down the tank's pad without any sharp objects pointed upward.

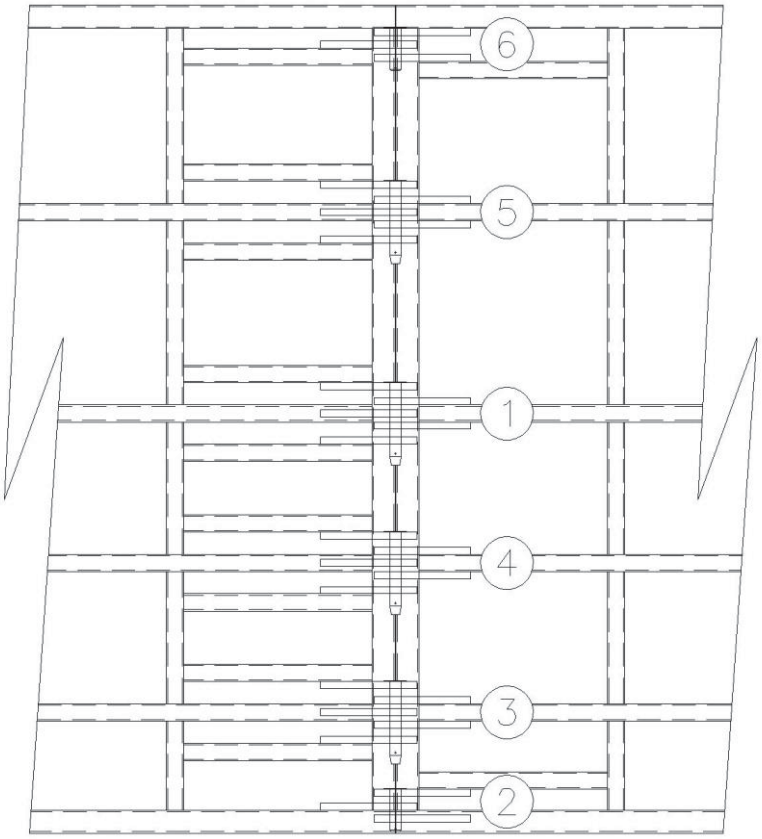
- Pool tank should only be placed on stable, level, compacted (ideally) soils on the cut side of a site, never the fill side

5. Setting Up The Panels

Once the site is ready, the pad should be placed on the site, marked at the center point and marked for the diameter for the tank to make setting the panels easy. Temporary supports should be used once the first panel is erected to ensure it remains stable.

As the panels are moved from the truck to the site, personnel should be ready with ladders, dead blow hammers and pins to assemble and secure the panel connecting plates. The telehandler will position the panel to allow the connecting plates on the end of the panel to alien the adjoining panels connecting plate such that the thru holes are centered on one another. 6 pins should be used to join panels at connecting points. The picture below shows pins with latch pins secured.

- The pins should be installed following order.



- All 6 pins must be installed in each panel before starting the next panel.

Tools needed to set up a pool tank include:

- 3/4" deep socket and ratchet for the liner clamps and most accessories
- Wrenches in various sizes, mainly 3/4"
- Telehandler on location
- Hammers
- 10' ladder
    - Only needed without the Panel manipulator, at least two long chains, 15' x3/8" DOS alloy chain sling, rated for 15,000 lbs. at 60 degrees

6. Installing the Liner with Pinnacle Manufacturing Clamps

Pinnacle Manufacturing's pool tanks come as a complete kit except for the pad (lies under the tank) and inner liner (that comes into contact with fluids). There are a number of companies offering the pads and liners with several options shown in Appendix B.

Installing the tank liner may seem like a straightforward process. However, liner manufacturers offer a variety of different types, and special care must be taken to avoid both weakening the liner when unfolding it for installation and creasing it when folding up to put away. Pinnacle Manufacturing strongly suggests that the customer request training directly from the liner manufacturer to better understand the process, cautions, limitations (heat/caustics) and weather impact.

To prevent pinching the liner, ¼" X 12" X 168" felt padding should be placed over the inside joints of the panel and secured with the provided felt retainers.

Pinnacle Manufacturing provides unique liner clamps with each pool tank. The number of clamps varies with the size of the tanks (e.g., the diameter). The clamps are easy to adjust and can be tightened with standard ratchets. Once the liner is pulled up/over the top of the panel, the clamps can be dropped in place and the bolts tightened to ensure the liner remains in place. Note that the fill and draw lines are designed to fit on top of the panel, not the liner clamps.

7. Precautions

Customers should strictly abide by the following precautions:

- Fluids to be used with the pool tank should never exceed the design standard of 8.333 lb. /gal.
- Pool tank should only be placed on stable, level, compacted (ideally) soils on the cut side of a site, never the fill side.
- Drivers should be reminded to unhook all hoses from suction lines before leaving the location.
- Customers should carefully follow the manufacturer's procedures for installing and packing up the flexible pads and liners, as they can become damaged either by being stretched or creased
  during installation or while being folded up to move to the next location.

8. Customer Care/Helpline

Pinnacle Manufacturing gladly offers onsite training for customers purchasing pool tanks, allowing crews to become efficient in setting up and disassembling the tanks. See your sales representative for more information. Pinnacle Manufacturing further encourages customers to contact the pads and liner manufacturers to arrange for onsite assistance and training to ensure the longest useful life of these items. Should customers experience any problems or need replacement parts or additional accessories, they may call 256-840-8031 and ask for the Pinnacle Manufacturing sales department.

9 . Appendix B: Pad/Liner Vendors

Colorado Lining International
Chris Trevino
28043 FM 1485 East
New Caney, TX 77357
Phone: 303.951.5938
Email: ctrevino@coloradolining.com
Web: www.coloradolining.com

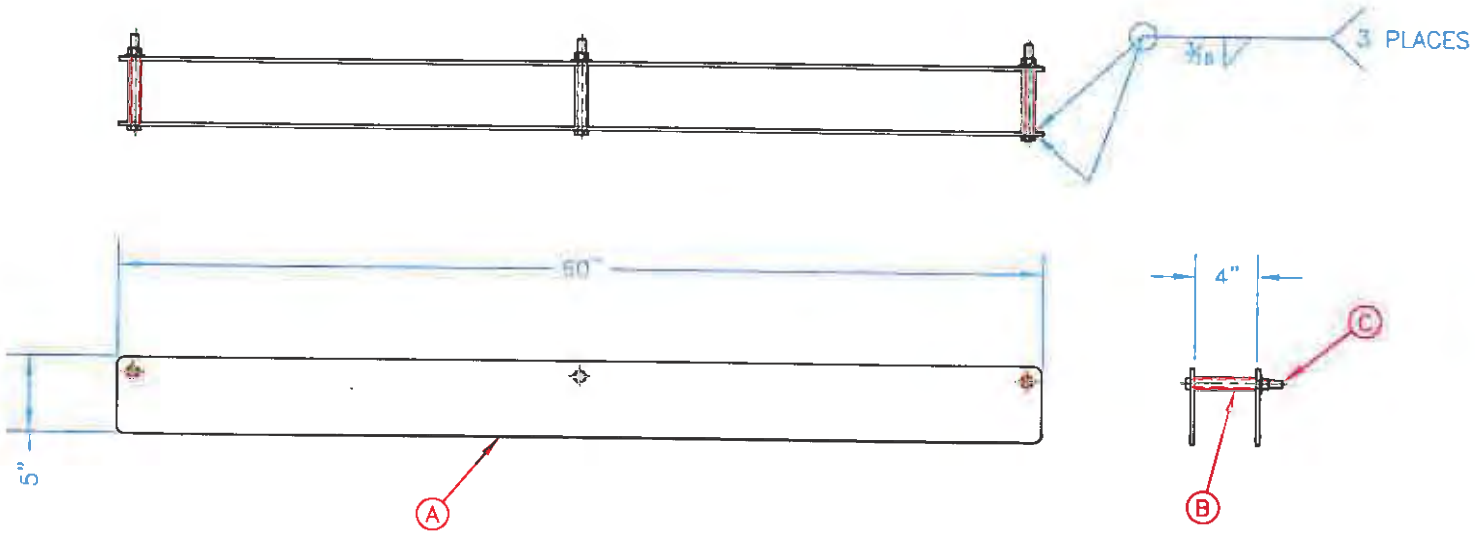
Layfield Environmental Systems
Stephen Valero
1166 Fesler St, Suite B
EI Cajob, CA 92020
Phone: 404.557.5884
Email: svalero@layfieldgroup.com
Web: www.layfieldgroup.com

GSE Lining Technology, Inc.
Mike Odom
19103 Gundle Road
Houston, TX 77073
Email: todom@gseworld.com
Web: www.gseworld.com

Appendix D
Pinnacle Engineering Drawings and Specifications

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

NO	DESCRIPTION	PART NO	QTY.	WT
A	PL 1/4" x 5" x 60" BURNOUT		2	
B	PIPE 1/2" SCH40 x 4" LG.		3	
C	BOLT Ø1/2" x 6" LG. c/w F.W. & LOCKNUT		3	



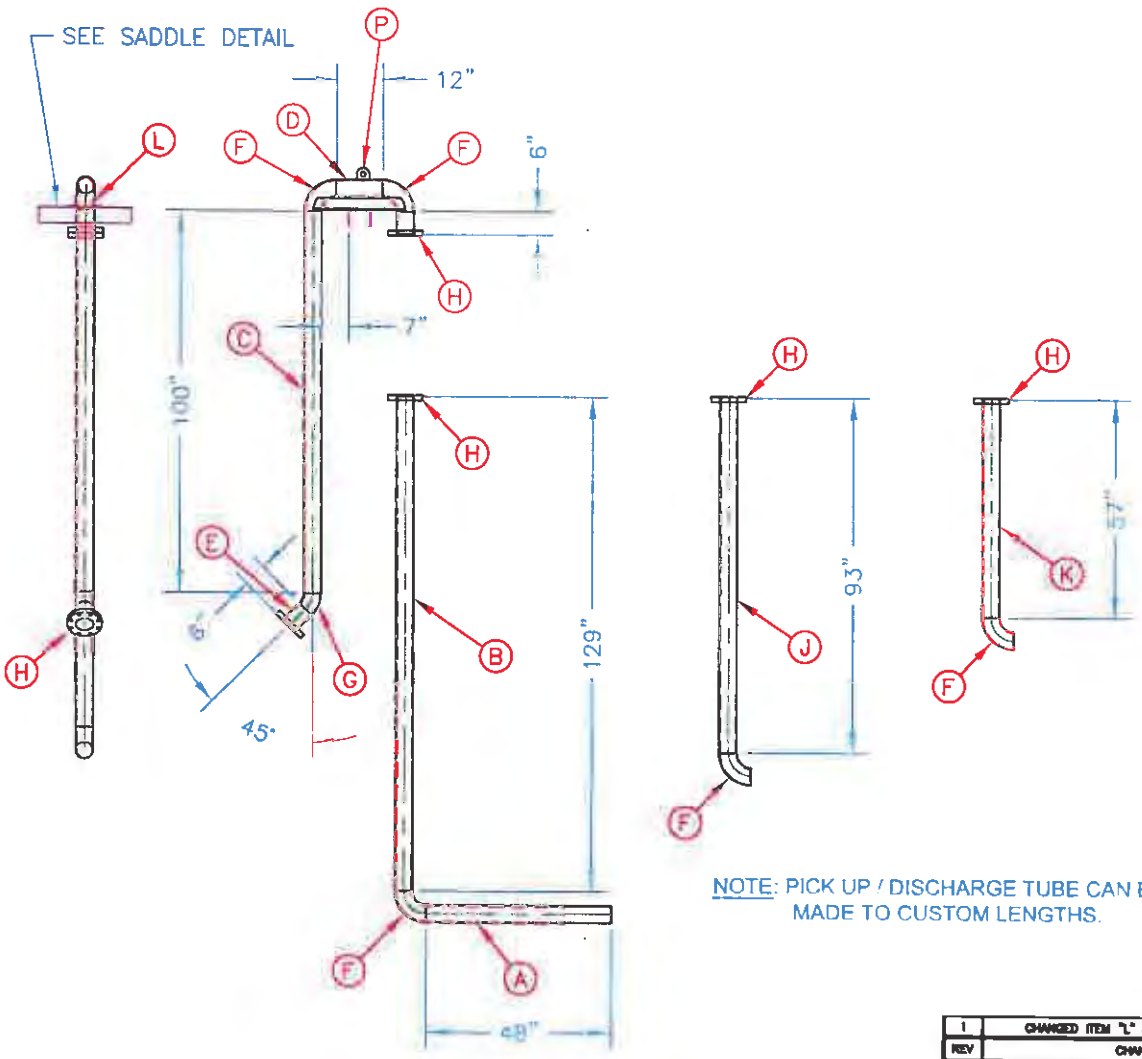
ALABAMA REGISTERED No. 42675 PROFESSIONAL ENGINEER TROY MICHAEL OLIVER

2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz Alabama 35957
Telephone 256 840-8031

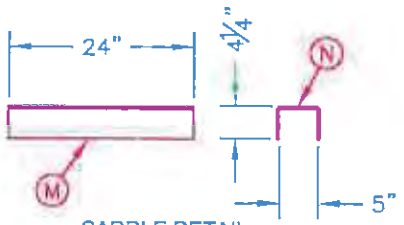
Liner Clamp Detail
Pool Tank

B



NO	DESCRIPTION	PART NO	QTY	WT
A	PIPE 4" SCH10 x 48" LG.		2	
B	PIPE 4" SCH10 x 129" LG.		2	
C	PIPE 4" SCH10 x 100" LG.		4	
D	PIPE 4" SCH10 x 12" LG.		4	
E	PIPE 4" SCH10 x 6" LG.		4	
F	ELBOW 90° L.R. 4" SCH10		12	
G	ELBOW 45° L.R. 4" SCH10		4	
H	FLANGE SLIP-ON 150#		12	
J	PIPE 4" SCH10 x 93" LG.		1	
K	PIPE 4" SCH10 x 57" LG.		1	
L	L 3" x 2" x 1/4" x 24" LG.		8	
M	PL 1/4" x 4" x 24"		8	
N	PL 1/4" x 5" x 24"		4	
P	PL 1/2" x 3 1/8" x 3 1/4"		4	

MATERIAL REQ'D FOR (4) UNIT



SADDLE DETAIL

NOTE: PICK UP / DISCHARGE TUBE CAN BE MADE TO CUSTOM LENGTHS.

ALABAMA REGISTERED No. 42676 PROFESSIONAL ENGINEER LARRY MICHAEL OLIVER

2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-5031

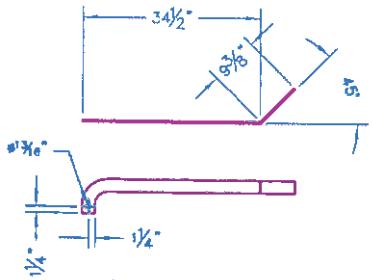
Cane Line Detail
Big Pool Tank

REV	CHANGE	ECN	DATE	BY
1	CHANGED ITEM "L" & PIPE TO SCH10		10-04-12	CES

REVISION

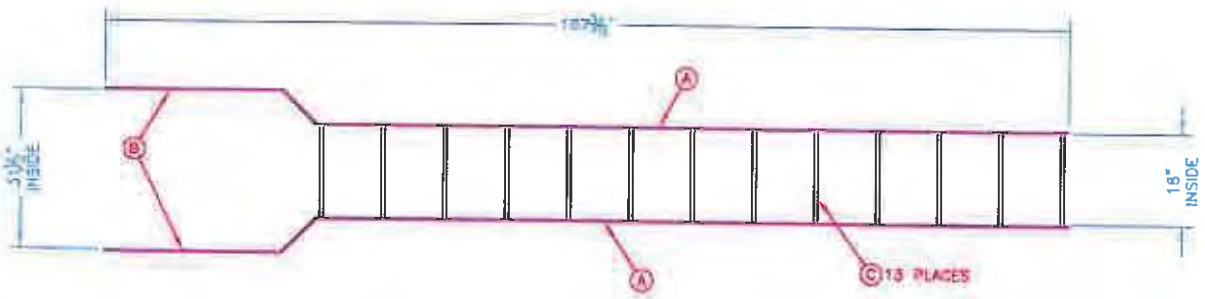
B

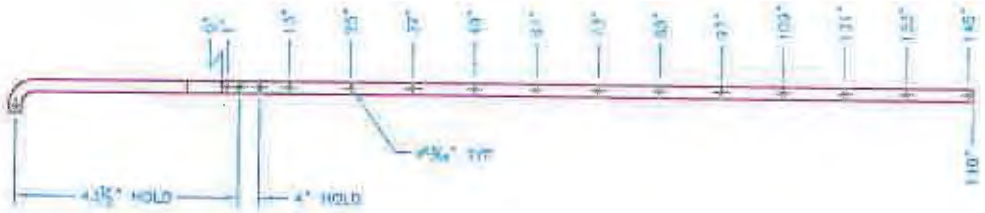
1



ITEM "B" DETAIL
(1) REQ'D AS SHOWN
(1) REQ'D OPPOSITE

A	F.B. 2 1/2" x 3/8" x 148" LG.		2	
B	PL 3/8" x 2 1/2" x 43 7/8" BURNOUT (SEE DETAIL)		2	
C	R.B. Ø3/4" x 18 1/2" LG		13	





ALABAMA REGISTERED
No. 12570
ENGINEER
JERRY MICHAEL OLIVER

2-16-2013

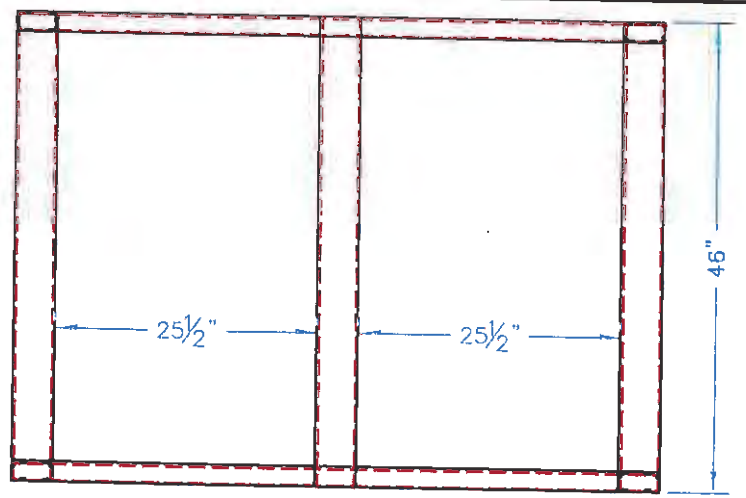
PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

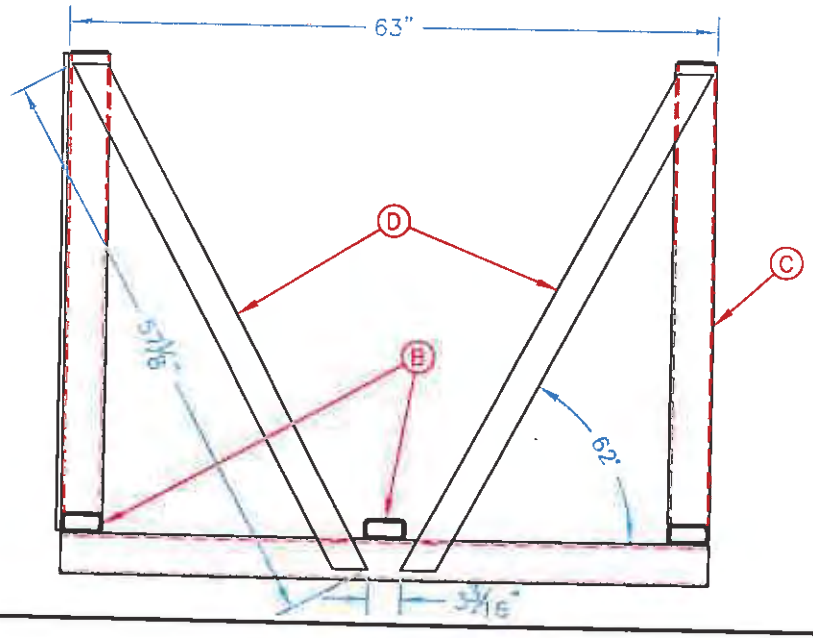
Ladder Detail
Pool Tank PT-42

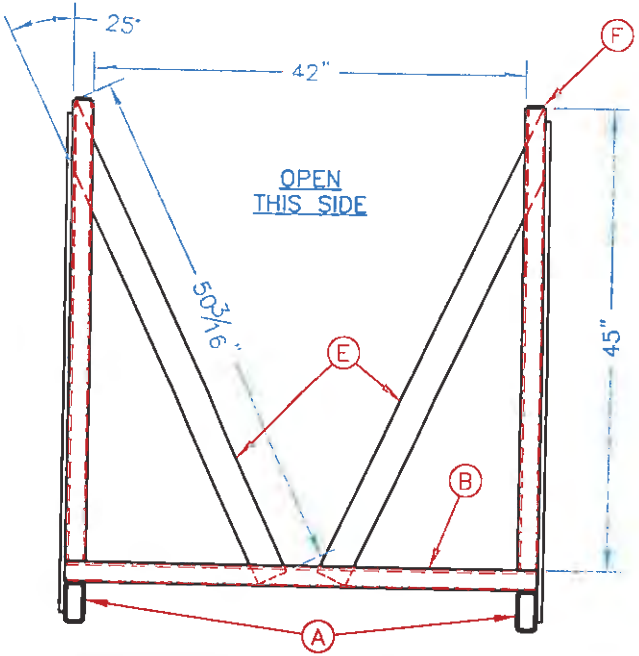
REV	CHANGE	ECN	DATE	BY

REVISION

B







NO	DESCRIPTION	PART NO	QTY	WT
A	TUBING 4" x 2" x 1/4" x 63" LG.		2	
B	TUBING 4" x 2" x 1/4" x 46" LG.		3	
C	TUBING 4" x 2" x 1/4" x 45" LG		4	
D	F.B. 3" x 1/2" x 57 1/8" LG.		4	
E	F.B. 3" x 1/2" x 50 3/16" LG.		2	
F	1/4" PL CAP		4	

ALABAMA REGISTERED No. 12575 PROFESSIONAL ENGINEER JERRY MICHAEL OLIVER

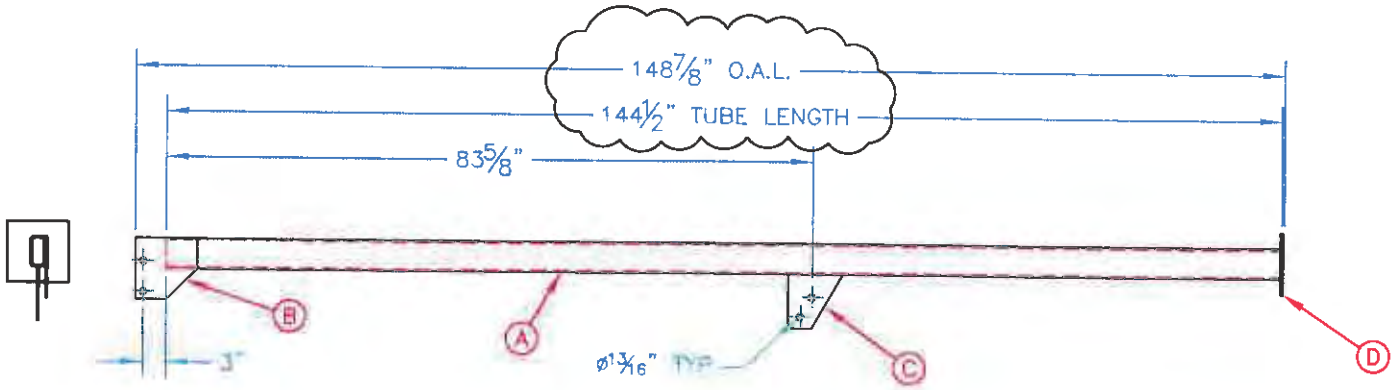
2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

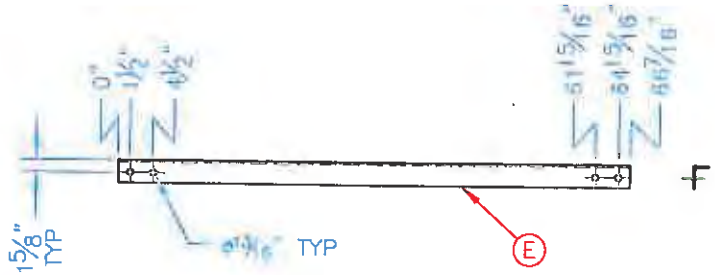
Liner Clamp Pallet Detail
PT-42 Pool Tank

B

NO	DESCRIPTION	BURN FILES	QTY	WT
A	TUBE 4" x 2" x 1/4" WALL x 144 1/2" LG.		1	
B	PL 1/4" x 8" x 8" BURNOUT	POOL TANK PLATFORM PARTS	1	
C	PL 1/4" x 7" x 7" BURNOUT	POOL TANK PLATFORM PARTS	1	
D	PL 3/8" x 6" x 6"		1	
E	L 3" x 2" x 1/4" x 66 7/16" LG.		1	



COLUMN DETAIL



KICK BRACE DETAIL

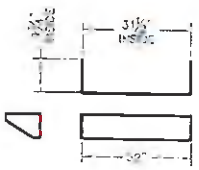
ALABAMA REGISTERED ENGINEER LARRY MICHAEL OLIVER

2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8001

Platform Support Column Detail
Pool Tank PT-42

B



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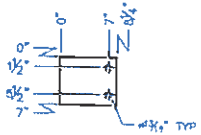
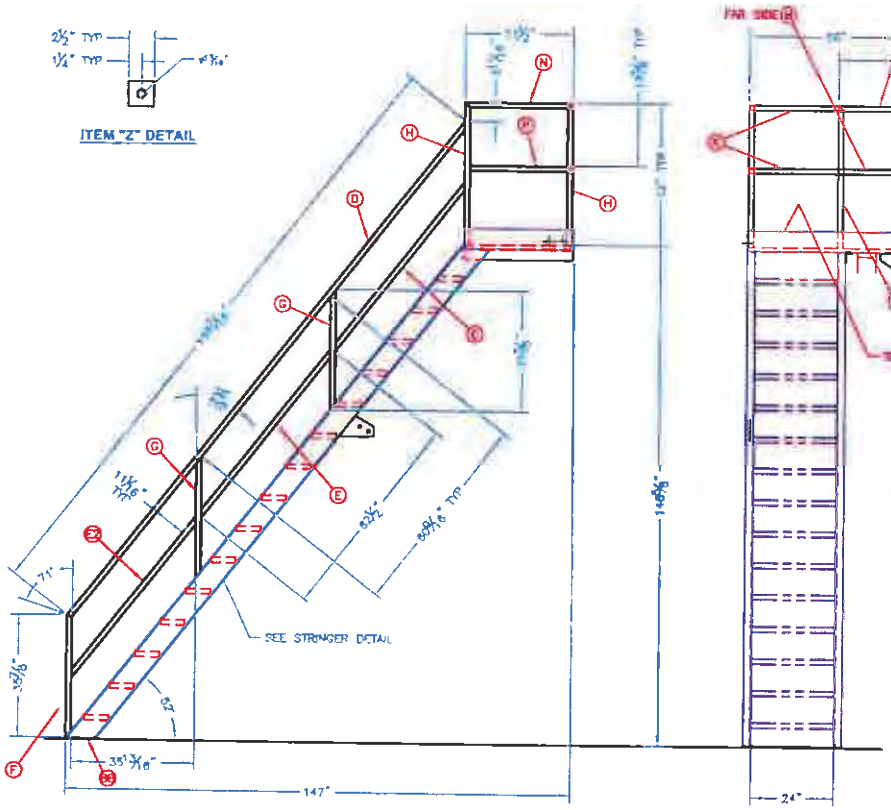
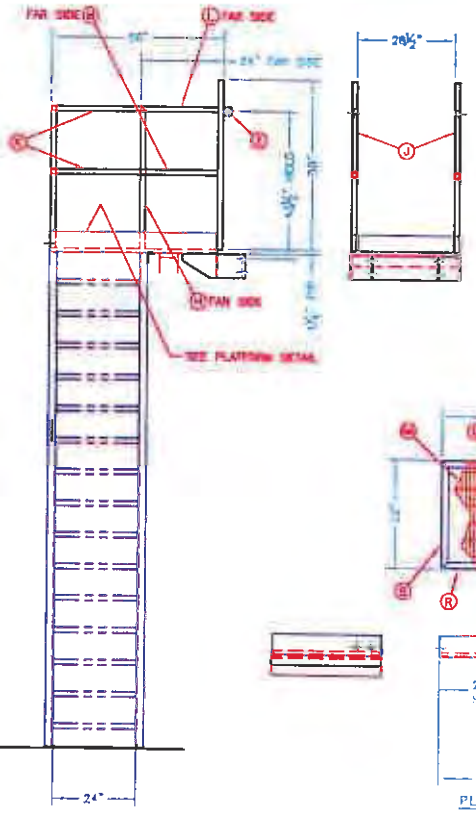


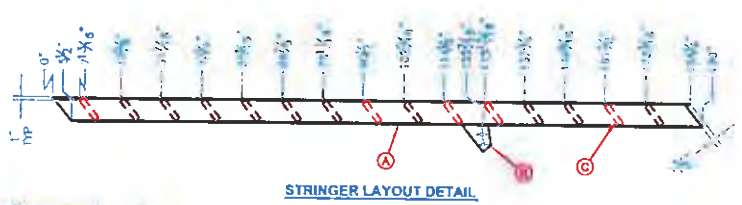
ITEM "Y" DETAIL

NO	DESCRIPTION	MATERIAL	QTY	WT
U	L 3" x 2" x 1/4" x 32" LG.		1	
V	PL 1/4" x 5" x 32"		1	
W	PL 1/4" x 8 7/8" x 32"		2	
X	PL 1/4" x 7" x 51" BURNOUT (SEE DETAIL)		1	
Y	PL 3/8" x 7" x 8 1/4" BURNOUT (SEE DETAIL)		3	
Z	PL 3/8" x 2 1/2" SQ. BURNOUT (SEE DETAIL)		2	
AA	GRATING 31" x 47 3/4"		1	
BB	PL 1/4" x 9" x 28 1/2"		1	

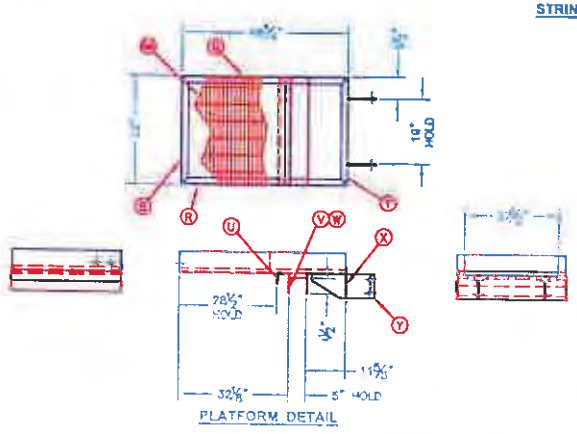
NO	DESCRIPTION	MATERIAL	QTY	WT
A	C7 x 9.86 x 180" LG.		2	
B	PL 1/4" x 7 5/8" x 7 3/4" BURNOUT		2	
C	GRIP STRUT 7" WIDE x 24"		15	
D	TUBE 1 1/2" SQ. x 11ga. x 186 7/16" LG.		2	
E	TUBE 1 1/2" SQ. x 11ga. x 82 1/2" LG.		4	
E2	TUBE 1 1/2" SQ. x 11ga. x 39 15/16" LG.		2	
F	TUBE 1 1/2" SQ. x 11ga. x 35 7/8" LG.		2	
G	TUBE 1 1/2" SQ. x 11ga. x 35 3/8" LG.		4	
H	TUBE 1 1/2" SQ. x 11ga. x 42" LG.		3	
J	TUBE 1 1/2" SQ. x 11ga. x 30" LG		2	
K	TUBE 1 1/2" SQ. x 11ga. x 47" LG		2	
L	TUBE 1 1/2" SQ. x 11ga. x 22 1/2" LG		1	
M	TUBE 1 1/2" SQ. x 11ga. x 21" LG.		1	
N	TUBE 1 1/2" SQ. x 11ga. x 31 1/2" LG.		1	
P	TUBE 1 1/2" SQ. x 11ga. x 28 1/2" LG.		1	
Q	PL 1/4" x 7 3/4" x 48 1/4" BURNOUT		1	
R	PL 1/4" x 7 3/4" x 48 1/4" BURNOUT		1	
S	PL 1/4" x 7 3/4" x 31 1/2" BURNOUT		1	
T	PL 1/4" x 7 3/4" x 31 1/2" BURNOUT		1	







STRINGER LAYOUT DETAIL



PLATFORM DETAIL

ALABAMA REGISTERED No. 12678 PROFESSIONAL ENGINEER LARRY MITCHELL OLIVER

2-16-2013

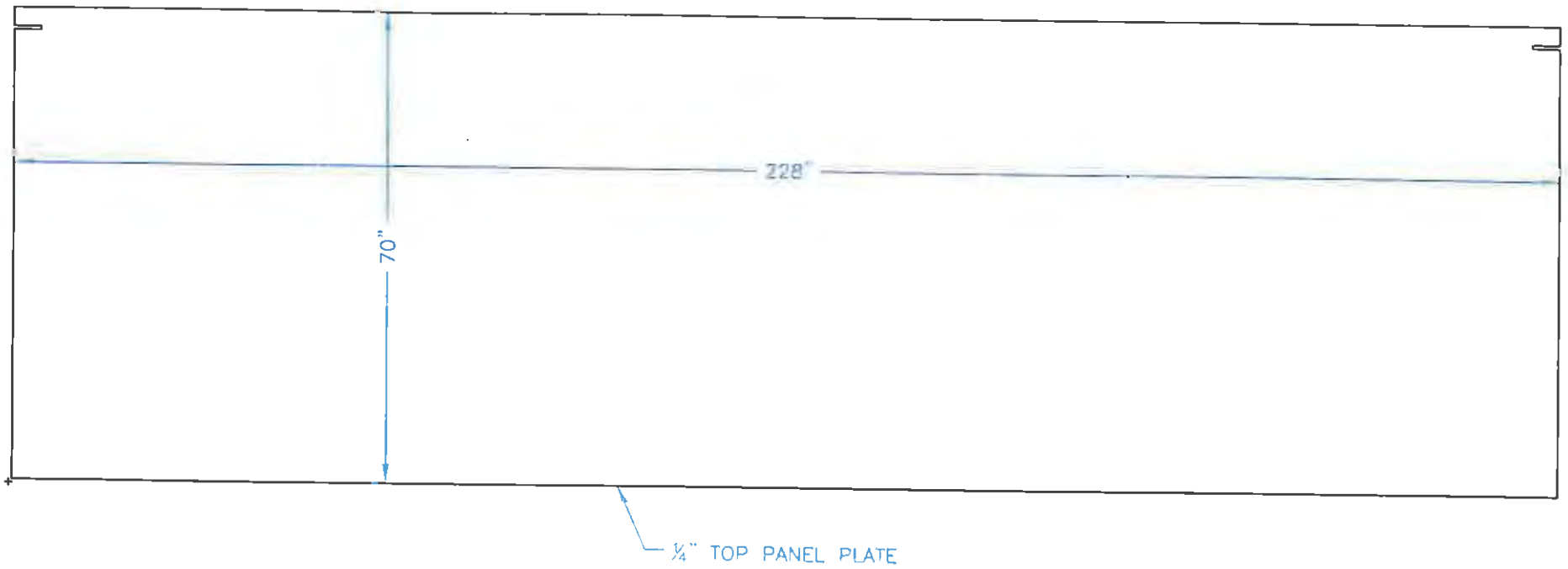
PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

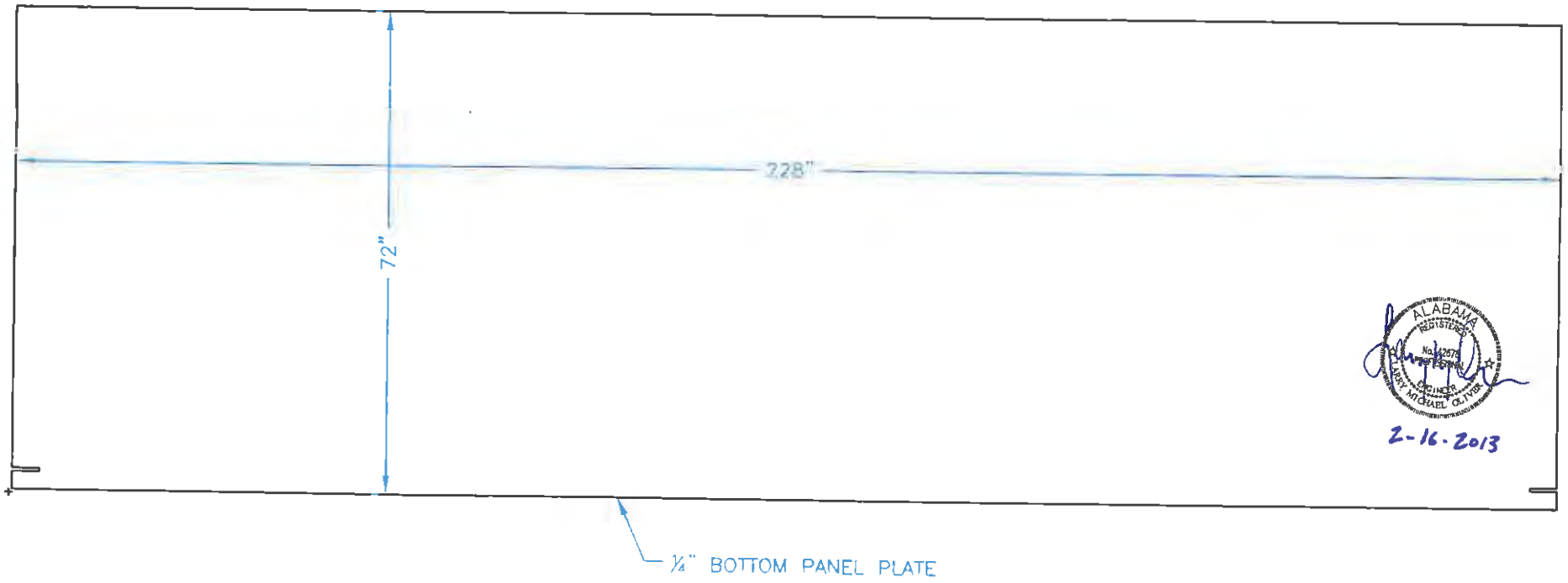
Stair & Platform Detail
Pool Tank PT-42

REV	DESCRIPTION	BY	CHK	DATE
	ORIGINAL			

REVISION

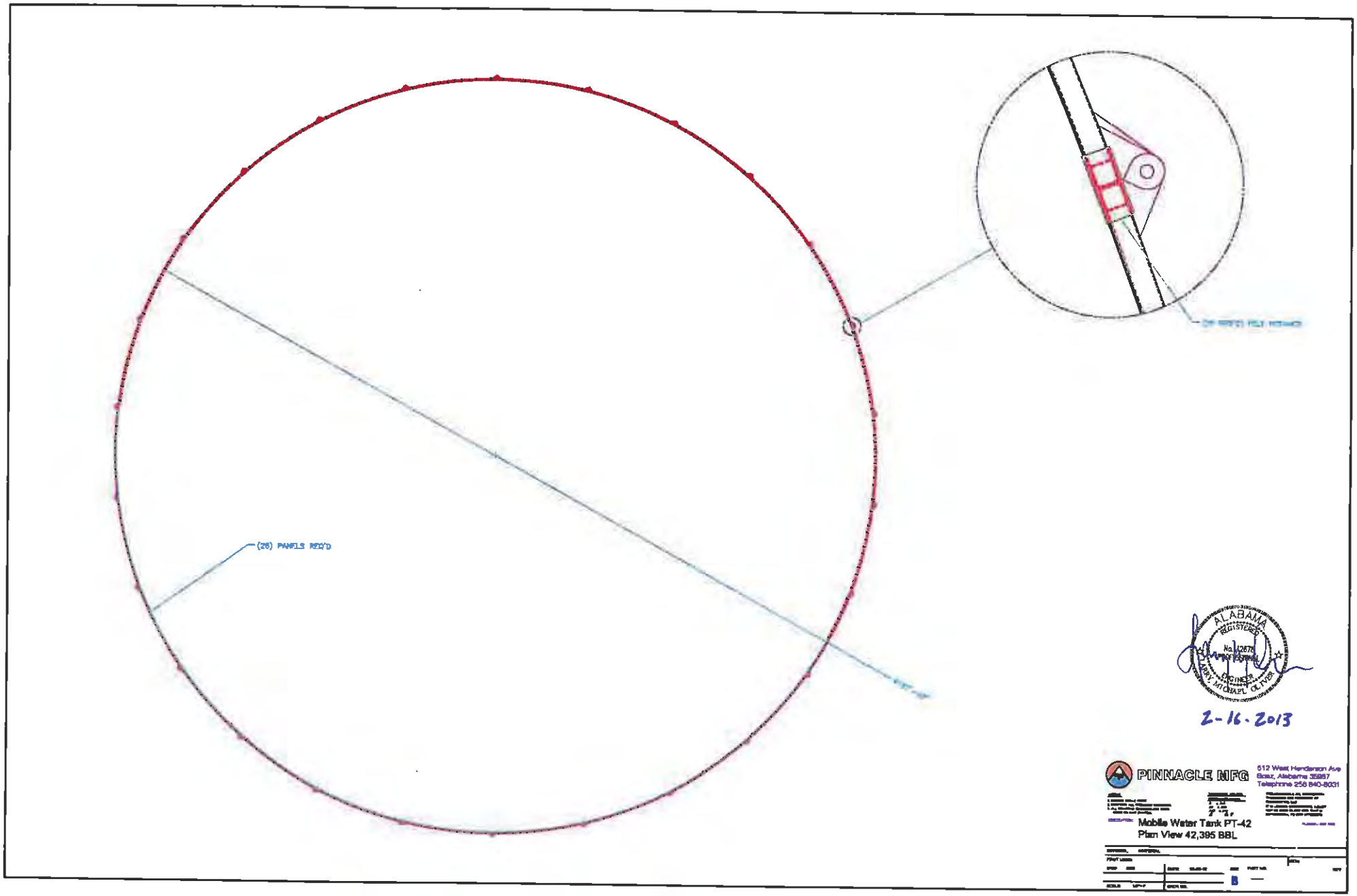
B





ALABAMA REGISTERED No. 12670 ENGINEER LARRY MICHAEL OLIVER

2-16-2013



ALABAMA REGISTERED No. 12678 ENGINEER JERRY MITCHELL OLIVER

2-16-2013

PINNACLE MFG

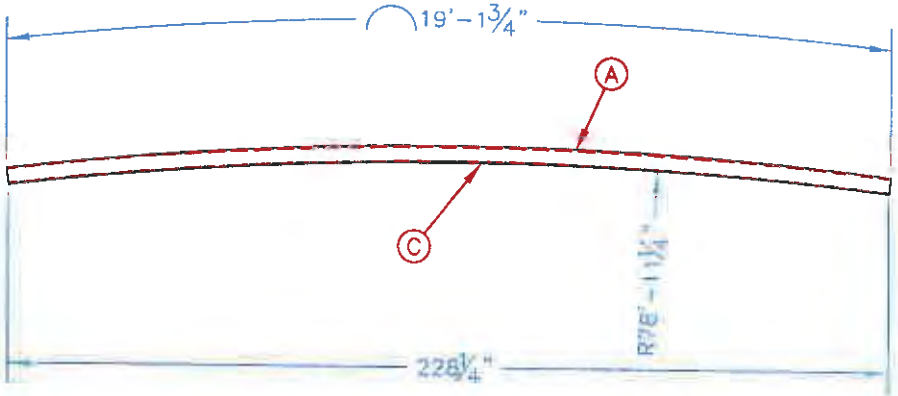
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

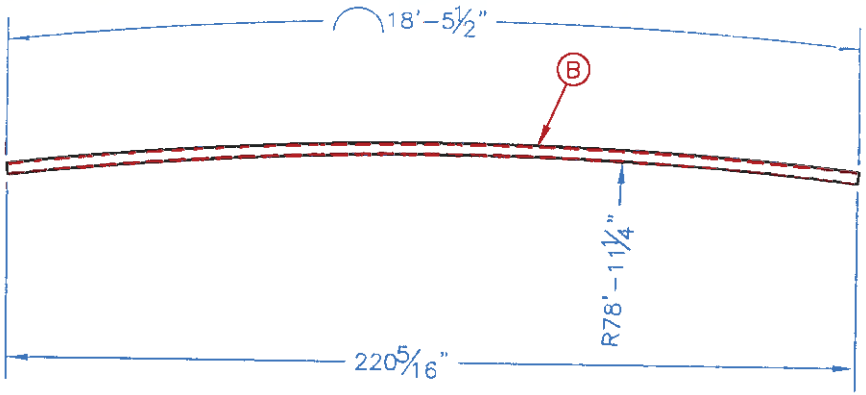
Mobile Water Tank PT-42
Plan View 42,395 BBL

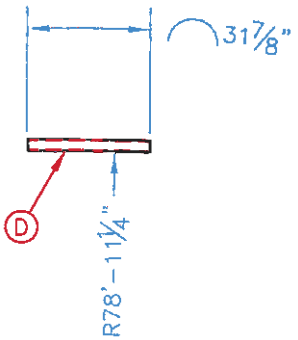
B

NO	DESCRIPTION	PART NO	QTY	WT
A	TUBE 4" SQ. x 1/4" WALL		2	
B	TUBE 3" SQ. x 1/4" WALL		4	
C	PL 1/4" x 72" x 228"		2	
D	TUBE 3" SQ. x 1/4" WALL		11	

MATERIAL REQ'D FOR (1) PANEL







ALABAMA REGISTERED PROFESSIONAL ENGINEER LARRY MICHAEL OLIVER

2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

Rolled Tube Detail
Pool Tank PT-42

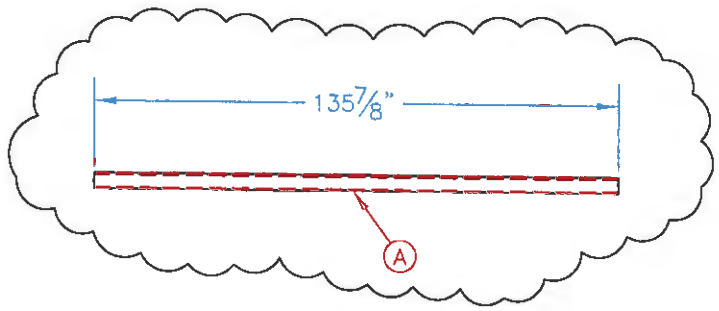
REVISION

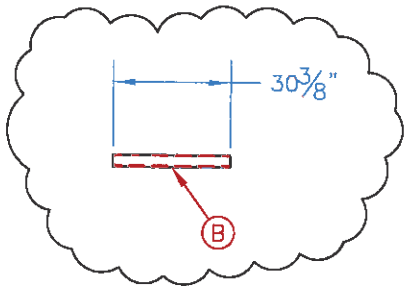
B

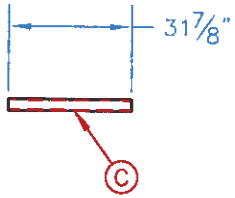
1

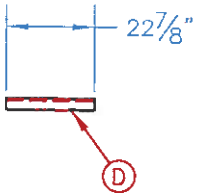
NO	DESCRIPTION	PART NO	QTY	WT
A	TUBE 4" SQ. x 1/4" WALL x 135 7/8" LG.		2	
B	TUBE 3" SQ. x 1/4" WALL x 30 3/8" LG.		2	
C	TUBE 3" SQ. x 1/4" WALL x 31 7/8" LG.		2	
D	TUBE 3" SQ. x 1/4" WALL x 22 7/8" LG.		5	
E	TUBE 3" SQ. x 1/4" WALL x 15 3/8" LG.		2	
F	L 3" x 3" x 3/8" x 33" LG.		2	

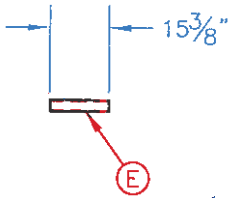
MATERIAL REQ'D FOR (1) PANEL

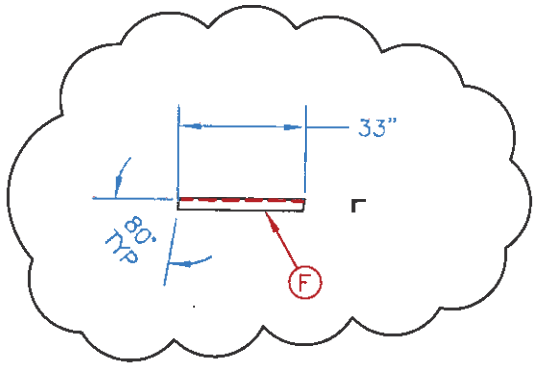












ALABAMA REGISTERED No. 32675 PROFESSIONAL ENGINEER LARRY MICHAEL OLIVER

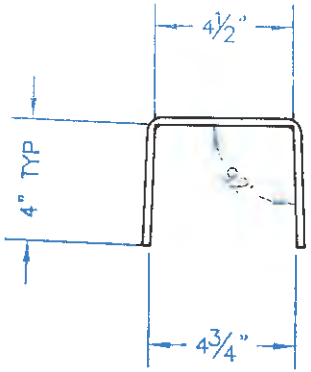
2-16-2013

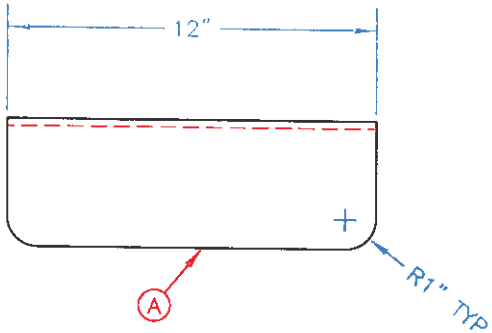
PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

Vertical Tube Detail
Pool Tank PT-42

2

NO	DESCRIPTION	PART NO	QTY	WT
A	PL 1/4" x 12" x 12 1/2"		26	





ALABAMA REGISTERED ENGINEER LARRY MICHAEL OLIVER

2-16-2013

PINNACLE MFG

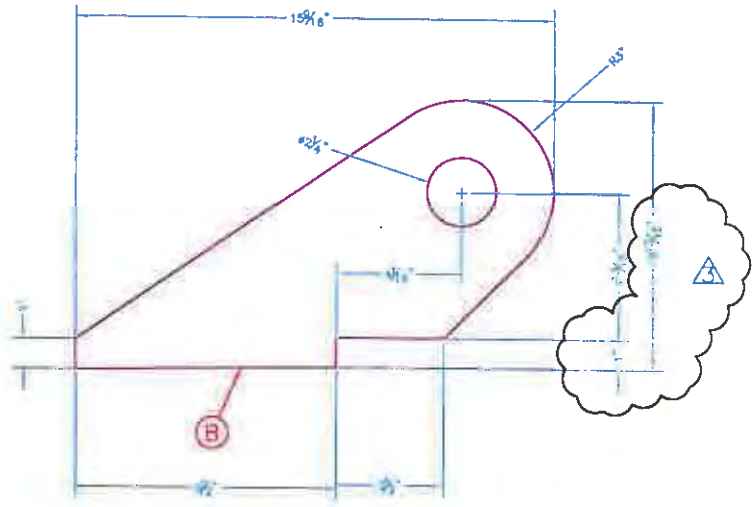
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

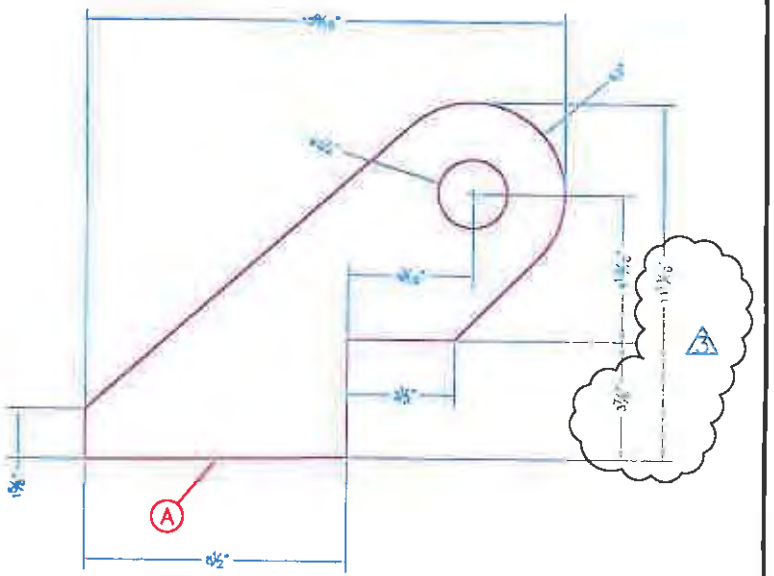
Felt Retainer - Pool Tank Detail

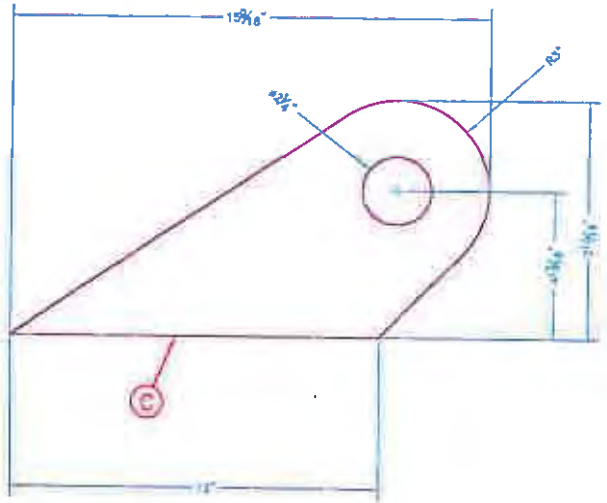
B

NO.	DESCRIPTION	PART NO	QTY.	WT
A	PL 1 1/4" x 11 13/16" x 18 9/16" BURNOUT		21	
B	PL 1 1/4" x 8 15/16" x 16 9/16" BURNOUT		4	
B	PL 1 1/4" x 7 13/16" x 15 9/16" BURNOUT		1	

MATERIAL REQ'D f/ (1) PANEL







ALABAMA REGISTERED No. 12578 PROFESSIONAL ENGINEER TROY MICHAEL OLIVER

2-16-2013

REV	CHANGE	ECN	DATE	BY
3	REVISED WHERE MARKED		11-26-12	CES
2	CHANGED QTY FOR ITEM "A"		11-05-12	CES
1	ADDED ITEM "C"		10-23-12	CES

REVISION

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

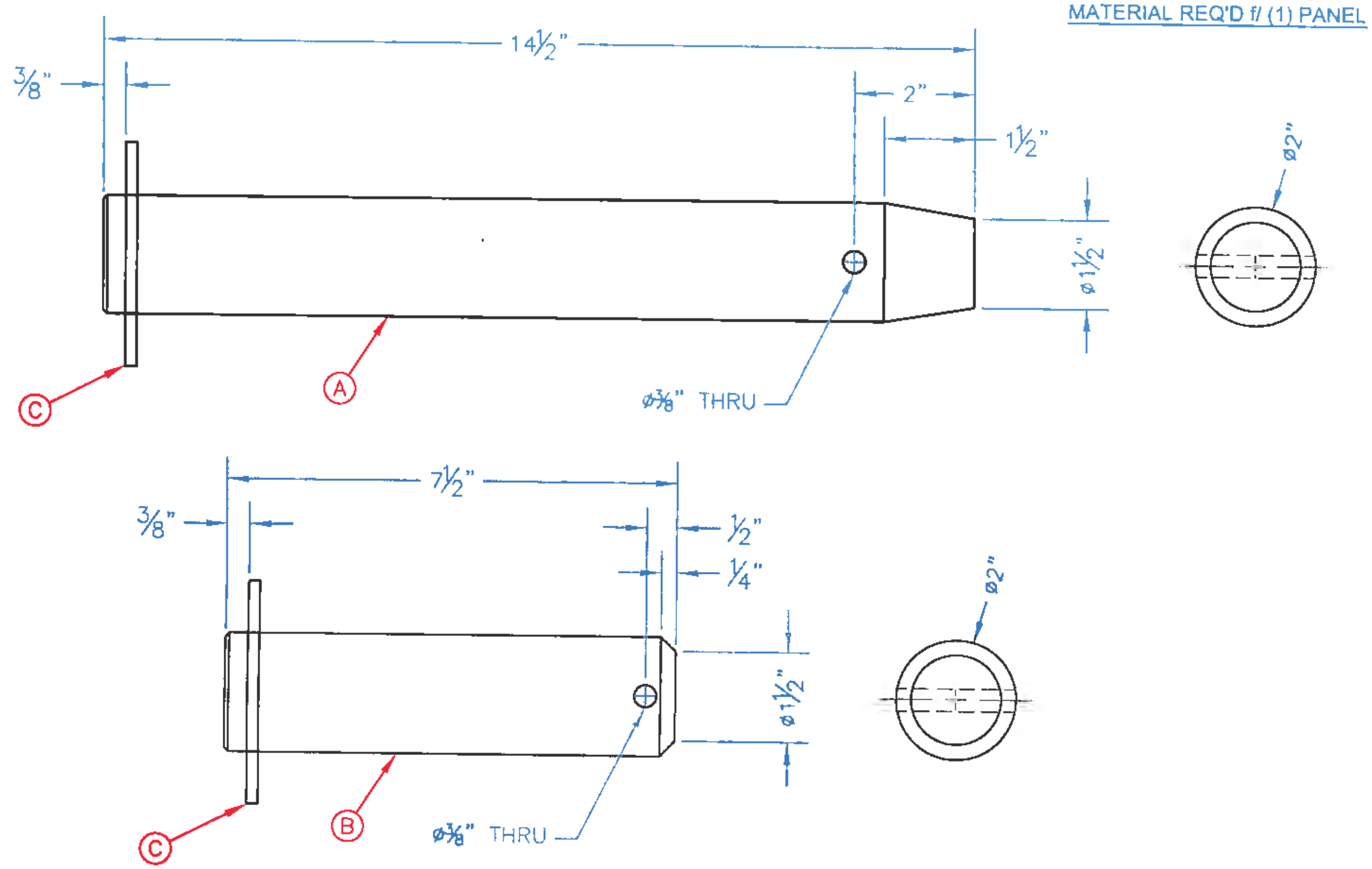
Panel Hinge - Pool Tank Detail

SIZE B

REV 3

NO	DESCRIPTION	PART NO	QTY	WT
A	CR Ø2" x 14 1/2" LG.		4	
B	CR Ø2" x 7 1/2" LG.		2	
C	WASHER 3 3/4" O.D. x 2 1/16" I.D.		6	
D	LOCK PIN Ø5/16" x 2 1/2" FASTENALL #0157027		5	

MATERIAL REQ'D f/ (1) PANEL



ALABAMA REGISTERED PROFESSIONAL ENGINEER No. 12575 LARRY MICHAEL OLIVER

2-16-2013

PINNACLE MFG
512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8031

Panel Hinge Pin - Pool Tank Detail

REVISION

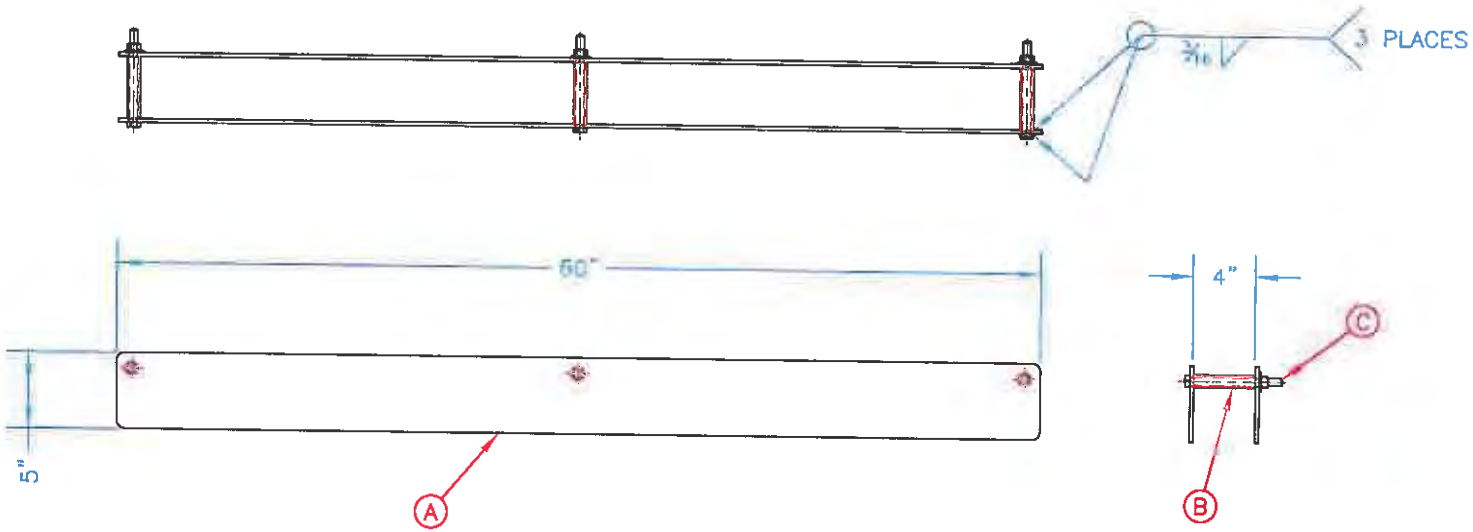
2 | 11-08-13

1 | 10-08-12

SIZE B

REV 2

NO	DESCRIPTION	PART NO	QTY	WT
A	PL 1/4" x 5" x 60" BURNOUT		2	
B	PIPE 1/2" SCH40 x 4" LG.		3	
C	BOLT Ø1/2" x 6" LG c/w F.W. & LOCKNUT		3	



ALABAMA REGISTERED ENGINEER MARK MICHAEL OLIVER

2-16-2013

PINNACLE MFG

512 West Henderson Ave
Boaz, Alabama 35957
Telephone 256 840-8331

Liner Clamp Detail
Pool Tank

B

CALCULATION SUMMARY

Date: July 11, 2012
Project: Pinnacle Mfg. Mobile Water Tank

OBJECTIVE:

Design Support walls for 42,395 barrel mobile water tank

SOLUTION/CONCLUSION/RESULT:

Retaining wall will rest on flat ground surface prepared to withstand 3000 pounds-per-square-foot net soil pressure.
A lining will be placed on the inside of the support walls and ground to retain the water.
Shell height of the mobile water tank is 12'-6".
Inside diameter of the tank is 157'-10".
Mobile water tank has no roof.
The tank shell thickness is 0.25".
No fittings or ladder access in provided in the design.

The design will be adequate under static and 100 mph wind loading conditions.

CALCULATION BASIS:

Criteria:

- The tank is constructed in 26 equal sections which will be pin connected in the field to form the desired tank diameter.
- The tank support wall sits on level ground able to withstand the wall pressures.
- The water tank design conforms to API Standard 650.
- The structural steel analysis and design complies with the specifications and requirements contained in the AISC "Manual of Steel Construction 14th Edition" - Allowable Stress Design.
- The structural steel, plate steel conform to ASTM A36/36M.
- No tank anchorage provided.
- Wind design pressure for overturning is 18 pounds-per-square-foot.
- The required safety factor against overturning is 1.5.
- Seismic load is not considered for temporary storage tanks.
- Gravity loading is limited to the self weight of the tank and the pressure applied to the tank wall by the stored fluid.
- Fluid load is based on water (62.4 pounds-per-cubic-foot).
- The pin fasteners shall conform to ASTM A36.
- Electrodes shall be E70 series electrodes, except E70-T-4 is not allowed.
- Fillet weld shall be 3/16" minimum welds
- No allowance for a corrosion layer for the steel tank.

CYLINDRICAL TANK SHELL

Water depth, H (ft) = 12 feet

Cylindrical shell diameter, D(ft) = 157.83 ft

Hydro-pressure, p = Design Density * H = 62.4 pcf * 11.5 ft = 718 psf

Ring tension, Th = p*(D/2)/12 (lb/in) = (718*(157.83/2))/12 = 4,719 lb/in

Allowable tensile stress, Ft = 0.6*Fy (psi) = 0.6 * 36 ksi = 21,600 psi

Welded joint efficiency factor, E = 0.85

Thickness of shell, **ts (min)** = Th/(Ft*E) (in) = 4719/(21600*.85) = **0.257 inches**

Horizontal Support Beams

Spacing = 26 inches = 2.16 feet

Wind pressure = 18 psf

Load on horizontal support beam = 18 *2.16 = 39 plf = 0.039 klf

Span = 20 feet

Moment = $WL^2/8 = (0.039*(20)^2)/8 =$ 1.95 k-ft

Section Modulus = (M * 12)/(0.66*Fy) = (1.95 *12)/(0.66*36) = 0.98 in^3

HSS 3" sq. x 1/4" wall - Sx = 2.01 in^3

Safety factor = 2.01/0.98 = 2.05 **O.K.**

Pin Connection

Load = 718 psf * 11.5 ft * 20 ft = 165,140 pounds

4 Pin Connections - 165,140 / 4 = 41,285 pounds per connection

A36 material - double shear connection

Pin size = 2 inches

Pin shear capacity = 2 * fv *(pi *d_b^2/4) = 2*0.6 *36000*(3.14*2^2/4) = 135,648

Safety factor = 135,648/41,285 = 3.28 **O.K.**

Bearing strength of connection plate:

$\varphi Rn = 1.2\ Lc\ t\ Fu < 2.4\ db\ t\ Fu$

$\varphi Rn = 1.2*2*1.25*58 < 2.4*2*1.25*58$

$\varphi Rn = 174 \text{ kips} < 348 \text{ kips}$

$\varphi Rn = 0.75*174 = 131 \text{ kips}$

Safety factor = 131,000/41,285 = 3.17 **O.K.**

Weld capacity of connection:

Capacity = 0.707 * .1875 * 20 ksi * 24" * 2 plates = 127 kips

Weld efficiency = 0.85 * 127 kips = 108 kips

Safety factor = 108,000/41,285 = 2.6 **O.K**

STABILTY ANALYSIS OF THE TANK

Check overturning and sliding of the tank

Dead Load (D.L.) = 3.1416 *D*H *t*.49k/cf = 63.3 kips

Base wind speed per API 650

Wind pressure on projected area of cylindrical shell, Ps = 18 psf

Under standard wind speed 100 mph

Lateral wind pressure on shell, Pw = Ps*Area = 18*157.83*12.5/1000 = 35.5 kips

Safety factor against sliding = 63.3/35.5 = 1.78 **O.K**

Overturning moment applied to tank (100 mph wind)

Moment = 35.5 * 12.5/2 = 222 k-ft

Shell Moment resistance = 63.3 * 12.5/2 = 396 k-ft

Safety factor against overturning = 396/222 = 1.78 **O.K**

Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

LADDER DESIGN PT-10, PT-24, PT-42

Check Ladder Rung

Rung Material - 3/4" diameter rod

Section Modulus of Rod = 0.048 in^3

Moment of Rod = (250 lbs/2) * (18/12/2) = 93.75 lbs-ft total or 0.094 kips-ft

Section Modulus = 0.094 / 2 = 0.047 in^3 < 0.048 in^3 **PASS**

Check deflection: = $(250 * 1.5^3)/48 * 29x10^6 * 0.049$ = .00001
= .00001< 0.05 **PASS**

Check Ladder Vertical Member

Member Material - 2-1/2" X 3/8 FB

Load = 250 lbs. / 2 = 125 lbs.

Material Strength = (0.9375 sq. in. - (0.8125" (hole)*.375) * 22 ksi = 13.9 kips **PASS**

Check Mounting Bolt

Bolt Material - 1/2" diameter A36

Shear Strength = 1.6 kips

Load = 2 * 125 lbs. = 250 lbs.

1.6 k > .25 k **PASS** (Greater than 6 times)

Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

STRINGER DESIGN

PT-10, PT-24, PT-42

Stringer Material - C 7 X 9.8

Stringer Design: 150 LB. Uniform Load

Maximum Stringer Span 7 feet (9'-71/2" Span, braced at 7')

Moment (150 lb. Load) =(0 .15 * 7^2)/8 = 0.92 k-ft
Section Modulus (150 lb. Load) = M/F_b = 0.92*12/24 = 0.46 in^3

Section Modulus (Channel) = 6.08 in^3 >0.46 in^3 **Pass**

Check deflection: = (150 * 84^3)/48 * 29x10^6 *21.3 =
= 0.01 inches < 0.23 inches
Pass

= L / 360 = 84/ 360 = 0.23
= **Pass**

Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

HANDRAIL DESIGN PT-10, PT-24,PT-42

Handrail Material - 1-1/2" square tubing -11 gage handrail

2010 International Building

Handrail Design: 100 LB. Vertical Load with
50 LB. Horizontal Load
acting simultaneously

200 LB. Concentrated Load

Maximum Span 5' 2"

Moment (100 lb. Load) = .100/2 * 5.16/2 = 0.129 k-ft
Section Modulus (100 lb. Load) = M/F_b = .129*12/24 = 0.064 in^3

Moment (50 lb. Load) = .050/2 * 5.16/2 = .06 k-ft
Section Modulus (50 lb. Load) = M/F_b = .06*12/24 = 0.03 in^3

Section Modulus (Total Load) = 0.064 + 0.03 = 0.094 in^3

Section Modulus (tube) = 0.26 in^3 > 0.094 in^3 **Pass**

Moment (200 lb. Load) = .200/2 * 5.16/2 = 0.258 k-ft
Section Modulus (200 lb. Load) = M/F_b = .258*12/24 = 0.129 in^3 **Pass**

Check deflection: = (200 * 62^3)/48 * 12x106 *.198 =
= 0.17 inches

= L / 360 = 62/ 360 = 0.17
= **Pass**

Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

VERTICAL STANCHION DESIGN

Handrail Material - 1.5" X 1.5" X 11 gage tubing

Stanchion Design: 200 LB. Concentrated Load

Maximum Stanchion Span 34.5"

Moment (200 lb. Load) = .200 * 2.875 = 0.575 k-ft
Section Modulus (200 lb. Load) = M/F_b = 0.575*12/24 = 0.2875 in^3

Section Modulus (Tube) = 0.26 in^3 > 0.2875 in^3 **Pass**
Safety Factor = 1

Check deflection: = $(200 * 34.5^3)/48 * 29x10^6 * .198$ =
= 0.03 inches < 0.1 inches

= L / 360 = 34.5/ 360 = 0.1
= **Pass**

Stanchion Welded to C7 - Stanchion centered on C7

Length of weld on each side of Tube Stanchion = 1.5"

Weld thickness = 0.1 pipe thickness

Weld strength = 0.1 * sin 45 deg. * 20 ksi = 1414 lbs per inch
Pass

4 sides*1.5"*1414 lb per inch = 8484 lbs

Weld safety factor = 8484/200 = 42

Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

PLATFORM DESIGN

Check Platform Cross Support Channel

Platform Material - Angle 3X2X 1/4

Section Modulus of Angle = .542 in^3

Moment of Angle = .300 * $2.5^2/8$ = 0.234 kips-ft Load =100 psf

Section Modulus = 0.234 / 2 = 0.117 in^3 < .542 in^3 **PASS**

Check deflection: = $(300 * 30^3)/48 * 29x10^6*1.09$ = .01
= .01< 0.08 **PASS**

Check Platform End Channel

Member Material - Bent Plate 5 3/4" X 2" X 1/4"

Section Modulus of Plate = 1.53 in^3

Load = 100 psf

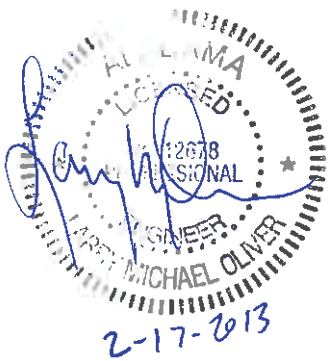
Angle Spacing on Platform = 2 feet

Length of Plate Support = 4'

Moment = Pl/4 = (0.375*4')/4 = .375 k-ft.

Section Modulus = .375 / F_b = .375*12/24 = .1875 in^3 < 1.53 in^3 **PASS**

Check deflection: = $375*48^3/(48*29x10^6*5.11$ =
= 0.01 inches < 0.13 inches **PASS**



Larry M. Oliver Enterprises, Inc.
7228 Oakbriar Dr. S
Mobile, Alabama 36619

Project: Pinnacle Pool Tank
Date: February 17, 2013

PLATFORM DESIGN

Check Platform Column

Column Material - Tube 4X2X 1/4

Unbraced length = 7 feet

Vertical Load on Column =[(.150 * 2.5 * 4)/4] + .525 = 0.9 kips

Eccentricity of Column = 7" =0.583'

Load on Column = [(0.9 * .583) + 0.9] *1.68 = 2.39 kips
= 2.39< 32 kips **PASS**
Safety Factor = 32/2.39 = 13

Check Horizontal Brace Compression

Brace Material - Angle 3X2X 1/4 Area = 1.19 in^2

Unbraced length = 7 feet

Axial Load on Brace = 2*12*.013 = 0.3 kips

Allowable Load on Angle = 4.1 kips **PASS**

Appendix E
Geotextile Specifications

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

Sales Office:
Engineered Synthetic Products, Inc.
Tel (770) 564-1857
Fax (770) 564-1818
www.espgeosynthetics.com

Geotextile Product Description Sheet

SKAPS GT-110
Nonwoven Geotextile

SKAPS GT-110 is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibers, which are formed into a random network for dimensional stability. SKAPS GT-110 resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. SKAPS GT-110 conforms to the physical property values listed below:

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight (Typical)	ASTM D 5261	oz/yd^2 (g/m^2)	10.0 (339)
Grab Tensile	ASTM D 4632	lbs (kN)	250 (1.11)
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs (kN)	100 (0.444)
CBR Puncture Resistance	ASTM D 6241	lbs (kN)	700 (3.11)
Permittivity*	ASTM D 4491	sec^{-1}	1.2
Water Flow*	ASTM D 4491	gpm/ft^2(l/min/m^2)	80 (3251)
AOS*	ASTM D 4751	US Sieve (mm)	100 (0.150)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – ft	12.5 x 360 / 15 x 300
Square Yards Per Roll	500
Estimated Roll Weight - lbs	320

* At the time of manufacturing. Handling may change these properties.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. SKAPS assumes no liability in connection with the use of this information.

SKAPS Industries,
335 Athena Dr, Athens, GA 30601,
Phone:(706)-354-3700, Fax(706)-354-3737,
www.skaps.com

Made in U.S.A.

Appendix F
Liner Specifications

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

SMOOTH LLDPE GEOMEMBRANE
ENGLISH UNITS

POLY-FLEX
POLYETHYLENE GEOMEMBRANES

Property	Test Method	Minimum Average Values 40 Mil Nominal
Thickness, mils	ASTM D 5199	
minimum average		40
lowest individual reading		36
Sheet Density, g/cc (max)	ASTM D 1505/D 792	0.939
Tensile Properties[1]	ASTM D 6693	
1. Break Strength, lb/in		152
2. Break Elongation, %		800
2% Modulus, lb/in^2 (max)	ASTM D 5323	60,000
Tear Resistance, lb	ASTM D1004	22
Puncture Resistance, lb	ASTM D 4833	56
Axi-Symetric Break Strain, %	ASTM D 5617	30
Carbon Black Content[2], %	ASTM D 1603	2.0 - 3.0
Carbon Black Dispersion[3]	ASTM D 5596	-Note 3-
Oxidative Induction Time (OIT)		
Standard OIT, minutes	ASTM D 3895	100
Oven Aging at 85^{o}C	ASTM D 5721	
High Pressure OIT - % retained after 90 days	ASTM D 5885	60
UV Resistance[4]	ASTM D 7238	
High Pressure OIT[5] - % retained after 1600 hrs	ASTM D 5885	35
1. Width (feet)		23
2. Length (feet)		750
3. Area (square feet)		17,250
4. Gross Weight (pounds, approx.):		3,435

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gauge length of 1.3 inches; Break elongation is calculated using a gauge length of 2.0 inches.

(2) Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.

(3) Carbon black dispersion for 10 different views: 9 in Categories 1 and 2, with 1 allowed in Category 3.

(4) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(5) UV resistance is based on percent retained value regardless of the original HP-OIT value.

POLY-FLEX, INC.
2000 West Marshall Drive • Grand Prairie, Texas 75051, U.S.A.
888-765-9359 • 972-337-7113 • Fax 972-337-7233 • www.poly-flex.com

TEXTURED LLDPE GEOMEMBRANE
ENGLISH UNITS

POLY-FLEX®
POLYETHYLENE GEOMEMBRANES

Property	Test Method	Minimum Average Values 40 Mil	60 Mil	80 Mil
Thickness, mils	ASTM D 5994			
minimum average		38	57	76
lowest individual of 8 of 10 readings		36	54	72
lowest individual of 10 readings		34	51	68
Asperity Height[1], mils	ASTM D 7466	10	10	10
Sheet Density, g/cc (max.)	ASTM D 1505/D 792	0.939	0.939	0.939
Tensile Properties[2]	ASTM D 6693			
1. Break Strength, lb/in		60	90	120
2. Break Elongation, %		250	250	250
2% Modulus, lb/in^2 (max.)	ASTM D 5323	60,000	60,000	60,000
Tear Resistance, lb	ASTM D 1004	22	33	44
Puncture Resistance, lb	ASTM D 4833	44	66	88
Axi-Symetric Break Strain, %	ASTM D 5617	30	30	30
Carbon Black Content[3], %	ASTM D 1603	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596		--Note 4--	
Oxidative Induction Time (OIT) Standard OIT, minutes	ASTM D 3895	100	100	100
Oven Aging at 85°C	ASTM D 5721			
High Pressure OIT - % retained after 90 days	ASTM D 5885	60	60	60
UV Resistance[5]	ASTM D 7238			
High Pressure OIT[6] - % retained after 1600 hrs	ASTM D 5885	35	35	35
Roll Dimensions				
1. Width (feet):		23	23	23
2. Length (feet):		750	500	375
3. Area (square feet):		17,250	11,500	8,625
4. Gross weight (pounds, approx.):		3,465	3,465	3,435

1 Of 10 readings; 8 must be ≥ 7 mils and lowest individual reading must be ≥ 5 mils.
2 Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.
3 Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.
4 Carbon black dispersion for 10 different views: Nine in Categories 1 and 2 with one allowed in Category 3.
5 The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
6 UV resistance is based on percent retained value regardless of the original HP-OIT value.

These data are provided for informational purposes only and are not intended as a warranty or guarantee. Poly-America, L.P. assumes no responsibility in connection with the use of these data. Suitablility for a particular use shall be determined by and is the sole responsibility of the end user. These values are subject to change without notice. REV. 03/14

Appendix G
Geonet Specifications

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

PRODUCT DATA SHEET

GSE HyperNet Geonet

GSE HyperNet geonet is a synthetic drainage material manufactured from a premium grade high density polyethylene (HDPE) resin. The structure of the GSE HyperNet geonet is formed specifically to transmit fluids uniformly under a variety of field conditions. The geonet is formulated to be resistant to ultraviolet light for a period of time necessary to complete the installation.

AT THE CORE:
A synthetic geonet engineered specifically to transmit fluids consistently under a variety of field conditions.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value			
			HyperNet	HyperNet HF	HyperNet HS	HyperNet UF
Transmissivity[1], gal/min/ft (m^2/sec)	ASTM D 4716	1/540,000 ft^2	9.66 (2 x 10^{-3})	14.49 (3 x 10^{-3})	28.98 (6 x10^{-3})	38.64 (8 x 10^{-3})
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 5035/7179	1/50,000 ft^2	45	55	65	75
Carbon Black Content, %	ASTM D 1603[3]/4218	1/50,000 ft^2	2.0	2.0	2.0	2.0
NOMINAL ROLL DIMENSIONS						
Geonet Thickness, mil	ASTM D 5199	1/50,000 ft^2	200	250	275	300
Roll Width[2], ft			15	15	15	15
Roll Length[2], ft			330	290	270	250
Roll Area, ft^2			4,950	4,350	4,050	3,750

NOTES:
- [1]Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [2]Roll widths and lengths have a tolerance of ±1%.
- [3]Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

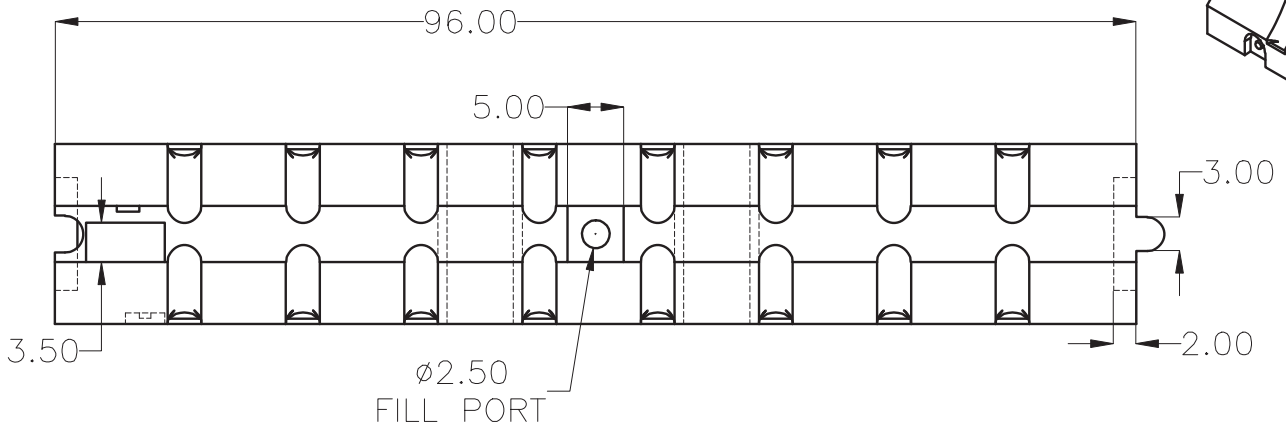
DURABILITY RUNS DEEP

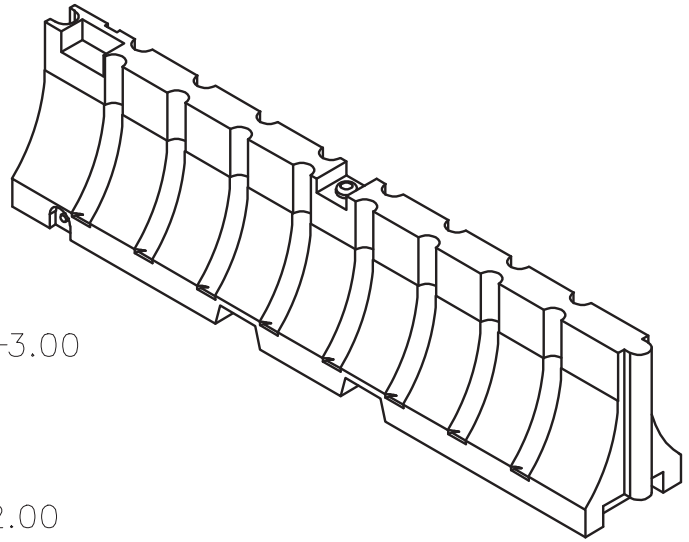
For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

Appendix H
Secondary Containment Berm Specifications

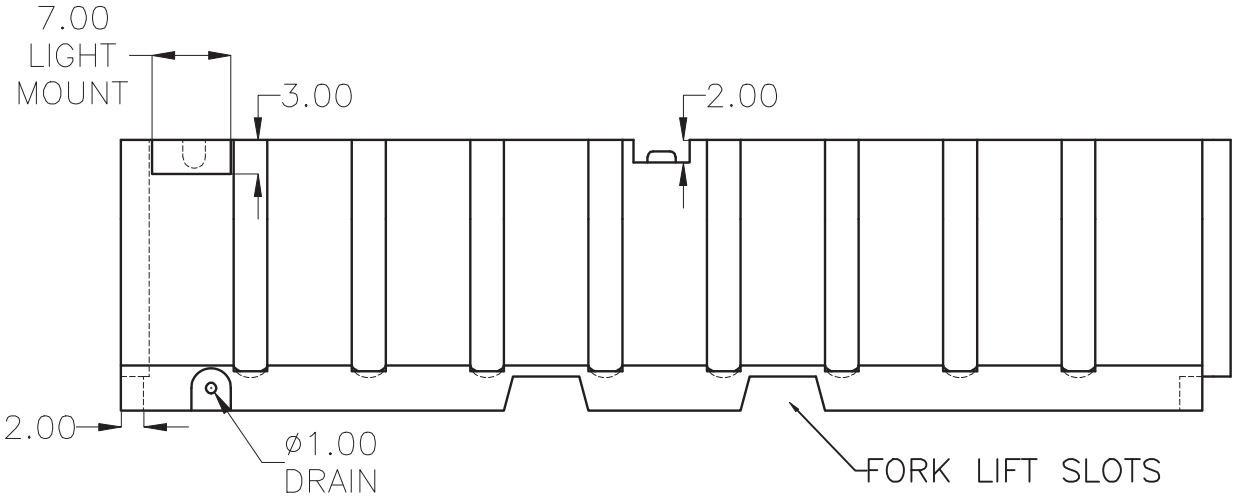
R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

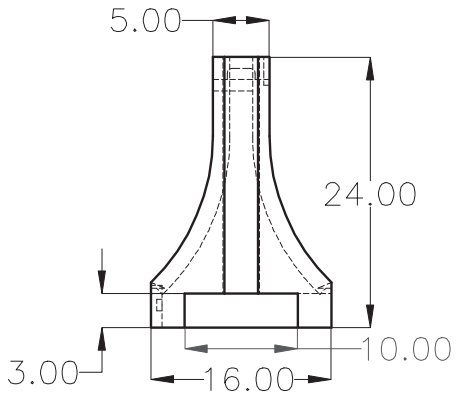
24" BARRIER





APROX. 1/4" WALL THICKNESS





Appendix I
Contact Information

R.T. Hicks Consultants, Ltd.
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Contact Info

Applicant	
Company	Devon Energy Production, LP
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Primary Contact	
Company	Complete Energy Services Water Transfer & Treatment
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Secondary Contact	
Company	R.T. Hicks Consultants
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