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-144
Revised August 1, 2011

For temporary pits, closed-loop systems, and below-grade tanks, submit to the appropriate NMOCD District Office.
For permanent pits and exceptions submit to the Santa Fe Environmental Bureau office and provide a copy to the appropriate NMOCD District Office.

Pit, Closed-Loop System, Below-Grade Tank, or Proposed Alternative Method Permit or Closure Plan Application

Type of action: ☒ Permit of a pit, closed-loop system, below-grade tank, or proposed alternative method
☐ Closure of a pit, closed-loop system, below-grade tank, or proposed alternative method
☐ Modification to an existing permit
☐ Closure plan only submitted for an existing permitted or non-permitted pit, closed-loop system, below-grade tank, or proposed alternative method

Instructions: Please submit one application (Form C-144) per individual pit, closed-loop system, below-grade tank or alternative request

Please 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: Alamo Permian Resources, LLC OGRID #: 274841
Address: 415 W. Wall Street, Suite 500, Midland, Texas 79701
Facility or well name: Cedar Lake #5
API Number: 30-015-41021 OCD Permit Number:
U/L or Qtr/Qtr: Section 30 Township T17S Range R31E County: Eddy
Center of Proposed Design: Latitude 32 48 29.433 Longitude -103 54 50.918 NAD: ☐ 1927 ☒ 1983
Surface Owner: ☐ Federal ☒ State ☐ Private ☐ Tribal Trust or Indian Allotment

2.
☒ **Pit:** Subsection F of 19.15.17.11 NMAC
Temporary: ☒ Drilling ☐ Workover
☐ Permanent ☐ Emergency ☐ Cavitation ☐ P&A
☒ Lined ☐ Unlined Liner type: Thickness 20 mil ☒ LLDPE ☐ HDPE ☐ PVC ☐ Other
☒ String-Reinforced
Liner Seams: ☒ Welded ☐ Factory ☐ Other Volume: See Plate 1 Dimensions: L x W x D

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3.
☐ **Closed-loop System:** Subsection H of 19.15.17.11 NMAC
Type of Operation: ☐ P&A ☐ Drilling a new well ☐ Workover or Drilling (Applies to activities which require prior approval of a permit or notice of intent)
☐ Drying Pad ☐ Above Ground Steel Tanks ☐ Haul-off Bins ☐ Other
☐ Lined ☐ Unlined Liner type: Thickness mil ☐ LLDPE ☐ HDPE ☐ PVC ☐ Other
Liner Seams: ☐ Welded ☐ Factory ☐ Other

4.
☐ **Below-grade tank:** Subsection I of 19.15.17.11 NMAC
Volume: bbl Type of fluid:
Tank Construction material:
☐ Secondary containment with leak detection ☐ Visible sidewalls, liner, 6-inch lift and automatic overflow shut-off
☐ Visible sidewalls and liner ☐ Visible sidewalls only ☐ Other
Liner type: Thickness mil ☐ HDPE ☐ PVC ☐ Other

5.
☐ **Alternative Method:**
Submittal of an exception request is required. Exceptions must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

Permit submittal withdrawn by operator

6.

Fencing: Subsection D of 19.15.17.11 NMAC *(Applies to permanent pits, temporary pits, and below-grade tanks)*

☐ Chain link, six feet in height, two strands of barbed wire at top *(Required if located within 1000 feet of a permanent residence, school, hospital, institution or church)*

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

☐ Alternate. Please specify_____

7.

Netting: Subsection E of 19.15.17.11 NMAC *(Applies to permanent pits and permanent open top tanks)*

☐ Screen ☐ Netting ☐ Other _____

☐ Monthly inspections (If netting or screening is not physically feasible)

8.

Signs: Subsection C of 19.15.17.11 NMAC

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

☒ Signed in compliance with 19.15.16.8 NMAC

9.

Administrative Approvals and Exceptions:

Justifications and/or demonstrations of equivalency are required. Please refer to 19.15.17 NMAC for guidance.

Please check a box if one or more of the following is requested, if not leave blank:

☐ Administrative approval(s): Requests must be submitted to the appropriate division district or the Santa Fe Environmental Bureau office for consideration of approval.

☒ Exception(s): Requests must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

10.

Siting Criteria (regarding permitting): 19.15.17.10 NMAC

Instructions: ***The applicant must demonstrate compliance for each siting criteria below in the application. Recommendations of acceptable source material are provided below. Requests regarding changes to certain siting criteria may require administrative approval from the appropriate district office or may be considered an exception which must be submitted to the Santa Fe Environmental Bureau office for consideration of approval. Applicant must attach justification for request. Please refer to 19.15.17.10 NMAC for guidance.*** **Siting criteria does not apply to drying pads or above-grade tanks associated with a closed-loop system.**

Ground water is less than 50 feet below the bottom of the temporary pit, permanent pit, or below-grade tank. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells **SEE FIGURE 1**	☐ Yes ☒ No
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; Visual inspection (certification) of the proposed site **SEE FIGURE 3**	☐ Yes ☒ No
Within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. *(Applies to temporary, emergency, or cavitation pits and below-grade tanks)* - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image. **SEE FIGURE 4**	☐ Yes ☒ No ☐ NA
Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. *(Applies to permanent pits)* - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image.	☐ Yes ☐ No ☒ NA
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. - NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site. - **SEE FIGURE 2**	☐ Yes ☒ No
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 4** - Written confirmation or verification from the municipality; Written approval obtained from the municipality	☐ Yes ☒ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site - **SEE FIGURE 5**	☐ Yes ☒ No
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division. **SEE FIGURE 6**	☐ Yes ☒ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; Topographic map. **SEE FIGURE 7**	☐ Yes ☒ No
Within a 100-year floodplain. - FEMA map. **SEE FIGURE 8**	☐ Yes ☒ No

11.
Temporary Pits, Emergency Pits, and Below-grade Tanks Permit Application Attachment Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Hydrogeologic Report (Below-grade Tanks) - based upon the requirements of Paragraph (4) of Subsection B of 19.15.17.9 NMAC
- ☒ Hydrogeologic Data (Temporary and Emergency Pits) - based upon the requirements of Paragraph (2) of Subsection B of 19.15.17.9 NMAC
- ☒ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☒ Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☒ Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

☐ Previously Approved Design (attach copy of design) API Number: _____ or Permit Number: _____

12.
Closed-loop Systems Permit Application Attachment Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Geologic and Hydrogeologic Data (only for on-site closure) - based upon the requirements of Paragraph (3) of Subsection B of 19.15.17.9
- ☐ Siting Criteria Compliance Demonstrations (only for on-site closure) - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☐ Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☐ Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

☐ Previously Approved Design (attach copy of design) API Number: _____

☐ Previously Approved Operating and Maintenance Plan API Number: _____ *(Applies only to closed-loop system that use above ground steel tanks or haul-off bins and propose to implement waste removal for closure)*

13.
Permanent Pits Permit Application Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Hydrogeologic Report - based upon the requirements of Paragraph (1) of Subsection B of 19.15.17.9 NMAC
- ☐ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☐ Climatological Factors Assessment
- ☐ Certified Engineering Design Plans - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Dike Protection and Structural Integrity Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Leak Detection Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Liner Specifications and Compatibility Assessment - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Quality Control/Quality Assurance Construction and Installation Plan
- ☐ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☐ Freeboard and Overtopping Prevention Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Nuisance or Hazardous Odors, including H_2S, Prevention Plan
- ☐ Emergency Response Plan
- ☐ Oil Field Waste Stream Characterization
- ☐ Monitoring and Inspection Plan
- ☐ Erosion Control Plan
- ☐ Closure Plan - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

14.
Proposed Closure: 19.15.17.13 NMAC
Instructions: Please complete the applicable boxes, Boxes 14 through 18, in regards to the proposed closure plan.

Type: ☒ Drilling ☐ Workover ☐ Emergency ☐ Cavitation ☐ P&A ☐ Permanent Pit ☐ Below-grade Tank ☐ Closed-loop System ☐ Alternative

Proposed Closure Method:
- ☐ Waste Excavation and Removal
- ☐ Waste Removal (Closed-loop systems only)
- ☒ On-site Closure Method (Only for temporary pits and closed-loop systems)
  - ☒ In-place Burial ☐ On-site Trench Burial
- ☐ Alternative Closure Method (Exceptions must be submitted to the Santa Fe Environmental Bureau for consideration)

15.
Waste Excavation and Removal Closure Plan Checklist: (19.15.17.13 NMAC) ***Instructions: Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.***

- ☐ Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC
- ☐ Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC
- ☐ Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings)
- ☐ Soil Backfill and Cover Design Specifications - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- ☐ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC
- ☐ Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

16.

Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only: (19.15.17.13.D NMAC)

Instructions: Please indentify the facility or facilities for the disposal of liquids, drilling fluids and drill cuttings. Use attachment if more than two facilities are required.

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Will any of the proposed closed-loop system operations and associated activities occur on or in areas that *will not* be used for future service and operations?

☐ Yes (If yes, please provide the information below) ☐ No

Required for impacted areas which will not be used for future service and operations:

☐ Soil Backfill and Cover Design Specifications - - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

☐ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC

☐ Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

17.

Siting Criteria (regarding on-site closure methods only): 19.15.17.10 NMAC

Instructions: Each siting criteria requires a demonstration of compliance in the closure plan. Recommendations of acceptable source material are provided below. Requests regarding changes to certain siting criteria may require administrative approval from the appropriate district office or may be considered an exception which must be submitted to the Santa Fe Environmental Bureau office for consideration of approval. Justifications and/or demonstrations of equivalency are required. Please refer to 19.15.17.10 NMAC for guidance.

Ground water is less than 50 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☒ No ☐ NA
Ground water is between 50 and 100 feet below the bottom of the buried waste - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☒ No ☐ NA
Ground water is more than 100 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☒ Yes ☐ No ☐ NA
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 300 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	☐ Yes ☒ No
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. - NM Office of the State Engineer - iWATERS database; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; Written approval obtained from the municipality	☐ Yes ☒ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division	☐ Yes ☒ No
Within an unstable area. - 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	☐ Yes ☒ No

18.

On-Site Closure Plan Checklist: (19.15.17.13 NMAC) ***Instructions: Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.***

☒ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC

☒ Proof of Surface Owner Notice - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC

☐ Construction/Design Plan of Burial Trench (if applicable) based upon the appropriate requirements of 19.15.17.11 NMAC

☐ Construction/Design Plan of Temporary Pit (for in-place burial of a drying pad) - based upon the appropriate requirements of 19.15.17.11 NMAC

☒ Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC

☒ Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC

☒ Waste Material Sampling Plan - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC

☒ Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings or in case on-site closure standards cannot be achieved)

☒ Soil Cover Design - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

☒ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC

☒ Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

19.
Operator Application Certification:

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

Name (Print): Carie Stoker Title: Regulatory

Signature: Carie Stoker Date: 2/26/13

e-mail address: cstoker@basinsoil.com and r@trihickscomsult.com Telephone: 432-682-1122 (Hicks: 505/266-5004)

20.
OCD Approval: ☐ Permit Application (including closure plan) ☐ Closure Plan (only) ☐ OCD Conditions (see attachment)

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

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

21.
Closure Report (required within 60 days of closure completion): Subsection K of 19.15.17.13 NMAC

Instructions: Operators are required to obtain an approved closure plan prior to implementing any closure activities and submitting the closure report. The closure report is required to be submitted to the division within 60 days of the completion of the closure activities. Please do not complete this section of the form until an approved closure plan has been obtained and the closure activities have been completed.

☐ **Closure Completion Date:** _____

22.
Closure Method:

☐ Waste Excavation and Removal ☐ On-Site Closure Method ☐ Alternative Closure Method ☐ Waste Removal (Closed-loop systems only)

☐ If different from approved plan, please explain.

23.
Closure Report Regarding Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only:

Instructions: Please indentify the facility or facilities for where the liquids, drilling fluids and drill cuttings were disposed. Use attachment if more than two facilities were utilized.

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Were the closed-loop system operations and associated activities performed on or in areas that *will not* be used for future service and operations?

☐ Yes (If yes, please demonstrate compliance to the items below) ☐ No

Required for impacted areas which will not be used for future service and operations:

☐ Site Reclamation (Photo Documentation)
☐ Soil Backfilling and Cover Installation
☐ Re-vegetation Application Rates and Seeding Technique

24.
Closure Report Attachment Checklist: ***Instructions: Each of the following items must be attached to the closure report. Please indicate, by a check mark in the box, that the documents are attached.***

☐ Proof of Closure Notice (surface owner and division)
☐ Proof of Deed Notice (required for on-site closure)
☐ Plot Plan (for on-site closures and temporary pits)
☐ Confirmation Sampling Analytical Results (if applicable)
☐ Waste Material Sampling Analytical Results (required for on-site closure)
☐ Disposal Facility Name and Permit Number
☐ Soil Backfilling and Cover Installation
☐ Re-vegetation Application Rates and Seeding Technique
☐ Site Reclamation (Photo Documentation)

On-site Closure Location: Latitude _____ Longitude _____ NAD: ☐ 1927 ☐ 1983

25.
Operator Closure Certification:

I hereby certify that the information and attachments submitted with this closure report is true, accurate and complete to the best of my knowledge and belief. I also certify that the closure complies with all applicable closure requirements and conditions specified in the approved closure plan.

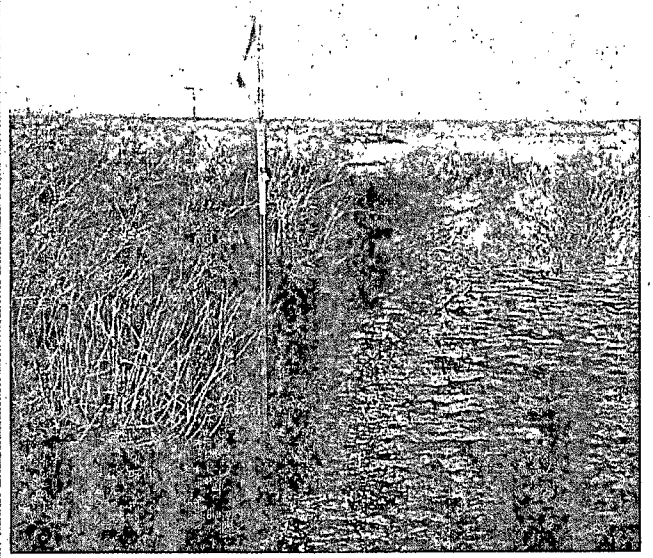
Name (Print): _____ Title: _____

Signature: _____ Date: _____

e-mail address: _____ Telephone: _____

February 2013

C-144 Permit Package for Cedar Lake #5 Temporary Pit Section 30 T17S R31E Eddy County NM



Prepared for
Alamo Permian Resources, LLC
Midland, Texas

Prepared by
R.T. Hicks Consultants, Ltd.
Albuquerque, New Mexico

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

February 27, 2013

Mr. Mike Bratcher
NMOCD District 2
811 South First Street
Artesia, New Mexico 88210

RE: Alamo Permian Cedar Lake #5, API - 30-015-41021

Dear Mike:

On behalf of Alamo Permian Resources, R.T. Hicks Consultants submits the attached C-144 application for the above-referenced well. We will begin building the location no sooner than 30 days from now. We would like to guide you through a site inspection of this location, as the US Fish and Wildlife Service Wetlands Mapper identifies a "wetland" about 260 feet from the proposed temporary pit. Our site investigation demonstrates to our satisfaction that this mapped wetland does not meet the definition in OCD Rules as a wetland. While site evidence clearly shows the mapped wetland is an ephemeral surface water body, we observed no evidence on the ground or in historic aerial photographs that this area is "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico."

Pit drilling at this location provides a higher net environmental benefit over closed loop due to the presence of high pressure water flows above the pay zone. Approval of pit drilling at this location will reduce the size of the pad and allow the anticipated water flow to be managed in an orderly manner (rather than a long line of water trucks trying to stay ahead of the flow into frac tanks). Pit drilling also minimizes the truck volume entering Highway 82 just over the crest of a hill.

Please note the following:

1. The generic plans were recently approved by OCD (Geoff Leking).
2. The pit is a double horseshoe to segregate, as much as possible, the saline mud and cuttings from the fresh water cuttings/mud.
3. We anticipate "in place" burial of stabilized solids in conformance with the applicable NMOCD Rules. If necessary, the flow-back cell of the temporary pit may be used for trench burial, after modification of this permit and an inspection by OCD.
4. The drilling pad was originally staked for closed-loop drilling. While the location of the well is unchanged, the corners of the drilling pad will be modified to accommodate the use of a temporary pit.
5. The temporary pit is on the south side of the location.
6. This letter is copied to the surface landowner to comply with the notification requirement that the operator intends on-site burial of drilling waste.

C-144 and Site Specific Information for Temporary Pit

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

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 temporary pit.

Figure 1 is an area geologic and topographic map that shows:

1. The location of the temporary pit as an orange square in the central portion of the map, east of the town of Loco Hills.
2. Water wells from the OSE database as a blue triangle inside colored circles that indicate well depth. 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. Three wells shown in the OSE database for the mapped area are mis-located and do not exist; these wells are not plotted on Figure 1.
3. Water wells from the USGS database as large green triangles.
4. Water wells, which are not documented in the public databases but were identified by field inspection or published reports as light blue squares.
5. The depth-to-water from the most recent available measurement for each well is provided adjacent to the well symbol.
6. Also plotted on the Figure is our opinion of the groundwater elevation surface based upon the data contained in this application.

Figure 2 is the same base map as Figure 1 that shows:

1. The location of the temporary pit as an orange square east of the town of Loco Hills.
2. Water wells with the same symbols as those shown in Figure 1.
3. The identifier number of the well (see Table below).

Geology

The proposed temporary pit is located on exposures of Quaternary Age eolian and piedmont deposits (Qe/Qp on Figure 1). These deposits are a relatively thin covering of the underlying redbeds of the Dockum Group. In the area of the location, the surface deposits are fine-grained alluvial soils probably underlain by ancient lake deposits .

An important geologic structural feature of the area is the Artesia-Vacuum Arch. This structure is described as "a shallow east-west trending structure that overlies the deeper, older Abo shelf edge reef trend and Bone Spring flexure"[1], which is roughly sub-parallel to the Artesia-Lovington Highway in Eddy County. The referenced document also states "...Burnett Oil Company's lease in Section 13 T17S R30E in the Grayburg-Jackson reservoir (Brian Brister, Personal Communication, 2003). *This area is located along the crest of the Artesia-Vacuum arch and has a sufficiently high structural elevation* [emphasis added] so that the karsted, highly permeable Jackson zone of the San Andres reservoir is above the oil-water contact."

[1] http://www.netl.doe.gov/kmd/cds/disk41/C-%20Basin%20Analysis/NT15131-OFR%20479.pdf

Topographically, the site lies on a south side of the relatively flat bottom of an ephemeral lake. As shown in Figures 3 and 4, an identified drainage (watercourse) leaves the ancient lakebed about 500 feet southwest of the staked location and the deepest portion of the lakebed that occasionally holds water is about 225 feet north of the staked location. The proposed temporary pit lies 35 feet south of the staked location.

Water Table Elevation

The water wells identified on Figures 1 and 2 to determine the water table elevation below the temporary pit are presented in Table 1. Most of the information is derived from Open File Report OF-95[2]. Hicks Consultants has visited many of the wells listed below and was able to update depth to water measurements provided in the 1978 report for several of these well. Also on Table 1 are several wells that are found only in OCD files (e.g. wells 37 and 38) and wells identified and measured in the field (well 35).

	Well Location						Well Source Information							Groundwater Elevation Data						
Well Numbers (see Map)	Township (south)	Range (east)	Section	Quarter Section (64,	16,	4)	NM-OSE Database	USGS Database	Open File Rpt. 95	GW Report No. 3	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.)	Gauging Date
Misc - 40	16	30	24	2	2	1			✓		✓	--	--	3,828	3,828	380.1	330.69	3,497	3,497	10/17/1977
USGS-1445	16	32	30	1	4	3		✓	✓		✓	--	--	4,138	4,142	101	46.19	4,092	4,096	3/30/1971
Misc - 5	17	28	2	2	4	2			✓			✓	✓		3,590		27.6	3,560	3,562	1/1/1948
Misc - 35	17	28	2	4	2	4						✓	✓		3,574		35.8		3,538	9/6/2012
Misc - 2	17	28	14		2	2			✓		✓	✓	--		3,590		80	3,540	3,510	Pre 1978
Misc - 17	17	28	22		3	2			✓		✓	✓	✓	--	3,579		45.5	3,520	3,534	1/1/1948
USGS-1222	17	28	22	4	2	4		✓			✓	✓	✓	3,578		95	78.6	3,499		1/13/1999
Misc - 0	17	29	8	2	3	1			✓		✓	✓	✓	3,617	3,617	92.7	90.1	3526.9		10/14/1977
Misc - 3	17	29	22	1	1	1			✓		✓	✓	✓	3,550	3,545		79.7	3,470	3,465	11/29/1948
Misc - 41 (MW)	17	29	22	3	2	3							✓		3,535		73		3,462	8/15/2004
Misc - 36	17	29	29	4	4	4			✓		✓	✓	✓		3,545		102.4		3442.6	10/4/2012
Misc - 38	17	30	16	3	3	3								No Groundwater Saturation (NMOCD Files)						
Misc - 37 (MW)	17	30	30	2	1	1						✓	✓		3,615	271.6	264.45		3,351	9/28/2005
Misc - 26	18	29	24	1	4	2			✓		✓	✓	✓	3,436	3,436		156.44	3,280	3,280	10/18/1977
Misc - 28	18	30	32	3	2	4			✓				--	3,380			161.28	3,219		4/8/1971
Misc - 27	18	30	32	4	2	3			✓		✓	✓	--	3,370	3,368	266	158.77	3,211	3,209	10/18/1977
Misc - 44	18	30	21		2	4			✓			✓	--	3,495			266.48	3,229		12/9/1965
Misc - 45	18	30	22	2	2	2			✓		✓	--	--	3,430	3,435		239.26	3,191	3,196	4/8/1971
Misc - 46	18	31	1	4	4	4			✓		✓	--	--	3,797	3,798		460.42	3,337	3,338	4/7/1971
Misc - 49	16	31	14	3	0	0			✓		✓	✓	--		4,208		113.4		4,095	12/9/1948
Misc - 50	16	31	23	4	4	3			✓		✓	✓	--	4,240	4,245	161.8	155.02	4,085	4,090	3/30/1971

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

Table 1: Groundwater Data

Visual inspections of questionable wells were performed to verify the information provided by the public records and published reports. Initially, an attempt was made to identify each well using USGS topographic maps. The surface elevations of wells identified on the maps were 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. Locations that could not be verified by maps

[2] See ftp://geoinfo.nmt.edu/Open-file_Reports/OFR014-99/76-99/95 (1978)

or photographs were verified in the field. Attempts were also made to gauge wells during the field investigation when access was permitted. In the general area of the Wilson #3, no wells exist in any databases, no wells were identified on topographic maps or air photos and no wells were found during the field inspection.

Hydrogeology

Figure 1 presents the groundwater elevation in the aquifers of the Dockum Group (red beds).

In certain areas on the west facing cliff of the Caprock, groundwater seeps from the Ogallala Aquifer into the thin alluvium abutting the cliff face. The USGS well 1445 may measure groundwater in the saturated alluvium that exists adjacent to the Caprock in the headwaters of Taylor Draw. Alternatively, this well measures Ogallala groundwater beneath a thin veneer of alluvial material.

Theoretically, groundwater as defined by OCD Rules may exist in the thin alluvium adjacent to Taylor Draw. If such groundwater did exist, we believe that windmills or other wells would tap this water, as they do southeast of Maljamar where the alluvium can supply wells with sufficient water for limited uses. The lack of wells within Taylor Draw and in the area around the Wilson #3 site is strong evidence that shallow alluvial groundwater does not exist.

The lack of deep water wells in the area supports a conclusion that groundwater is very deep and not economical to develop. An equally likely hypothesis is that groundwater does not exist in the area, as is the case around the town of Loco Hills. In the area around Loco Hills, OCD files show dry monitor wells adjacent to the Loco Hills Water Disposal Facility (well #38). Hicks Consultants drilled a well near a proposed surface waste disposal facility (well #37) that encountered saturation but recovery tests showed this zone produced less than 5 gallons per day. We conclude that a water-bearing zone that produces 5-gallons/day is not "groundwater" as defined by OCD Rules. Therefore, well #37 lies within the area labeled as "no saturation or variable saturation". Perhaps this dry zone extends along the crest of the Artesia-Vacuum arch to the east, in the area of Cedar Lake #5.

If groundwater did exist in the Dockum Group aquifers beneath the site, available and projected groundwater data suggest the elevation of water would be about 3340 feet asl (see Figure 1). The surface elevation of Cedar Lake #5 is 3581.2. Thus, if groundwater is present in these Triassic aquifers, the depth to water would be about 241 feet.

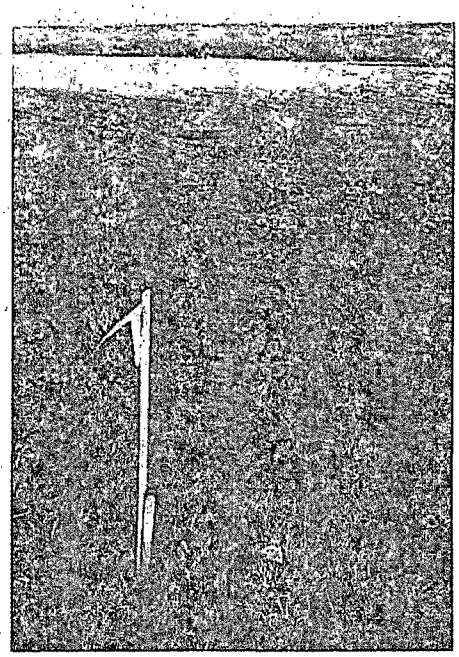
Distance to Surface Water

Figure 3 and the site visit demonstrates that the location is not within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark).

- As stated above, about 500 feet southwest of the western edge of the proposed temporary pit is the start (headwaters) of a named watercourse, Cedar Lake Draw (see

Figures 3 and 4). No physical evidence of this watercourse is present within 200 feet of the proposed pit

- About 260 feet from the north edge of the proposed temporary pit is an identified ephemeral unnamed lake (the proposed pit is about 35 feet north of the staked location shown on all figures)
- No evidence of sinkholes exists on the ground, on maps or aerial photographs. However, very small scale soil slump features do exist within the ancient lake bottom. Some of these small-scale features (see photograph) are located just north of the proposed location, about 200-feet from the northern edge of the temporary pit. However, these features are small enough to be abandoned animal burrows.
- Outside of the ancient lake bottom, in the area characterized by small dunes and mesquite, no small-scale slump features are present



Distance to Permanent Residence or Structures

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

- The only structures in the area are oil wells and tank batteries

Distance to Non-Public Water Supply

Figures 1 and Figure 2 demonstrates 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 and 2 show the locations of all area water; the nearest water well is located approximately 6 miles southwest. No domestic water wells are within 1000 feet of the location.
- No springs were identified within the mapping area.

Distance to Municipal Boundaries and Fresh Water Fields

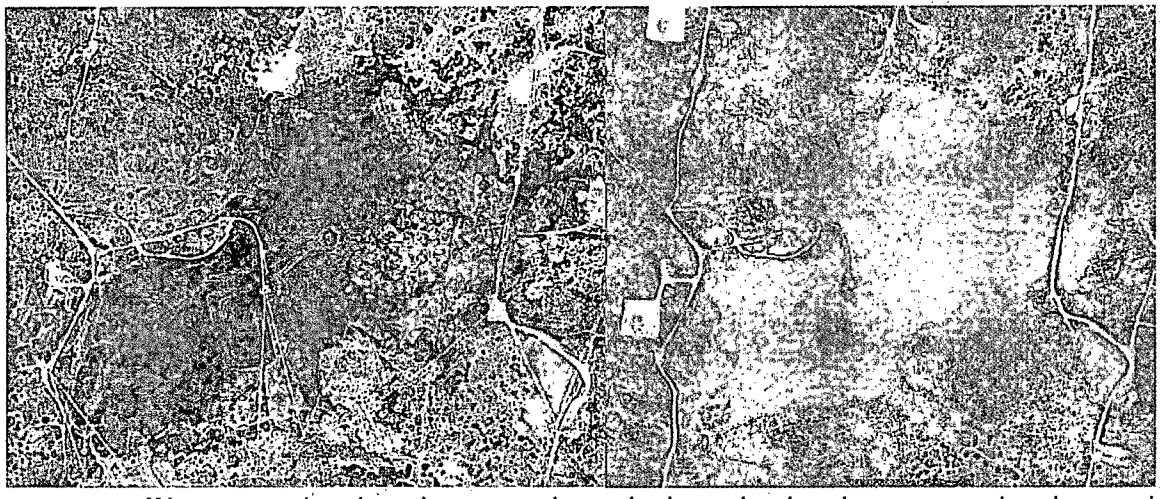
Figure 5 demonstrates that the location is not within incorporated municipal boundaries or defined municipal fresh water well fields covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended.

- The closest communities are Maljamar, NM approximately 10 miles to the east and Loco Hills, which is about 5 miles west.
- The closest public well field is located approximately 8 miles to the northeast, on the Caprock where the Ogallala Aquifer provides abundant water.

Distance to Wetlands

Figure 6 demonstrates the location is within 500 feet of a wetland identified by the USFWS "Wetland Mapper".

- The definition of wetland under NMOCD Rules is:
  "Wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico...
- The closest identified wetland on the USFS Wetland Mapper is the ephemeral lake about 260 feet northwest of the location, identified in Figures 3, 4 and 6. This wetland is identified as a palustrine system unconsolidated bottom class (PUB, see data at the end of this application for a description of this wetland system).
- A portion of Cedar Lake Draw is also shown as a wetland, located about 500 feet to the southwest
- The Google Earth image below left is dated 5/8/2009 and shows water in the central excavated area of the ephemeral lake. The Google Earth image on the right (dated 3/2/2012) shows the excavated area is dry. Both images show that the low area in the southwest corner of the lakebed is dry. Both images also show an excavated channel from the low area in the southwest to the excavated area in the center of the ancient lakebed.



- We suggest that these images and our site investigation demonstrate that the area in the southwest corner of the ancient lake was a wetland (as defined by OCD Rules) as was the central portion of the lakebed – both of which appear as PUB (on the wetlands mapper). The excavations in the ancient lakebed have eliminated the wetland area closest to the proposed pit and have minimized any exit of water into Cedar Lake Draw from this ancient lakebed; eliminating any wetlands from this area of the draw.
- We propose an examination with OCD to identify a "prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico" in the mapped areas in the southwest corner of the ancient lakebed and within Cedar Lake Draw nearest the proposed pit.

Distance to Subsurface Mines

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

- The nearest caliche pit is located approximately 2 miles to the southwest
- Field inspection shows several un-mapped caliche pits nearby.

Distance to High or Critical Karst Areas

Figure 8 shows the location of the temporary pits with respect BLM Karst areas

- The proposed temporary pit is located within a "low" potential karst area.
- The nearest "high" or "critical" potential karst area is located approximately 20 miles west of the site.
- No evidence of solution voids or any ground instability were observed near the site during the field inspection.
- The small-scale slump features/animal burrows are not present in the mesquite sand area of the proposed temporary pit.

Distance to 100-Year Floodplain

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

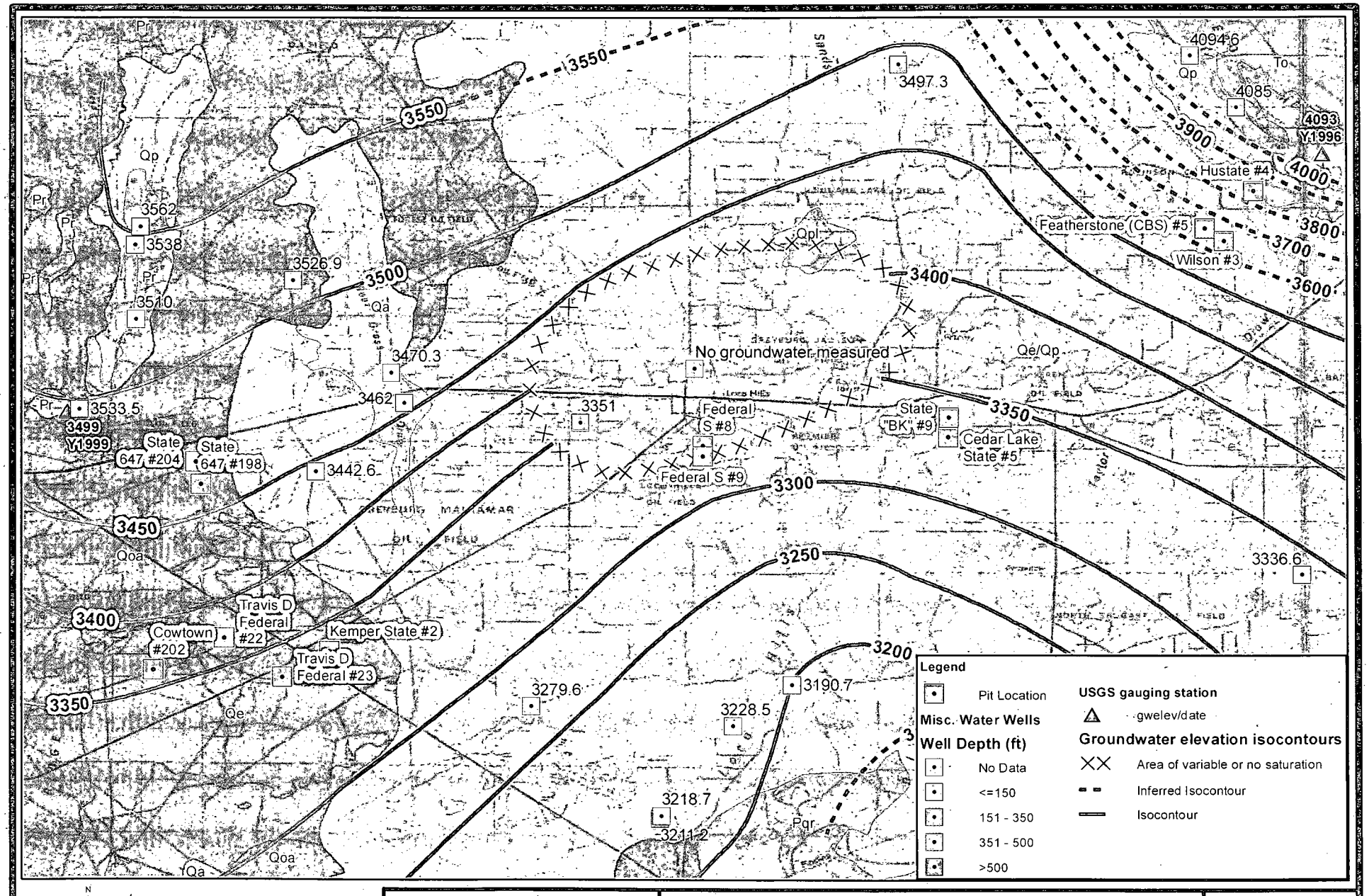
- The location is in Section 2 T17S R31E
- This location plots in Zone X, which is defined as an area of minimal flood hazard, generally above the 500-year flood level

Temporary Pit Design

Please refer to Plates 1a, 1b and 1c for the design of the temporary pit and the Design and Construction Plan at the end of this application. Note that the location of the temporary pit is about 30 feet south of the staked location.

Site Specific Information
Figures

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



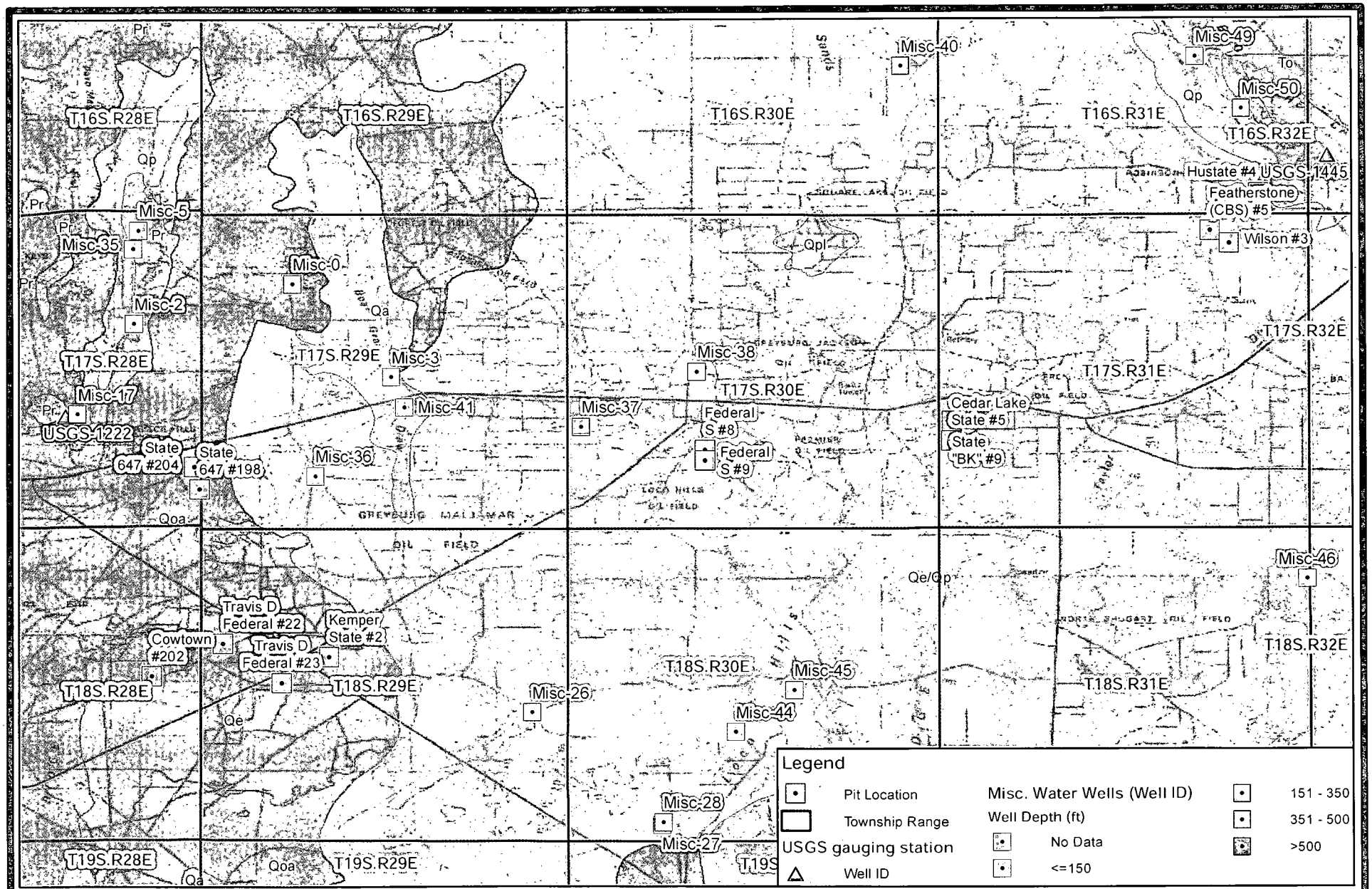
R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

Geology and Groundwater Elevation

Figure 1

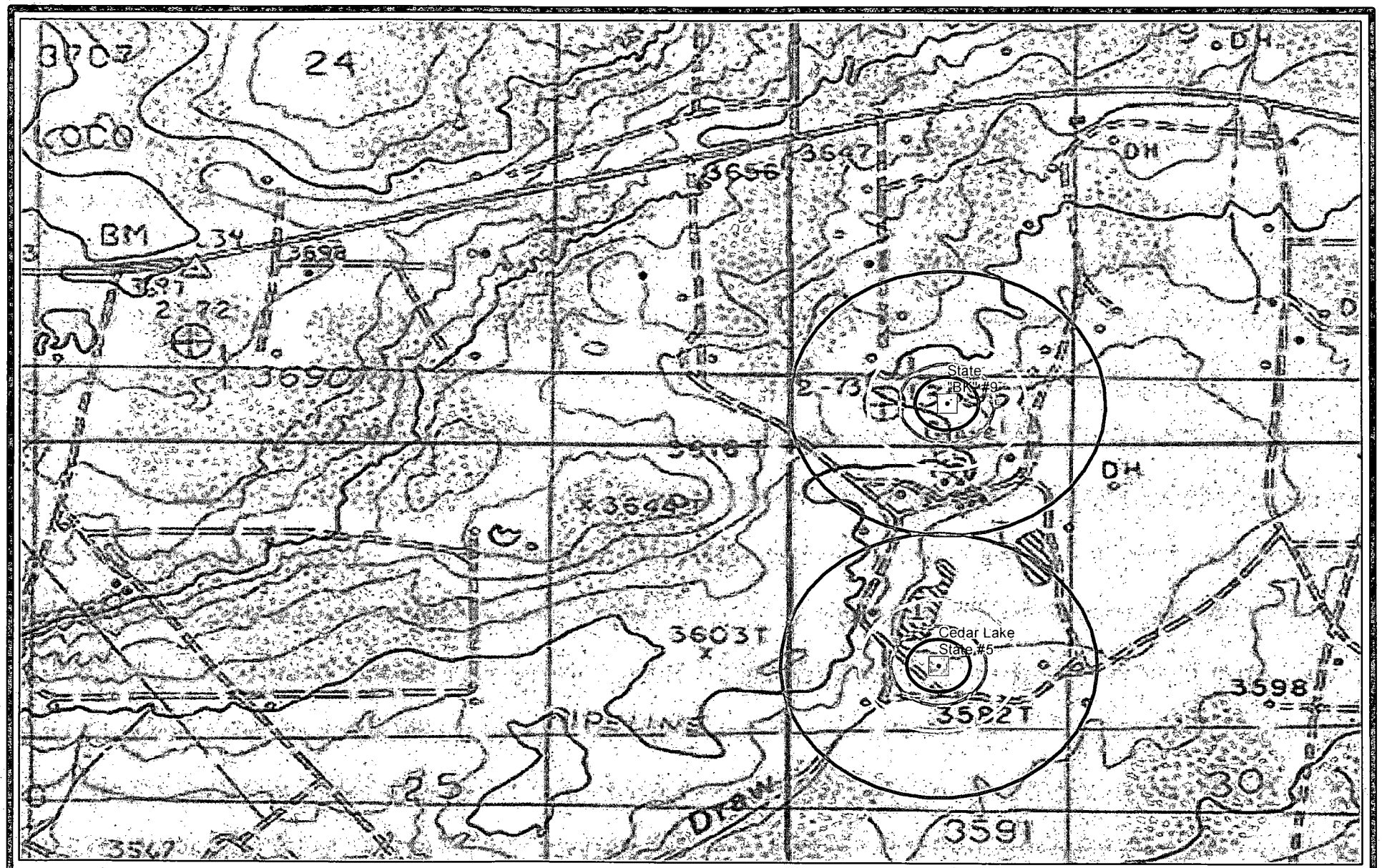
Alamo Permian 2013 Drilling Program

Feb 2013

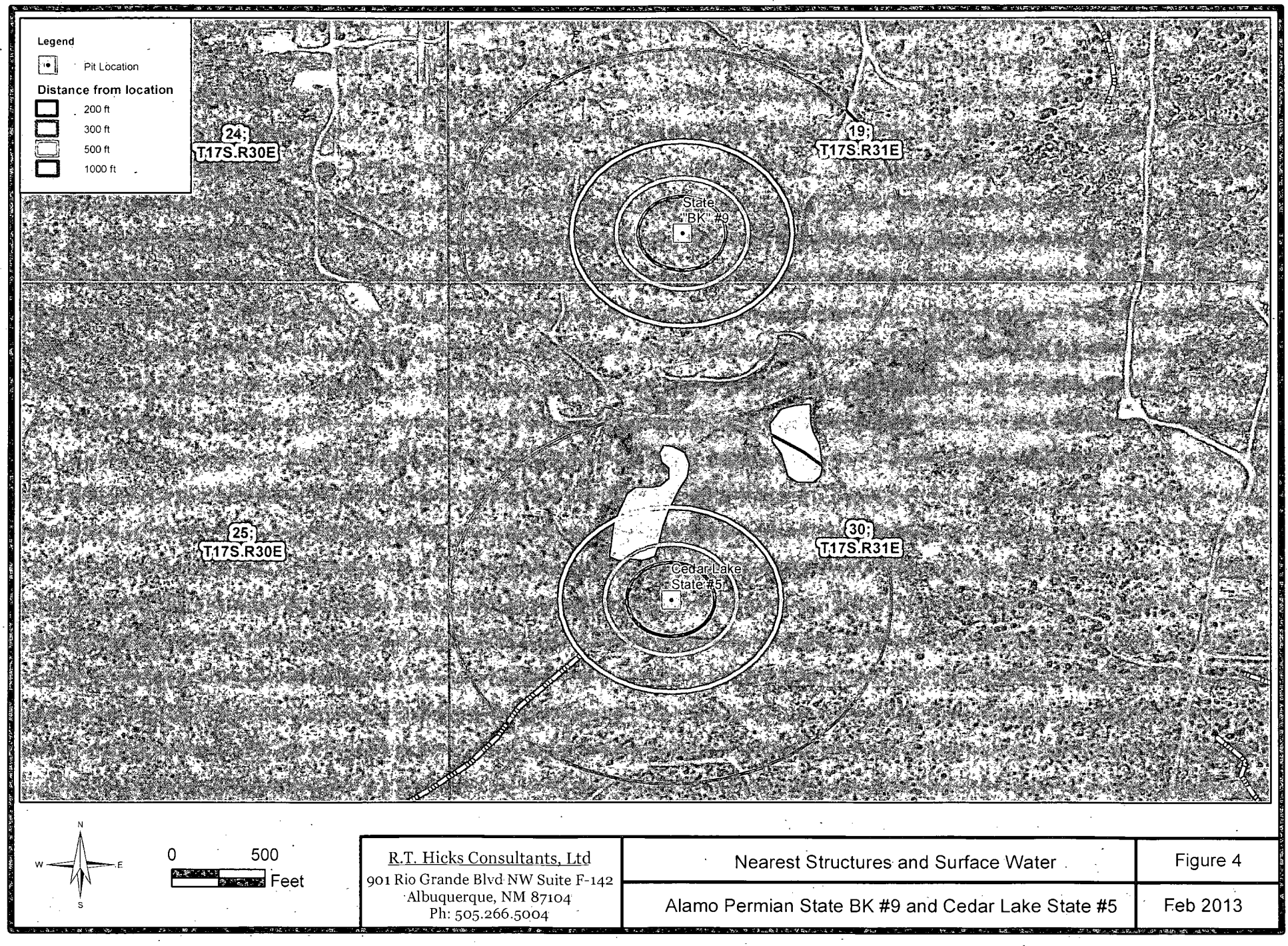


R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

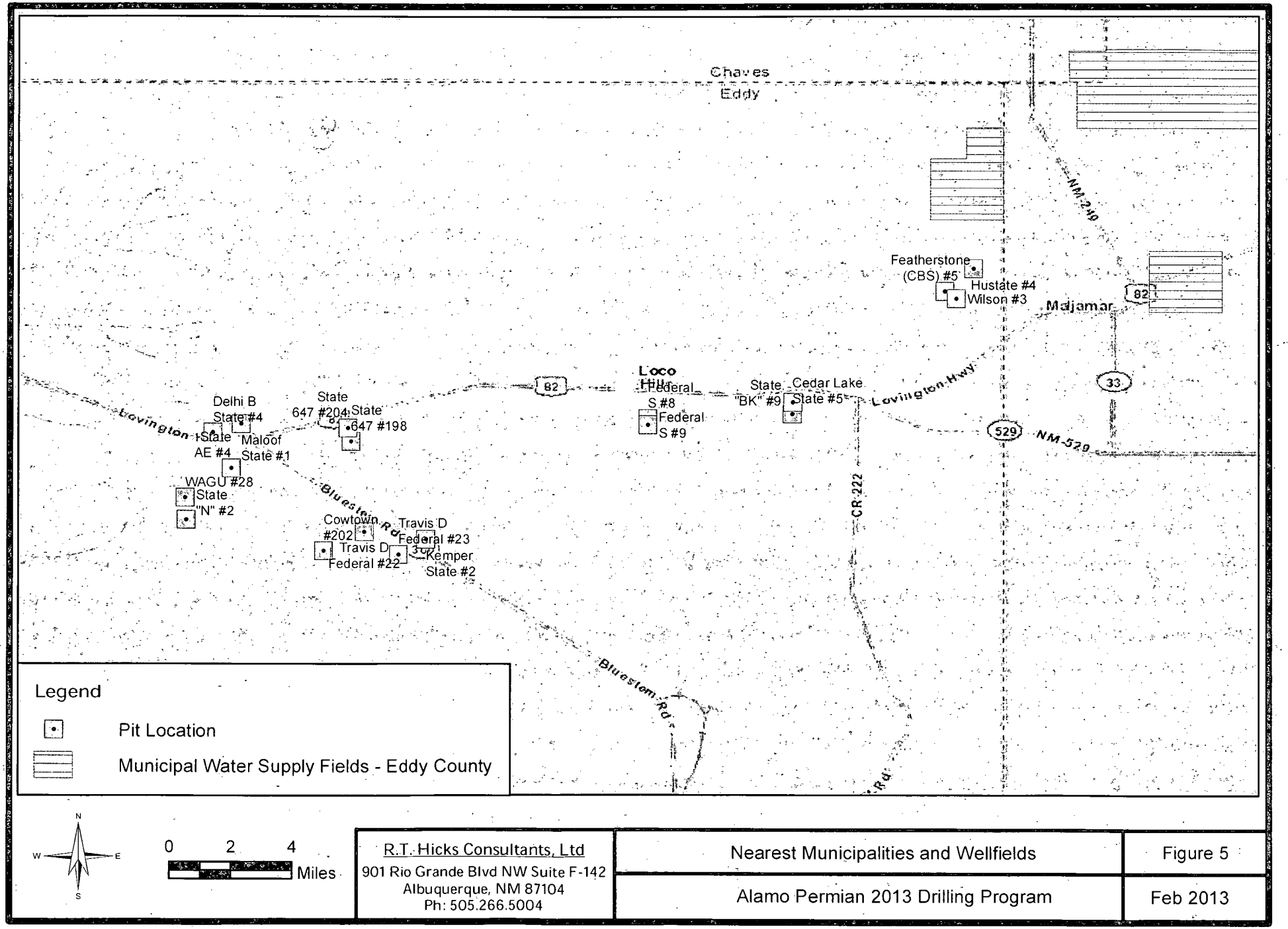
Well Identification Numbers	Figure 2
Alamo Permian 2013 Drilling Program	Feb 2013



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Topographic Map	Figure 3
	Alamo Permian State BK #9 and Cedar Lake State #5	Feb 2013



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearest Structures and Surface Water	Figure 4
	Alamo Permian State BK #9 and Cedar Lake State #5	Feb 2013



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

Nearest Municipalities and Wellfields

Figure 5

Alamo Permian 2013 Drilling Program

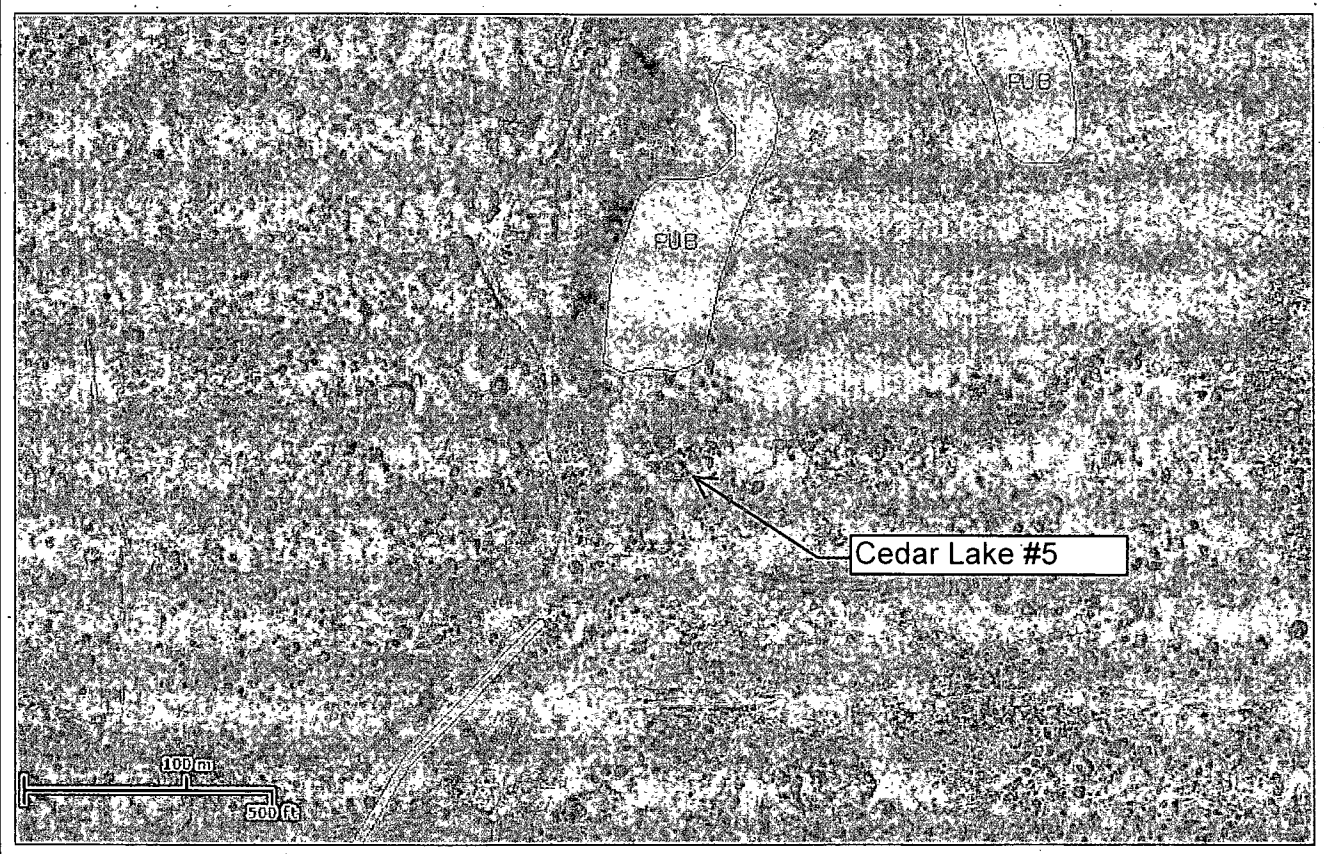
Feb 2013

U.S. Fish and Wildlife Service

National Wetlands Inventory

Figure 6 - Wetland Mapper

Feb 17, 2013

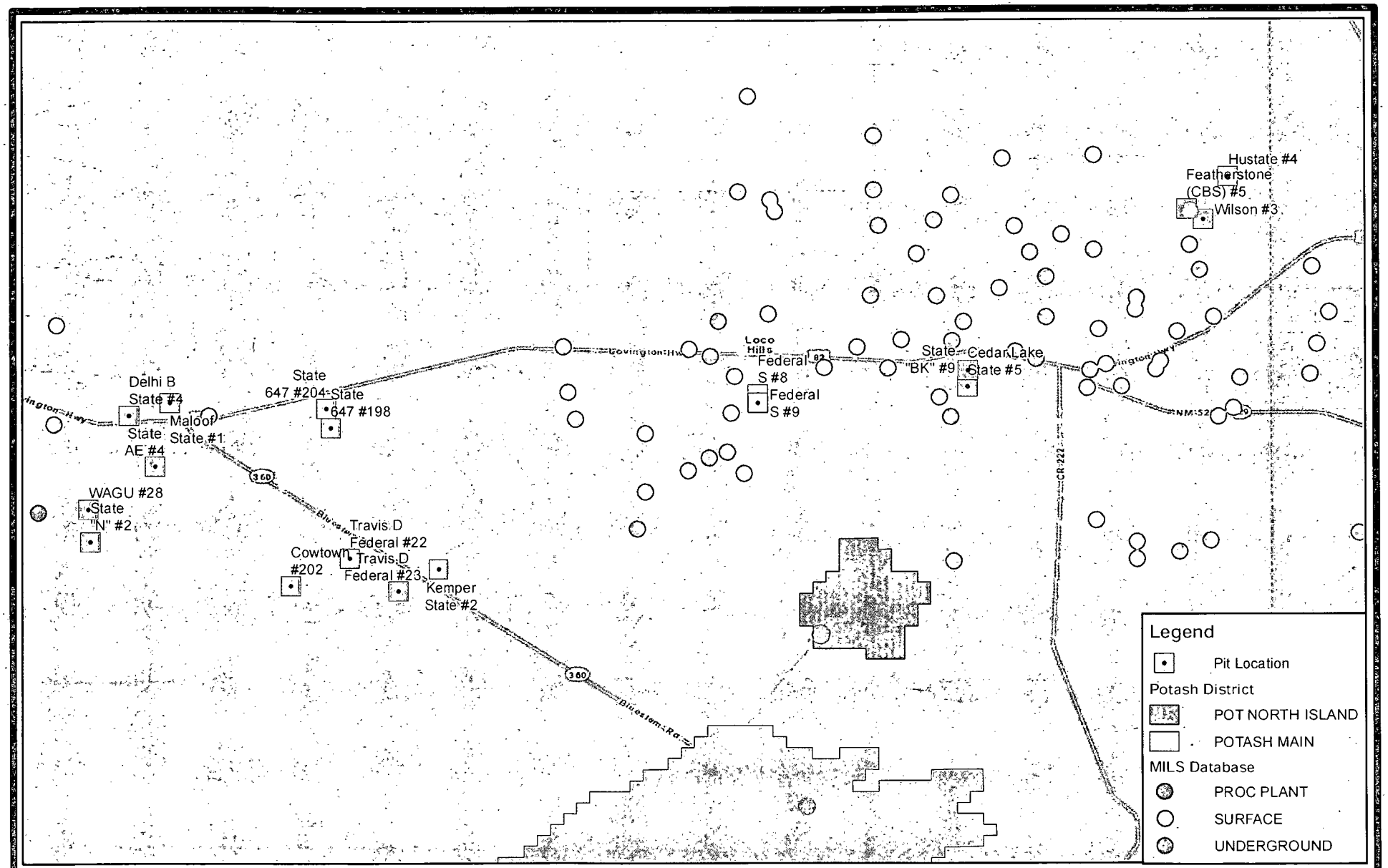


Wetlands

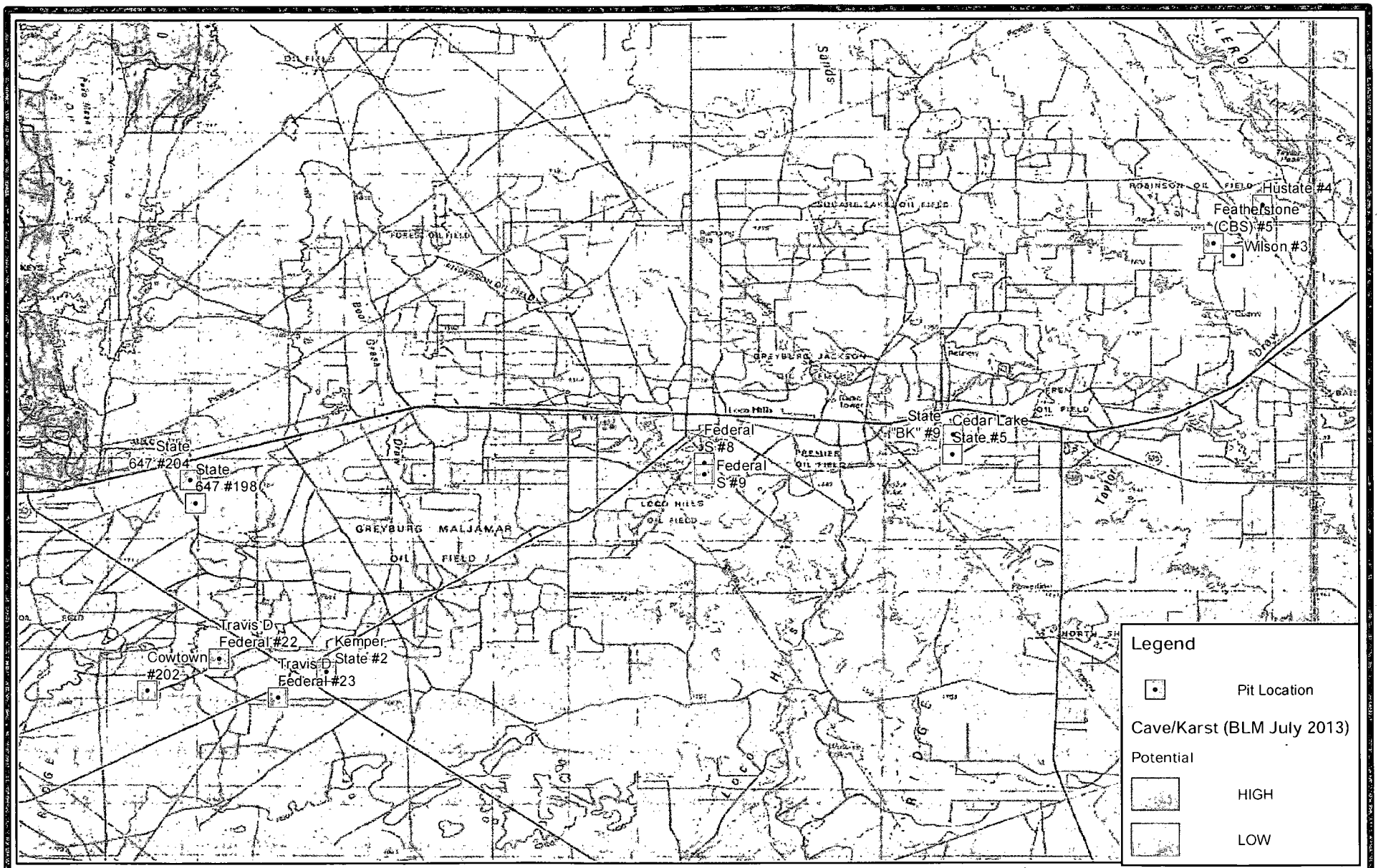
- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

User Remarks:

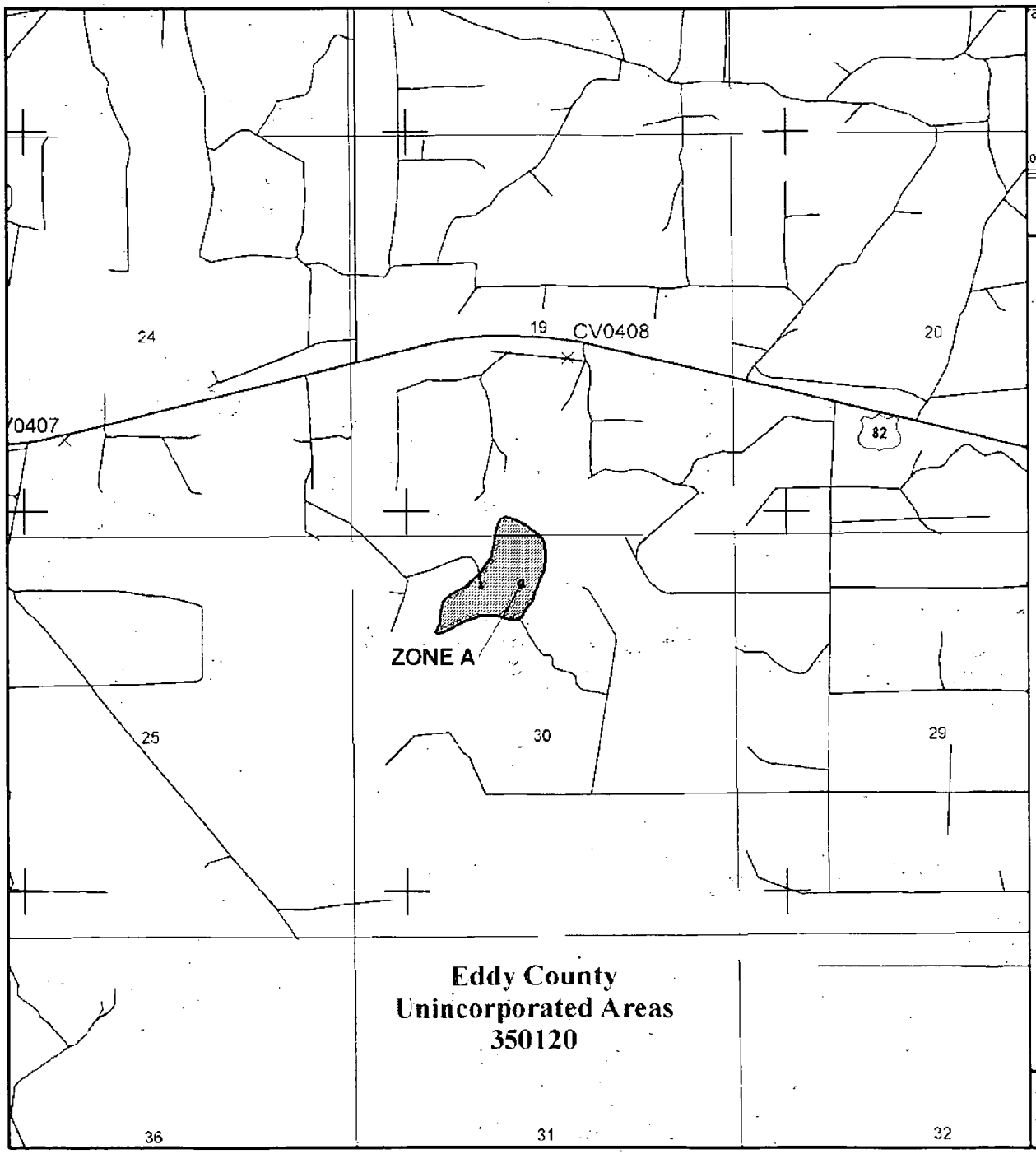
Alamo Permian - Cedar lake #5



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearest Mines and Mining Districts	Figure 7
	Alamo Permian 2013 Drilling Program	Feb 2013



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	BLM Cave/Karst Potential	Figure 8
	Alamo Permian 2013 Drilling Program	Feb 2013



ance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

0 0 1,000 2,000 3,000 4,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0425D

FIRM

FLOOD INSURANCE RATE MAP

EDDY COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 425 OF 2000

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EDDY COUNTY UNINCORPORATED AREAS	350120	0425	D

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
35015C0425D

EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Site Specific Information Plates

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

Survey Information

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
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

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

WELL LOCATION AND ACREAGE DEDICATION PLAT

1 API Number	2 Pool Code	3 Pool Name

4 Property Code	5 Property Name	6 Well Number
	CEDAR LAKE	005

7 OGRID No.	8 Operator Name	9 Elevation
274841	ALAMO PERMIAN RESOURCES, LLC	3581.2

10 Surface Location

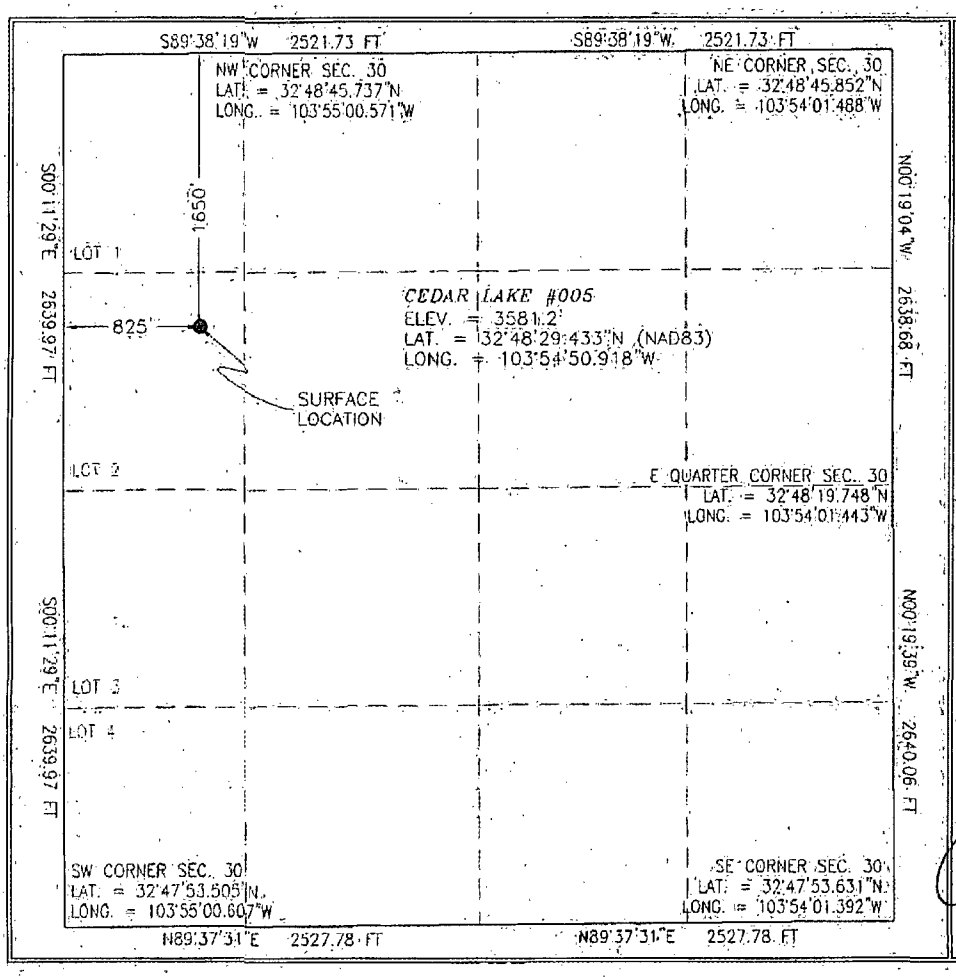
UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
2	30	17 S	31E		1650	NORTH	825	WEST	EDDY

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

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

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.

Signature Date

Printed Name

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.

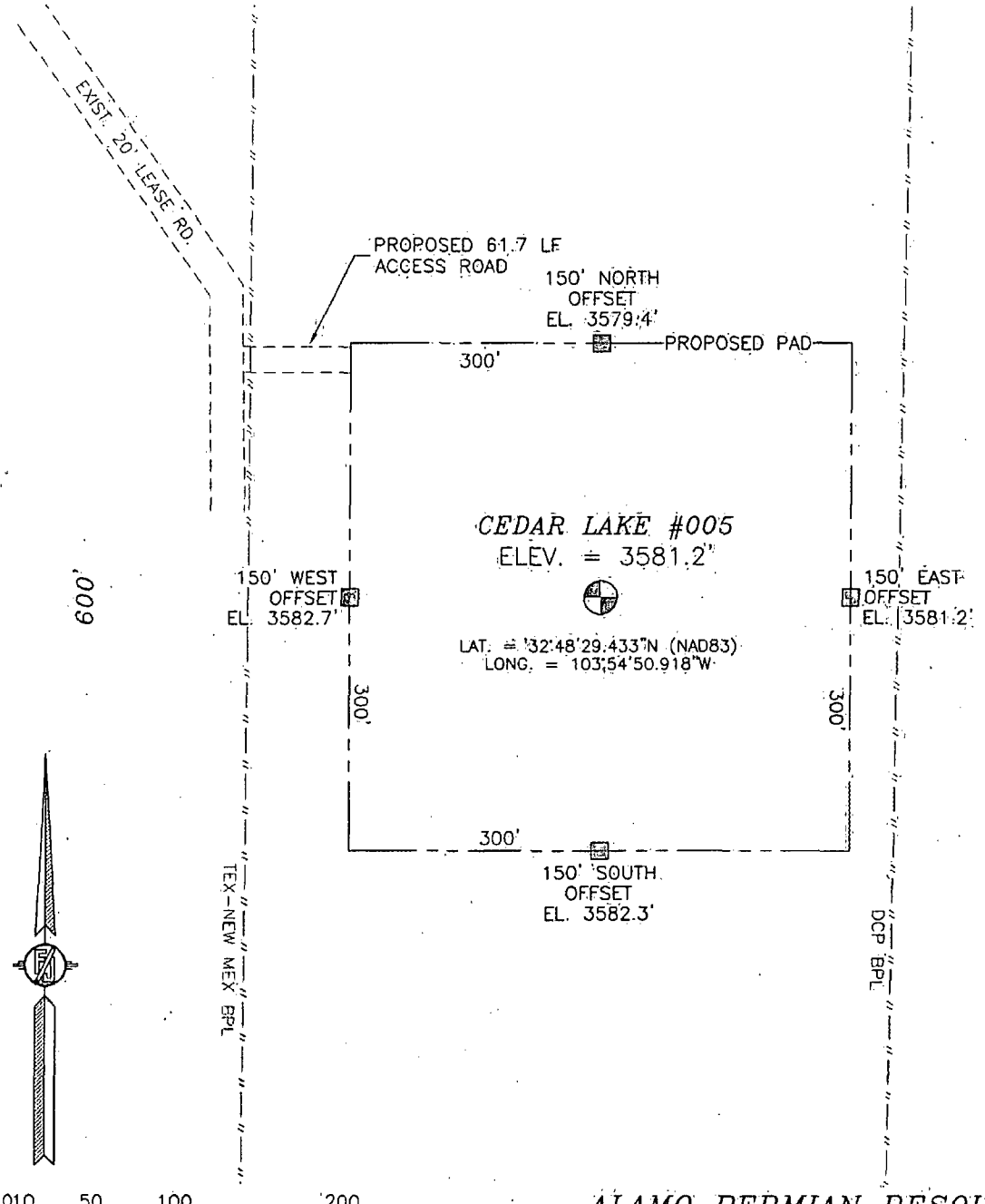
DECEMBER 20, 2012
Date of Survey

Signature and Seal of Professional Surveyor

Certificate Number EILIMON F. JARAMILLO, PLS 12797

SURVEY NO. 1445

SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO



010 50 100 200

SCALE 1" = 100'

DIRECTIONS TO LOCATION

FROM THE INTERSECTION OF STATE HIGHWAY 82 AND CR 221 (SKELLY ROAD) GO EAST ON STATE HIGHWAY 82 APPROX. 0.1 OF A MILE TO LEASE ROAD ON RIGHT SIDE (SOUTH) OF STATE HIGHWAY 82, TURN RIGHT (SOUTH) GO APPROX. 0.7 OF A MILE TO A ROAD LATH WITH RED AND WHITE FLAGGING ON LEFT SIDE (EAST) OF LEASE ROAD. LOCATION IS APPROX. 175 FT EAST.

ALAMO PERMIAN RESOURCES, LLC

CEDAR LAKE #005

LOCATED 1650 FT. FROM THE NORTH LINE AND 825 FT. FROM THE WEST LINE OF SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M. EDDY COUNTY, STATE OF NEW MEXICO

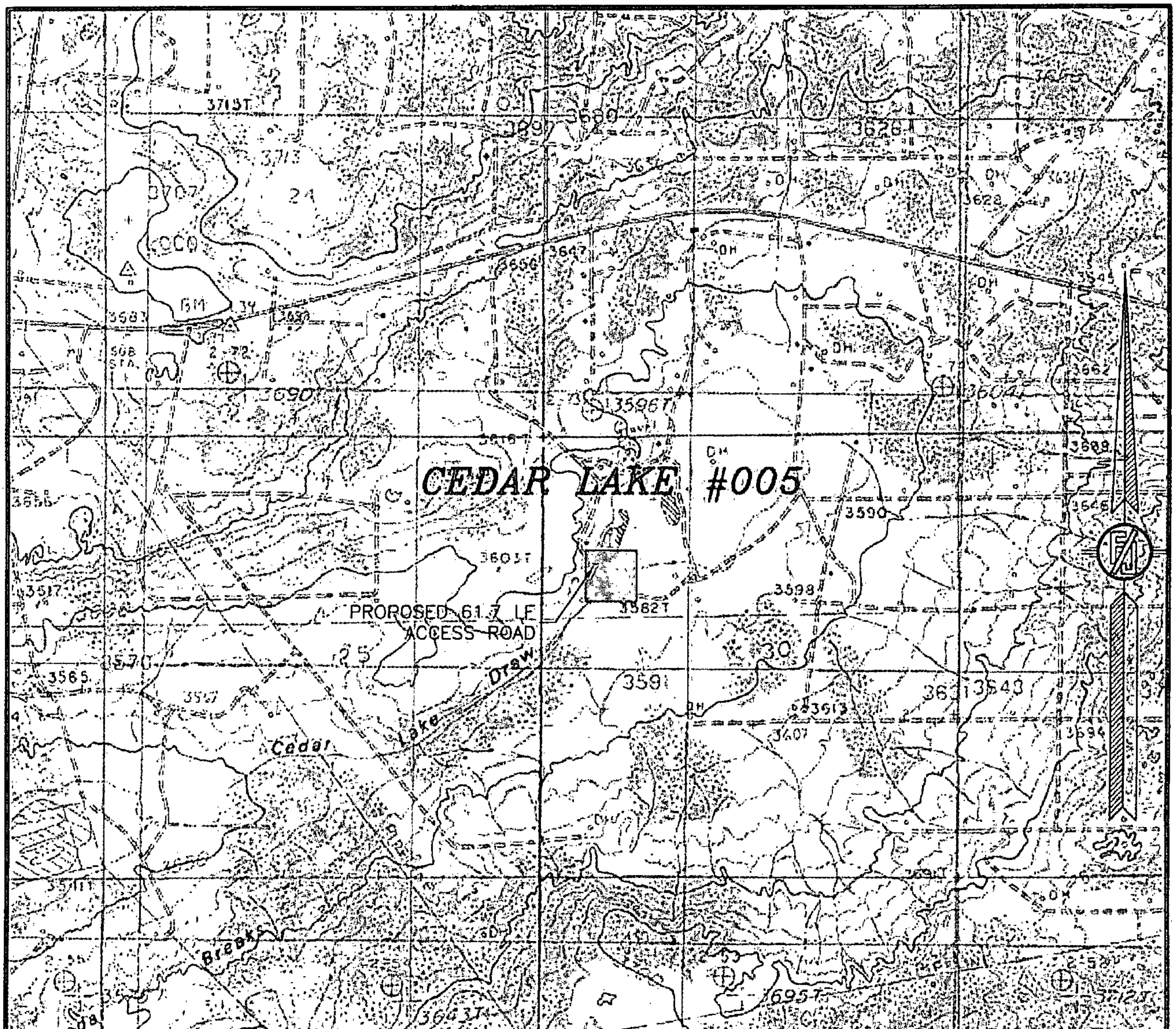
DECEMBER 20, 2012

SURVEY NO. 1445

MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 *CARLSBAD, NEW MEXICO*

SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

LOCATION VERIFICATION MAP



USGS QUAD MAP:
LOCO HILLS, NM

NOT TO SCALE

ALAMO PERMIAN RESOURCES, LLC
CEDAR LAKE #005
LOCATED 1650 FT. FROM THE NORTH LINE
AND 825 FT. FROM THE WEST LINE OF
SECTION 30, TOWNSHIP 17 SOUTH,
RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

DECEMBER 20, 2012

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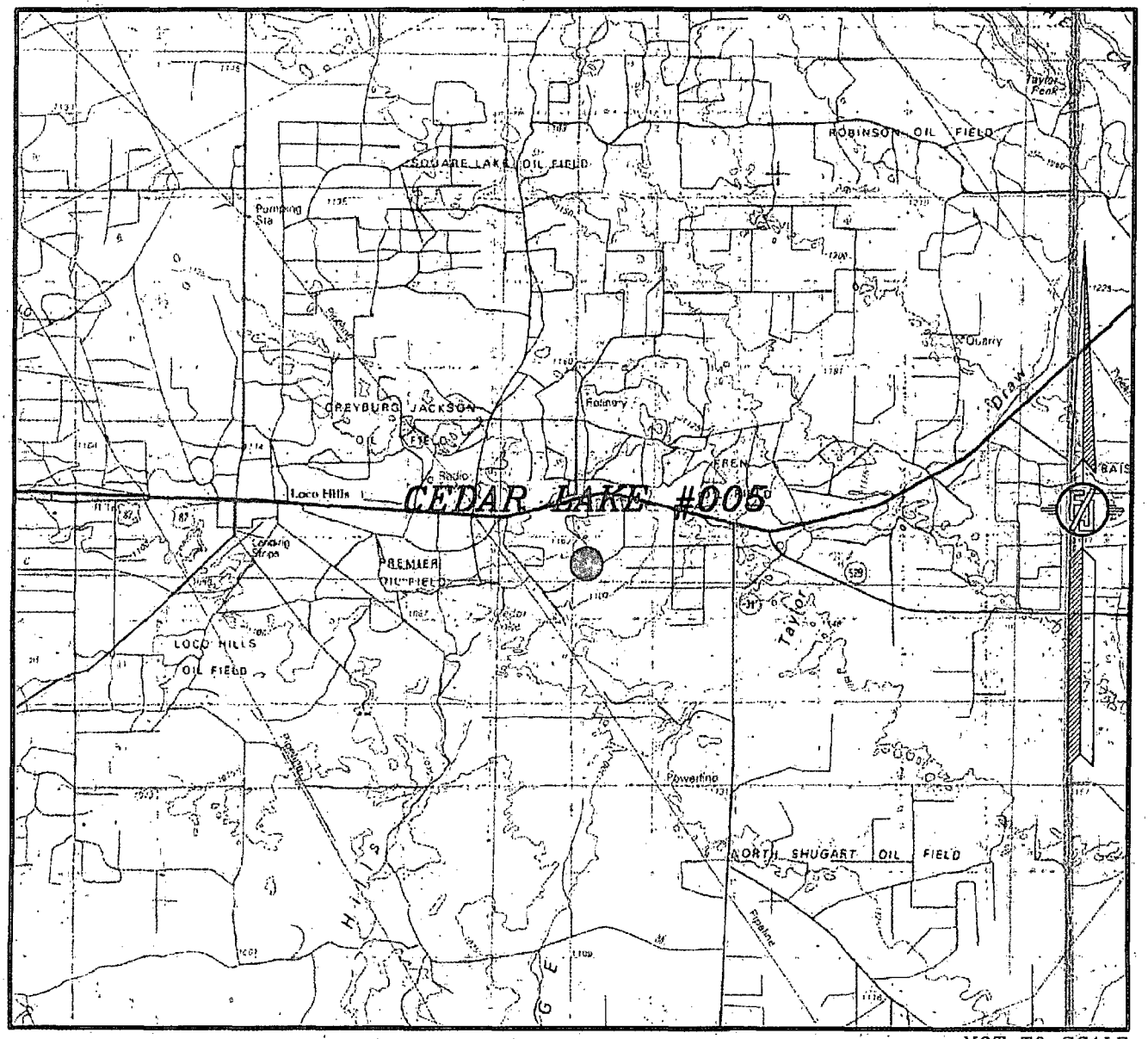
MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 CARLSBAD, NEW MEXICO

SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

VICINITY MAP



NOT TO SCALE

ALAMO PERMIAN RESOURCES, LLC
CEDAR LAKE #005
LOCATED 1650 FT. FROM THE NORTH LINE
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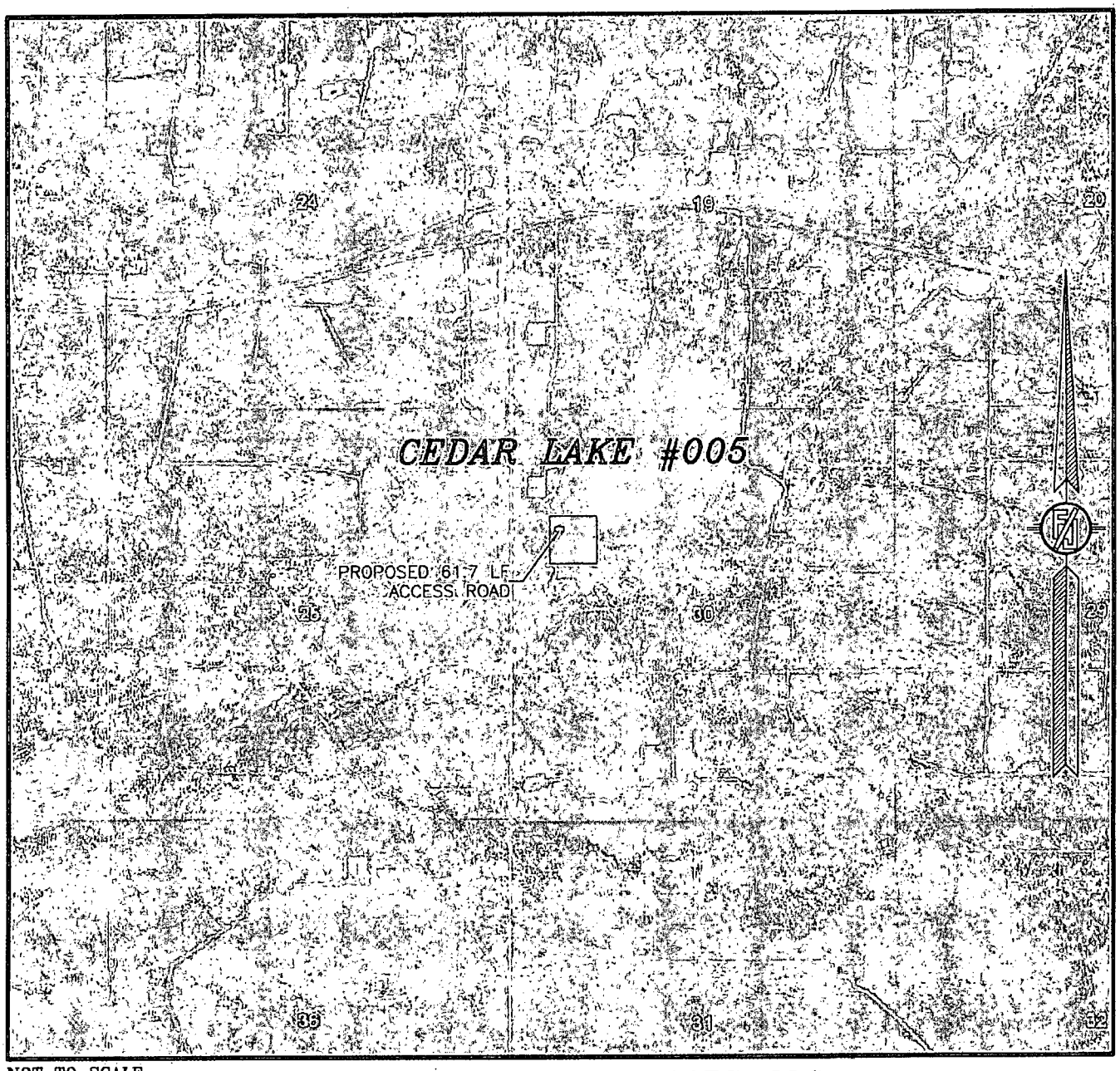
MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 CARLSBAD, NEW MEXICO

SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

AERIAL PHOTO



NOT TO SCALE
AERIAL PHOTO:
GOOGLE EARTH
MARCH 2012

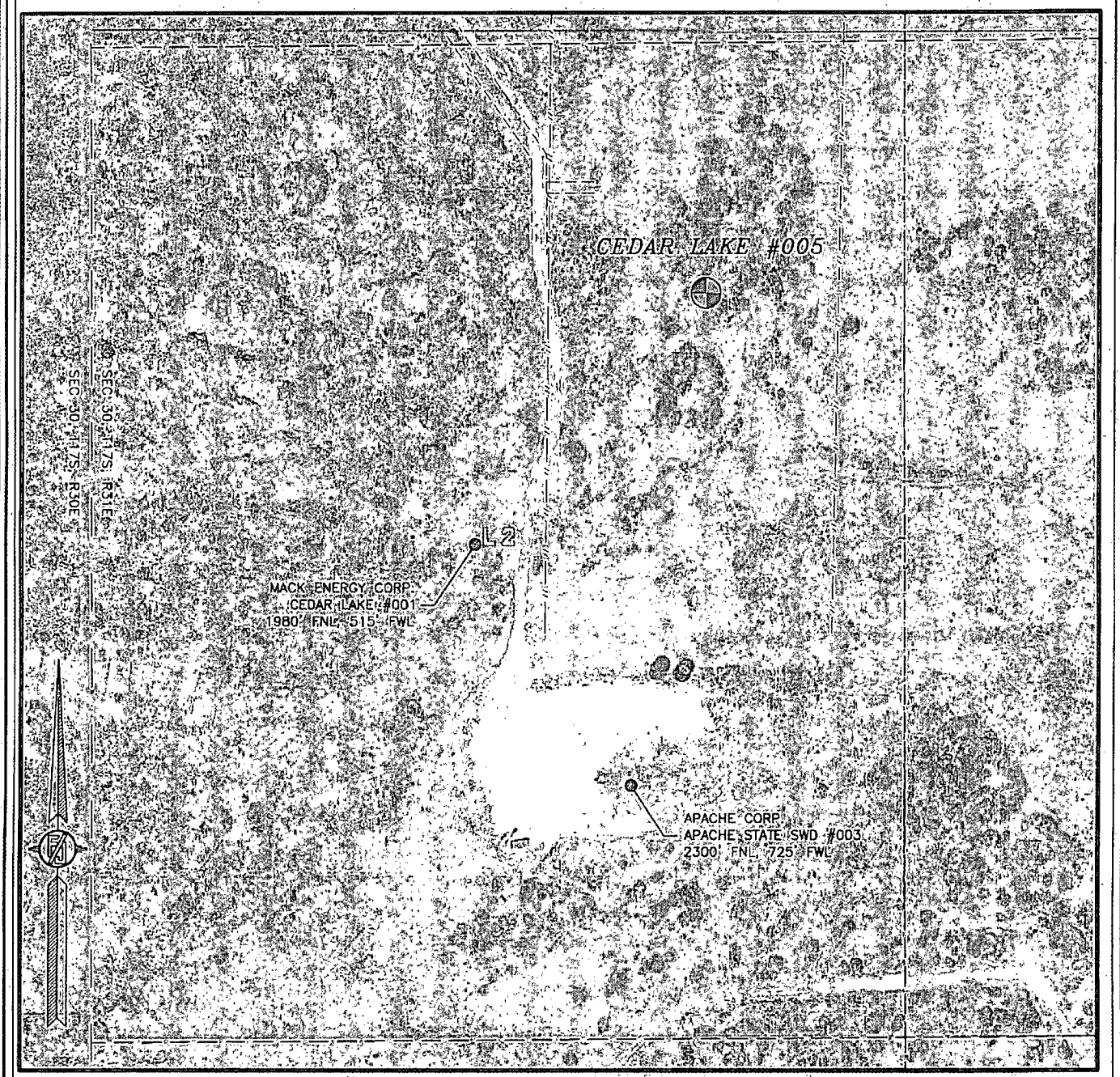
ALAMO PERMIAN RESOURCES, LLC
CEDAR LAKE #005
LOCATED 1650 FT. FROM THE NORTH LINE
AND 825 FT. FROM THE WEST LINE OF
SECTION 30, TOWNSHIP 17 SOUTH,
RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

DECEMBER 20, 2012

SURVEY NO. 1445

MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 CARLSBAD, NEW MEXICO

SECTION 30, TOWNSHIP 17 SOUTH, RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO



AERIAL PHOTO:
GOOGLE EARTH
MARCH 2012

020 100 200 300
SCALE 1" = 200'

UNIT E – LOT 2
SECTION 30, TOWNSHIP 17 SOUTH,
RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

FOR INFORMATION PURPOSES ONLY, DATA COMPILED FROM FIELD, OCD RECORDS AND UNCONTROLLED AERIAL PHOTOGRAPHY

ALAMO PERMIAN RESOURCES, LLC
CEDAR LAKE #005
LOCATED 1650 FT. FROM THE NORTH LINE
AND 825 FT. FROM THE WEST LINE OF
SECTION 30, TOWNSHIP 17 SOUTH,
RANGE 31 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO

DECEMBER 20, 2012

SURVEY NO. 1445

MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 CARLSBAD, NEW MEXICO

Generic Plans for Temporary Pits

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Temporary Pit Design Plan

Plates 1a, 1b, and 1c show the design of the temporary pit proposed for this project. Field conditions and the drilling rig layout will determine the final configuration of the pit cells, which will consists of the following:

1. A cell for drilling fluid circulation and cuttings storage
2. A cell for the storage of fresh water (drilling/stimulation) and stimulation flow-back water prior to re-use or disposal

In addition to the commitments listed below, the operator will install a system that can drain water entrained in the drilling waste of the drilling pit. As described in the closure plan, this system of filtered perforated pipe and drainage mats cover much of the bottom of the drilling cell of the pit – the cut brine cell and the inner cell. The system will drain to the lowest corner of each cell, generally near the suction area. The exact location will be determined upon completion of the cells. Standpipes rise from the depression and house a solar-powered pump. The drainage system for the cut brine cell removes water to the brine cell via the solar pumps. This water can be placed in an above-ground tank or the fluids cell of the pit for temporary storage before re-use or disposal. The drainage system in the brine cell may also be used to introduce water below the residual cuttings/mud, causing the introduced fluid to move upwards through the cuttings/mud and enhance the solids rinsing process. Introduced water to the brine cell (which will become cut brine or saturated brine after movement through the cuttings) can be removed from the pit for re-use via a vacuum truck or recovered from the drainage system at the bottom.

The temporary storage of fluids, fluid reuse or fluid disposal will be conducted in a manner approved by division rules that prevents the contamination of fresh water and protects public health and the environment. This drainage and rinsing system allows the operator to:

- Recover clear water for possible re-use,
- Reduce the concentration of constituents of concern in the drilling waste by removing some water entrained in the drilling waste.

Precipitation and the possible addition of relatively fresh water (see closure plan) will rinse the solid drilling waste, causing additional reduction in the constituents of concern as the water is recovered for re-use or disposal.

For any temporary storage of fluids derived from the drilling pit and placed in an above-ground tank, the following will apply:

1. Construction, operation and maintenance of the temporary storage tank(s) will adhere to all applicable NMOCD Rules including but not limited to:
    a. Safety stipulations
    b. Protection from hydrogen sulfide mandates
    c. Signage and identification requirements
    d. Secondary containment requirements for temporary tanks

e. Applicable netting requirements

2. Any cleaning of the temporary tank(s) will adhere to NMOCD Rules relating to tank cleaning.
3. Transportation of water or drilling fluids derived from the drilling pit will adhere to all applicable NMOCD Rules relating to transportation.
4. Storage of water or drilling fluids in temporary above-ground tanks will also adhere to all applicable Federal mandates.

During final closure of the pit, the tanks and secondary containment system will be removed from the location and the area beneath the tank inspected for any leakage. If any leakage is suspected, the operator will sample the soil beneath the tanks and report any release pursuant to NMOCD Rules.

Finally, we intend to place any temporary tank used in conjunction with the pit drainage system on a 20-mil liner with a berm around it that would allow any inadvertently released fluids to drain or be pumped back into the pit.

Construction/Design Plan of Temporary Pit

1. The operator or qualified contractor will design and construct the pit to contain liquids and solids and prevent contamination of fresh water and protect public health and the environment.
2. Prior to constructing the pit the operator or qualified contractor will strip and stockpile the topsoil for use as the final cover or fill at the time of closure.
3. The operator will post an upright sign in compliance with 19.15.16.8 NMAC. The operator will post the sign in a manner and location such that a person can easily read the legend. The sign will 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.
4. The operator will fence the pit in a manner that prevents unauthorized access and will maintain the fences in good repair. The operator will fence the pit 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 will be completely fenced at all times excluding drilling and workover operations. During drilling or workover operations, the operator is not required to fence the edge of the pit adjacent to the drilling or workover rig.
5. The operator will design and construct the temporary pit to prevent unauthorized releases and ensure the confinement of liquids.
6. The temporary pit will 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.
7. The slopes of the pit will be no steeper than two horizontal feet to one vertical foot (2H:1V). Unless an alternate slope, protective to fresh water, public health and the environment, is proposed and approved by the appropriate division district office.
8. As an addition engineering control to address any concerns relating to the presence of karst and associated instability, during construction of the pit the contractor will compact

the earth material that forms the foundation for the pit liner. An expected proctor density of greater than 90% will be achieved by

a. Adding water to the earth material as appropriate,
b. Compacting the earth by walking a crawler-type tractor down the sides and bottom of the pit
c. Repeating this process with a second 6-inch lift of earth material if necessary

9. The operator will design and construct the temporary pit with a geomembrane liner. The geomembrane liner will consist of 20-mil string reinforced LLDPE or equivalent liner material that the appropriate division district office approves. The geomembrane liner will be composed of an impervious, synthetic material that is resistant to petroleum hydrocarbons, salts and acidic and alkaline solutions. The liner material will be resistant to ultraviolet light. Liner compatibility will comply with EPA SW-846 method 9090A.
10. The operator will minimize liner seams and orient them up and down, not across a slope. The operator will use factory-welded seams. Prior to any field seaming, the operator will overlap liners four to six inches and orient seams parallel to the line of maximum slope, *i.e.*, oriented along, not across, the slope. The operator will minimize the number of welded field seams in corners and irregularly shaped areas. Qualified personnel will weld Field seams.
11. Construction will avoid excessive stress-strain on the liner.
12. Geotextile will be placed under the liner where needed to reduce localized stress-strain or protuberances that may otherwise compromise the liner's integrity.
13. The operator and/or qualified contractor retained by the operator will anchor the edges of all liners in the bottom of a compacted earth-filled trench. The anchor trench will be at least 18 inches deep.
14. The operator and/or qualified contractor retained by the operator will ensure that the liner is protected from any fluid force or mechanical damage at any point of discharge into or suction from the lined temporary pit.
15. The operator and/or qualified contractor retained by the operator will design and construct the temporary pit to prevent run-on of surface water. As necessary, a berm or ditch will surround the temporary pit to prevent run-on of surface water.
16. The volume of the temporary pit (fluids cell plus drilling cell), including freeboard, does not exceed 10 acre-feet (77,583 bbls).

Temporary Pit Operating and Maintenance Plan

The operator will operate and maintain the pit to contain liquids and solids and maintain the integrity of the liner, liner system, or any secondary containment system to prevent contamination of fresh water and protect public health and the environment as described below:

1. If feasible, the operator will recycle, reuse or reclaim of all drilling fluids and recovered water in a manner approved by division rules that prevents the contamination of fresh water and protects public health and the environment. Specifically, drilling fluids and reclaimed water will be transferred to other drilling operations for use (see closure plan).
2. If re-use is not possible, fluids will be sent to disposal at division-approved facility.
3. Reuse or disposal of fluids from the pit will be conducted in a manner approved by division rules that prevents the contamination of fresh water and protects public health and the environment.
4. The operator will not discharge into or store any hazardous waste in the pit.
5. If any pit liner's integrity is compromised, or if any penetration of the liner occurs above the liquid's surface, then the operator will notify the appropriate division district office within 48 hours (phone or email) of the discovery and repair the damage or replace the liner.
6. If the pit develops a leak or if any penetration of the pit liner occurs below the liquid's surface, then the operator will remove all liquid above the damage or leak line within 48 hours, notify the appropriate district office within 48 hours (phone or email) of the discovery and repair the damage or replace the pit liner.
7. The injection or withdrawal of liquids from the pit will be accomplished through a header, diverter or other hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.
8. The operator will install diversion ditches and berms around the pit as necessary to prevent the collection of surface water run-on.
9. The operator will immediately remove any visible layer of oil from the surface of the temporary pit and maintain on site an oil absorbent boom to contain and remove oil from the pit's surface.
10. Only fluids used or generated during the drilling or workover process will be discharged into the temporary pit. The discharge of workover fluids to the drilling pit as a rinse to the drilling waste solids is discussed in the closure plan (below).
11. The operator will maintain the temporary pit free of miscellaneous solid waste or debris.
12. Although hydrocarbon-based drilling mud is not anticipated for use, the operator will use a tank made of steel to contain hydrocarbon-based drilling fluids if need be.
13. Immediately after cessation of drilling, the operator will remove any visible or measurable layer of oil from the surface of a drilling pit, in the manner described above.
14. The operator will maintain at least two feet of freeboard for the temporary pit.
15. The operator will inspect the temporary pit containing drilling fluids at least daily while the drilling rig is on-site to ensure compliance with this plan.
16. After drilling operations, the operator will inspect the temporary drilling pit weekly so long as liquids remain in the temporary pit.

17. The operator will maintain a log of such inspections and make the log available for the appropriate district office's review upon request.
18. The operator will file a copy of the log with the appropriate division district office when the operator closes the temporary pit.
19. The operator will remove all free liquids from the temporary pit within 30 days from the date that the operator releases the drilling rig – unless granted an extension of time by the District Office. The operator will note the date of the drilling rig's release on form C-105 or C-103 upon well completion.

Temporary Pit Closure Plan

Protocols and Procedures

The operator will use the following procedures and protocols to implement the closure:

- The operator will notify the surface owner by certified mail, return receipt requested, prior to closure, that the operator plans to close the temporary pit.
- The operator of the temporary pit will notify the applicable division district office verbally or by email at least 72 hours, but not more than one week, prior to any closure operation. The notice will include the operator's name and the location to be closed by unit letter, section, township and range, well's name, number, the API number.
- The operator of the temporary pit will remove all liquids from the temporary pit prior to closure and either:
  - Dispose of the liquids in a division-approved facility, or
  - Recycle, reuse or reclaim the liquids for use in drilling another well.
- Fluids on and entrained in the drilling waste will be removed from the pit for re-use or disposal.
- The operator may request extensions of time for the pit to hold free liquids as extensions may be necessary to allow the addition of water to the outer horse shoe of the pit to cause rinsing of solid waste and removal of constituents of concern via the pit drainage system to the inner shoe then to an above-ground tank (or truck) or to the fluids cell of the temporary pit. Sources of water for rinsing the solid drilling waste in the outer horse shoe include:
  - Residual fresh water in the workover cell not used for hydraulic fracturing (removed from the workover cell prior to the introduction of flow-back)
  - Flow-back of water pumped down hole during hydraulic fracturing that is less than 50% of the estimated TDS of pit pore water based on field conductance or specific gravity measurements[1].
- Fluids pumped from the outer horseshoe drainage system are transferred to the inner shoe drainage system causing relatively low salinity water to move up through the cuttings, dissolving the rock salt cuttings.
- When the inner shoe contains at least 130 barrels of clear water (one water truck load), the brine or cut brine can be removed for re-use in drilling operations or sent to disposal.
- The operator shall remove all free liquids from the temporary pit within 30 days from the date that the operator released the drilling rig. The operator shall note the date of the drilling rig's release on form C-105 or C-103 upon well completion. The operator will request an extension of up to three months from the appropriate division district office if necessary to allow for rinsing of drilling waste solids and the recovery of water for re-use.

[1] If water pumped from the pit drainage system prior to stimulation is 9.5 pounds/gallon and distilled water is 8.3 pounds per gallon, discharge to the outer shoe ceases when measurements of flow back are 8.9 pounds/gallon or less

- After removal of all standing water, cuttings rinsing ceases and drilling cell drainage begins as:
    - Water from the outer horseshoe drainage system discharges to the surface of the inner shoe
    - Solar pumping from the inner shoe drainage system transfers water to an above-grade tank or the fluids cell of the temporary pit
- Fluids drained from the cell are temporarily stored in the above-ground tank or fluids cell and are removed for re-use or disposal. Both temporary storage of fluids from the pit and reuse or disposal will be conducted in a manner approved by division rules that prevents the contamination of fresh water and protects public health and the environment.
- The operator will close the temporary pit within six months of the date that the operator releases the drilling rig. An extension not to exceed three months may be requested of the applicable district office.
- The operator will close the pit by an earlier date that the division requires because of imminent danger to fresh water, public health or the environment.
- Within 60 days of closure completion, the operator will submit a closure report on form C-144, with necessary attachments to document all closure activities including sampling results; information required by 19.15.17 NMAC; a plot plan; and details on back-filling, capping and covering, where applicable.
- 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.
- The operator will provide a plat of the pit location on form C-105 with the closure report within 60 days of closing the temporary pit.

Additional Protocols and Procedures for On-Site Closure

- The operator has provided the surface owner notice of the operator's proposal of an on-site closure (see transmittal letter for proof of notice to the landowner) as required in 19.15.17.13.F(1)(b).
- Upon receipt of NMOCD approval for on-site closure (in-place burial,), the operator will notify the surface owner by certified mail, return receipt requested, that the operator plans to close the pit and where the operator has approval for on-site closure. Evidence of mailing of the notice will demonstrate compliance with this requirement.
- The operator will place a steel marker at the center of an on-site burial (unless the surface owner requires an alternative marker that is acceptable to the appropriate division district office). The steel marker will be not less than four inches in diameter and will be cemented in a three-foot deep hole at a minimum. The steel marker will extend at least four feet above mean ground level and at least three feet below ground level. The operator name, lease name and well number and location, including unit letter, section, township and range, and that the marker designates an on-site burial location will be welded, stamped or otherwise permanently engraved into the metal of the steel marker.

- The operator will report the exact location of the on-site burial on form C-105 filed with the division.
- If the State of New Mexico or the Federal government owns the land surface, no deed exists, the land is held in trust. Therefore, the operator cannot file a deed notice identifying the exact location of the on-site burial with the county clerk in the county. The exact location of the on-site burial will be transmitted to the surface owner by copy of the form C-105 discussed above.
- If the surface is not in the public domain, the operator will file a deed notice identifying the exact location of the on-site burial with the county clerk in the county. The exact location of the on-site burial will be transmitted to the surface owner by copy of the form C-105 discussed above.

In-place closure is the preferred closure alternative for the temporary pit. If waste sampling results suggest that standards for in-place closure are not met for the entire drilling cell (inner horseshoe and outer horseshoe), the operator will implement excavation and removal as described in later sections of this plan

Site Reclamation Plan

After the operator has closed the pit, the operator will reclaim the pit location and all areas associated with the pit, including associated access roads to a safe and stable condition that blends with the surrounding undisturbed area. The operator will substantially restore the impacted surface area to the condition that existed prior to oil and gas operations by placement of the soil cover as provided in Subsection H of 19.15.17.13 NMAC, re-contour the location and associated areas to a contour that approximates the original contour and blends with the surrounding topography and re-vegetate according to Subsection I of 19.15.17.13 NMAC.

Soil Cover Design Plan

If the operator removes the pit contents or remediates any contaminated soil to the division's satisfaction the soil cover will consist of the background thickness of topsoil or one foot of suitable material to establish vegetation at the site, whichever is greater.

The soil cover for the in-place burial will consist of a minimum of four feet of compacted, non-waste containing, earthen material. The soil cover will include either the background thickness of topsoil or one foot of suitable material to establish vegetation at the site, whichever is greater.

The operator will construct the soil cover to the site's existing grade and prevent ponding of water and erosion of the cover material.

Re-vegetation Plan

1. The first growing season after the operator closes the pit, including access roads; the operator will seed or plant the disturbed areas.
2. The operator will accomplish seeding by drilling on the contour whenever practical.
3. The operator will obtain vegetative cover that equals 70% of the native perennial vegetative cover (un-impacted by overgrazing, fire or other intrusion damaging to native vegetation).
4. In the absence of specific guidance from the surface owner, the operator will follow BLM mandates for the seed mixture not including noxious weeds, and maintain that cover through two successive growing seasons. The operator will notify NMOCD of the specific mixture prior to seeding.
5. During the two growing seasons that prove viability, there will be no artificial irrigation of the vegetation.
6. The operator will repeat seeding or planting until it successfully achieves the required vegetative cover.
7. If conditions are not favorable for the establishment of vegetation, such as periods of drought, the operator may request that the division allow the operator to delay seeding or planting until soil moisture conditions become favorable or may require the operator to use additional cultural techniques such as mulching, fertilizing, irrigating, fencing or other practices.
8. The operator will notify the division when it has seeded or planted and when it successfully achieves re-vegetation.

In-place Closure Plan

In the event that sampling of the drilling waste suggests that the inner and outer horseshoe of the drilling cell meet the criteria for in-place closure, the operator will proceed with in-place closure for one or both cells (inner and outer horseshoe).

Siting Criteria Compliance Demonstration for In-Place Burial

The Siting Criteria Compliance Demonstration for the temporary pit show that the requirements of 19.15.17.10 NMAC are met for in-place closure.

Waste Material Sampling Plan for In-place Burial

The operator will collect at a minimum, a five-point, composite sample of the contents of the temporary pit after treatment or stabilization.

The purpose of the sampling after the waste material is stabilized is to demonstrate that:

- Benzene, as determined by EPA SW 846 method 8021B or 8260B, does not exceed the concentration limit for in-place burial;
- Total BTEX, as determined by EPA SW-846 method 8021B or 8260B, does not exceed the concentration limit for in-place burial;
- The GRO and DRO combined fraction, as determined by EPA SW-846 method

- 8015M, does not exceed the concentration limit for in-place burial;
- TPH, as determined by EPA method 418.1 does not exceed the concentration limit for in-place burial;
- Chloride, as determined by EPA method 300.1, does not exceed the concentration limit for in-place burial or the background concentration, whichever is greater.
- The Stabilized waste passes the paint filter liquids test (EPA SW-846, method 9095)

Protocols and Procedures for In-Place Burial

In addition to the General Conditions Protocols and Procedures and the Additional Protocols and Procedures for On-site Closure listed above, the operator will execute the following steps for in-place closure of the pit:

A. The operator will measure the distance between the top of the drilling waste and existing grade to determine if stabilized drilling waste (see stabilization methods, below) will be at least 4-feet below existing grade to allow installation of the soil cover (see soil cover design, above).
B. The operator will stabilize or solidify the contents of the pit to a bearing capacity sufficient to support the temporary pit's final cover. However, the operator will not mix the pit contents with soil or other material at a mixing ratio of greater than 3:1, (3 parts soil or other material to 1 part drilling waste).
C. Specifically, the drilling waste will be stabilized in the cell by adding no more than 3 parts clean fill derived from the excavation of the pit to 1 part drilling waste.
D. After stabilization such that the waste material will support the soil cover, the mixture will be re-sampled (as necessary) pursuant to NMOCD Rules (see above).
E. If sample results show that stabilized waste in the inner and outer horse shoe of the cell satisfy the regulatory standards for in-place burial, the operator will measure the distance between the stabilized waste and existing grade and, if necessary, transfer stabilized waste from one shoe to the other to allow for placement of the soil cover (see design criteria, above).
F. Cover the geomembrane lined, filled, temporary pit with compacted, non-waste containing, earthen material; construct a division-prescribed soil cover; recontour and re-vegetate the site as described in this plan. Specifically, a 4-foot thick soil cover consistent with NMOCD Rules will be placed over the stabilized waste.
G. If necessary to meet the other mandates of NMOCD Rules (e.g placement of a 4-foot soil cover to existing grade) and this closure plan, the stabilized drilling waste in the inner horseshoe will be excavated and placed in the outer horseshoe. The operator will implement confirmation sampling consistent with excavation and removal (see below) if this option is exercised on the inner horseshoe. This process would be conducted according to applicable regulations as described below, not allowing waste stabilization to exceed a 3:1 mixing ratio (3 parts soil or other material to 1 part drilling waste), testing

stabilized waste to demonstrate compliance with in-place burial standards as required, sampling to confirm no release has occurred beneath the inner horseshoe.

H. Any excess liner above the stabilized waste will be removed for re-use or disposal.

Excavation and Removal Closure Plan

IF THE CRITERIA FOR ON-SITE CLOSURE (IN-PLACE BURIAL) FOR SOME OR ALL OF THE TEMPORARY PIT ARE NOT MET, THE OPERATOR WILL ADHERE TO NMOCD RULES AND IMPLEMENT THE FOLLOWING ACTIONS FOR ONLY THE MATERIALS THAT DO NOT MEET CRITERIA FOR IN PLACE CLOSURE:

Protocols and Procedures for Excavation and Removal

The operator will close the temporary pit by excavating the drilling waste that does not meet the criteria for in-place closure (e.g. solids in the inner shoe) and any synthetic pit liners that cannot be re-used and transferring those materials to one of the division-approved facilities listed below:

Controlled Recovery, Inc.	NM-01-0006
Lea Land, LLC	NM-01-0035

If the sampling program described below demonstrates that a release has not occurred or that any release does not exceed the concentrations specified in Subparagraph (b.ii) of Paragraph (1) of Subsection B of 19.15.17.13 NMAC, then the operator will:

1. Backfill the temporary pit excavation with compacted, non-waste containing, earthen material;
2. Construct a division-prescribed soil cover to existing grade as described in the Soil Cover Plan (above);
3. Re-contour and re-vegetate the site as described in the Re-vegetation Plan (above).

Confirmation Sampling Plan for Excavation and Removal

The operator will test the soils beneath the temporary pit after excavation to determine whether a release has occurred. To determine if a release has occurred, the operator and/or qualified contractor will collect, at a minimum:

- A five-point, composite sample
- Individual grab samples from any area that is wet, discolored or showing other evidence of a release.

The purpose of this sampling is to demonstrate that:

- Benzene, as determined by EPA SW-846 method 8021B or 8260B does not exceed concentration limits of the Rule;
- Total BTEX, as determined by EPA SW-846 method 8021B or 8260B does not exceed concentration limits of the Rule;
- The GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, does not exceed concentration limits of the Rule;
- The TPH, as determined by EPA method 418.1 does not exceed 2,500 mg/kg; and
- Chloride, as determined by EPA method 300.1, does not exceed concentration limits of the Rule or the background concentration, whichever is greater.

Reporting

The operator shall notify the division of its results on form C-141. If the operator or the division determines that a release has occurred, then the operator will comply with 19.15.29 NMAC and 19.15.30 NMAC, as appropriate.

Publications Regarding Wetlands

Derived from

http://books.google.com/books?id=UDU411JLwI8C&pg=PA393&source=gbs_toc_r&cad=4#v=onepage&q&f=false

http://mtnhp.org/nwi/PUB_PAB.asp

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mt.gov
Montana's Official State Website

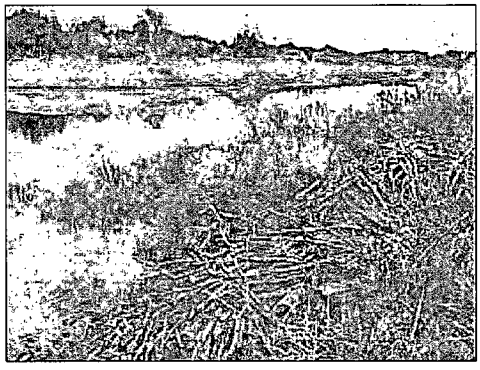
MONTANA NATURAL HERITAGE PROGRAM

Search

Palustrine System Unconsolidated Bottom Class (PUB), Aquatic Bed Class (PAB)

Summary

The Unconsolidated Bottom Class has <30% vegetation cover and a surface with >25% of the particles smaller than stones. The closely related Aquatic Bed Class has >30% vegetation cover of plants growing on or below the water's surface for most of the growing season in almost all years. Most of our wetlands in this class have a mix of silt, clay, and organic matter as substrate.



Environment

Typically found along watercourses in meander cutoffs (oxbows) and beaver ponds. The low vegetation cover is often due to relatively deep (>.5m) and turbid water that inhibits a higher cover of emergent or submerged plants. In these situations, the hydrologic modifier will be "permanently flooded" but during years of drought, this may vary considerably.

Vegetation

These shallow ponds with silty bottoms usually have a concentric zone of emergent vegetation around the drier perimeter. See the **Palustrine System Emergent Wetlands Class** for a description of this vegetation. As the water depth increases to about .5m typical emergents like cattail (*Typha latifolia*), sedges (*Carex* spp.), and bulrush (*Scirpus* and *Schoenoplectus* spp.) become very sparse and submerged plants become more abundant, including species of waterweed (*Elodea* spp.), water milfoil (*Myriophyllum* spp.), bladderworts (*Utricularia* spp.), pondweeds (*Potamogeton* spp.) and Mare's tail (*Hippuris vulgaris*).

Ecological Dynamics and Management Considerations

Beavers are responsible for the formation of many of these wetlands, which may persist in this state for some period of time but will eventually drain or become filled with silt and transition to a different wetland or non-wetland environment. In mountainous landscapes, this type and the animals that depend on it for habitat would be extremely rare without the beavers' dam-building activity. Floodplain dynamics create another typical setting for these ponds.

If river hydrology is altered, or if beaver activity ceases, existing types may fill in with sediment and new locations may not be created. If livestock have access to this type, they can degrade the habitat by trampling the vegetation, pugging the soft soil nearby, and exposing soil for weed colonization sites. As is true with all

wetlands, maintaining the hydrology is key to maintaining the wetland; changes in the quality or quantity of water reaching the wetland will alter the vegetation and habitat values.

Hydrogeomorphic Types and Functions

PUB and PAB wetlands correspond to several HGM types depending on location. In the NWI classification system, only those wetlands occurring within the stream or river channel are classified as Riverine. Wetlands occurring within the bankful channel and/or the active floodplain of a river or stream have a lotic landscape position; those surrounded by uplands have a terrene landscape position. Within the Gallatin sampling area, the PUB wetlands had a lotic landscape position when they were associated with beaver activity, or a terrene position when they were not on an active floodplain. The PAB wetlands we sampled were also typically beaver ponds, and so were classified as lotic river or stream. These are important habitats due to the dependable presence of water in most years, a rarity in much of our arid landscape. Amphibians and aquatic reptiles are especially dependent but waterfowl and numerous other creatures also need these wetlands.

Typical HGM Types Associated With PAB/PUB Wetlands

Landscape Position	Landform	Lotic Water Size Modifier	Lotic Flow Regime	Water Flow Path
1. Terrene	Depression Floodplain			Bidirectional Throughflow Isolated *Inflow* Outflow
2. Lotic		River Stream	Dammed Reach Low Gradient	

Functions Associated With PAB/PUB Wetlands

Function	Relative Importance	Comments
1. Surface and Groundwater Storage and Streamflow Maintenance	High to Moderate	Larger and deeper depressions are the most effective. Fine textured and high organic content soils are better. Throughflow water paths and terrene outflow wetlands are less effective. Wetlands on higher order streams are more important.
2. Nutrient Cycling	High to Low	Vegetated types have higher importance. Denitrification is higher with organic substrates. A fluctuating water table is best. High organic content and fine textured substrates are most effective. Lotic wetlands are more important in preserving water quality, especially on lower order streams.
3. Maintain Plant Community	High to Moderate	Dammed reaches and other deeper water environments can have little vegetation. Otherwise, a variety of water depths create different vegetation zones for these distinctive plant communities.
4. Retention of sediments, elements, and	High to Low	Terrene throughflow basins and most lotic wetlands other than flats are the most effective. Ponds with a small watershed are of low

compounds		importance. Vegetated wetlands are more effective.	
5. Shoreline Stabilization	Low	Most of these types are ponds with little shoreline erosion potential.	
6. Terrestrial Habitat	High	These water sources are critical for waterfowl and many other animal species.	
7. Aquatic Habitat	High	Amphibian and aquatic reptile habitat value is high, especially with deeper water depths. These types may also provide good fish habitat. The long water retention time is important for some macroinvertebrates.	
8. Conservation of Wetland Biodiversity	High	These are relatively common types but the absence of beaver could significantly diminish these occurrences.	

New Mexico
Wetland Resources

Wetlands cover about 482,000 acres (0.6 percent) of New Mexico, a reduction of about 33 percent from the wetland acreage that existed about 200 years ago (Dahl, 1990). New Mexico's wetland acreage places the State 34th in total wetland acreage among the 48 conterminous States.

Wetlands are ecologically important and economically valuable to the State. Wetlands provide important wildlife habitat. For example, in the Rio Grande Valley, wetlands provide habitat for 246 species of birds, 10 species of amphibians, 38 species of reptiles, and 60 species of mammals (U.S. Fish and Wildlife Service, 1990). Wetlands also provide stopover, feeding, and breeding grounds for migratory waterfowl (fig. 1).

Riparian (streamside) wetlands along perennial streams are important as migration corridors for a variety of waterfowl and other wildlife. The playa lakes in eastern New Mexico are vital links in a chain of wetlands along the Central Flyway, which extends from central Canada to the coast of Texas. Areas of springs and marshes provide essential habitat for many rare and endangered species and for indigenous fish and wildlife in the western part of the State.

Wetlands contribute to flood attenuation, bank stabilization, and improved water quality. New Mexico's tourist industry benefits from the beauty of the State's diverse wetlands. These wetlands provide opportunities for recreational activities that include fishing, hunting, bird watching, nature photography, camping, and hiking.

TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in New Mexico is shown in figure 2*A*; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in New Mexico are described below.

System	Wetland description
Palustrine	Wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted, herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

Although wetlands occur in all areas of New Mexico, they are most numerous in the eastern and northern areas of the State (fig. 2*A*). In the Southern Rocky Mountains (fig. 2*B*), wetlands are mostly in high mountain valleys and intermountain basins. In the Great Plains, wetlands occur along the flood plains of the Canadian and Pecos Rivers and in association with playa lakes. In the Colorado Plateaus and Basin and Range, wetlands are sparsely distributed, with the exception of wetlands associated with the San Juan, San Francisco, and Gila Rivers.

Palustrine wetlands are distributed statewide. In New Mexico, palustrine wetlands include forested wetlands in river flood plains and near springs and seeps; scrub-shrub wetlands such as bottomland shrubland; emergent wetlands, such as marshes, fens, alpine snow glades, and wet and salt meadows; aquatic bed wetlands in shallow ponds and small lakes; and sparsely or nonvegetated wetlands such as playa lakes. Palustrine wetlands along rivers, streams, springs, lakes, and ponds are called riparian wetlands. Riparian wetlands along the State's major rivers provide habitat for fish, wildlife, and diverse plant life. They also provide habitat for migrating, overwintering, and nesting waterfowl. One of the more notable riparian wetlands in New Mexico is in the Bosque del Apache National Wildlife Refuge. The 57,191-acre refuge lies along 9 miles of the Rio Grande in south-central New Mexico. Marshes within the refuge are ideal winter habitat for migratory birds, including ducks, geese, sandhill cranes, and whooping cranes. Efforts are being made to maintain and restore native riparian cottonwood habitat in the refuge for a variety of birds and other wildlife. Many western species of riparian trees and shrubs, such as willows and cottonwoods, have been lost because of nonnatural streamflow regimes (Howe and Knopf, 1991). The nonnatural flows followed the completion of water projects in the first half of the 20th century, resulting in rapid colonization and expansion of the exotic Russian-olive and salt cedar.

The playa lakes of eastern New Mexico provide habitat for migrating, overwintering, and nesting waterfowl in the Central Flyway (U.S. Fish and Wildlife Service, 1990). The estimated number of playa lakes in the State is 1,700, and they range in area from less than 1 acre to more than 600 acres (Nelson and others, 1983). The

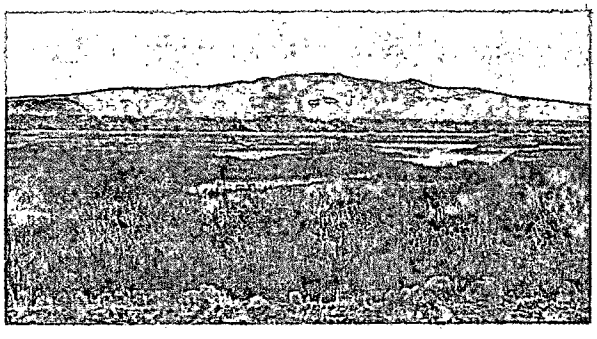


Figure 1. Bosque del Apache National Wildlife Refuge. These riparian wetlands provide habitat for migratory and resident waterfowl, fish, and other wildlife. *(Photograph by Lisa Carter, U.S. Geological Survey.)*

playa lakes range in wetness from dry lake bed to shallow lake and can be fresh or saline. The freshwater playas are numerous, small to medium in size, and serve as zones of recharge to the underlying aquifer (Osterkamp and Wood, 1987). The saline playas are larger and fewer than the freshwater playas and are areas of discharge from the underlying aquifer. Most playa lakes in New Mexico are palustrine. However, playa lakes larger than 20 acres are classified as lacustrine wetlands, as are the shallow areas of large reservoirs.

Riverine wetlands occur in the shallow river channels of perennial streams. There are about 3,500 miles of streams in New Mexico (Ong and others, 1993).

HYDROLOGIC SETTING

Wetlands form where a persistent water supply is at or near the land surface. The location and persistence of the supply of water is a function of precipitation and runoff patterns, evaporation potential, topography, and the presence of a shallow water table.

Precipitation and runoff rates differ annually and with location and season. Average annual precipitation in New Mexico (fig. 2*C*) ranges from about 8 inches in the northwestern corner of the State and in the southern Rio Grande Valley to 24 inches in the mountains of the northern and southern parts of the State. Runoff (fig. 2*D*) is greatest in the northern mountains and smallest in the desert areas of the southern and eastern parts of the State. Much of the runoff from the mountains occurs during concurrent snowmelt and rainfall in the spring and summer.

Average annual pan evaporation varies across the State and ranges from about 40 to 112 inches per year (Nelson and others, 1983). Most evaporation occurs from March through September and decreases with increasing altitude. Because annual evaporation exceeds annual rainfall, most of the State has a net annual moisture deficit. The moisture deficit is a limiting factor in the formation of wetlands and to the continued existence of some of the more fragile wetlands. Even those areas of the State having the highest precipitation and lowest evaporation (high mountain regions) can be unfavorable for development of wetlands because of steep topography, shifting stream channels, and unfavorable soil conditions (Cooper, 1986).

Shallow water tables and groundwater discharge into topographic depressions, streams, and springs maintain wetlands in many areas of New Mexico. These wetlands can be along small streams that have perennial flow in only short reaches or along larger, perennial streams. In intermountain basins, wetlands are maintained by a shallow water table and springs whose source is recharge from precipitation and runoff that occur during spring and summer.

Climatic, topographic, and hydrologic characteristics differ among and sometimes within the physiographic provinces. New Mexico's diverse physiography, climate, and topography result in diverse hydrologic settings for wetland formation.

In the Colorado Plateaus and Basin and Range Provinces (fig. 2*B*), wetlands occur in springs and seeps, around oxbow lakes, along streams and rivers, around reservoirs, and in other areas where the water table is near the land surface. The arid climate of this region results in a low density and acreage of wetlands. Wetlands, although few in number, are vital to wildlife of these physiographic provinces.

In the Great Plains, wetlands occur in riparian zones along perennial streams, around oxbow lakes, in isolated natural depressions with permanent or seasonal water supply, in playa lakes, and in association with other lakes, reservoirs, channelized streams, rivers, and irrigation ditches. Playa lakes make up the largest area of wetlands in this province.

The area of playa lakes has topography classified as either smooth plains, irregular plains, or tablelands (Nelson and others, 1983). Smooth plains are largely on upland terrain, and irregular plains and tablelands are mostly on lowland terrain. Because of the flatness of the terrain, there is generally little stream drainage, and playa lakes collect most of the surface runoff. The playa lakes are

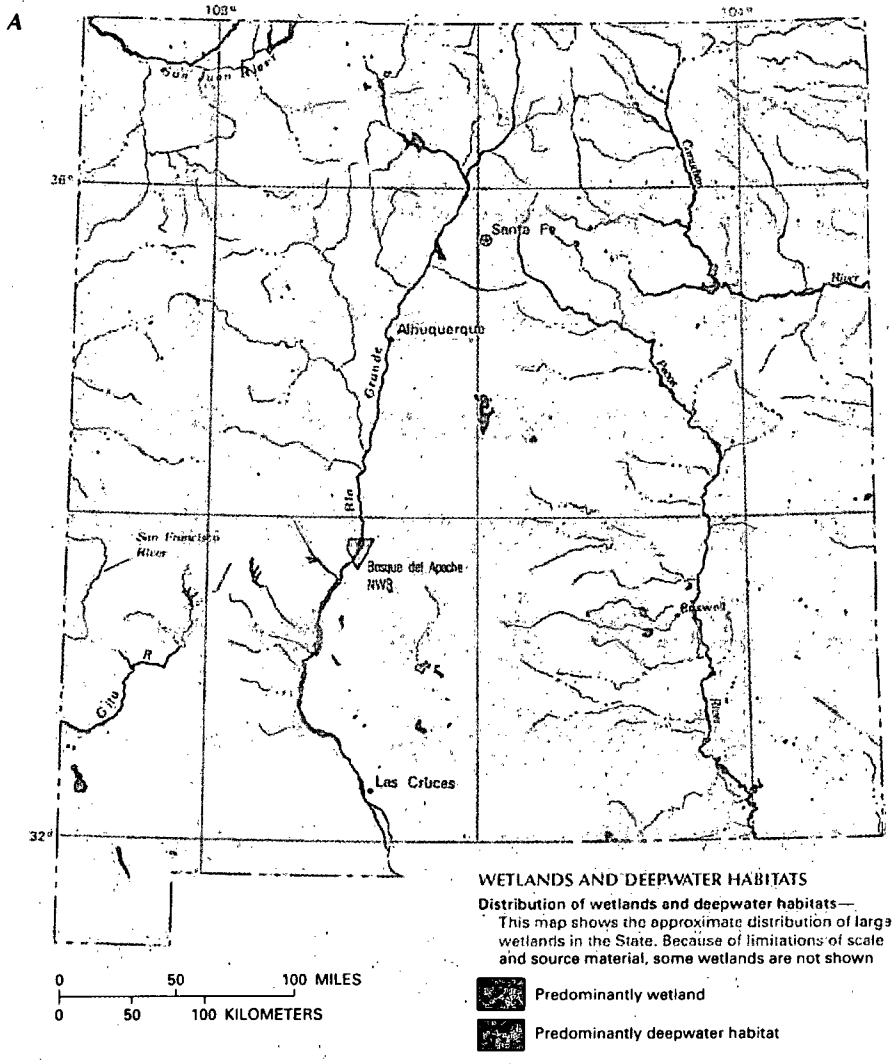


Figure 2. Wetland distribution in New Mexico and physical and climatological features that control wetland distribution in the State. *A*, Distribution of wetlands and deepwater habitats. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991.)*

usually shallow depressions that have large surface area relative to the total volume of water contained in them. Consequently, most playa lakes have small storage capacities.

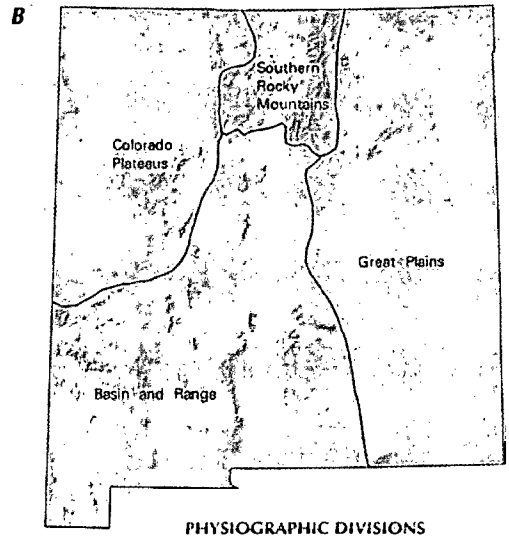
Studies by Osterkamp and Wood (1987) indicate that freshwater playa lakes in the Great Plains of New Mexico originate wherever surface depressions collect precipitation runoff. The lakes enlarge as a result of dissolution of carbonates by water infiltrating the unsaturated zone above the underlying aquifer and subsequent subsidence of the lake bed. Over time, the older central lake acquires a layer of clay-rich deposits that largely restricts water movement from the playa lake to the underlying aquifer. Water probably is removed from freshwater playa lakes primarily by recharge to the underlying aquifer from the areas around the lake where lake-bed sediments have not yet accumulated (Osterkamp and Wood, 1987) and by evaporation that in some years ranges as high as 96 to 112 inches per year (Nelson and others, 1983). There is no general agreement on the origin of saline playa lakes; however, Wood and Jones (1990) propose that the source of the salinity is from the concentration by evaporation of runoff and shallow, fresh ground water that discharges from the underlying aquifer.

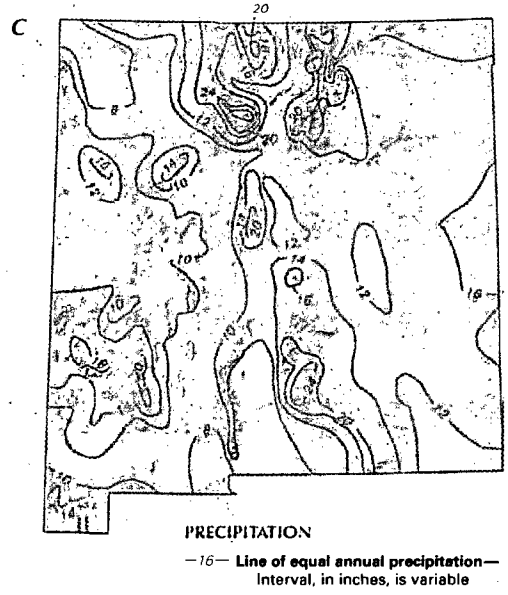
In the Southern Rocky Mountains, wetlands occur in two physiographically and climatically distinct settings, mountain valleys and intermountain basins. Generally, mountain valleys are geologically young and therefore steep. The valleys have been shaped over time either by running water throughout their entire length or by glaciers at higher altitudes and running water at lower altitudes. At high altitudes in some mountain valleys, glaciation formed large cirque basins in which remnant glaciers or late-melting snow maintains spring, seep, and snow-bed wetlands. Also, at these high altitudes, ponds form in depressions behind slumping saturated soils or in depressions caused by the weight of accumulated snow. Below the cirque basins, wetlands occur in the glaciated, U-shaped valleys, on saturated cliff faces, at the sloping floor near the sides of the valley, in glacial kettle ponds, in oxbow lakes, in depressions on glacial moraines, in lakes created by terminal or lateral moraines, in landslide-formed lakes, in seeps and springs, and in beaver ponds. In steep, V-shaped, nonglaciated areas of mountain valleys, wetlands occur as narrow riparian wetlands, near seeps and springs, and in beaver ponds (Windell and others, 1986).

Intermountain basins were filled by sediments derived from erosion of the surrounding mountains. The large, flat valleys are drained by low-gradient meandering streams and rivers. Intermountain-basin wetlands occur along these streams and rivers, in constructed and natural impoundments, around oxbow lakes, and in other areas where the water table is near the land surface. The shallow water table is maintained by underlying aquifers, impermeable substrates, or annual floods (Windell and others, 1986).

TRENDS

The FWS has estimated that from the 1780's to the 1980's, wetland acreage in New Mexico decreased by 33 percent—from about 720,000 to 482,000 acres (Dahl, 1990). Much of the decrease is attributable to the loss of native vegetation along streams because





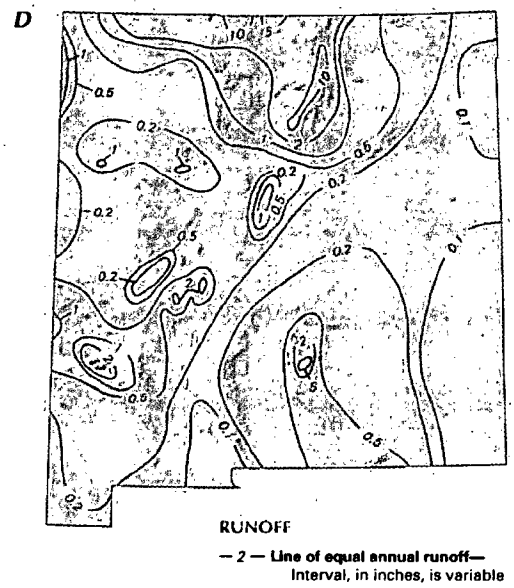


Figure 2. Continued. Wetland distribution in New Mexico and physical and climatological features that control wetland distribution in the State. ***B***, Physiography. ***C***, Average annual precipitation. ***D***, Average annual runoff. *(Sources: B, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center. C and D, Gold and Denis, 1986.)*

of a change in streamflow resulting from reservoir construction or agricultural water diversions. The loss of native vegetation along streams alters riparian-wetland functions and allows the proliferation of nonnative vegetation (Howe and Knopf, 1991).

Wetland losses in rural areas can be attributed to conversion to cropland, dewatering or diverting water for irrigation, and overgrazing by livestock. Development of urban areas has caused wetland loss or degradation owing to encroachment of residential and commercial construction, dewatering for municipal and industrial water supply, channelization, and contamination from inadequately treated sewage and industrial waste. Other causes of wetland loss or degradation are clear cutting, burning, hard-rock mining and related activities that produce toxic acidic or alkaline runoff, placer mining, erosion and sedimentation, sand and gravel mining, road and railroad construction, and dam and reservoir construction in wetland areas (Windell and others, 1986).

Some human activities have helped to form wetlands or enlarge existing ones. The construction of reservoirs between 1916 and 1985, which provided for storage of more than 5.9 million acre-feet of surface water (Garrabrant and Garn, 1990), resulted in the formation of wetlands along the edge of those water bodies. However, such gains are at the expense of the original, natural riparian wetlands. Farm-pond construction also contributes to the formation of wetlands around the edge of the pond. More than one-half of the State's cropland is irrigated (Garrabrant and Garn, 1990), and leaking ditches and seeps and return flow associated with irrigation have contributed to the formation of wetlands.

CONSERVATION

Many government agencies and private organizations participate in wetland conservation in New Mexico. The most active agencies and organizations and some of their activities are listed in table 1.

Federal wetland activities.—Development activities in New Mexico wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; and the 1986 Emergency Wetlands Resources Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency, and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

Table 1. Selected wetland-related activities of government agencies and private organizations in New Mexico, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
FEDERAL						
Department of Agriculture						
Consolidated Farm Service Agency	...	•	...	...	...	...
Forest Service	•	...	•	•	•	•
Natural Resources Conservation Service	...	•	•	...	•	•
Department of Defense						
Army Corps of Engineers	•	•	•	...	...	•
Military reservations	•	...	...	...	...	...
Department of the Interior						
Bureau of Land Management	•	...	•	•	•	•
Bureau of Reclamation	•	...	•	...	•	•
Fish and Wildlife Service	•	...	•	•	•	•
Geological Survey	...	...	...	...	•	...
National Biological Service	...	...	...	...	•	...
National Park Service	•	...	•	•	•	•
Environmental Protection Agency	...	•	...	...	•	•
STATE						
Department of Game and Fish	•	•	•	•	•	•
Energy, Mineral, and Natural Resources Department	...	...	•	...	...	...
Environment Department	•	•	...	•	•	...
State Engineer Office	•	•	...	...	...	•
University of New Mexico						
Natural Heritage Program	...	...	...	...	•	•
COUNTY AND LOCAL GOVERNMENTS						
Albuquerque Open Space Division	•	...	•	•	•	•
Santa Fe County	...	...	...	...	•	•
PRIVATE ORGANIZATIONS						
National Audubon Society	...	...	•	...	...	...
Sierra Club	...	...	•	...	•	...
The Nature Conservancy	...	...	...	•	...	...

The 1986 Emergency Wetlands Resources Act encourages wetland protection through funding incentives. The act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service provides guidance to States in developing the wetland component of their plans.

The U.S. Forest Service (FS) manages five National Forests in New Mexico that contain diverse wetlands and riparian ecosystems. The FS also coordinates with State agencies and private landowners on wetland-conservation activities.

The FWS manages six National Wildlife Refuges in New Mexico that provide habitat for migrating birds, endangered species, and other wildlife and wildlife-oriented public recreation. Under the 1986 Emergency Wetlands Resources Act, the FWS evaluated eight priority wetland sites in the State for acquisition (U.S. Fish and Wildlife Service, 1990).

A goal of the Bureau of Land Management (BLM) is to restore, maintain, and improve riparian wetland area conditions on public land in New Mexico. The BLM is responsible for the management of 12.8 million acres of public land in the tristate area of New Mexico,

Oklahoma, and Kansas, which includes 27,600 acres of riparian wetland (Bureau of Land Management, 1990).

State wetland activities.—The principal State agencies in New Mexico that regulate or manage wetlands are the Department of Game and Fish, Environment Department, and the State Engineer Office. Also involved is the State Park and Recreation Division of the Energy, Mineral, and Natural Resources Department, which developed the New Mexico Wetlands Priority Conservation Plan (New Mexico Energy, Minerals, and Natural Resources Department, 1988). This plan is a component of the 1986 Statewide Comprehensive Outdoor Recreation Plan. The goals of agencies managing wetlands in New Mexico are to provide habitat for fish and wildlife and for diverse plant species, to maintain wetlands for erosion and flood control, and to enhance wetlands as agricultural, recreational, and scenic resources.

State management of wetlands in New Mexico began with an assessment of State wetlands by the State Park and Recreation Division (New Mexico Energy, Minerals, and Natural Resources Department, 1988). The steps in the assessment were to locate wetlands, determine their types, assess their quality, prioritize them according to their value and benefit, and rate the probable effect on them of each of the major causes of wetland losses. The Division considers the seven major causes of loss or degradation of wetlands in New Mexico to be (1) municipal water development, (2) natural water-table fluctuation, (3) development of land surfaces, (4) pollution, (5) erosion, tree cutting, or siltation, (6) invasion by nonnative plant species, and (7) poor management. The assessment of the quality of wetlands is based on habitat conditions, the dominance of native or rare species, the presence of terrestrial animals, and the uniqueness of the wetland in New Mexico. State government acquisition of wetlands will be based on whether the public values and benefits of wetlands can be maintained or realized under present ownership (New Mexico Energy, Minerals, and Natural Resources Department, 1988).

County and local wetland activities.—The Open Space Division of the city of Albuquerque acquires, manages, and restores wetlands. The Division also conducts feasibility studies and inventories wetlands in areas under its jurisdiction. The county of Santa Fe is involved in research and inventory of wetlands in the county.

Private wetland activities.—Private organizations involved in wetland management and conservation in New Mexico include the National Audubon Society, the Sierra Club, and The Nature Conservancy. A principal activity of the National Audubon Society and the Sierra Club is the restoration and creation of wetlands. The Sierra Club also conducts research in wetlands. The Nature Conservancy acquires wetlands and other ecologically valuable habitats for conservation. A major goal of these private organizations is to inform the public about the value of wetlands.

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