Accepted for the record - 11/20/2023.

General Information

NMOCD District:	District 1	Incident ID:	nAPP2210967015
Landowner:	NMSLO	API:	30-025-31209
Client:	BTA Oil Producers, LLC.	Site Location:	Gem #4 Water Transfer Line
Date:	08/08/2023	Project #:	22E-02120
Client Contact:	Kelton Beaird	Phone #:	(432) 312-2203
Vertex PM:	Chance Dixon	Phone #:	(575) 988-1472

Objective

The objective of the environmental remediation work plan is to identify exceedances found during the spill assessment and site characterization activities and propose an appropriate remediation technique to address the open release for the Gem #4 Water Transfer Line (hereafter referred to as "Gem"). This incident occurred when a poly-flowline, used to transfer fluids between production facilities, ruptured and caused approximately 20 barrels (bbls) of produced water into and access road in the surrounding pasture east of the Gem #4 well site. Closure criteria has been selected as per New Mexico Administrative Code (NMAC) 19.15.29.12. All applicable research as it pertains to closure criteria selection is presented in Attachment 1. The closure criteria for the site is presented below (Table 1).

Table 1. Closure Criteria for Soils to Remediation & Reclamation Standards

	Constituent	Limit
0-4 feet bgs (19.15.29.13)	Chloride	600 mg/kg
	TPH (GRO+DRO+MRO)	100 mg/kg
DTGW > 100 feet (19.15.29.12)	Chloride	20,000 mg/kg
	TPH (GRO+DRO+MRO)	2,500 mg/kg
	GRO+DRO	1,000 mg/kg
	BTEX	50 mg/kg
	Benzene	10 mg/kg

Site Assessment/Characterization

Site characterization was started on June 21, 2023, and completed on July 25, 2023. A total of 13 borehole sample points were established and samples were collected for field screening. The boreholes were obtained at various depths for horizontal and vertical delineation. Samples at the deepest vertical distance and horizontal distance that tested below closure criteria were submitted to a laboratory for analysis. In total, 23 samples were submitted to Hall Environmental Analysis Laboratory, Albuquerque, NM and Cardinal Laboratories, Hobbs, NM for analysis. The characterization sampling locations are presented in Figure 1 (Attachment 2). Laboratory analysis results have been compared to the above-noted closure criteria and the results from the characterization activity are presented in Table 2 (Attachment 3). Exceedances are identified in the table as bold and highlighted in green.

Remedial Activities

Areas identified with contaminant concentrations above closure criteria will be remediated through excavation. Laboratory results from the site assessment/characterization have been referenced to estimate both the vertical and horizontal limits of the impacts and the volume of soil to be removed. The soil will be excavated to the extent of the known contamination above the applicable closure criteria. Field screening will be utilized to confirm the removal of contaminated soil below the applicable closure criteria. Contaminated soils will be stored on a 30mil liner prior to disposal at an approved facility. Once excavation is complete, confirmatory samples will be collected and laboratory analysis completed to confirm closure criteria guidelines are met. Excavations will be backfilled with clean soil sourced locally.

Exceedances to closure criteria were found at sample points BH23-01, BH23-07, BH23-15, BH23-16, and BH23-17. The affected area where the exceedances were located will be excavated to 4 feet bgs. The impacted area will then be sampled and remediated until it is below the selected closure criteria. The sidewalls at less than 4 feet bgs will assume NMOCD's strictest closure criteria while the base at greater than or equal to 4 feet bgs will assume the reclamation standard at DTGW >100' closure criteria. The top 4 feet will then be reclaimed under NMOCD's strictest criteria as required by Subsection A of 19.15.29.13 NMAC. Mechanical excavation equipment will be used to complete the excavation at these boreholes and hand excavation will be utilized in areas where mechanical excavation would be deemed unsafe. Backfill of the excavation will be halted until this work plan receives approval from NMOCD. The estimated volume to be excavated is 300 yards.

Sample Point	Excavation Depth	Remediation Method
BH22-01	4'	Backhoe
BH22-07	2'	Backhoe
BH22-15	4'	Backhoe
BH22-16	4'	Backhoe
BH22-17	4'	Backhoe

Should you have any questions or concerns, please do not hesitate to contact Chance Dixon at 575.988.1472 or cdixon@vertex.ca.

Fernando Rodriguez

Fernando Rodriguez, B. Sc.
INTERMEDIATE BIOLOGIST, REPORTING

8/14/2023
Date

Chance Dixon

Chance Dixon, B. Sc.
PROJECT MANAGER, REPORT REVIEW

8/14/2023
Date

Attachments

Attachment 1: NMOCD C-141 Report
Attachment 2: Closure Criteria Research
Attachment 3: Sample Locations - Remediation Plan Figure 1
Attachment 4: Laboratory Results Table and Laboratory Analysis

ATTACHMENT 1

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-141
Revised August 24, 2018
Submit to appropriate OCD District office

Incident ID	nAPP2210967015
District RP	
Facility ID	
Application ID	

Release Notification

Responsible Party

Responsible Party: BTA Oil Producers, LLC	OGRID: 260297
Contact Name: Bob Hall	Contact Telephone: 432-682-3753
Contact email: bhall@btaoil.com	Incident # (assigned by OCD) nAPP2210967015
Contact mailing address: 104 S. Pecos St., Midland, TX 79701	

Location of Release Source

Latitude: 32.59651 Longitude: -103.63531
(NAD 83 in decimal degrees to 5 decimal places)

Site Name: Gem #4 Water Transfer Line	Site Type: Pipeline ROW
Date Release Discovered: 4/18/2022	API# *(if applicable)* Nearest well: 30-025-31209

Unit Letter	Section	Township	Range	County
N	2	20S	33E	Lea

Surface Owner: ☒ State ☐ Federal ☐ Tribal ☐ Private (*Name:*)

Nature and Volume of Release

Material(s) Released (Select all that apply and attach calculations or specific justification for the volumes provided below)

☐ Crude Oil	Volume Released (bbls)	Volume Recovered (bbls)
☒ Produced Water	Volume Released (bbls) 20 BBL	Volume Recovered (bbls) 10 BBL
	Is the concentration of dissolved chloride in the produced water >10,000 mg/l?	☒ Yes ☐ No
☐ Condensate	Volume Released (bbls)	Volume Recovered (bbls)
☐ Natural Gas	Volume Released (Mcf)	Volume Recovered (Mcf)
☐ Other (describe)	Volume/Weight Released (provide units)	Volume/Weight Recovered (provide units)

Cause of Release

Rupture in a poly flowline used to transfer produced water between tank batteries.

State of New Mexico
Oil Conservation Division

Incident ID	nAPP2210967015
District RP	
Facility ID	
Application ID	

Site Assessment/Characterization

This information must be provided to the appropriate district office no later than 90 days after the release discovery date.

What is the shallowest depth to groundwater beneath the area affected by the release?	>100 (ft bgs)
Did this release impact groundwater or surface water?	☐ Yes ☒ No
Are the lateral extents of the release within 300 feet of a continuously flowing watercourse or any other significant watercourse?	☐ Yes ☒ No
Are the lateral extents of the release within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark)?	☐ Yes ☒ No
Are the lateral extents of the release within 300 feet of an occupied permanent residence, school, hospital, institution, or church?	☐ Yes ☒ No
Are the lateral extents of the release within 500 horizontal feet of a spring or a private domestic fresh water well used by less than five households for domestic or stock watering purposes?	☐ Yes ☒ No
Are the lateral extents of the release within 1000 feet of any other fresh water well or spring?	☐ Yes ☒ No
Are the lateral extents of the release within incorporated municipal boundaries or within a defined municipal fresh water well field?	☐ Yes ☒ No
Are the lateral extents of the release within 300 feet of a wetland?	☐ Yes ☒ No
Are the lateral extents of the release overlying a subsurface mine?	☐ Yes ☒ No
Are the lateral extents of the release overlying an unstable area such as karst geology?	☐ Yes ☒ No
Are the lateral extents of the release within a 100-year floodplain?	☐ Yes ☒ No
Did the release impact areas **not** on an exploration, development, production, or storage site?	☐ Yes ☒ No

Attach a comprehensive report (electronic submittals in .pdf format are preferred) demonstrating the lateral and vertical extents of soil contamination associated with the release have been determined. Refer to 19.15.29.11 NMAC for specifics.

Characterization Report Checklist: ***Each of the following items must be included in the report.***

- ☒ Scaled site map showing impacted area, surface features, subsurface features, delineation points, and monitoring wells.
- ☒ Field data
- ☒ Data table of soil contaminant concentration data
- ☒ Depth to water determination
- ☒ Determination of water sources and significant watercourses within ½-mile of the lateral extents of the release
- ☒ Boring or excavation logs
- ☒ Photographs including date and GIS information
- ☒ Topographic/Aerial maps
- ☒ Laboratory data including chain of custody

If the site characterization report does not include completed efforts at remediation of the release, the report must include a proposed remediation plan. That plan must include the estimated volume of material to be remediated, the proposed remediation technique, proposed sampling plan and methods, anticipated timelines for beginning and completing the remediation. The closure criteria for a release are contained in Table 1 of 19.15.29.12 NMAC, however, use of the table is modified by site- and release-specific parameters.

Form C-141
Page 4

State of New Mexico
Oil Conservation Division

Incident ID	nAPP2210967015
District RP	
Facility ID	
Application ID	

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: Kelton Beaird Title: Environmental Manager

Signature: Date: 8-15-23

email: KBeaird@btaoil.com Telephone: 432-312-2203

OCD Only

Received by: Shelly Wells Date: 8/16/2023

Incident ID	nAPP2210967015
District RP	
Facility ID	
Application ID	

Remediation Plan

Remediation Plan Checklist: ***Each of the following items must be included in the plan.***

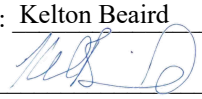
- [X] Detailed description of proposed remediation technique
- [X] Scaled sitemap with GPS coordinates showing delineation points
- [X] Estimated volume of material to be remediated
- [X] Closure criteria is to Table 1 specifications subject to 19.15.29.12(C)(4) NMAC
- [X] Proposed schedule for remediation (note if remediation plan timeline is more than 90 days OCD approval is required)

Deferral Requests Only: ***Each of the following items must be confirmed as part of any request for deferral of remediation.***

- [ ] Contamination must be in areas immediately under or around production equipment where remediation could cause a major facility deconstruction.
- [ ] Extents of contamination must be fully delineated.
- [ ] Contamination does not cause an imminent risk to human health, the environment, or groundwater.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: Kelton Beaird Title: Environmental Manager

Signature:  Date: 8-15-23

email: KBeaird@btaoil.com Telephone: 432-312-2203

OCD Only

Received by: Shelly Wells Date: 8/16/2023

- [ ] Approved
- [ ] Approved with Attached Conditions of Approval
- [ ] Denied
- [ ] Deferral Approved

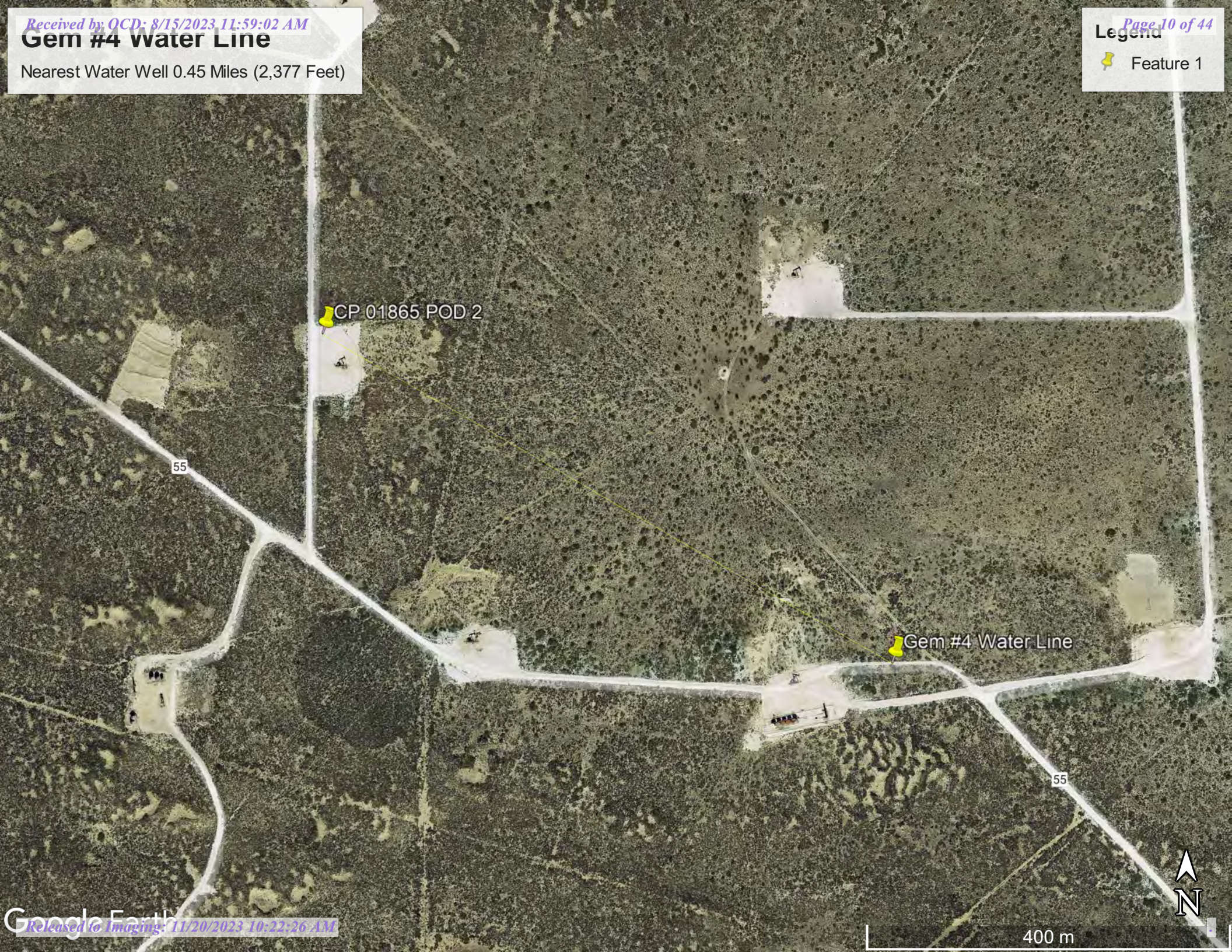
Signature: _____ Date: _____

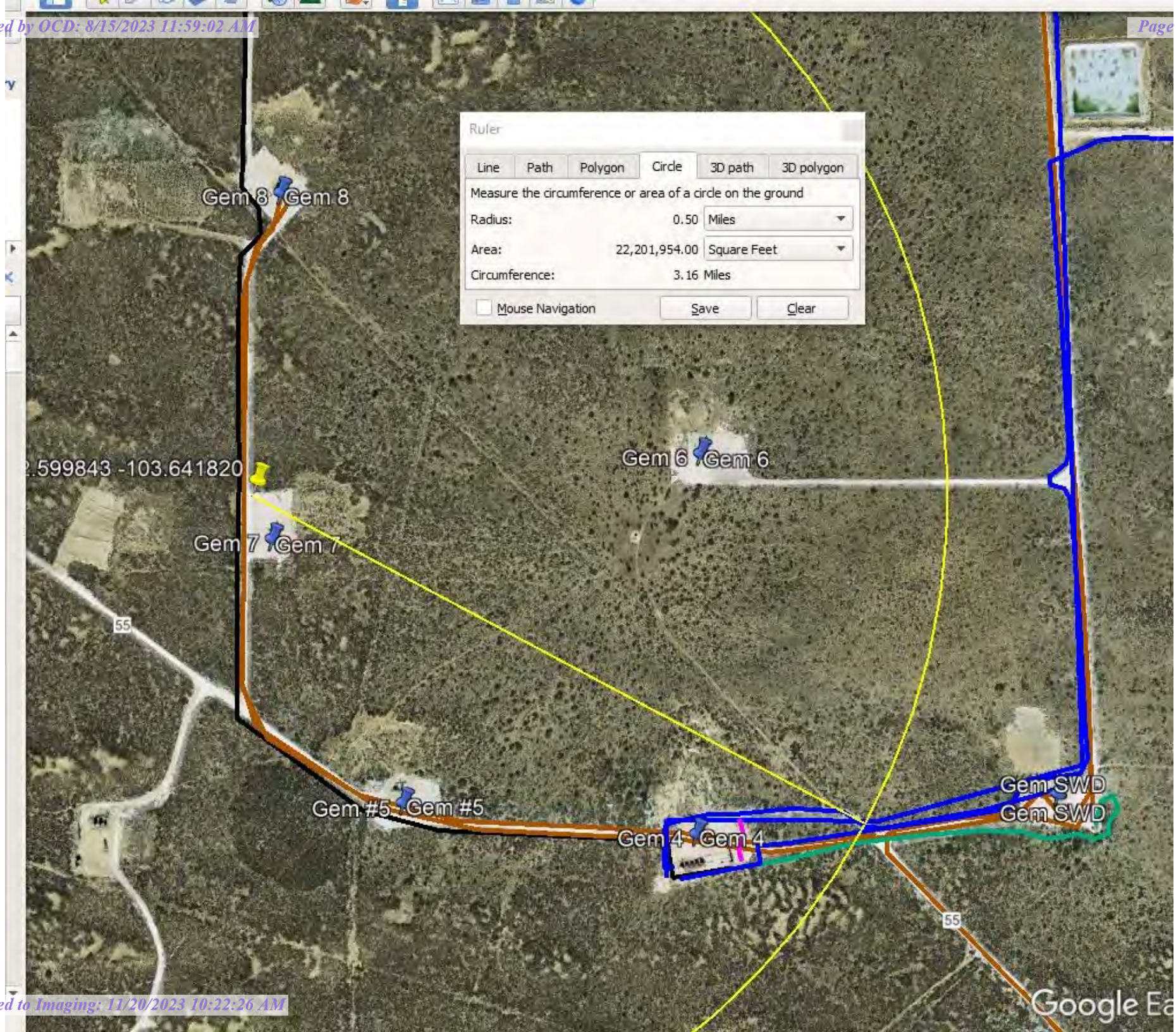
ATTACHMENT 2

Closure Criteria Worksheet			
Site Name: Gem #4 Water Transfer Line			
Spill Coordinates: 32.59651, -103.63531		**X:**	**Y:**
Site Specific Conditions		**Value**	**Unit**
1	Depth to Groundwater	**>105**	feet
2	Within 300 feet of any continuously flowing watercourse or any other significant watercourse	193,948	feet
3	Within 200 feet of any lakebed, sinkhole or playa lake (measured from the ordinary high-water mark)	12,793	feet
4	Within 300 feet from an occupied residence, school, hospital, institution or church	12,139	feet
5	i) Within 500 feet of a spring or a private, domestic fresh water well used by less than five households for domestic or stock watering purposes, **or**	2,377	feet
	ii) Within 1000 feet of any fresh water well or spring	2,377	feet
6	Within incorporated municipal boundaries or within a defined municipal fresh water field covered under a municipal ordinance adopted pursuant to Section 3-27-3 NMSA 1978 as amended, unless the municipality specifically approves	No	(Y/N)
7	Within 300 feet of a wetland	18,788	feet
8	Within the area overlying a subsurface mine	No	(Y/N)
9	Within an unstable area (Karst Map)	Low	Critical High Medium Low
10	Within a 100-year Floodplain	500	year
11	Soil Type	KM, PU	
12	Ecological Classification	Sandhills and Loamy sand	
13	Geology	Qep	
	NMAC 19.15.29.12 E (Table 1) Closure Criteria	>100'	<50' 51-100' >100'

Gem #4 Water Line

Nearest Water Well 0.45 Miles (2,377 Feet)




Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the circumference or area of a circle on the ground
Radius: 0.50 Miles
Area: 22,201,954.00 Square Feet
Circumference: 3.16 Miles
Mouse Navigation
Save
Clear
Gem 8
Gem 8
.599843 -103.641820
Gem 6
Gem 6
Gem 7
Gem 7
55
Gem #5
Gem #5
Gem 4
Gem 4
Gem SWD
Gem SWD
55
Google Ea

Gem #4 Water Line

0.5 Mile Radius with Release and CP01865 POD 2

New Mexico Office of the State Engineer

Point of Diversion Summary

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

Well Tag	POD Number	Q64	Q16	Q4	Sec	Tws	Rng	X	Y
NA	CP 01865 POD1	4	3	2	02	20S	33E	628390	3608155

Driller License: 1753 **Driller Company:** VANGUARD WATER WELLS

Driller Name: FRIESSEN, JACOBOIEL.NER

Drill Start Date:	02/08/2021	**Drill Finish Date:**	02/08/2021	**Plug Date:**	
Log File Date:	07/22/2021	**PCW Rcv Date:**		**Source:**	
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	0 GPM
Casing Size:	2.00	**Depth Well:**	105 feet	**Depth Water:**	0 feet

New Mexico Office of the State Engineer

Water Column/Average Depth to Water

(A CLW##### in the POD suffix indicates the POD has been replaced & no longer serves a water right file.)

(R=POD has been replaced, O=orphaned, C=the file is closed)

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

POD Number	Code	POD Sub-basin	County	Q 64	Q 16	Q 4	Sec	Tws	Rng	X	Y	Distance	Depth Well	Depth Water	Water Column
CP 01865 POD2		CP	LE	3	1	3	02	20S	33E	627454	3607733	706	105	0	105
CP 01865 POD1		CP	LE	4	3	2	02	20S	33E	628390	3608155	841	105	0	105
CP 00748 POD1		CP	LE			2	01	20S	33E	630197	3608428*	2375			
CP 00653 POD1		CP	LE		4	4	04	20S	33E	625573	3607367*	2492	60		
CP 00798 POD1		CP	LE	2	1	1	24	20S	33E	629348	3603892*	3715	850		
CP 00658 POD1		CP	LE	2	2	4	26	19S	33E	628857	3611125*	3828	100		
CP 00750 POD1		CP	LE		3	4	07	20S	34E	631639	3605834*	3892	320		
L 07213		L	LE	4	1	4	31	19S	34E	631700	3609351*	4134	160	110	50

Average Depth to Water: **36 feet**
Minimum Depth: **0 feet**
Maximum Depth: **110 feet**

Record Count: 8

UTMNAD83 Radius Search (in meters):

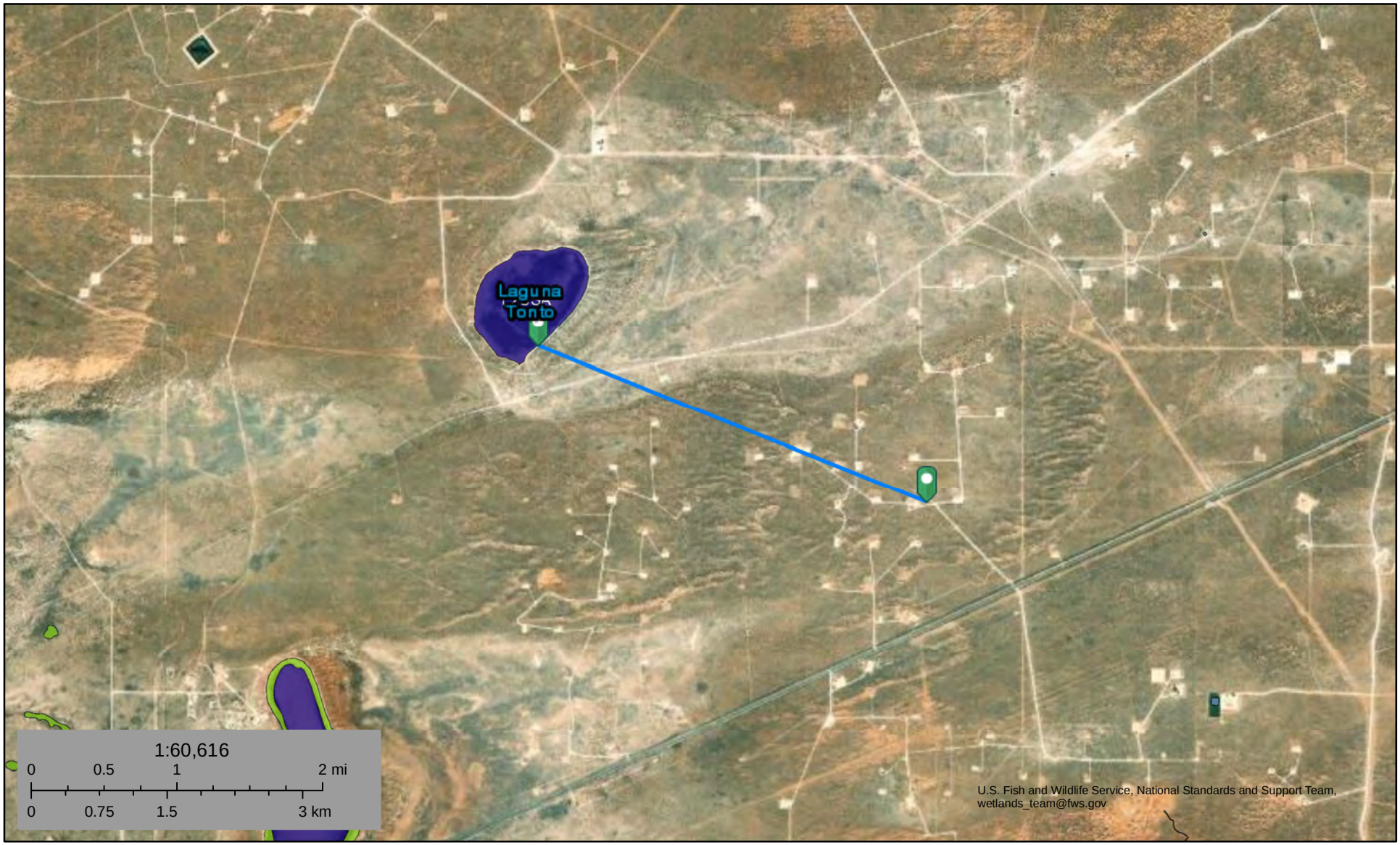
Easting (X): 628065.87 **Northing (Y):** 3607379.18 **Radius:** 5000

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

6/15/22 11:04 AM WATER COLUMN/ AVERAGE DEPTH TO WATER

U.S. Fish and Wildlife Service
National Wetlands Inventory

Laguna Tonto 2.42 Miles (12,793 Feet)



June 15, 2022

Wetlands

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

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

Gem #4 Water Line

Nearest Residence: 2.3 Miles (12,139 Feet)

U.S. Fish and Wildlife Service
National Wetlands Inventory

Nearest Wetland 3.56 Miles (18,788 Feet)

June 15, 2022

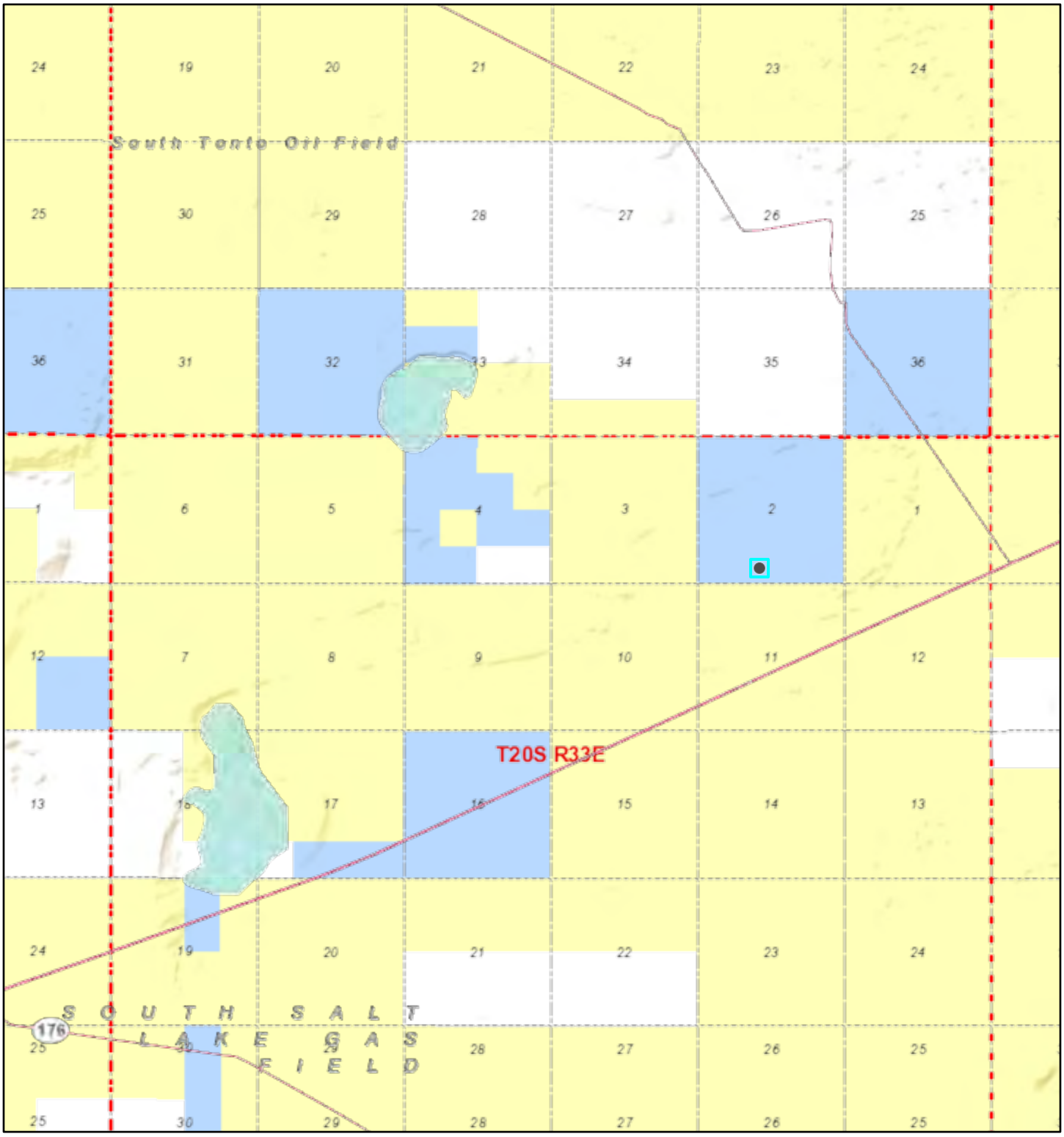
Wetlands

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

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

Active Mines in New Mexico



6/15/2022, 1:06:47 PM

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

Township / Range

Sections

Land Ownership

Bureau of Land Management

Bureau of Reclamation

Department of Agriculture

Department of Defense

Department of Energy

National Park Service

Private Land

State Game and Fish

State Land

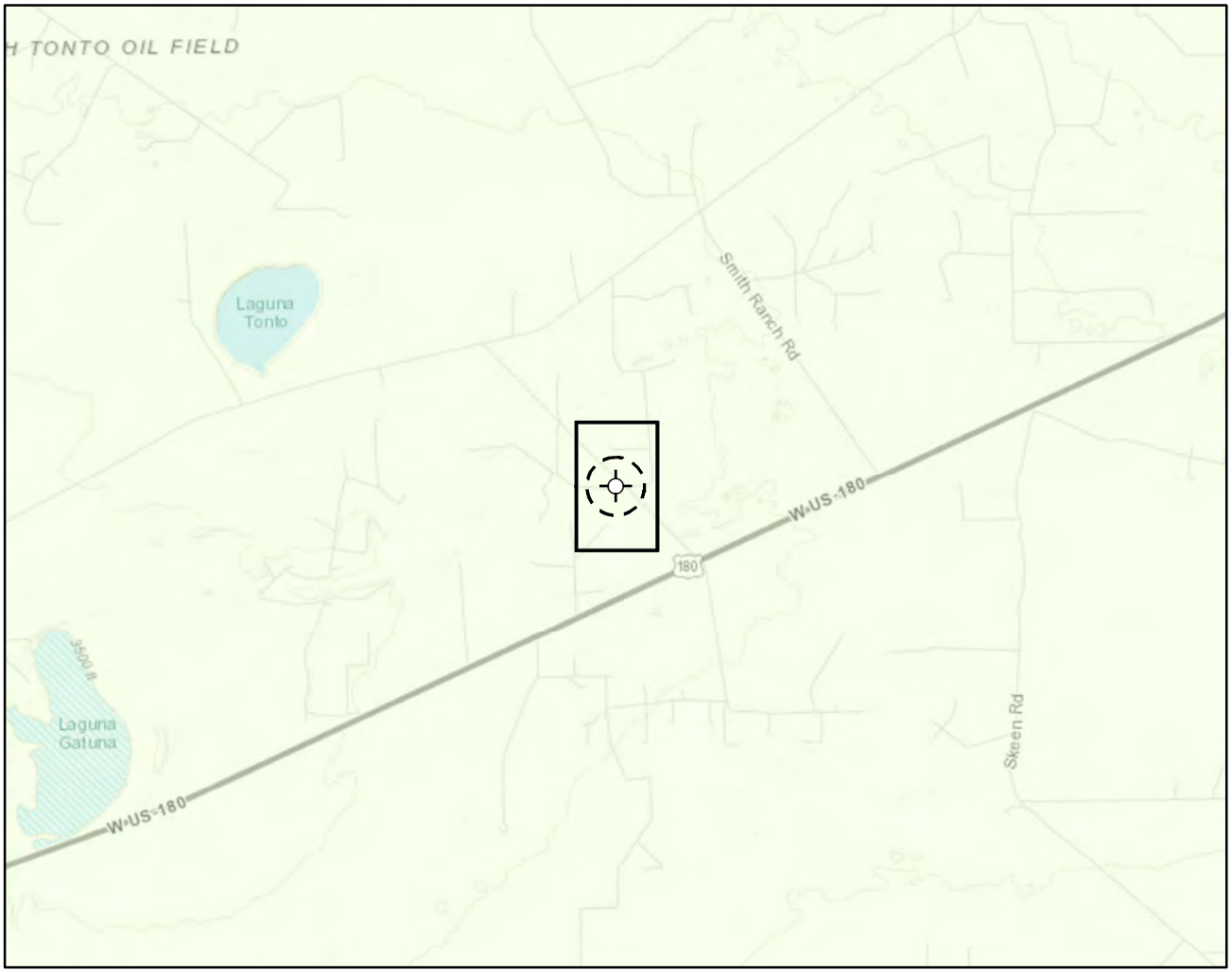
State Parks

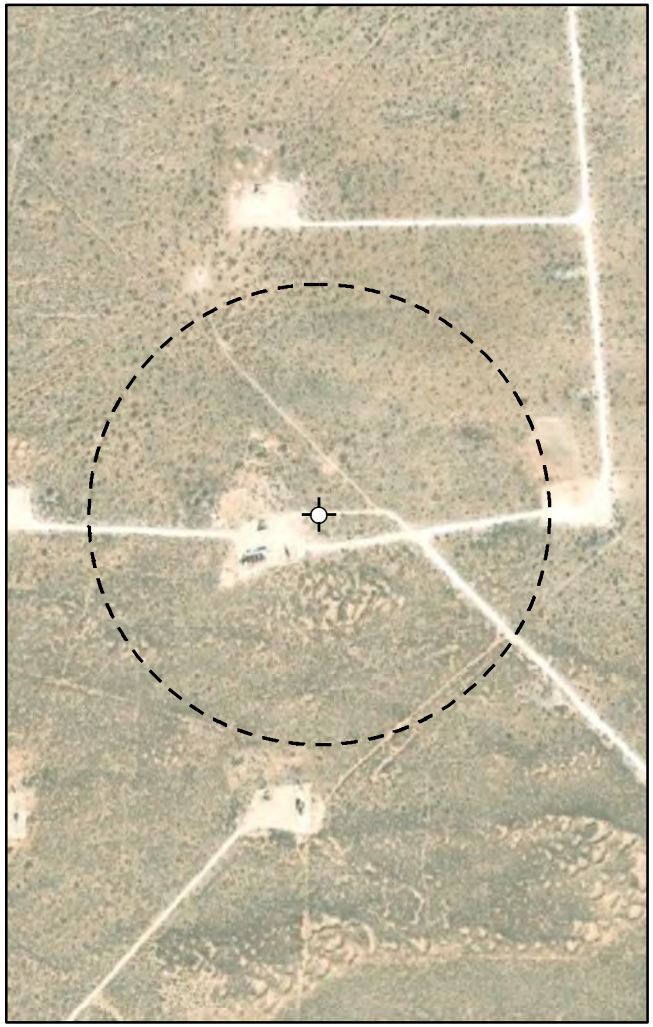
Tribal

U.S. Bureau of Land Management - New Mexico State Office, Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

EMNRD MMD GIS Coordinator

New Mexico Energy, Minerals and Natural Resources Department (http://nm-emnrd.maps.arcgis.com/apps/webappviewer/index.html?id=1b5e577974664d689b47790897ca2795)





Karst Potential

- Critical
- High
- Medium
- Low

- Site Location
- Site Location Buffer (1,000 ft.)

Overview Map

0 0.25 0.5 1 mi

Detail Map

0 150 300 600 ft.

VERTEX

Map Center:
Lat/Long: 32.596510, -103.635310

NAD 1983 UTM Zone 13N
Date: Jun 15/22

N

Karst Potential
Gem #4 Water Line

FIGURE:
X

BTA

Geospatial data presented in this figure may be derived from external sources and Vertex does not assume any liability for inaccuracies. This figure is intended for reference use only and is not certified for legal, survey, or engineering purposes.

Note: Inset Map, ESRI 2018; Overview Map: ESRI World Topographic. Karst potential data sourced from Rosswell Field Office, Bureau of Land Management, 2020 or United States Department of the Interior, Bureau of Land Management. (2018). Karst Potential.

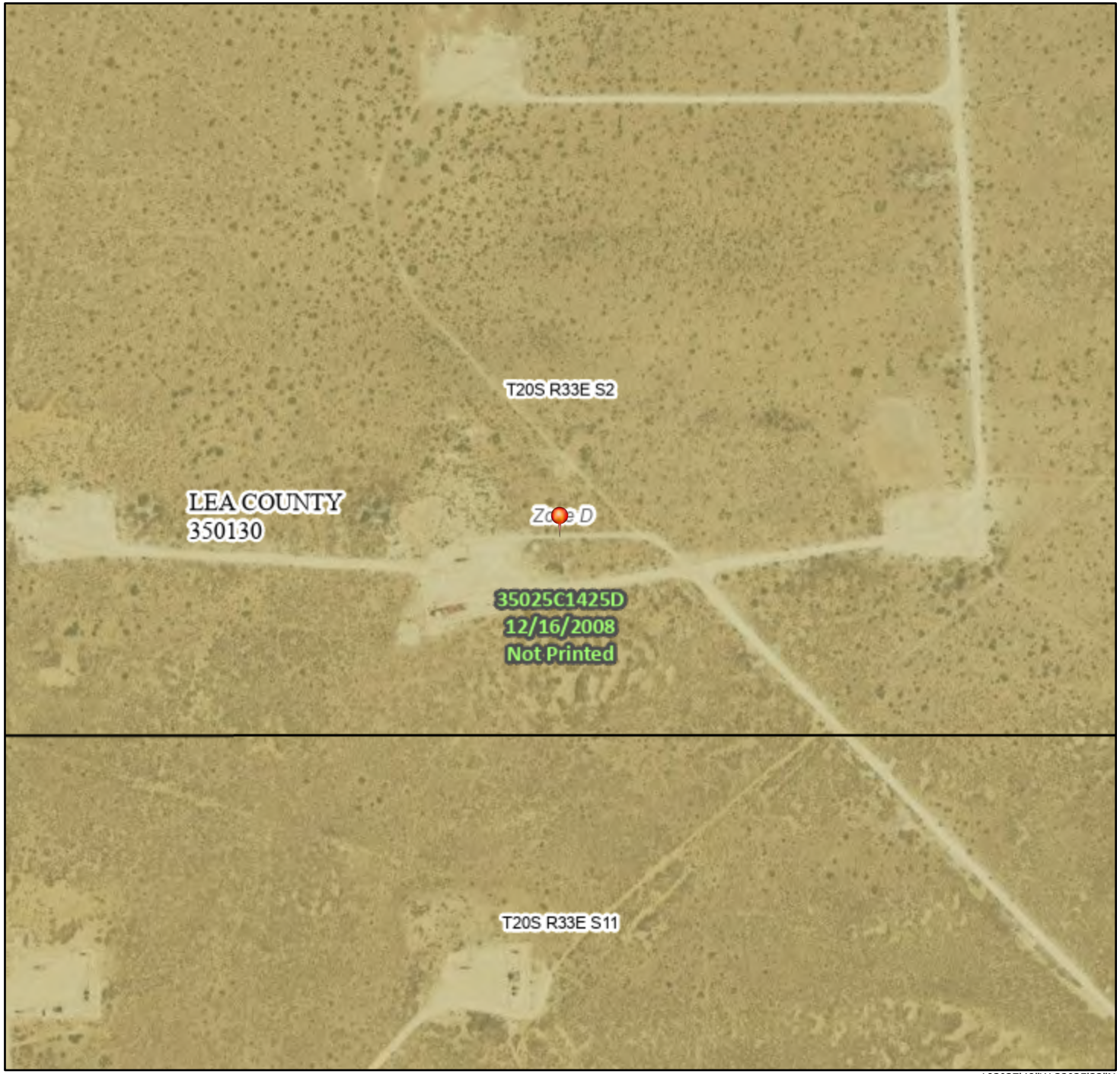
VERSATILITY. EXPERTISE.

Document Path: G:\1-Projects_US PROJECTS\BTA Oil Producers LLC\22E-02120 - Gem #4 Water Line\Figure X Karst Potential Gem #4 Water Line.mxd

National Flood Hazard Layer FIRMette

FEMA

103°38'26"W 32°36'3"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

103°37'48"W 32°35'32"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/14/2023 at 3:29 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Lea County, New Mexico

TF—Tonuco loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tw3c
Elevation: 3,280 to 4,460 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Tonuco and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tonuco

Setting

Landform: Ridges, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits

Typical profile

A - 0 to 12 inches: loamy fine sand
Bw - 12 to 17 inches: loamy sand
Bkkm - 17 to 39 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 12 to 20 inches to petrocalcic
Drainage class: Excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R077DY048TX - Shallow 12-17" PZ
Hydric soil rating: No

Minor Components

Simona

Percent of map unit: 15 percent
Landform: Ridges, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: R070BD002NM - Shallow Sandy
Hydric soil rating: No

Berino

Percent of map unit: 10 percent
Landform: Ridges, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: R070BD003NM - Loamy Sand
Hydric soil rating: No

Cacique

Percent of map unit: 5 percent
Landform: Ridges, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: R070BD004NM - Sandy
Hydric soil rating: No

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 19, Sep 8, 2022

USDA Natural Resources Conservation Service

Ecological site R077DY048TX
Shallow 12-17" PZ

Accessed: 08/14/2023

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

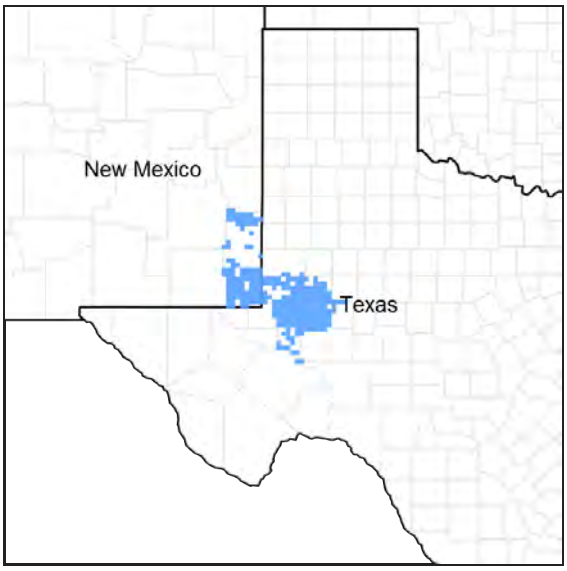


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 077D–Southern High Plains, Southwestern Part

This MLRA 77D is characterized by nearly level to gently undulating plains with scattered playa depressions. Soil temperature regime is thermic and soil moisture regime is aridic bordering on ustic. Sandy and loamy soils are generally well drained and range from shallow to deep and medium- to coarse-textured. Native vegetation is short- to midgrasses and sandy sites support tallgrasses with sand shin oak and mesquite. Current land use is mainly rangeland, although irrigated cropland is expanding.

Classification relationships

This ecological site is correlated to soil components at the Major Land Resource Area (MLRA) level which is further described in USDA Ag Handbook 296

Ecological site concept

This site occurs on shallow, calcareous soils on uplands. The reference vegetation consists of primarily shortgrasses with midgrasses, few forbs, and very few shrubs. Abusive grazing practices can lead to a shift in the plant community. Removal of fire from the ecosystem can lead to an increase in woody plant cover.

Associated sites

R077DY042TX	**Limy Upland 12-17" PZ** Shallow sites can be found adjacent to limy upland sites. The limy upland sites will occur as gently undulating soils that occur on broad upland plains.
R077DY047TX	**Sandy Loam 12-17" PZ** Sandy loam sites occur adjacent to shallow sites as deeper soils on nearly level plains.

Similar sites

R077DY047TX	**Sandy Loam 12-17" PZ** Sandy loam sites have similar forage plant communities with higher production potential.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Bouteloua eriopoda*

Physiographic features

Soils correlated in the MLRA 77D Shallow ecological site are shallow to a petrocalcic horizon. They were formed in moderately fine textured eolian sediments of the Blackwater Draw Formation of Pleistocene age. These soils are typically on gently sloping plains, narrow ridges, and side slopes along draws. Slope ranges from 0 to 15 percent.

The landforms for the Shallow site include Plain, Ridge, and Side slopes.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	2,000–5,000 ft
Slope	0–15%
Water table depth	72 in
Aspect	Aspect is not a significant factor

Climatic features

Continental Steppe climate is prevalent in MLRA 77D. This climate type is typical of interiors of continents and is characterized by large variations in the magnitude of ranges in daily temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. This climate regime is also known for being semi-arid with mild winters.

Droughts occur with monotonous frequency although there will be years having excessive precipitation resulting in large accumulations of water that little benefit is obtained from the rainfall events. If good rains occur in the spring and summer months, annual production will be favorable even if the remainder of the year is not favorable. Most of the annual precipitation occurs as a result from spring and early summer thunderstorms. Due to the fact that the area is mainly flat, local flooding may occur but only of short duration. There is very little precipitation and infrequent snowfall amounts in the winter.

During the late winter and early spring months, dust storms occur very frequently. The flat plains of the area contribute very little resistance to the strong winds. Dust in many of these storms remains in the air for several days after the storms have passed.

Daytime temperatures are warm in the summer but there is a large diurnal range and most nights are comfortable. In summers, the normal daily maximum temperatures are in the low to mid 90s and the normal minimum temperatures are in the upper 60s and low 70s. Even though the temperatures may be high, the low humidity and high evaporation rates create a cooling effect during the nighttime hours. Fall months exhibit extremely variable weather. Winters are mild and are characterized by frequent cold fronts accompanied by strong, gusty, northerly winds. Most of the cold fronts are dry as they pass through the area.

Table 3. Representative climatic features

Frost-free period (average)	211 days
Freeze-free period (average)	233 days
Precipitation total (average)	20 in

Influencing water features

Soil features

The soils of this site are very shallow to shallow well drained, calcareous, gravelly soils. Permeability is moderate and runoff is low to medium. Parent material is a thin mantle of medium to moderately coarse textured eolian sediments over an indurated layer.

Major Soil Taxonomic Units correlated to this site include: Blakeney soils, Conger soils, Simona soils, and Slaughter soils.

Table 4. Representative soil features

Surface texture	(1) Gravelly clay loam (2) Loam (3) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	7–20 in
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2–3 in
Calcium carbonate equivalent (0-40in)	10–60%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–4
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	5–65%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

The Reference Plant Community of the Shallow Ecological Site was a Shortgrass/Midgrass Community (1.1). Few if any tallgrass species could be found. Grass species accounted for 90 percent of the total site production. A wide variety of forbs are produced on this site with scattered woody shrubs equally accounting for 10 percent of the total annual production. This site occurs on gently to moderately sloping upland areas. Slopes typically range from 1 to 5 percent. The soils of the site vary from shallow fine sandy loams to loams with a depth of 12 to 20 inches over indurated caliche. The soils have good plant-soil-moisture relationships, but moisture-holding capacity is moderate, often limiting productivity.

The dominant shortgrass species is black grama (*Bouteloua eriopoda*), with lesser amounts of buffalograss (*Bouteloua dactyloides*) and Wright threeawn (Aristida wrightii). Trace amounts of Hall's panicum (*Panicum hallii*), blue grama (*Bouteloua gracilis*) and hairy grama (*Bouteloua hirsuta*) can be found on the site. The dominant midgrass species is sideoats grama (*Bouteloua curtipendula*) and plains bristlegrass (*Setaria macrostachya*), with lesser amounts of cane bluestem (*Bothriochloa barbinodis*), Arizona cottontop (*Digitaria californica*), sand dropseed (*Sporobolus cryptandrus*), slim tridens (*Tridens muticus*), tobosagrass (*Pleuraphis mutica*), vine mesquite (*Panicum obtusum*), and Reverchon bristlegrass (*Setaria reverchonii*). A good variety of forbs exist but the amount varies greatly from year to year depending on moisture. The more commonly found forbs are trailing ratany (*Krameria lanceolata*), orange zexmania (Zexmania hispida), bush sunflower (*Simsia calva*), dotted gayfeather (*Liatris punctata*), white prairie clover (*Dalea albiflora*), gaura spp. (Gaura spp.), plains blackfoot (Melampodium leucanthus), tansy aster (*Machaeranthera tanacetifolia*), Texas croton (*Croton texensis*), Texas sleepy daisy (*Xanthisma texanum*), western ragweed (Ambrosia psilstachya), Oenothera spp. (Oenothera spp.), yellow spiny daisy (Haplpappus spinulosus), and desert holly (*Atriplex hymenelytra*). The major shrubs are catclaw acacia (*Acacia greggii*), vine ephedra (*Ephedra antisyphilitica*), lotebush (*Ziziphus obtusifolia*), pricklypear spp. (Opuntia spp.), javalina bush (*Condalia ericoides*), and winterfat (*Krascheninnikovia lanata*).

Fire plays a role in the ecology of this site as well as most other high plains sites. The general role of fire was to sustain the natural grassland and suppress shrubby species. Fire helps to keep a balance between the grasses, forbs and shrubs. However, in the shortgrass region, fire was probably secondary to climate in shaping the reference vegetative state. A drier climate (<20 inches annual precipitation) creates a situation where the subsoil is dry more often than it is wet. Plant roots grow in response to moisture and this dryer climate favors short grasses with fibrous root systems or short rhizomatous grasses. Annual forbs are stimulated by fire and diversity is generally increased. Heavy grazing after a fire can have a negative effect if conditions are dry and remain so for an extended period.

Periodic overgrazing and trampling by migrating herds of bison and elk as well as resident herds of pronghorn antelope occurred during drought periods. Bison moved about in large herds over the region somewhat regulated by water sources and fire frequency.

However, long rest periods followed once the large herds of bison moved out of the area, allowing the resilient grassland to re-establish and maintain its structure.

Variations in climatic factors, especially the amount and timing of precipitation, greatly influence the productivity of ecological sites and are largely responsible for the fluctuations in the amount of vegetative growth from one season to the next. It is not unusual for fluctuations of greater than 50% to occur from one year to another. These types of climatic variation are part of the overall environment in which the reference state developed. However, it needs to be pointed out that long-term drought (4 to 6 years of rainfall 50 percent below the mean) can act in concert with other forces to affect changes in plant communities. For instance, extended drought weakens plants and makes them more susceptible to the effects of overgrazing. Drought conditions coupled with fire can be damaging and need long periods of time to fully recover. Extremely dry summers followed by wet winters can favor cool-season annual grasses at the expense of perennial warm-season species. A well-adapted, healthy community could better withstand such rigors of drought. However, even they experience damage that would result in some departure from the former stable state. Usually, the departure would be temporary.

When domestic livestock were brought to the plains in the 1870's, it was largely an open range situation. By 1890, however, most of the area had been fenced and livestock were confined to these areas continually. Not understanding the limits of rangeland productivity, European settlers overstocked the area with domesticated livestock almost universally. As overgrazing occurred on this site, there was a reduction of the less grazing resistant

midgrass species, a decline in mulch and organic matter, and consequently a reduction in intensity and frequency of fires. The shift in plant cover to less palatable shortgrass species and the decline in soil cover, favors woody plant encroachment.

With continuous heavy grazing, no fire, no brush management and/or pest management this site will transition to the Shortgrass/Shrub/Annuals Community (1.2). As livestock and wildlife numbers increase and grazing use exceeds a plants ability to sustain defoliation, the more palatable and generally more productive species decline in stature, productivity and density. The tendency of this site is to become a shortgrass dominant site if long term grazing abuse occurs. This will lead to a decline in the vigor of sideoats grama and other palatable midgrass species. Croton species and western ragweed will increase and hairy tridens (*Erioneuron pilosum*), annual broomweed (Guitierrezia dracunculoides), broom snakeweed (*Gutierrezia sarothrae*), mesquite (*Prosopis glandulosa*) and numerous annuals will invade the site. The production of vegetation has shifted from mostly herbaceous vegetation to increasing amounts of woody shrubs. Herbaceous vegetation is still the largest production in this state. Nutrient cycling, the water cycle, watershed protection and biological functions have changed somewhat. This state can transition back to reference with good management practices such as prescribed grazing, brush management and pest management. Prescribed burning could be used if the fuel load and conditions allow.

If long-term, heavy grazing continues with no fire or any form of brush and pest management, a major threshold will be crossed to the Shrub/Shortgrass Community (2.1). In this state, mesquite, broom snakeweed and pricklypear will dominate the site. The typical shortgrass species will be perennial three-awns, hairy tridens and other invading low quality short grasses. Bare areas will increase with annuals filling the voids.

The loss of herbaceous cover and increased bare soil encourages accelerated erosion. Nutrient cycling, the water cycle, watershed protection and biological functions have been severely reduced.

The plant community is so degraded that it cannot reverse retrogression without extensive energy and management inputs. Prescribed grazing with rest periods during the growing season, re-seeding with adapted native grass species, chemical and/or mechanical brush management, and some form of pest management will be required to return this state back to the reference state. With the reduced amounts of grass fuel, prescribed burning is usually not an option in this state.

In the early 1930's Lehman lovegrass (*Eragrostis lehmanniana*), a grass of African origin, was introduced in the southern high plains as a drought tolerant, easy to establish introduced grass species. This grass species was used in many grass mixtures and pasture plantings in an attempt to re-seed poor condition rangeland following mechanical brush management and to return old cropland fields to a perennial vegetative state for livestock grazing purposes. This grass is both invasive and persistent; published evidence indicates that variables such as elevation, summer precipitation, winter temperatures, and soils impact its abundance and distribution. Shallow upland sites in a weakened state near established areas of Lehman lovegrass may become invaded by this grass. Presently, several thousand acres of loam, clay loam and sandy loam sites have been invaded to the point that Lehman lovegrass is the dominant grass species with few if any native species remaining. The resulting plant community is a Lehman Lovegrass/Shrub Dominant Community (3.1). Once this lovegrass has become well established, returning the site to reference would be expensive and generally not very successful or practical. Prescribed burning for seedbed preparation purposes may be necessary to remove excessive amounts of plant biomass. Moderate to heavy mechanical brush management, heavy seedbed preparation and re-seeding to a native grass mixture would be required. The application of herbicides can be effective to reduce competition from this lovegrass species, but there is only a narrow time of treatment opportunity. Since this grass species has become naturalized much like K.R. bluestem has in Central Texas, it is unlikely that it will disappear through any natural processes such as competition from native species.

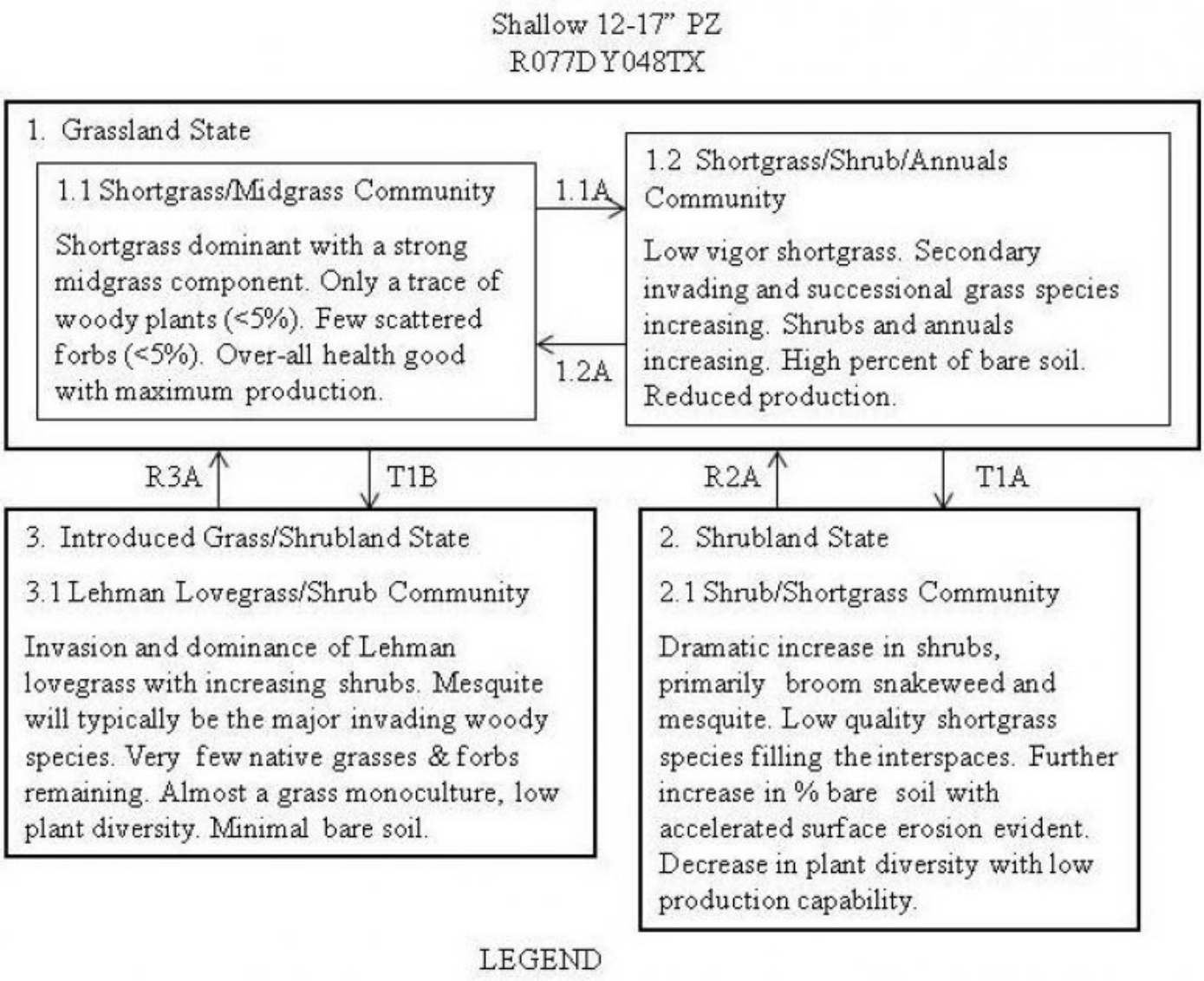
NOTE: Rangeland Health Reference Worksheets have been posted for this site on the Texas NRCS website (www.tx.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions.

STATE AND TRANSITIONAL PATHWAYS: (DIAGRAM)

Narrative:
The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances; it does not mean that this would happen the same way in every instance. Local professional

guidance should always be sought before pursuing a treatment scenario.

State and transition model



LEGEND

1.1A - Heavy Continuous Grazing, No Fire, No Brush Management, No Pest Management
1.2A - Prescribed Grazing, Prescribed Fire, Brush Management, Pest Management
T1A - Heavy Continuous Grazing, No Fire, Long-term Drought, No Brush Management, No Pest Management
R2A - Prescribed Grazing, Growing Season Rests, Brush Management, Range Planting, Pest Management
T1B - Heavy Continuous Grazing, Invasion Introduced Grass, No Fire, No Brush Management, No Pest Management
R3A - Prescribed Fire, Prescribed Grazing, Growing Season Rests, Brush Management, Range Planting, Pest Management

State 1
Grassland State

The Reference Plant Community of the Shallow Ecological Site is a Shortgrass/Midgrass Community (1.1). Few if any tallgrass species can be found. Grass species account for 90 percent of the total site production. A wide variety of forbs are produced on this site with scattered woody shrubs equally accounting for 10 percent of the total annual production. The dominant shortgrass species was black grama, with lesser amounts of buffalograss and Wright threeawn. With continuous heavy grazing, no fire, no brush management and/or pest management this site will

transition to the Shortgrass/Shrub/Annuals Community (1.2). As livestock and wildlife numbers increase and grazing use exceeds a plants ability to sustain defoliation, the more palatable and generally more productive species decline in stature, productivity and density. The tendency of this site is to become a shortgrass dominant site if long-term grazing abuse occurs. This will lead to a decline in the vigor of sideoats grama and other palatable midgrass species.

Community 1.1
Shortgrass/Midgrass Community

Figure 4. 1.1 Shortgrass/Midgrass Community

The Reference Plant Community of the Shallow Ecological Site is a Shortgrass/Midgrass Community (1.1). Grass species account for 90 percent of the total site production with black grama dominating and a strong midgrass component. A wide variety of forbs are produced on this site with scattered woody shrubs equally accounting for 10 percent of the total annual production. This site occurs on gently to moderately sloping upland areas. Slopes typically range from 1 to 5 percent. The shallow soils of the site vary from fine sandy loams to loams. The soils have good plant-soil-moisture relationships, but moisture-holding capacity is moderate, often limiting productivity. Most energy and nutrient cycling was contained in the narrow grass/soil interface and evapo-transpiration was minimal. Maintenance of this plant community requires continued proper grazing management as well as occasional brush and pest management.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	450	900	1350
Shrub/Vine	25	50	75
Forb	25	50	75
Tree	0	0	0
Microbiotic Crusts	0	0	0
Total	**500**	**1000**	**1500**

Figure 6. Plant community growth curve (percent production by month). TX1251, Warm-season bunchgrasses w/ forbs & shrubs. Warm-season bunchgrasses with forbs and shrubs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	3	5	12	16	15	20	18	9	1	0

Community 1.2
Shortgrass/Shrub/Annuals Community

Figure 7. 1.2 Shortgrass/Shrub/Annuals Community

With continuous heavy grazing, no fire, no brush management and/or pest management this site will transition to the Shortgrass/Shrub/Annuals Community (1.2). As livestock and wildlife numbers increase and grazing use exceeds a plants ability to sustain defoliation, the more palatable and generally more productive species decline in stature, productivity and density. The tendency of this site is to become a shortgrass dominant site if long term grazing abuse occurs. This will lead to a decline in the vigor of sideoats grama and other palatable midgrass species. Croton species and western ragweed will increase and hairy tridens, annual broomweed, broom snakeweed, mesquite and numerous annuals will invade/increase on the site. The production of vegetation has shifted from mostly herbaceous vegetation to increasing amounts of woody shrubs. Herbaceous vegetation is still the largest production in this state. Nutrient cycling, the water cycle, watershed protection and biological functions have changed somewhat. This state can transition back to the reference community with good management practices such as prescribed grazing, brush management and pest management. Prescribed burning could be used if the fuel load and conditions allow.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	300	600	900
Shrub/Vine	200	300	400
Forb	60	80	100
Tree	0	0	0
Microbiotic Crusts	0	0	0
Total	**560**	**980**	**1400**

Figure 9. Plant community growth curve (percent production by month). TX1252, Shortgrass Dominant/Invading Shrub Community. Warm-season shortgrasses with increasing shrubs and forbs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	3	5	12	16	15	20	18	9	1	0

Pathway 1.1A
Community 1.1 to 1.2

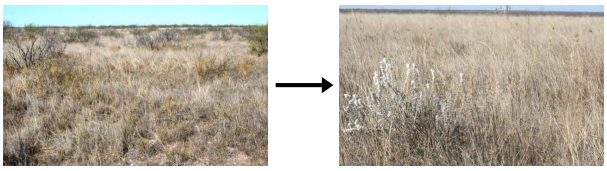
Shortgrass/Midgrass Community

Shortgrass/Shrub/Annuals Community

With continuous heavy grazing, no fire, no brush management and/or pest management this site will shift to the

Shortgrass/Shrub/Annuals Community (1.2). As livestock and wildlife numbers increase and grazing use exceeds a plants ability to sustain defoliation, the more palatable and generally more productive species decline in stature, productivity and density.

Pathway 1.2A
Community 1.2 to 1.1



Shortgrass/Shrub/Annuals Community **Shortgrass/Midgrass Community**

This state can transition back to near reference conditions with good management practices such as prescribed grazing, brush management and pest management. Prescribed burning could be used if the fuel load and conditions allow.

Conservation practices

Brush Management
Prescribed Burning
Integrated Pest Management (IPM)
Prescribed Grazing

State 2
Shrubland State

If long-term, heavy grazing continues with no fire or any form of brush and pest management, a major threshold will be crossed from the Grassland State (1.0) to the Shrubland State (2.0). In this state, mesquite, broom snakeweed and pricklypear will dominate the site. The typical shortgrass species will be perennial three-awns, hairy tridens and other invading low quality short grasses. Bare areas will increase with annuals filling the voids.

Community 2.1
Shrub/Shortgrass Community

Figure 10. 2.1 Shrub/Shortgrass Community

If long-term, heavy grazing continues with no fire or any form of brush and pest management, a major threshold will be crossed to the Shrub/Shortgrass Community (2.1). In this state, mesquite, broom snakeweed and pricklypear will dominate the site. The typical shortgrass species will be perennial threeawns, hairy tridens and other invading low quality short grasses. Bare areas will increase with annuals filling the voids. The loss of herbaceous cover and increased bare soil encourages accelerated erosion. Nutrient cycling, the water cycle, watershed protection and

biological functions have been severely reduced. The plant community is so degraded that it cannot reverse retrogression without extensive energy and management inputs. Prescribed grazing with rest periods during the growing season, re-seeding with adapted native grass species, chemical and/or mechanical brush management, and some form of pest management will be required to return this state back to the reference state. With the reduced amounts of grass fuel, prescribed burning is usually not an option in this state.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	400	500	600
Grass/Grasslike	150	300	450
Forb	60	80	100
Microbiotic Crusts	0	0	0
Tree	0	0	0
Total	**610**	**880**	**1150**

Figure 12. Plant community growth curve (percent production by month). TX1254, Shrub/Shortgrass/Annuals Community. Spring and fall growth of shortgrasses, annuals, and shrubs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	4	6	10	16	15	20	15	12	1	0

State 3
Introduced Grass/Shrubland State

Lehman lovegrass is the dominant grass species with few if any native species remaining. The resulting plant community is a Lehman Lovegrass/Shrub Dominant Community (3.1). Once this lovegrass has become well established, returning the site to the reference state(1)would be expensive and generally not very successful or practical.

Community 3.1
Lehman Lovegrass/Shrub Community

Figure 13. 3.1 Lehman Lovegrass/Shrub Community

Several thousand acres of loam, clay loam and sandy loam sites in the southern high plains that are in a degraded state have been invaded by Lehman lovegrass to the point that it is the dominant grass species with few if any native species remaining. The resulting plant community is a Lehman Lovegrass/Shrub Dominant Community (3.1). Once this lovegrass has become well established, returning the site to the reference state(1) would be expensive and generally not very successful or practical. Prescribed burning for seedbed preparation purposes may be necessary to remove excessive amounts of plant biomass. Moderate to heavy mechanical brush management,

heavy seedbed preparation and re-seeding to a native grass mixture would be required. The application of herbicides can be effective to reduce competition from this lovegrass species, but there is only a narrow time of treatment opportunity. It is unlikely that Lehman loverass will disappear through any natural processes such as competition from native species.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1200	2100	3000
Shrub/Vine	300	550	800
Forb	5	10	15
Tree	0	0	0
Microbiotic Crusts	0	0	0
Total	**1505**	**2660**	**3815**

Figure 15. Plant community growth curve (percent production by month). TX1255, Lehman Lovegrass/Shrub Dominant Community. Lehman lovegrass with shrub dominance..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	5	8	16	18	12	15	18	6	1	0

Transition T1A
State 1 to 2

If long-term, heavy grazing continues with no fire or any form of brush and pest management, a major threshold will be crossed from the Shortgrass/Shrubs/Annuals Community (1.2) to the Shrub/Shortgrass Community (2.1). In this state, mesquite, broom snakeweed and pricklypear will dominate the site.

Transition T1B
State 1 to 3

If long-term, heavy grazing continues with no fire or any form of brush and pest management, along with encroachment of introduced grasses such as Lehman lovegrass, a major threshold will be crossed from the Shortgrass/Shrubs/Annuals Community (1.2) to the Lehman lovegrass/ Shrubs Community. Dominant species include Lehman lovegrass and mesquite.

Restoration pathway R2A
State 2 to 1

The plant community is so degraded that it cannot reverse retrogression without extensive energy and management inputs. Prescribed grazing with rest periods during the growing season, re-seeding with adapted native grass species, chemical and/or mechanical brush management, and some form of pest management will be required to return this state back to the reference state(1). With the reduced amounts of grass fuel, prescribed burning is usually not an option in this state.

Conservation practices

Brush Management
Range Planting
Integrated Pest Management (IPM)
Prescribed Grazing

Restoration pathway R3A

State 3 to 1

Returning the site to the reference state would be expensive and generally not very successful or practical. Prescribed burning for seedbed preparation purposes may be necessary to remove excessive amounts of plant biomass. Moderate to heavy mechanical brush management, heavy seedbed preparation and re-seeding to a native grass mixture would be required.

Conservation practices

Brush Management
Prescribed Burning
Range Planting
Prescribed Grazing

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Shortgrass**			125–375	
	black grama	BOER4	*Bouteloua eriopoda*	125–375	–
2	**Midgrass**			100–300	
	sideoats grama	BOCU	*Bouteloua curtipendula*	100–300	–
3	**Midgrasses**			175–525	
	large-spike bristlegrass	SEMA5	*Setaria macrostachya*	50–150	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	25–75	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	25–75	–
	Arizona cottontop	DICA8	*Digitaria californica*	25–75	–
	tobosagrass	PLMU3	*Pleuraphis mutica*	25–75	–
	vine mesquite	PAOB	*Panicum obtusum*	0–1	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	0–1	–
4	**Shortgrasses**			50–150	
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	25–75	–
	buffalograss	BODA2	*Bouteloua dactyloides*	25–75	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–5	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–5	–
	Hall's panicgrass	PAHA	*Panicum hallii*	0–5	–
Forb					
5	**Forbs**			25–75	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	2–5	–
	desertholly	ATHY	*Atriplex hymenelytra*	2–5	–
	Texas croton	CRTE4	*Croton texensis*	2–5	–
	whiteflower prairie clover	DAAL	*Dalea albiflora*	2–5	–
	beeblossom	GAURA	*Gaura*	2–5	–
	trailing krameria	KRLA	*Krameria lanceolata*	2–5	–
	dotted blazing star	LIPU	*Liatris punctata*	2–5	–

	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	2–5	–
	tanseyleaf tansyaster	MATA2	*Machaeranthera tanacetifolia*	2–5	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	2–5	–
	evening primrose	OENOT	*Oenothera*	2–5	–
	awnless bushsunflower	SICA7	*Simsia calva*	2–5	–
	Texas sleepydaisy	XATE	*Xanthisma texanum*	2–5	–
Shrub/Vine					
6	**Shrubs**			25–75	
	bigtooth maple	ACGRG	*Acer grandidentatum var. grandidentatum*	4–12	–
	catclaw acacia	ACGRG3	*Acacia greggii var. greggii*	4–12	–
	javelina bush	COER5	*Condalia ericoides*	4–12	–
	clapweed	EPAN	*Ephedra antisyphilitica*	4–12	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	4–12	–
	pricklypear	OPUNT	*Opuntia*	4–12	–
	lotebush	ZIOB	*Ziziphus obtusifolia*	4–12	–

Animal community

This site is inhabited by dove, quail, deer and pronghorn. Limited populations of pronghorn antelope frequent the site. The limited amount of woody plants does not provide good cover and food sources for deer.

This rating system provides general guidance as to animal preference for plant species. It also indicates possible competition between kinds of herbivores for various plants. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. Grazing preference does not necessarily reflect the ecological status of the plant within the plant community. For wildlife, plant preferences for food and plant suitability for cover are rated.

Preferred (P) – Percentage of plant in animal diet is greater than it occurs on the land
Desirable (D) – Percentage of plant in animal diet is similar to the percentage composition on the land
Undesirable (U) – Percentage of plant in animal diet is less than it occurs on the land
Not Consumed (N) – Plant would not be eaten under normal conditions; only consumed when other forages not available.
Used, but degree of utilization unknown (X) – Percentage of plant in animal diet is unknown
Toxic (T) – Rare occurrence in diet and, if consumed in any tangible amounts results in death or severe illness in animal

Hydrological functions

These shallow soils have moderate to moderately low runoff potential due to slopes which range from 1 to 5 percent. These soils are fertile and absorb water at a moderate rate. Moisture storage is limited by the 12 to 20 inch depth to indurated caliche.

Recreational uses

This site has very little value from an aesthetic standpoint. The site is occupied almost exclusively by native short and midgrass species with few woody shrubs. Recreational activities could include bird hunting, camping, hiking, bird watching, photography, and horseback riding.

Wood products

None.

Other products

None.

Other information

None.

Inventory data references

NRCS FOTG – Section II of the FOTG Range Site Descriptions and numerous historical accounts of vegetative conditions at the time of early settlement in the area were used in the development of this site description. Vegetative inventories were made at several site locations for support documentation.

Inventory Data References (documents):
NRCS FOTG – Section II - Range Site Descriptions
NRCS Clipping Data summaries over a 20 year period

Other references

Reviewers and Technical Contributors:
Mark Moseley, RMS, NRCS, Boerne, Texas
Justin Clary, RMS, NRCS, Temple, Texas
Kelly Attebury, RSS, NRCS, Lubbock, Texas

Other references: (List other references used in the description or correlation of this site.)
J.R. Bell, USDA-NRCS Rangeland Management Specialist (retired)
Natural Resources Conservation Service - Range Site Descriptions
USDA-Natural Resources Conservation Service - Soil Surveys & Website soil database
Rathjen, Frederick W., The Texas Panhandle Frontier, Rev. 1998, Univ. of Texas Press
Hatch, Brown and Ghandi, Vascular Plants of Texas (An Ecological Checklist)
Texas A&M Exp. Station, College Station, Texas
Texas Tech University – Department of Natural Resources Management
Kingsbury, John M. (1964) Poisonous Plants of the United States and Canada.
Soil Science: November 1964 - Volume 98 - Issue 5 - ppg 349.
Sosebee, Ronald E. Timing – The Key to Herbicidal Control of Broom Snakeweed. Department of Natural Resources Management, Texas Tech University, Lubbock, Texas.

Contributors

Clint Rollins, RMS, NRCS, Amarillo, Texas

Acknowledgments

Site Development and Testing Plan

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem

condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Stan Bradbury, Zone RMS, NRCS, Lubbock, Texas
Contact for lead author	806-791-0581
Date	09/04/2007
Approved by	Mark Moseley, RMS, NRCS, Boerne, Texas
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Slight to moderate.

2. **Presence of water flow patterns:** Slight to moderate.

3. **Number and height of erosional pedestals or terracettes:** Slight to moderate.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20-25% bare ground.

5. **Number of gullies and erosion associated with gullies:** Slight to moderate.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to slight.

7. **Amount of litter movement (describe size and distance expected to travel):** Slight to moderate.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Water erosion hazards are moderate to severe.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Shallow clays and clay loam surfaces; weak fine granular surface; hard; friable; few fine roots; calcareous; moderately alkaline; moderate permeability; well drained; good plant-soil moisture; moderate SOM.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Low vegetative cover and percent slopes makes this site susceptible to erosion.

This site is a very slowly permeable soil, runoff is medium to high depending on slopes and available water holding capacity is moderate to high.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Warm-season midgrasses > Warm-season shortgrasses>>

    Sub-dominant:

    Other: Forbs = Shrubs/Vines

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses due to their growth habit will exhibit some mortality and decadence though minimal.

---

14. **Average percent litter cover (%) and depth (in):** Litter is dominantly herbaceous.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 to 1500 pounds per acre.

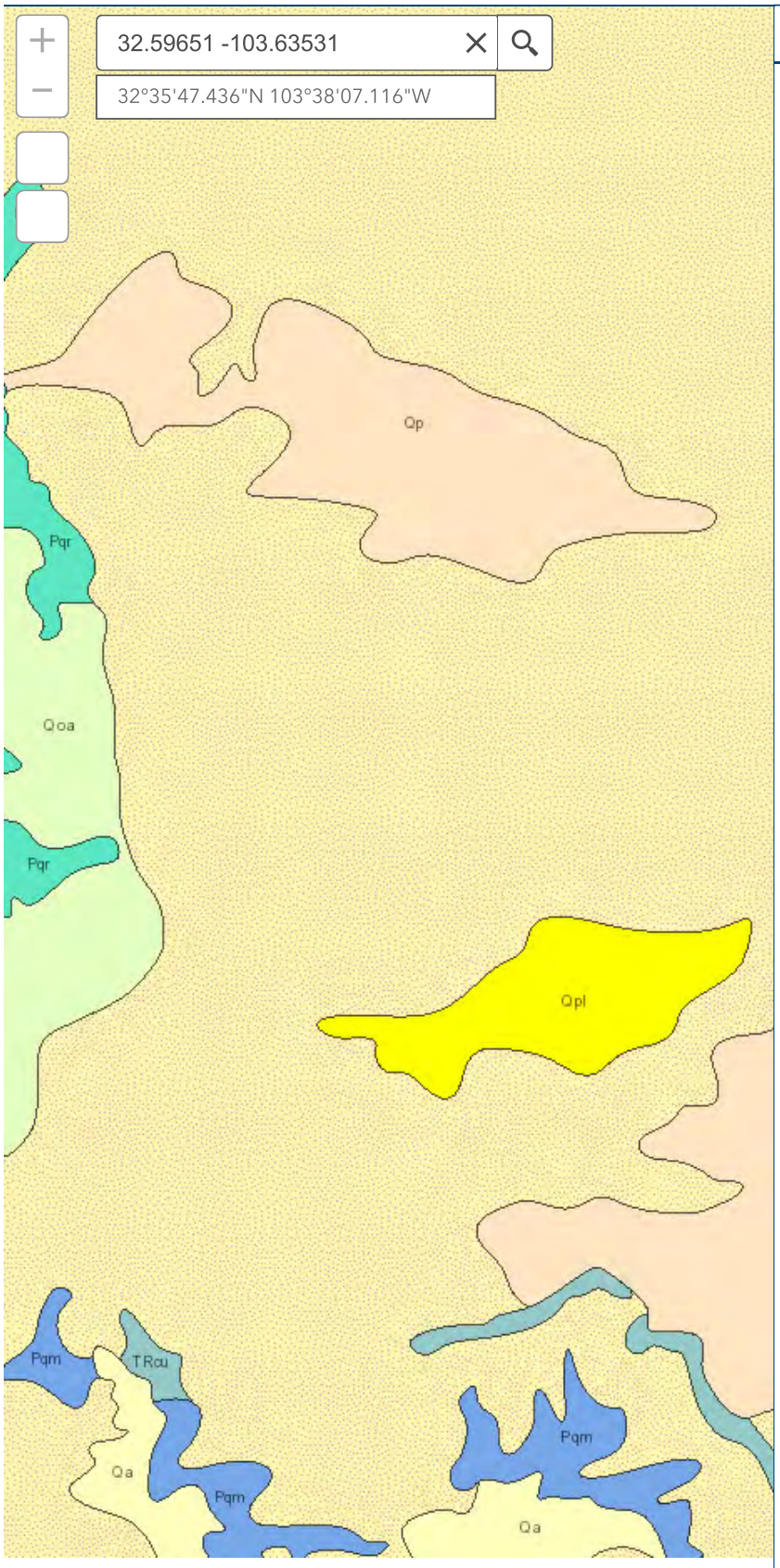
---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Mesquite, pricklypear, and broom snakeweed can become invasive.

---

17. **Perennial plant reproductive capability:** All plant species should be capable of reproduction except during periods of prolonged drought conditions, heavy natural herbivory or intense wildfires.

NMBGMR Interactive Resources Map



Layer List

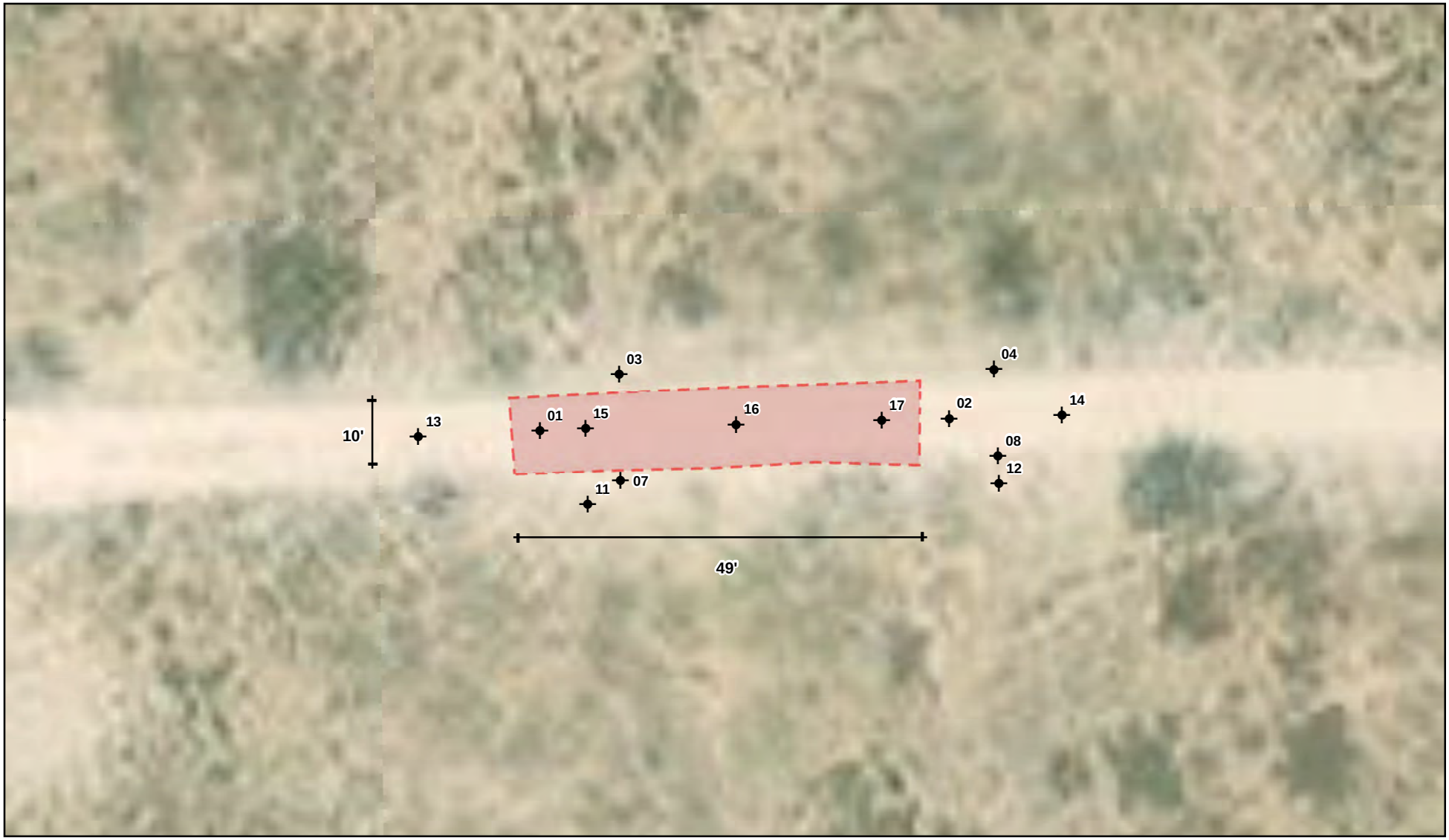
Layers

- Geographic_Resources
- Geologic_Resources
  - Precambrian
  - GEOCHRONOLOGY
  - Geologic Maps at 1:24,000 Scale
  - Geologic Maps at Other Scales
  - State Geologic Map 1:500,000
  - Quaternary Faults
  - Valles Caldera at 1:50,000 Scale
- Water_Resources
- Energy_Resources
- Mineral_Resources
- Recreation_Resources

App State

Click to restore the map extent and layers visibility where you left off.

ATTACHMENT 3



Borehole (Prefixed by "BH23-") Area of Exceedance/Proposed Excavation (~441 sq.ft.)

VERTEX

0 10 20 Ft

Map Center:
Lat/Long: 32.596505, -103.635266

NAD 1983 UTM Zone 13N
Date: Aug 09/23

N

Characterization Schematic
Gem #4 Water Line

FIGURE:
1

BTA

Geospatial data presented in this figure may be derived from external sources and Vertex does not assume any liability for inaccuracies. This figure is intended for reference use only and is not certified for legal, survey, or engineering purposes.

Note: Georeferenced image from ESRI, 2022. Site features from GPS by Vertex Professional Services Ltd., 2023.

VERSATILITY. EXPERTISE.

Document Path: G:\1-Projects_US PROJECT S\BTA Oil Producers LLC\2022\22E-02120 - Gem #4 Water Line\Figure 1 Characterization Schematic (22E-02120).mxd

ATTACHMENT 4

Client Name: BTA Oil Producers LLC
Site Name: Gem #4 Water Line
NMOCD Tracking #: nAPP2210967015
Project #: 22E-02120
Lab Reports: 2306C32, 2306D45, H233901

Table 2. Initial Characterization Laboratory Results - Depth to Groundwater >100 feet bgs

Sample Description			Field Screening			Petroleum Hydrocarbons							Inorganic
						Volatile		Extractable					
Sample ID	Depth (ft)	Sample Date	Volatile Organic Compounds (PID)	Extractable Organic Compounds (PetroFlag)	Chloride Concentration	Benzene	BTEX (Total)	Gasoline Range Organics (GRO)	Diesel Range Organics (DRO)	Motor Oil Range Organics (MRO)	(GRO + DRO)	Total Petroleum Hydrocarbons (TPH)	Chloride Concentration
			(ppm)	(ppm)	(ppm)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
BH23-01	0	2023-06-21	-	120	**2,500**	ND	ND	ND	ND	ND	ND	ND	**19000**
BH23-01	2	2023-06-22	-	-	**2,500**	-	-	-	-	-	-	-	-
BH23-01	4	2023-06-23	-	-	2,500	ND	ND	ND	ND	ND	ND	ND	19000
BH23-02	0	2023-06-21	-	80	**812**	ND	ND	ND	ND	ND	ND	ND	430
BH23-02	2	2023-06-22	-	77	550	ND	ND	ND	ND	ND	ND	ND	330
BH23-02	4	2023-06-23	-	-	1,375	ND	ND	ND	ND	ND	ND	ND	720
BH23-03	0	2023-06-21	-	77	500	ND	ND	ND	ND	ND	ND	ND	230
BH23-03	2	2023-06-22	-	40	250	ND	ND	ND	ND	ND	ND	ND	130
BH23-04	0	2023-06-21	-	37	300	ND	ND	ND	ND	ND	ND	ND	120
BH23-04	2	2023-06-22	-	32	200	ND	ND	ND	ND	ND	ND	ND	ND
BH23-07	0	2023-07-25	-	-	**1,134**	-	-	-	-	-	-	-	-
BH23-07	2	2023-06-22	-	65	450	ND	ND	ND	ND	ND	ND	ND	440
BH23-08	0	2023-06-21	-	24	300	ND	ND	ND	ND	ND	ND	ND	ND
BH23-08	2	2023-06-22	-	66	300	ND	ND	ND	ND	ND	ND	ND	ND
BH23-11	0	2023-06-22	-	79	200	ND	ND	ND	ND	ND	ND	ND	ND
BH23-11	2	2023-06-22	-	63	100	ND	ND	ND	ND	ND	ND	ND	ND
BH23-12	0	2023-06-22	-	31	175	ND	ND	ND	ND	ND	ND	ND	ND
BH23-12	2	2023-06-22	-	70	250	ND	ND	ND	ND	ND	ND	ND	ND
BH23-13	0	2023-06-23	-	67	425	ND	ND	ND	ND	ND	ND	ND	180
BH23-13	2	2023-06-23	-	-	750	ND	ND	ND	ND	ND	ND	ND	310
BH23-14	0	2023-06-23	-	42	300	ND	ND	ND	ND	ND	ND	ND	89
BH23-14	2	2023-06-23	-	74	300	ND	ND	ND	ND	ND	ND	ND	78
BH23-15	0	2023-07-25	-	-	**2,171**	-	-	-	-	-	-	-	-
BH23-15	2	2023-07-25	-	-	**5,464**	-	-	-	-	-	-	-	-
BH23-15	4	2023-07-25	-	-	6,570	-	-	-	-	-	-	-	-
BH23-16	0	2023-07-25	-	-	**1,269**	ND	ND	ND	ND	ND	ND	ND	**768**
BH23-16	2	2023-07-25	-	-	**2,151**	ND	ND	ND	ND	ND	ND	ND	**3560**
BH23-16	4	2023-07-25	-	-	6,481	ND	ND	ND	ND	ND	ND	ND	4040
BH23-17	0	2023-07-25	-	-	278	-	-	-	-	-	-	-	-
BH23-17	2	2023-07-25	-	-	**3,844**	-	-	-	-	-	-	-	-
BH23-17	4	2023-07-25	-	-	**4,452**	-	-	-	-	-	-	-	-

"ND" Not Detected at the Reporting Limit
"-" indicates not analyzed/assessed
Bold and green shaded indicates exceedance outside of NMOCD Reclamation Criteria (off-pad)

VERTEX

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 Rd., Aztec, NM 87410
Phone:(505) 334-6178 Fax:(505) 334-6170
District IV
1220 S. St Francis Dr., Santa Fe, NM 87505
Phone:(505) 476-3470 Fax:(505) 476-3462

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

CONDITIONS

Operator: BTA OIL PRODUCERS, LLC 104 S Pecos Midland, TX 79701	OGRID: 260297
	Action Number: 252252
	Action Type: [C-141] Release Corrective Action (C-141)

CONDITIONS

Created By	Condition	Condition Date
nvelez	Accepted for the record. Please see App ID 273060 for most updated status.	11/20/2023