

December 12, 2014



Mr. Mike Bratcher
Oil Conservation Division District 2 - Artesia
New Mexico Energy, Minerals, and Natural Resources Department
811 S. First Street
Artesia, New Mexico 88210

**TRANSMITTAL
SOIL ABATEMENT COMPLETION REPORT
TURNER B SOUTH TANK BATTERY
SECTION 29, TOWNSHIP 17 SOUTH, RANGE 31 EAST
LOCOC HILLS, EDDY COUNTY, NEW MEXICO**

Dear Mr. Bratcher,

On behalf of Linn Operating, Inc. (LINN), SKA Consulting, L.P. (SKA) has completed the Soil Abatement Completion Report for the above-referenced subject property located in Eddy County, New Mexico. The results are documented in the enclosed report.

Should you have any questions or comments regarding this report, please do not hesitate to contact me at (713) 266-6056 or brian.weaver@skaconsulting.com.

Sincerely,

SKA CONSULTING, L.P.

A handwritten signature in blue ink, reading 'Brian T. Weaver', with a checkmark at the end.

Brian T. Weaver, P.G.
Vice President/Partner

Enclosures: Soil Abatement Completion Report

cc: Mr. Daniel Frick, Linn Operating, Inc. (with enclosure)
Mr. Martin Stein, BLM (with enclosure)



Consulting Engineers, Scientists, and Geologists



**Soil Abatement Completion Report
Turner B South Tank Battery
Section 29, Township 17 South, Range 31 East
Loco Hills, Eddy County, New Mexico**

Prepared for:

**Linn Operating, Inc.
600 Travis Street, Suite 5100
Houston, Texas 77002**

December 2014

Project No. 12009-0005

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SOIL ABATEMENT COMPLETION REPORT
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SECTION 29, TOWNSHIP 17 SOUTH, RANGE 31 EAST
LOCO HILLS, EDDY COUNTY, NEW MEXICO

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Prepared for:

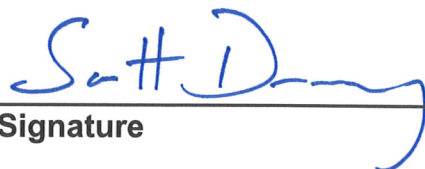
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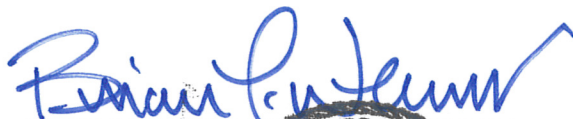
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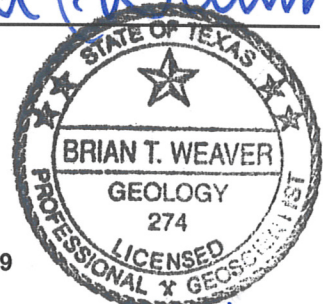
Reviewed by:

BRIAN T. WEAVER, P.G.
VICE PRESIDENT/PARTNER


Signature

December 2014

TEXAS REGISTERED ENGINEERING FIRM NO. F-005009
TEXAS REGISTERED GEOSCIENCE FIRM NO. 50011



12/12/14

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1.0 Executive Summary

SKA Consulting, L.P. (SKA) was retained by Linn Operating, Inc. (LINN) to prepare a Soil Abatement Completion Report for the Turner B South Tank Battery (Subject Property) located at Section 29, Township 17 South, Range 31 East in Loco Hills, Eddy County, New Mexico. See **Figure 1** for a site vicinity map.

The soil response actions conducted on the subject property as outlined within this report were initially proposed to the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) Oil Conservation Division (OCD) in a Site Investigation Report and Abatement Plan prepared by SKA in January 2014. The Site Investigation Report and Abatement Plan was approved by Mr. Mike Bratcher of the OCD in January 2014 with modifications to the Abatement Plan subsequently approved by Mr. Bratcher in April 2014. The Soil Abatement Completion Report herein details response actions conducted by SKA in May through June 2014 on the subject property.

The primary objectives of the Abatement Plan were: (1) perform corrective actions in three Areas of Concern (AOCs) identified within the former produced water release located on the subject property that were determined to exceed acceptable regulatory soil standards established by the OCD; and (2) prepare a report documenting the findings and conclusions of the Abatement Plan in order to obtain regulatory closure from the OCD.

In this effort, the abatement activities for impacted soils have included: (1) the excavation and removal of chloride and/or total petroleum hydrocarbon (TPH) impacted soils from the three AOCs; (2) the collection and laboratory analysis of confirmation soil samples to demonstrate that all remaining native (in-situ) soil within each AOC meet applicable OCD and United States Department of the Interior, Bureau of Land Management (BLM) remediation action levels as documented in the OCD-approved Abatement Plan; (3) proper waste classification of excavated soil, (4) the offsite disposal of 889 tons of impacted soil at an OCD-approved facility, (5) the backfilling of the three AOCs with 1,510 tons of acceptable imported soils, and (6) site restoration activities including recontouring and reseedling of backfilled areas according to BLM standards.

In June 2014, SKA completed three excavations at the subject property, located at AOC Nos. 1, 2, and 3. The most cost effective remedy was to remove, for off-site disposal, the soil that was most highly impacted by chlorides (>1000 mg/kg) and TPH (>5000 mg/kg) in accordance with New Mexico OCD regulatory standards and/or site specific guidelines. The depths of the excavations varied from approximately 2 to 6 feet below ground surface (ft-bgs) in selected areas with elevated chloride concentrations in soil (>1,000 mg/Kg), and approximately 2.5 ft-bgs in the one area with an elevated TPH concentration in soil (>5,000 mg/Kg). Since the tank battery is still currently active, no corrective actions (i.e., soil abatement) occurred within the limits of the secondary containment berms at the tank battery. Only those impacts to soil reported beyond the secondary containment berms at the tank battery are addressed in this Soil Abatement Completion Report.

Based on the results of the abatement activities summarized in this Soil Abatement Completion Report, SKA concludes the necessary response actions have been achieved for the Turner B South Tank Battery located at Section 29, Township 17 South, Range 31 East in Loco Hills, Eddy County, New Mexico. Therefore, no further soil sampling or soil response actions are

warranted. As such, SKA respectfully requests the New Mexico OCD issue regulatory closure of the subject property.

2.0 Introduction

The subject property is located at Section 29, Township 17 South, Range 31 East which is approximately 4.5 miles east of Loco Hills in Eddy County, New Mexico (**Figure 1**). The subject property consists of a tank battery including several aboveground storage tanks (ASTs) surrounded by a large earthen berm. Specifically, the subject property is located at:

Latitude: 32.808056°

Longitude: -103.896709°

The subject property is located within a vast and vacant area within northeastern Eddy County with the adjacent property in all directions consisting of various small brush and native grasses with a western sloping surface dissected by arroyos leading further west. A large, dry playa depression is located further west, approximately 3,800 feet from the subject property. No commercial or residential structures or developments are located within several miles of the subject property. The subject property is surrounded by extensive oil and/or gas exploration and production activities in all directions. References cited in this section and in the remainder of this report are contained in **Appendix 1**.

2.1 Site Background

On October 15, 2012, LINN reported a release of 256 barrels (bbls) of produced water to the New Mexico EMNRD - OCD and United States Department of the Interior BLM. Specifically, LINN verbally notified Mr. Randy Dade with the OCD and Ms. Terry Gregston with the BLM. The source of the release was immediately identified to be a hole within a steel pipe that was slightly buried belowground. Since the steel pipe was slightly buried belowground, this caused the pipe to corrode and eventually develop a hole. The steel pipe and subsequent hole were located within the limits of secondary containment at the tank battery and not at the wellhead. The release was initially contained within the secondary containment berms but ultimately washed-out a section of berm and flowed down-gradient along the western-most side of the lease road and onto the adjacent lands further west. Based on the natural topography surrounding the tank battery, the produced water release was confined to an area measuring approximately 24,255 square feet (10,189 square feet within the secondary containment berms and 14,066 square feet outside the secondary containment berms). More specifically, Ms. Terry Gregston with the BLM immediately mobilized to the subject property once notified and mapped the full extent of the produced water release with a global positioning system (GPS). The resulting map the BLM produced was provided to SKA and has been utilized for the site assessment and subsequent soil abatement activities (**Figure 2**).

LINN immediately performed abatement activities by mobilizing a vacuum truck to the subject property on October 15, 2012 and removed all standing water that was located both inside the secondary containment berms and along the side of the lease road. LINN estimated that approximately 40 bbls of produced water were recovered on October 15, 2012.

The BLM determined the release impacted previously documented cultural resources. Since the subject property and produced water release lie within federal lands managed by the BLM Carlsbad Field Office (CFO), an Archeological Data Recovery Plan was first required by the BLM as part of any future environmental site assessment and/or remediation efforts. Therefore, in March 2013 an Archeological Data Recovery Plan was prepared for the subject property and submitted to the BLM-CFO for review and approval. SKA received confirmation from the BLM

(Mr. Martin Stein) on July 23, 2013 that the Plan had been approved. Specifically the BLM approval cited a review of the report "*Archaeological Data Recovery Plan for LA 117293 and LA 171726, Linn Energy Turner "B" South Tank Battery Produced Water Release Cleanup, Eddy County, New Mexico,*" has been completed. This report was reviewed by the BLM Data Recovery Review Team and a copy was provided to the seven Indian tribes and pueblos that have ancestral ties to land within the CFO boundaries. No major questions or criticisms of the Plan were raised by any of the reviewers. As a result, the required permit for an archeological investigation to run concurrent with environmental site assessment and/or remediation activities was then requested from the BLM under the Archaeological Resources Protection Act (ARPA). A Cultural Resource Use Permit (Permit No. 110-8152-13-6) was then issued by the BLM on July 24, 2013 (expiration date: December 31, 2014).

2.2 Surface Topography

According to *Geohydrology of the Delaware Basin and Vicinity, Texas and New Mexico*, published by the United States Geological Survey (USGS), the site is located on the Northwest shelf, a stable platform area that forms the northern boundary for the Delaware Basin. The subject property is depicted on the USGS Loco Hills, New Mexico 7.5-minute topographic quadrangle at approximately 3,650 feet elevation south of the Fren Oil Field. The USGS quadrangle map notes that the subject property is in an area known as the Querecho Plains, which is bordered to the north and east by Mescalero Ridge and to the west by Nimenim Ridge. The area in which the subject property is located slopes to the northwest at about 150 feet per mile towards several playa features. A site vicinity map is included as **Figure 1**.

2.3 Geologic Setting

According to *Geology of Loco Hills Sand, Loco Hills Field, Eddy County, New Mexico*, published by the New Mexico Bureau of Mines and Mineral Resources, the upper geologic section in the immediate area consists of 200 feet of Holocene alluvial deposits of caliche, gypsum and quartz sand, gravel, and clay. Underlying the alluvial deposit is the Permian-age Rustler Formation. The Rustler is generally about 500 feet thick and its major component is limestone with beds of dolomite, anhydrite, and red sandstone. The beds of dolomite within the Rustler Formation have vugular porosity and are very resistive to weathering and form prominent outcrops where exposed.

Based on the previous drilling activities performed by SKA, the stratigraphy encountered within the depth investigated below the topsoil layer included fine silty sands (SM) and silty clays (CL) with very thin layers of small gravel and calcium carbonate nodules. Soil boring logs completed by SKA as part of this investigation are included in **Appendix 2**.

According to the United States Department of Agriculture (USDA) Web Soil Survey, the dominant soil type at the site is the Largo loam. The soil typically develops on 1 to 5 percent slopes between 3,000 to 4,200 feet elevation in areas with 10 to 14 inches of annual precipitation. Largo loam is often found on alluvial fans and plains. This soil is characteristically about 5 feet deep and well drained with a high available water capacity of about 10.0 inches.

2.4 Hydrogeology

According to *An Overview of the Hydrogeology of Saline Ground Water in New Mexico*, published by the USGS, the principal aquifer underlying northeast Eddy County is the Capitan aquifer, which is composed of the Capitan and Goat Seep Limestones consisting of dolomite and limestone strata. Aquifer thickness ranges from a few hundred to approximately 2,000 feet. Recharge occurs primarily through infiltration of precipitation in elevated terrain on the western side of the aquifer, from leakage from adjoining geologic units, and infiltration of surface water. The regional groundwater flow direction is to the east toward the Pecos River. Freshwater generally occurs in the Capitan aquifer west of the Pecos River. Hydraulic conductivity of the Capitan aquifer ranges from 1 to 25 feet per day (ft/d) west of the Pecos River and averages about 5 ft/d east of the river. Transmissivity may be as much as 10,000 square-feet per day in thicker parts of the aquifer that have well-developed porosity. According to *Geohydrology of the Delaware Basin and Vicinity, Texas and New Mexico*, the Capitan aquifer is used extensively for irrigation and wells can yield about 1,000 gallons per minute. Dissolved-solids concentrations range from 303 to 31,700 milligrams per liter, with the groundwater in the vicinity of northeast Eddy County having a dissolved-solids concentration of about 16,689 milligrams per liter.

A review of the New Mexico Office of the State Engineer (NMOSE) New Mexico Water Rights Reporting System (NMWRRS) database for on-line access to OSE well reports only identified three wells within 5,000 meters (3.1 miles) of the subject property. According to the NMWRRS, all three wells were drilled by Rodgers & Company, Inc. in January 2010 to depths of 55 feet (RA 11590 POD4), 60 feet (RA 11590 POD3), and 158 feet (RA 11590 POD1); however, no groundwater was reported in any of the three wells. Copies of the NMWRRS documentation are provided in **Appendix 3**.

A 1-mile water well search performed by Banks Environmental Data (Banks) identified two wells registered with the state within 1-mile. Both wells were plotted over 4,000 feet south of the site and listed as “exploratory” wells drilled to 55 and 60 feet below ground surface (ft-bgs) in 2010. Apparently, no groundwater was encountered and therefore, no hydrological data was provided. The two wells identified by Banks in proximity to the subject property (Map ID #'s 1 and 2) are actually two of the three wells identified during our review of the NMOSE NMWRRS database, as provided above (RA 11590 POD3 and RA 11590 POD4). A copy of the Banks Water Well Report is included in **Appendix 3**.

The site is located along the far eastern edge (escarpment) of the Cedar Lake playa depression (**Figure 1**). Based on our onsite inspection and a review of historical aerial photographs for the site (elevation: 3,670 feet AMSL) and the general area, the closest possible surface water body is a playa lake (Cedar Lake Playa) located approximately 3,800 feet west of the site (elevation: 3,583 feet AMSL) and any possible contaminants originating from the site would likely not affect this possible surface water body. Based on a review of historical aerial photographs and inspections during numerous visits to the site, this playa lake has historically been dry. Based on the vertical distance of the site relative to the dry playa lake (87 feet), depth to groundwater is likely confirmed to be over 100 ft-bgs.

3.0 Site Investigation Activities ---

The objective of the site investigation activities was to assess the magnitude and extent of contamination at the subject property from the October 2012 produced water release. This was accomplished by performing a field (subsurface) exploration, sampling, and analytical testing at the subject property.

The following sections provide a brief summary of the investigation activities conducted by SKA on the subject property as previously documented to the OCD in the Site Investigation Report and Abatement Plan, dated January 28, 2014.

3.1 Soil Assessment

The primary objectives of the field investigations were (1) to evaluate the extent of the chemicals of concern (COCs) in soils at the subject property and (2) to evaluate subsurface lithology beneath the Site.

On August 13 and 14, 2013, Mr. Chris Brown and Mr. Scott Drewry, Staff Environmental Scientists with SKA, supervised the installation of 26 soil borings (SB-1 through SB-26) across the subject property. A total of twelve soil borings (SB-1 through SB-12) were installed within the limits of the produced water release as previously mapped by the BLM to assess the magnitude of impacts and obtain vertical delineation, while fourteen soil borings (SB-13 through SB-26) were installed beyond the extent of the produced water release as previously mapped by the BLM for the purpose of horizontal delineation. Soil boring locations are shown on **Figure 3**.

Each soil boring was examined for obvious soil staining and/or odors by SKA's on-site personnel. Details of the stratigraphic conditions, identification, and descriptions of the soil encountered at each soil boring location were recorded on the Soil Boring Logs. SKA personnel utilized the Unified Soil Classification System (USCS) to classify the recovered soils. The lithology at the site generally consisted of fine Silty Sand (SM) for the uppermost 10 feet followed by some interbedded Silty Clay (CL) at depth. Soil Boring Logs prepared by SKA personnel are included in **Appendix 2**.

Soil samples collected from the soil borings selected for analytical testing were analyzed in the testing laboratory for chlorides by EPA Method SM4500 and total petroleum hydrocarbons (TPH) by EPA Method 8015. To aid in the selection of soil samples ultimately submitted for laboratory analysis, field screening was conducted for organic vapor concentrations using a Photoionization Detector (PID). Based on the PID field screening results and the TPH analytical testing results, six (6) soil samples were selected to be further analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA Method 8021B.

3.2 Cleanup Levels

Based on the New Mexico OCD *Guidelines for Remediation of Leaks, Spills, and Releases*, the risk ranking for the Turner B South Tank Battery is a zero (0) based on a depth to groundwater of over 100 feet, no water sources within 1,000 feet, and no surface water bodies within 1,000 feet of the Turner B South Tank Battery. Based on this ranking, the following remediation action levels were applicable:

Constituent	Soil Remediation Action Level (milligrams/kilogram)
Benzene	10
Total Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	50
Total Petroleum Hydrocarbons (TPH)	5,000

In its guidance, the OCD does not publish chloride remediation action levels for various risk rankings. Based on the low risk ranking for the site, a site-specific chloride remediation action level of 1,000 mg/kg was enforced.

3.3 Results

The results of the field sampling and analysis activities performed during this site investigation by SKA and the results of COCs identified in soils on the subject property revealed the following:

- The COCs identified in soil on the subject property were chlorides, TPH, and BTEX.
- Based on OCD regulations for petroleum releases and site-specific guidelines, the applicable remediation action levels for the subject property were determined to be: 1,000 mg/Kg for chlorides and 5,000 mg/Kg for TPH.
- No BTEX constituents were identified in exceedance of the OCD regulations.
- Remediation action level exceedances for chlorides and TPH were identified in soil within three (3) areas of concern (AOCs) on the subject property.
- AOC No. 1 is located within the produced water release along the westernmost portion of the subject property and associated with chloride remediation action level exceedances collected from soil borings SB-1, SB-3, and SB-5.
- AOC No. 2 is located within the produced water release along the caliche road adjacently west of the tank battery and associated with chloride remediation action level exceedances collected from soil borings SB-7 and SB-8.
- AOC No. 3 is located within the produced water release approximately 180 feet west of the tank battery and associated with TPH remediation action level exceedances collected from soil boring SB-4.

SKA concluded concentrations of chlorides and TPH were identified in surface soils in excess of their remediation action levels within three (3) AOCs located at the Turner B South Tank Battery. As a result, SKA concluded response actions (i.e., soil excavations) were warranted for AOC Nos. 1, 2, and 3 within the Turner B South Tank Battery. No COCs were identified in subsurface soil; therefore, no subsurface response actions were warranted for the subject property.

3.3.1 Areas of Concern

AOC No. 1:

AOC No. 1 was a chloride-impacted area that included soil borings SB-1, SB-3, and SB-5 measuring approximately 4,300 square feet located mostly within the lease road in proximity to the tank battery (**Figure 4**). Elevated concentrations of chlorides above 1,000 mg/Kg were reported at depths up to 8 ft-bgs. As a result, SKA concluded that the response actions (i.e., excavating and properly disposing/recycling of chloride-impacted soils offsite) were warranted on this portion of the subject property in an effort to obtain regulatory closure. These response actions are further described in **Section 4.0** of this report.

AOC No. 2:

AOC No. 2 was a chloride-impacted area that included soil borings SB-7 and SB-8 measuring approximately 1,850 square feet located within the lease road adjacent to the tank battery (**Figure 5**). Elevated concentrations of chlorides above 1,000 mg/Kg were reported at depths up to 3 ft-bgs. As a result, SKA concluded that the response actions (i.e., excavating and properly disposing/recycling of chloride-impacted soils offsite) were warranted on this portion of the subject property in an effort to obtain regulatory closure. These response actions are further described in **Section 4.0** of this report.

AOC No. 3:

AOC No. 3 was a TPH-impacted area that included soil boring SB-4 measuring approximately 1,075 square feet located with a natural drainage swale in proximity to the tank battery (**Figure 6**). An elevated concentration of TPH above 5,000 mg/Kg was reported at a depth of 2 ft-bgs. As a result, SKA concluded that the response actions (i.e., excavating and properly disposing/recycling of chloride-impacted soils offsite) were warranted on this portion of the subject property in an effort to obtain regulatory closure. These response actions are further described in **Section 4.0** of this report.

The AOCs with their extent of in-situ soils with chloride and TPH concentrations greater than 1,000 mg/kg and 5,000 mg/Kg, respectively, is estimated on **Figure 3**.

3.4 Conclusion and Recommendation

Based on the soil analytical data, SKA concluded soil response actions within AOC Nos. 1, 2, and 3 were required for the subject property in an effort to obtain regulatory closure from the New Mexico OCD.

4.0 Abatement Plan

The following sections summarize the objectives and response actions completed on the subject property in an effort to obtain regulatory closure from the New Mexico OCD.

4.1 Scope and Objectives

Based on the findings and conclusions of previous site investigations conducted on the subject property and the proposed response actions outlined in the Abatement Plan, it was determined that the only COCs in soils on the subject property at concentrations exceeding their respective New Mexico OCD remediation action levels were chlorides and TPH.

SKA conducted soil excavations, for off-site disposal, of soil that was adversely impacted with chlorides and TPH above their respective remediation action levels within AOC Nos. 1, 2, and 3. Since the tank battery is still currently active, no response actions (i.e., soil excavations) occurred within the limits of the secondary containment berms at the tank battery. The objectives of the response actions completed for AOC Nos. 1, 2, and 3 located on the subject property were:

- (1) Excavation (removal) of soils impacted with chloride concentrations exceeding the New Mexico OCD remediation action level of 1,000 mg/Kg from AOC Nos. 1 and 2.
- (2) Excavation (removal) of soils impacted with TPH concentrations exceeding the New Mexico OCD remediation action level of 5,000 mg/Kg from AOC No. 3.
- (3) Collect confirmation soil samples from AOC No. 1, AOC No. 2, and AOC No. 3 and analyze the confirmation soil samples for chlorides and/or TPH.
- (4) Ensure the remaining soil left in-place had concentrations of chloride and/or TPH below their respective New Mexico OCD remediation action levels for soils.
- (5) Disposal of the impacted soils at an OCD-approved off-site disposal and/or recycling facility.
- (6) Installation of a 20-mil high-density polyethylene (HDPE) liner at the 4-foot level of the excavation in AOC No. 1 to restrict infiltration of precipitation from passing through to higher chloride concentrations in deeper soils.
- (7) Backfilling all the excavations to surrounding grade with acceptable imported fill soil; and
- (8) The recontouring and reseeding of backfilled areas according to BLM standards.

The ultimate goal of the soil abatement activities was to protect groundwater and prevent erosion from saltwater scarring and vegetation loss. Therefore, the Abatement Plan focused on the removal of soils with the highest chloride and/or TPH concentrations that were within the reach of common excavating equipment. Removal and replacement of the impacted soils reduces the potential for additional leaching of chlorides into groundwater and creates a root media suitable for re-vegetation.

In addition, since the subject property is contained within BLM lands and archeological features have been previously documented in proximity to the subject property, an Archeological Data Recovery Plan was required by the BLM-CFO. Therefore, all soil abatement activities that were conducted as part of these corrective actions were conducted in strict accordance with the approved Archeological Data Recovery Plan under the direct supervision of the BLM-CFO. As such, all soil excavations conducted as part of the soil abatement activities were directly monitored and supervised by on-site archeologists.

4.1.1 Soil Excavations

On May 28, 2014, Blade Services, LLC, a subcontractor of SKA, initiated soil excavation activities on the subject property. Blade Services utilized a rubber-tire excavator (i.e., backhoe) to excavate soils within the three AOCs. Since the AOCs were contained within BLM lands with known archeological features and in accordance with the BLM-approved Archeological Data Recovery Plan, the strictest of care and precision was maintained during all phases of the excavation activities. As such, each AOC was excavated more cautiously in small cuts under the direct supervision of SKA. Mr. Scott Drewry, Environmental Scientist with SKA, performed all soil excavation oversight and confirmation soil sampling activities during the response actions. In addition, Dr. Jim A. Railey, Mr. Ryan Brucker, and Mr. Andy Larson, Archeologists with SKA, also performed all soil excavation oversight for purposes of compliance with the Archeological Data Recovery Plan. Photographs taken by our on-site personnel during the soil excavation activities are included in **Appendix 5**. A Site Plan is included as **Figure 2**.

All soil excavations were completed utilizing the backhoe and end-dump trucks for the transport of excavated soil and imported backfill soil. Confirmation soil samples were collected by SKA from the open excavations (AOCs) and immediately analyzed in the testing laboratory to confirm attainment of respective regulatory cleanup standards for soil. The ultimate extents of the excavations were determined by laboratory analytical testing results of the confirmation soil samples.

4.1.2 Soil Stockpiles

Excavated soil was temporarily stockpiled on-site and segregated based on origin. All excavated soil was placed onto 6-millimeter polyethylene sheeting pending waste disposal at an off-site disposal/recycling facility. The excavated soils were then transported off-site for disposal at an OCD-approved facility as RCRA-exempt, non-hazardous waste.

4.2 Areas and Volumes

The following sections describe the locations of the response actions conducted on the subject property and the quantity of media removed from the subject property. During the soil excavations, SKA's on-site personnel continuously inspected the sidewalls and bottoms of the excavation areas.

4.2.1 Soil Excavations

Area of Concern No. 1

SKA conducted response actions by excavating a total of 697 tons of chloride-impacted soil from AOC No. 1 to a depth of approximately 4 ft-bgs at previous soil borings SB-1, SB-3, and SB-5 (see **Figure 4**). Photographs taken by our on-site personnel during the soil response actions are included in **Appendix 5**.

Area of Concern No. 2

SKA conducted response actions by excavating a total of 108 tons of chloride-impacted soil from AOC No. 2 to a depth of approximately 2 ft-bgs at previous soil borings SB-7 and SB-8 (see **Figure 5**). Photographs taken by our on-site personnel during the soil response actions are included in **Appendix 5**.

Area of Concern No. 3

SKA conducted response actions by excavating a total of 84 tons of TPH-impacted soils from AOC No. 3 to a depth of approximately 2 ft-bgs at previous soil boring SB-4 (see **Figure 6**). Photographs taken by our on-site personnel during the soil response actions are included in **Appendix 5**.

4.2.2 Impacted Soils

SKA excavated (removed) a total of 889 tons of chloride and TPH-impacted soil from AOC Nos. 1, 2, and 3. The impacted soils were ultimately loaded into trucks for disposal at the Lea Land, LLC landfill located at Highway 62/180, Mile Marker 64 East, Carlsbad, New Mexico.

4.2.3 Backfill Materials

SKA also imported a total of 1,510 tons of clean backfill soil from the Lea Land, LLC landfill to complete the backfilling and site restoration activities. The backfill soils were silty/sandy/loamy soils of similar composition and color to the subject property along with caliche road-base material. Based on our observations, the backfill soils obtained from the landfill were surface to near surface soils from an unimproved area of the landfill property.

4.3 Confirmation Sampling

Confirmation soil samples collected from the subject property were analyzed at Cardinal Laboratories in Hobbs, New Mexico, which is a National Environmental Laboratory Accreditation Conference (NELAC)-accredited laboratory. All analyses were performed in accordance with EPA approved methods referenced in Title 40 of the Code of Federal Regulations (40 CFR) and "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA SW-846). The following sections provide descriptions of confirmation sampling procedures, sample analysis, and "clean-up" levels for the response actions performed by SKA on the subject property.

Discrete "grab" soil samples were collected from each AOC based on the sampling procedures outlined in the approved Abatement Plan. All soil samples collected were placed into laboratory-supplied glass jars, labeled, and temporarily stored in an ice-filled chest for preservation. Appropriate chain of custody documentation was maintained for all samples

delivered to the testing laboratory. Certificates of analysis and chain of custody documentation are included in **Appendix 4**.

Area of Concern No. 1:

A total of 19 discrete “grab” confirmation soil samples were initially collected by SKA personnel from the excavation and analyzed in the testing laboratory for chlorides by EPA Method SM4500. The 19 sidewall confirmation soil samples (AOC#1 - SW-1 through SW-17, SB-11-1, and SB-12-1) were collected from a depth of 2 ft-bgs, a central point along the sidewall of the excavation. Confirmation samples SW-1, SW-2, and SW-3 were collected from a 6 ft-bgs depth because the western portion of AOC No. 1 had previously been excavated and the current excavation began at a depth of 4 ft-bgs. Based on a modification of the original Abatement Plan and in accordance with OCD approval, no bottom confirmation soil samples were collected along the extent of the excavation. In lieu of excavating AOC#1 deeper, a 20-mil high-density polyethylene (HDPE) liner was approved to be installed along the entire bottom of the excavation prior to backfilling operations to restrict infiltration of precipitation from passing through to higher chloride concentrations in deeper soils. An excavation and confirmation soil sample location map is included as **Figure 4**.

Area of Concern No. 2:

A total of 11 discrete “grab” confirmation soil samples were initially collected by SKA personnel from the excavation and analyzed in the testing laboratory for chlorides by EPA Method SM4500. The 8 sidewall confirmation soil samples (AOC#2 – SW-1, SW-2, SW-3, SW-5, SW-6, SW-12, SW-13, and SW-14) were collected from a depth of 1 ft-bgs in the center of the sidewall; and 3 bottom confirmation soil samples (AOC#2: B-1, B-2, and B-11) were collected from depths that ranged from 2 ft-bgs to 2.5 ft-bgs along the extent of the AOC No.2 excavation. An excavation and confirmation soil sample location map is included as **Figure 5**.

Area of Concern No. 3:

A total of 8 discrete “grab” confirmation soil samples were initially collected by SKA personnel from the excavation and analyzed in the testing laboratory for total petroleum hydrocarbons (TPH) by EPA Method 8015. The 6 sidewall confirmation soil samples (AOC#3 – SW-1 through SW-6) were collected from a depth of 1 ft-bgs in the center of the sidewall; and 2 bottom confirmation soil samples (AOC#3: B-1 and B-2) were collected from a depth of 2.5 ft-bgs along the extent of the AOC No.3 excavation. An excavation and confirmation soil sample location map is included as **Figure 6**.

Backfill:

A total of 2 backfill confirmation soil samples were collected by SKA personnel from the Lea Land, LLC landfill. The backfill confirmation soil samples (Backfill 1 and Backfill 2) were analyzed in the testing laboratory for the same COCs associated with the subject property (chlorides by EPA Method SM4500, TPH by EPA Method 8015, and BTEX by EPA Method 8021).

4.3.1 Comparison to Data Clean Up Criteria

The following sections describe the results of analytical testing performed on soil samples collected during response action activities performed by SKA on the subject property.

The results of analytical testing performed on the confirmation soil samples obtained from the soil excavations at AOC Nos. 1, 2, and 3 are summarized in **Table 1**. All of the soil analytical results were compared to their applicable New Mexico OCD remediation action levels approved in the Abatement Plan. Laboratory certificates of analysis and chain-of-custody documentation are included in **Appendix 4**.

Area of Concern No. 1:

Based on the initial analytical results, 3 of the 19 sidewall confirmation samples (AOC#1: SW-6, SW-8, and SW-14) reported chloride concentrations in excess of the applicable OCD remediation action level of 1,000 mg/Kg. As a result, SKA concluded that over-excavation activities were warranted for these three sidewall confirmation sample locations (**see Section 4.4**). The remaining 16 sidewall confirmation soil samples reported chloride concentrations well below the applicable OCD remediation action level of 1,000 mg/Kg. Therefore, chloride-impacted soil has been successfully removed from the majority of AOC No. 1 and no further response actions are warranted for these portions of AOC No. 1. A summary of the soil analytical data for AOC No. 1 is included as **Table 1**. A Soil COC Map is included as **Figure 7**. Final laboratory analytical reports are included in **Appendix 4**.

Area of Concern No. 2:

Based on the initial analytical results, one of the sidewall confirmation soil samples (AOC#2: SW-2) and one of the bottom confirmation soil samples (AOC#2: B-11) reported chloride concentrations in excess of the applicable OCD remediation action level of 1,000 mg/Kg. As a result, SKA concluded over-excavation activities were warranted for the one sidewall and one bottom confirmation sample locations (**see Section 4.4**). The remaining 9 confirmation soil samples reported chloride concentrations well below the applicable OCD remediation action level of 1,000 mg/Kg. Therefore, chloride-impacted soil has been successfully removed from the majority of AOC No. 2 and no further response actions are warranted for these portions of AOC No. 2. A summary of the soil analytical data for AOC No. 2 is included as **Table 1**. A Soil COC Map is included as **Figure 8**. Final laboratory analytical reports are included in **Appendix 4**.

Area of Concern No. 3:

Based on the analytical results, none of the 8 confirmation soil samples (sidewalls and bottoms) reported TPH concentrations in excess of the applicable OCD remediation action level of 5,000 mg/Kg. As a result, SKA concludes that all TPH-impacted soil has been successfully removed and no further soil response actions are warranted with respect to AOC No. 3. A summary of the soil analytical data for AOC No. 3 is included as **Table 1**. A Soil COC Map is included as **Figure 9**. Final laboratory analytical reports are included in **Appendix 4**.

Backfill:

Based on the analytical results, the 2 backfill confirmation soil samples (Backfill 1 and Backfill 2) collected from the Lea Land, LLC landfill reported no detectable concentrations of TPH or BTEX constituents above their respective laboratory sample detection limits (i.e., non-detect). The backfill confirmation soil samples exhibited a detectable concentration of chlorides (64 mg/Kg); however, the detectable concentrations were far below the OCD remediation action level of

1,000 mg/Kg. As a result, the backfill soil was deemed acceptable for use for the on-site backfill. A summary of the soil analytical data for the backfill is included as **Table 1**. Final laboratory analytical reports are included in **Appendix 4**.

4.4 Over-Excavation Activities

Area of Concern No. 1:

Based on the initial analytical testing results, sidewall confirmation soil samples AOC#1: SW-6, SW-8, and SW-14 required over-excavation. SKA conducted over-excavation activities by excavating (removing) an additional 3 feet of chloride-impacted soil from the areas of previous sidewall confirmation soil samples AOC#1: SW-6, SW-8, and SW-14 (see **Figure 4**).

Upon successful completion of the over-excavation activities, 3 new discrete “grab” over-excavation sidewall confirmation soil samples AOC#1: SW-6B, SW-8B, and SW-14B were collected by SKA personnel for laboratory analysis. The over-excavation sidewall confirmation soil samples were submitted to the testing laboratory to be analyzed for chlorides by EPA Method SM4500.

Based on the analytical results, the over-excavation sidewall confirmation soil samples AOC#1: SW-6B, SW-8B, and SW-14B reported chloride concentrations below the applicable OCD remediation action level of 1,000 mg/Kg. As a result, SKA concludes that all chloride-impacted soil has been removed and no further soil response actions are warranted with respect to AOC No. 1. A summary of the soil analytical data for AOC No. 1 is included as **Table 1**. A Soil COC Map is included as **Figure 7**. Final laboratory analytical reports are included in **Appendix 4**.

Area of Concern No. 2:

Based on the initial analytical testing results, sidewall confirmation soil sample AOC#2: SW-2 and bottom confirmation sample B-11 required over-excavation. SKA conducted over-excavation activities by excavating (removing) an additional 2 feet of chloride-impacted soil from the area of previous sidewall confirmation soil sample AOC#2: SW-2 and an additional 1 foot of chloride-impacted soil from the area of previous bottom confirmation sample B-11 (see **Figure 5**).

Upon successful completion of the over-excavation activities, 2 new discrete “grab” over-excavation sidewall confirmation soil sample AOC#2: SW-2B and over-excavation bottom confirmation sample AOC#2: B-11B were collected by SKA personnel for laboratory analysis. The over-excavation sidewall and bottom confirmation soil samples were submitted to the testing laboratory to be analyzed for chlorides by EPA Method SM4500.

Based on the analytical results, the over-excavation confirmation soil samples AOC#2: SW-2B and B-11B both reported chloride concentrations that still exceeded the applicable remediation action level of 1,000 mg/Kg. As a result, SKA conducted an additional, second over-excavation by excavating (removing) an additional 2 feet of chloride-impacted soil from the area of previous sidewall confirmation soil sample AOC#2: SW-2B. An additional, second over-excavation was also conducted from the area of previous bottom confirmation soil sample AOC#2: B-11B. However, SKA discovered several buried 3-inch diameter poly transmission lines leading to the tank battery at this location (AOC #2 is located within the caliche oilfield lease road). As a result, the area for the additional, second over-excavation at bottom confirmation soil sample AOC#2: B-11B could not be over-excavated with conventional machinery (i.e., backhoe) due to

safety concerns. As a result, SKA initiated hand digging to the extent practical from the area to remove as much chloride-impacted soil from around the poly lines as possible. SKA immediately contacted the OCD for notification and concurrence. Upon discussion, the OCD concluded that an adequate amount of chloride-impacted soil had been removed from near the transmission lines within the oilfield lease road and that further over-excavation activities would not be required. Therefore, no further (i.e., deeper) soil response actions were conducted at over-excavation bottom confirmation soil sample AOC#2: B-11B.

Upon successful completion of the additional over-excavation activities at over-excavation sidewall confirmation soil sample AOC#2: SW-2B, a new discrete “grab” over-excavation sidewall confirmation soil sample AOC#2: SW-2C was collected by SKA personnel for laboratory analysis. The over-excavation sidewall confirmation soil sample was submitted to the testing laboratory to be analyzed for chlorides by EPA Method SM4500.

Based on the analytical results, the over-excavation sidewall confirmation soil sample AOC#2: SW-2C reported a chloride concentration below the applicable remediation action level of 1,000 mg/Kg. As a result, SKA concludes that all chloride-impacted soil has been removed and no further soil response actions are warranted with respect to AOC No. 2. A summary of the soil analytical data for AOC No. 2 is included as **Table 1**. A Soil COC Map is included as **Figure 8**. Final laboratory analytical reports are included in **Appendix 4**.

4.5 Site Restoration

The following sections describe the results of site restoration activities performed on the subject property and final disposition of the excavated soil once all appropriate environmental response actions were deemed complete by SKA.

Based on the analytical testing results of the confirmation soil samples collected from the sidewalls and bottoms of AOC Nos. 1, 2, and 3 on the subject property, no additional soil response actions are warranted. As a result, the excavations on the subject property were deemed complete and subsequently backfilled. Photographs taken by SKA’s on-site personnel during site restoration activities are included in **Appendix 5**.

Backfill

Between May 30 and June 10, 2014, SKA conducted backfilling operations for AOC Nos. 1, 2, and 3. Soil backfilling operations were conducted by Blade Services, LLC utilizing a rubber tire excavator (i.e., backhoe). Photographs taken by SKA’s on-site personnel during the backfilling operations are included in **Appendix 5**.

A total of 1,510 tons of acceptable backfill soil of similar composition and color to the subject property and caliche road-base were imported to the subject property to complete backfilling operations for AOC Nos. 1, 2, and 3.

Waste Disposal

Between May 30 and June 9, 2014, SKA conducted soil loading and removal activities for proper off-site disposal of impacted soils. All excavated soil was properly classified per disposal facility requirements and transported off-site for disposal/recycling at an OCD-approved facility. Soil load-out activities were conducted by Blade Services, LLC utilizing a backhoe. Photographs taken by SKA’s on-site personnel during load-out activities are included in

Appendix 5.

A total of 889 tons of impacted soil was excavated from AOC Nos. 1, 2, and 3 and transported from the subject property, via dump trucks, for off-site disposal/recycling as RCRA-exempt, non-hazardous waste at the Lea Land, LLC landfill located at Highway 62/180, Mile Marker 64 East, Carlsbad, New Mexico. Copies of the waste disposal manifests are included in **Appendix 3.**

Surface Restoration

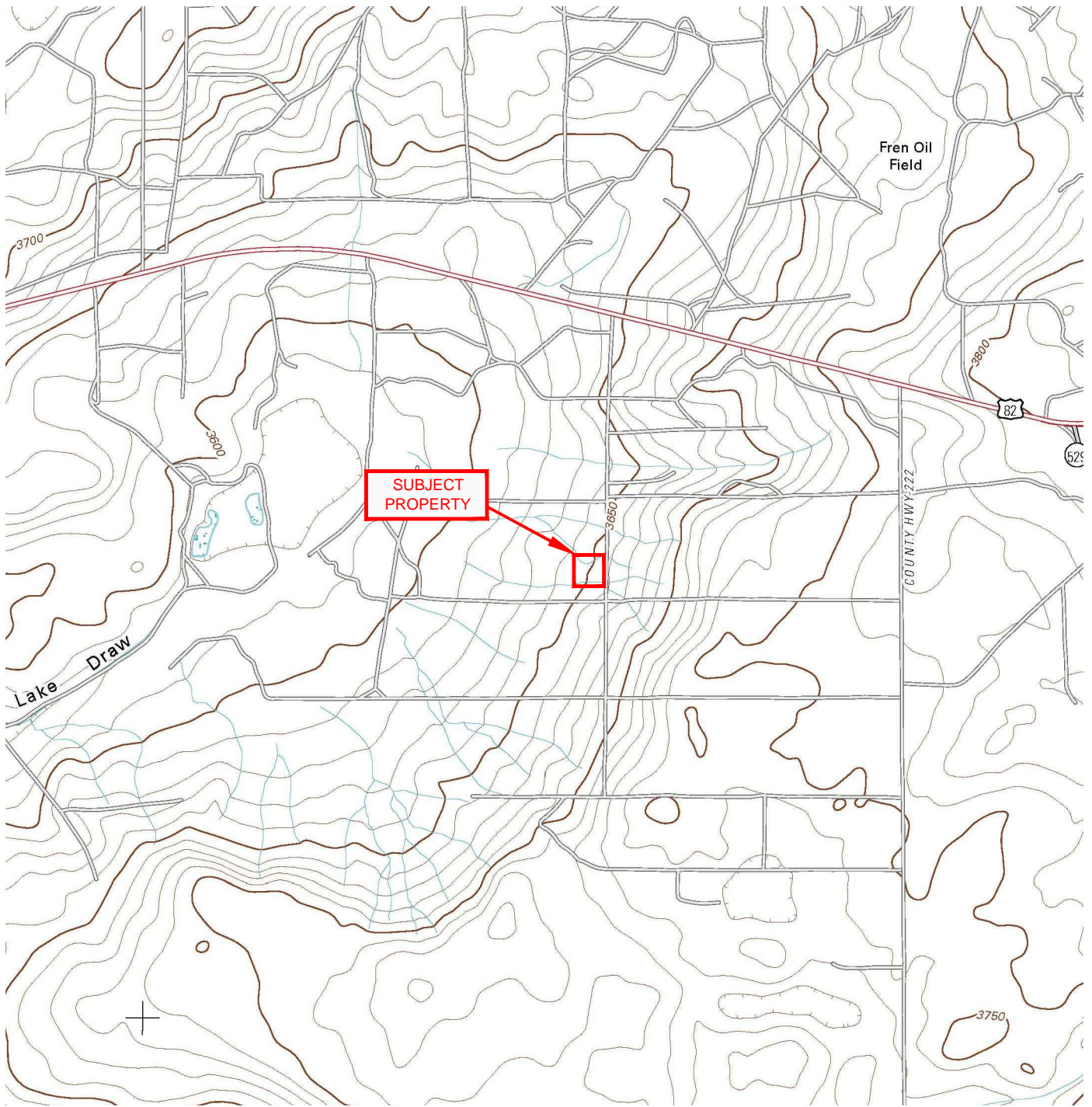
After backfilling, the oilfield lease road alongside the tank battery (AOC No. 2) was restored at the surface with caliche road-base while the remaining disturbed areas (AOC Nos. 1 and 3) were recontoured by mixing surrounding (native) topsoil to match the area topography. In accordance with BLM standards, the disturbed areas (AOC Nos. 1 and 3) were then raked at the surface, reseeded via broadcast and hand with the BLM-approved seed mix (BLM Seed Mix #2), covered and/or harrowed with surrounding topsoil in an effort to reduce seed predation and low germination rates, and watered.

5.0 Conclusions

Based on the results of the soil response actions summarized in this Soil Abatement Completion Report, SKA concludes all appropriate response actions have been achieved for the Turner B South Tank Battery located at Section 29, Township 17 South, Range 31 East in Loco Hills, Eddy County, New Mexico. SKA concludes no further soil sampling or soil response actions are warranted. Therefore, SKA respectfully requests the New Mexico OCD issue regulatory closure for the subject property.

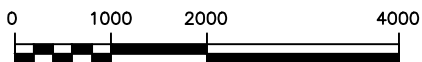
FIGURES

FIGURE 1
SITE VICINITY AND TOPOGRAPHIC MAP



QUADRANGLE LOCATION

REFERENCE: USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE
LOCO HILLS, NEW MEXICO
2010



APPROXIMATE SCALE: 1"=2000'



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SITE VICINITY AND TOPOGRAPHIC MAP

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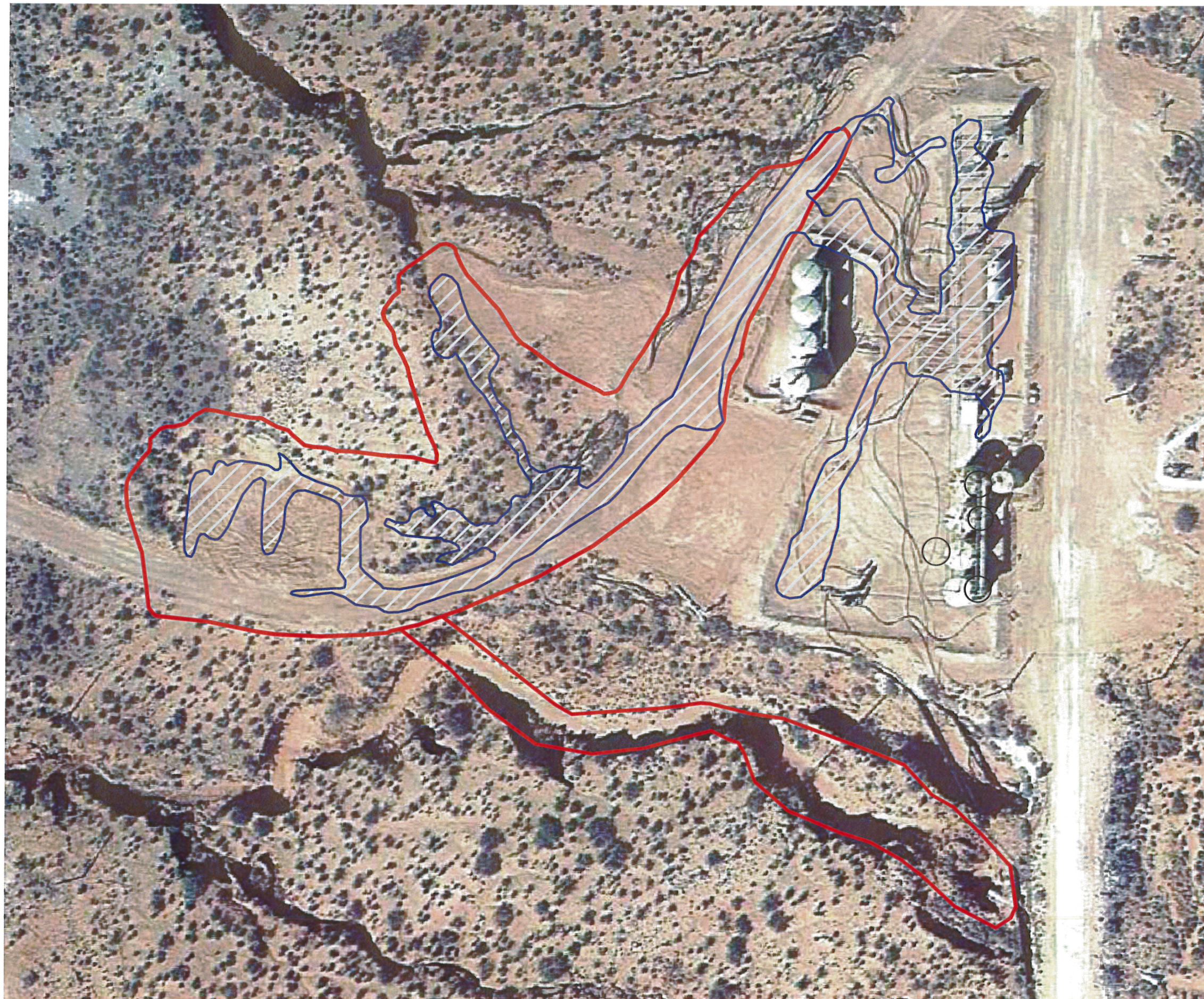
FIGURE
1



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3 THIRD REVISION	-	APPROVED BY: BTW

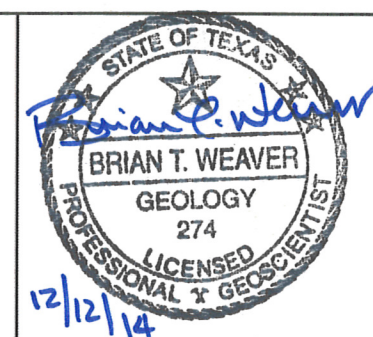
FIGURE 2
SITE PLAN



LEGEND

- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)

0 30 60
APPROXIMATE SCALE: 1"=60'



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SITE PLAN

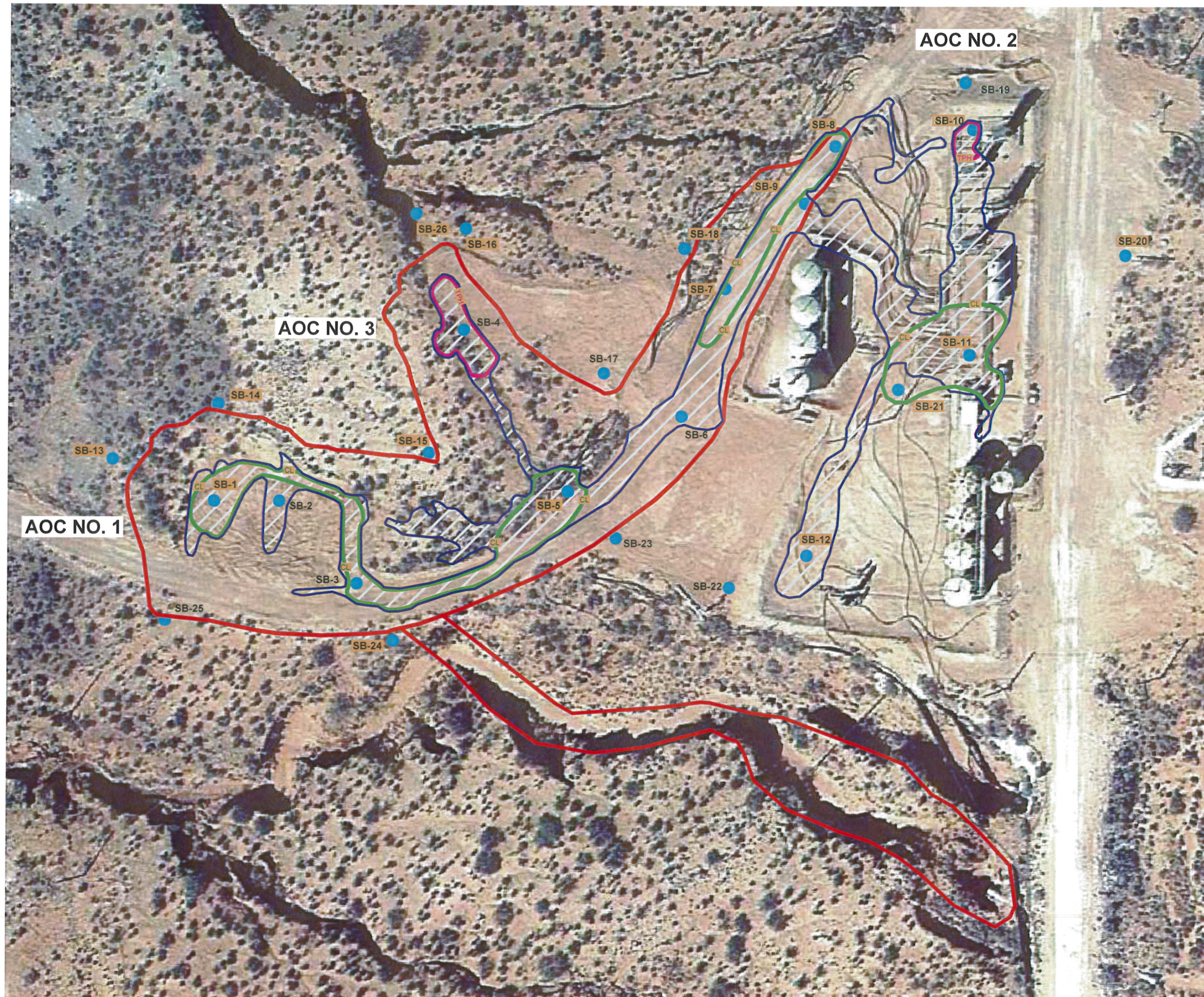
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FIGURE
2



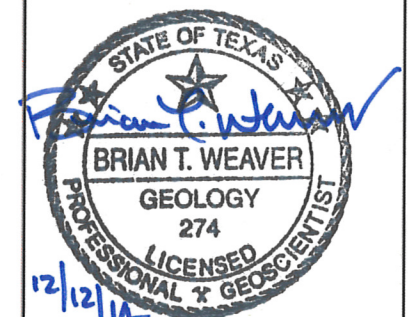
FIGURE 3
SITE INVESTIGATION MAP



LEGEND

- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- SOIL BORING LOCATION
- CHLORIDE IMPACTS IN SURFACE SOIL > 1,000 MG/KG
- TPH IMPACTS IN SURFACE SOIL > 5,000 MG/KG
- AOC AREA OF CONCERN

0 30 60
APPROXIMATE SCALE: 1"=60'



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SITE INVESTIGATION MAP

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FIGURE
3

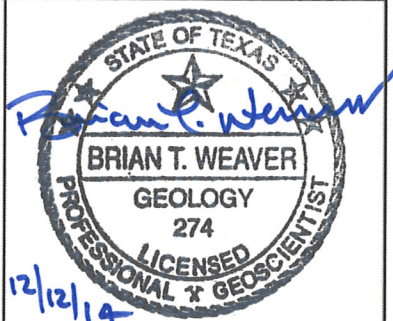
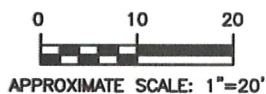


FIGURE 4
AOC NO. 1



LEGEND

- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC AREA OF CONCERN
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (CHLORIDES)



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AOC NO. 1 SAMPLE LOCATION MAP

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FIGURE
4



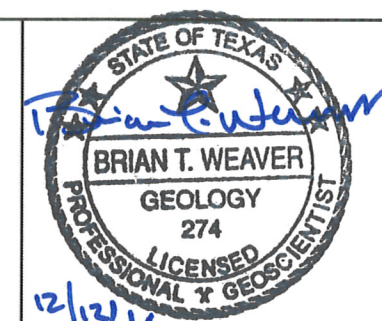
FIGURE 5
AOC NO. 2



LEGEND

- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (CHLORIDES)

0 10 20
APPROXIMATE SCALE: 1"=20'



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AOC NO. 2 SAMPLE LOCATIONS MAP

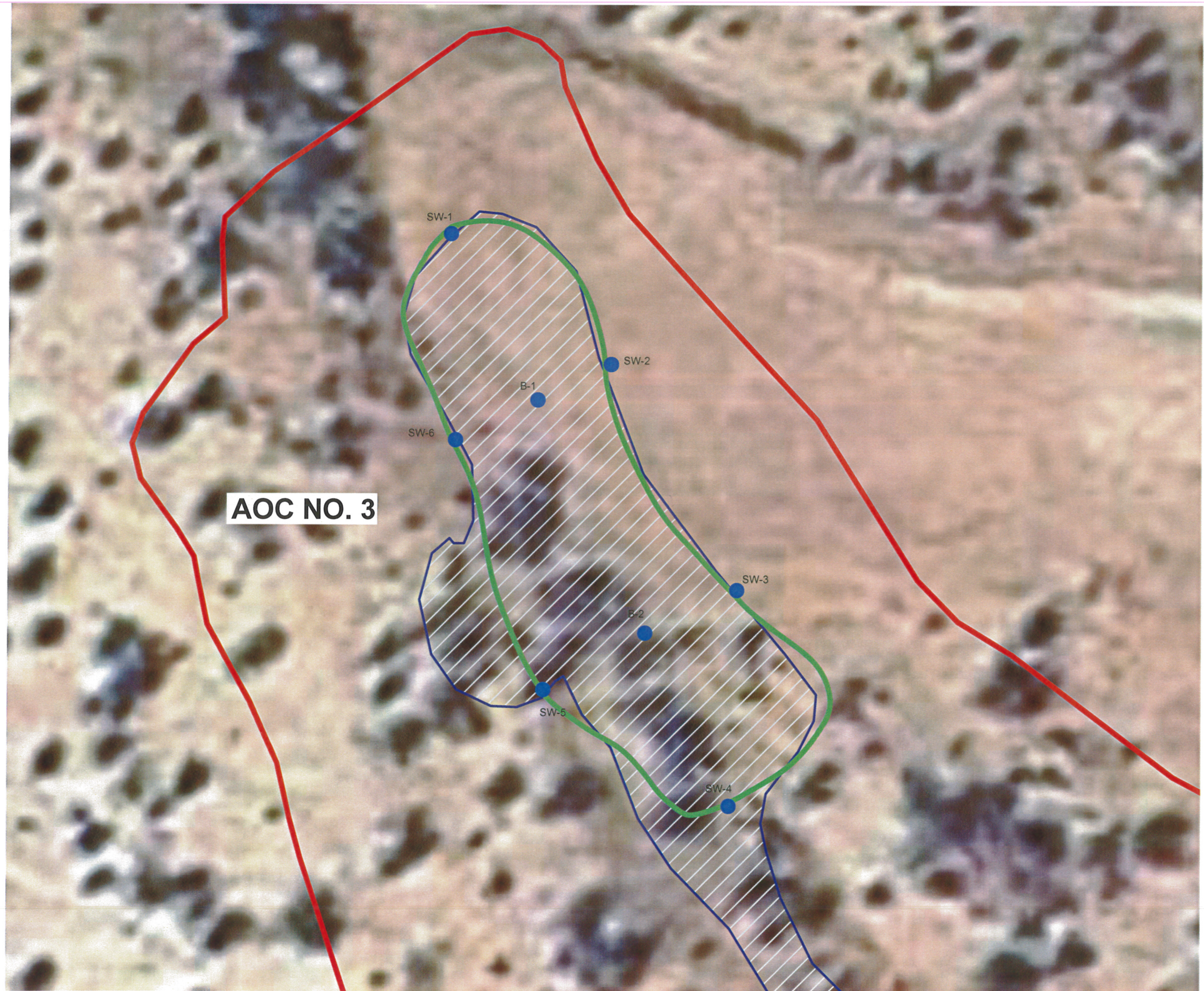
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3 THIRD REVISION	-	APPROVED BY: BTW

FIGURE
5



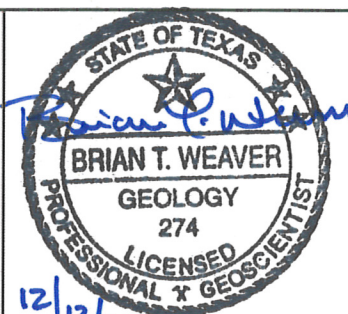
FIGURE 6
AOC NO. 3



LEGEND

- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC AREA OF CONCERN
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (TPH)

0 5 10
APPROXIMATE SCALE: 1"=10'



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AOC NO. 3 SAMPLE LOCATIONS MAP

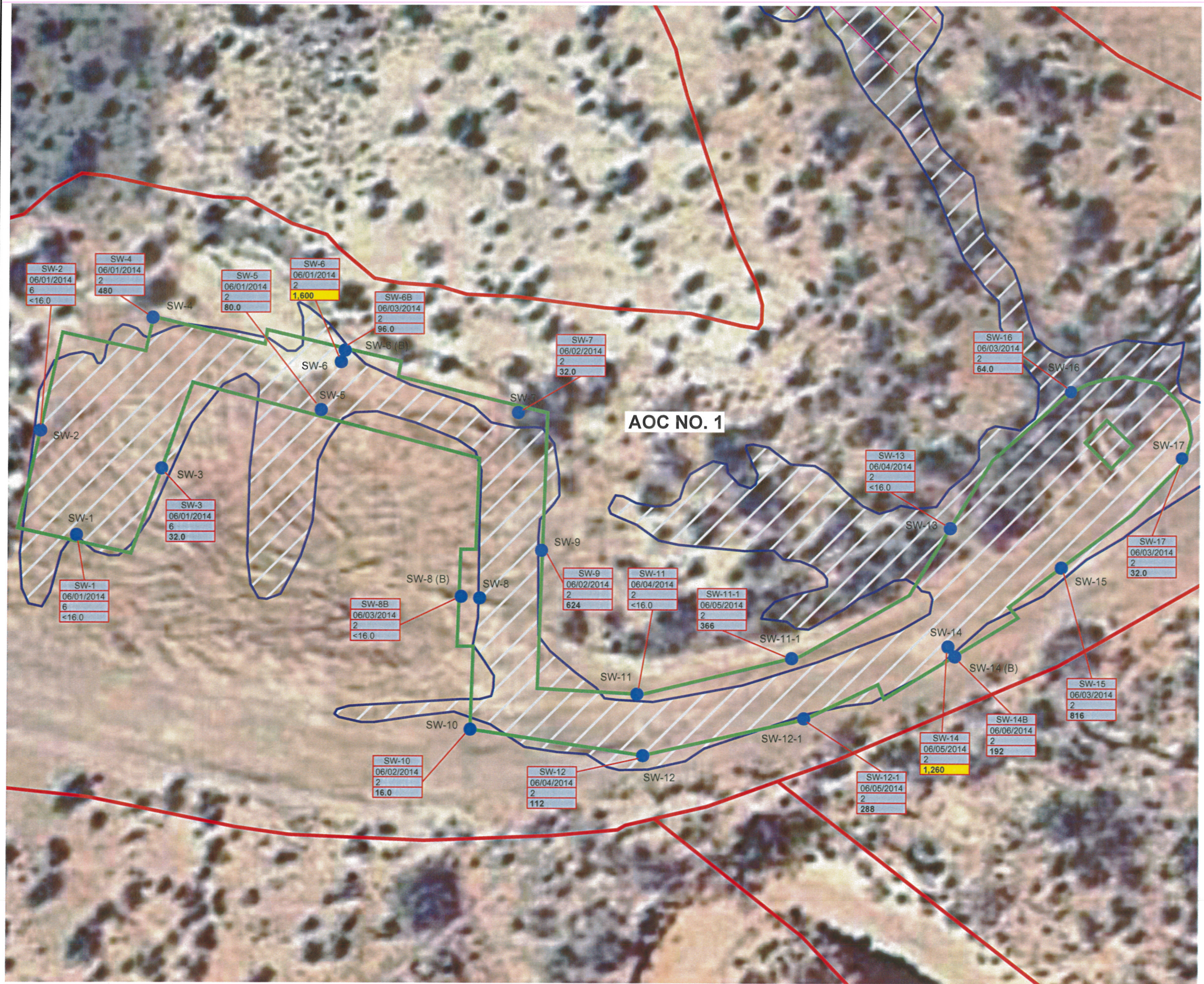
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FIGURE
6



FIGURE 7
AOC NO. 1 SOIL CONCENTRATION MAP



LEGEND

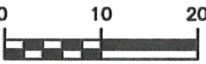
- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC AREA OF CONCERN
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (CHLORIDES)

SOIL CONCENTRATIONS (mg/kg)

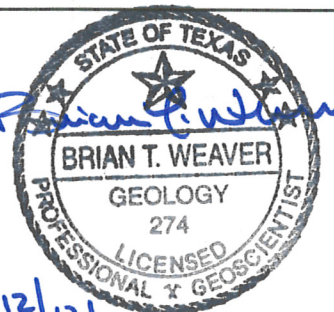
SAMPLE ID
DATE
DEPTH (ft-bgs)
CHLORIDE

NOTES:

- "mg/kg" REPRESENTS MILLIGRAM PER KILOGRAM.
- "ft-bgs" REPRESENTS FEET BELOW GROUND SURFACE.
- "<0.0010" INDICATES THE ANALYTE WAS NOT DETECTED BY THE LABORATORY AT OR ABOVE THE SPECIFIED LABORATORY DETECTION LIMIT.
- BOLDED CONCENTRATIONS EXCEED THE LABORATORY DETECTION LIMIT.
- CONCENTRATIONS HIGHLIGHTED YELLOW EXCEED ONE OR MORE SPECIFIED NEW MEXICO OIL CONSERVATION DIVISION DEFAULT REMEDIATION ACTION LEVEL.



APPROXIMATE SCALE: 1"=20'



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AOC NO. 1 COC CONCENTRATION MAP

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FIGURE 7



FIGURE 8
AOC NO. 2 SOIL CONCENTRATION MAP



LEGEND

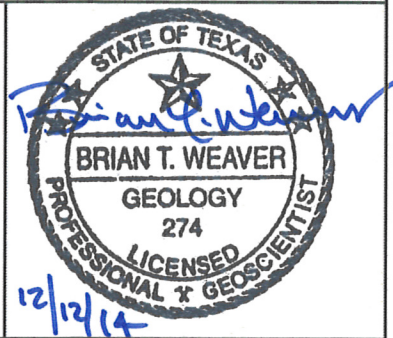
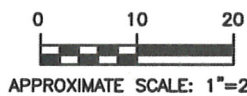
- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC AREA OF CONCERN
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (CHLORIDES)

SOIL CONCENTRATIONS (mg/kg)

SAMPLE ID
DATE
DEPTH (ft-bgs)
CHLORIDE

NOTES:

- "mg/kg" REPRESENTS MILLIGRAM PER KILOGRAM.
- "ft-bgs" REPRESENTS FEET BELOW GROUND SURFACE.
- "<0.0010" INDICATES THE ANALYTE WAS NOT DETECTED BY THE LABORATORY AT OR ABOVE THE SPECIFIED LABORATORY DETECTION LIMIT.
- BOLDED CONCENTRATIONS EXCEED THE LABORATORY DETECTION LIMIT.
- CONCENTRATIONS HIGHLIGHTED YELLOW EXCEED ONE OR MORE SPECIFIED NEW MEXICO OIL CONSERVATION DIVISION DEFAULT REMEDIATION ACTION LEVEL.



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AOC NO. 2 COC CONCENTRATION MAP

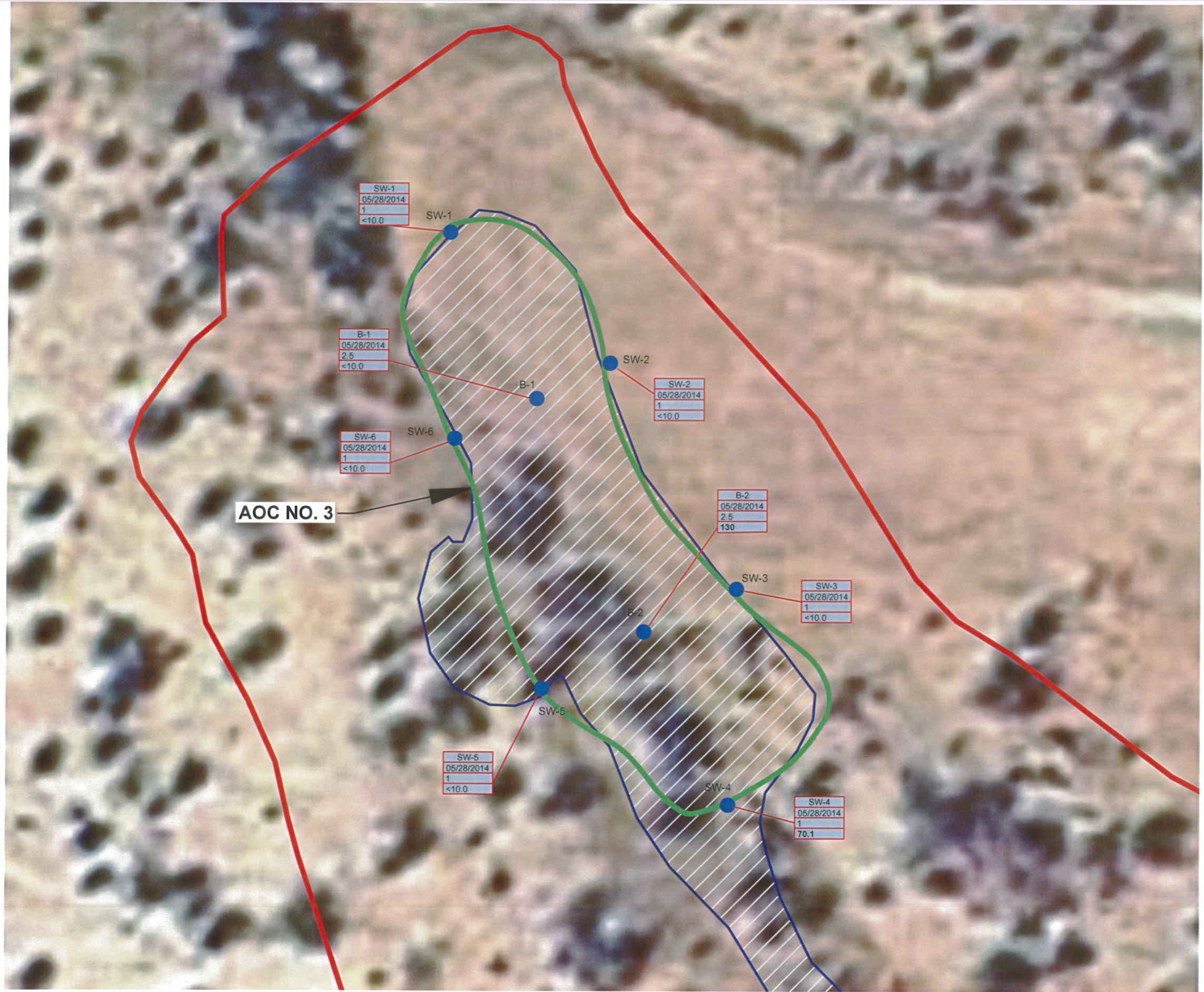
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FIGURE 8



FIGURE 9
AOC NO. 3 SOIL CONCENTRATION MAP



LEGEND

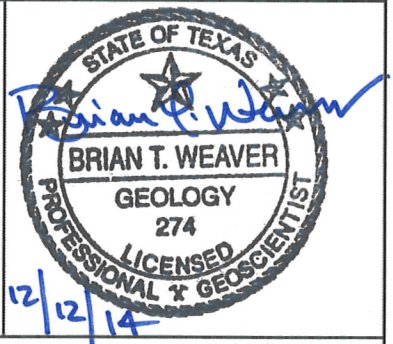
- LIMITS OF ARCHEOLOGICAL TREATMENT PLAN
- SPILL AREA (OCTOBER 2012)
- AOC AREA OF CONCERN
- SOIL SAMPLE LOCATIONS
- EXCAVATION LIMITS (TPH)

SOIL CONCENTRATIONS (mg/kg)

SAMPLE ID
DATE
DEPTH (ft-bgs)
TOTAL TPH

NOTES:

- "mg/kg" REPRESENTS MILLIGRAM PER KILOGRAM.
- "ft-bgs" REPRESENTS FEET BELOW GROUND SURFACE.
- "<0.0010" INDICATES THE ANALYTE WAS NOT DETECTED BY THE LABORATORY AT OR ABOVE THE SPECIFIED LABORATORY DETECTION LIMIT.
- BOLDED CONCENTRATIONS EXCEED THE LABORATORY DETECTION LIMIT.
- CONCENTRATIONS HIGHLIGHTED YELLOW EXCEED ONE OR MORE SPECIFIED NEW MEXICO OIL CONSERVATION DIVISION DEFAULT REMEDIATION ACTION LEVEL.



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AOC NO. 3 COC CONCENTRATION MAP

SOIL ABATEMENT COMPLETION REPORT
TURNER B SOUTH TANK BATTERY
LOCO HILLS, EDDY COUNTY, NEW MEXICO

DATE: DECEMBER 2014	JOB NO: 12009-0005	SCALE: AS SHOWN
1 FIRST REVISION	-	DRAWN BY: WPS
2 SECOND REVISION	-	CHECKED BY: SMD
3 THIRD REVISION	-	APPROVED BY: BTW

FIGURE
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