# 1R-2391

## Legacy Reserves
## Chamberlain TB

# Investigation & Remediation Report
# 7/25/13

# INVESTIGATION
# AND REMEDIATION REPORT
## Chamberlain Flow Line Leak
## and Historic Contamination
## #1RP-2391

Lea County, New Mexico

LAI Project No. 12-0126-01

July 25, 2013

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# 1.0 EXECUTIVE SUMMARY

This report has been prepared on behalf of Legacy Reserves, L.P. (Legacy) for submittal to the New Mexico Oil Conservation Division (OCD) to present the investigation and proposed remediation for an area of historic contamination located south of the Chamberlain Tank Battery (Site). In early 2009, while remediating a non-reportable flow line leak, a Legacy contractor exposed the historic contamination, which appears to be a former pit. Legacy notified the OCD District 1 office, in Hobbs, New Mexico, and submitted an initial C-141 on January 1, 2010. The Site is located in Unit C (NE 1/4, NW 1/4), Section 14, Township 15 South, Range 37 East, in Lea County, New Mexico. The geodetic position is north 33° 01' 16.7" and west 103° 10' 13.6." The surface owner is Angell Ranch Co., LLC.

In May 2009, Legacy retained Basin Environmental Consulting, LLC (Basin), located in Lovington, New Mexico, to investigate the historic contamination. Basin installed a temporary monitoring well near the east side of the historic contamination area, among other things. A groundwater sample from the temporary well was analyzed and reported ethylbenzene and xylenes at 0.0021 milligrams per liter (mg/L) and 0.0058 mg/L, respectively. The ethylbenzene and xylenes were below the New Mexico Water Quality Control Commission (WQCC) human health standards of 0.75 and 0.62 mg/L, respectively.

In April 2012, Legacy retained Larson & Associates, Inc (LAI) to investigate the historic contamination and prepare a remediation plan. Historic aerial photographs were reviewed to determine that the historic contamination was likely from a pit that had been covered. LAI personnel supervised excavation of approximately 4,220 cubic yards of soil that was disposed along with soil excavated by the previous contactors at the Jay Dan, LLC Landfarm located west of Lovington, New Mexico.

Remediation action levels were calculated for benzene, BTEX and TPH using criteria established by the OCD (Guidelines for Remediation of Leaks, Spills and Releases, August 13, 1993):

| Ranking Criteria | Result | Ranking Score |
|---|---|---|
| Depth-to-Groundwater | <50 feet | 20 |
| Wellhead Protection Area | No | 0 |
| Distance to Surface Water Body | >1000 Horizontal Feet | 0 |
| | **Total Score:** | **20** |

Based on the total ranking score, the remediation action levels are:

| | |
|---|---|
| **Benzene:** | **10 mg/kg** |
| **BTEX:** | **50 mg/kg** |
| **TPH:** | **100 mg/kg** |

During May, October and November 2012, LAI personnel collected soil samples from the bottom and sides of the excavation. The samples were analyzed by laboratory methods for benzene, toluene, ethylbenzene, xylenes (BTEX) by method SW-846-8021B, total petroleum hydrocarbons (TPH) including diesel (DRO) and gasoline (GRO) range organics by method SW0846-8015, and chloride by method E300. TPH exceeded the OCD cleanup level in most of the soil samples and failed to determine the vertical and horizontal extent of contamination.

During April, March and June 2013 LAI personnel supervised drilling and collecting soil samples from 9 borings (BH-1 through BH-9) that were drilled in the bottom (BH-1, BH-2 and BH-4) and around the perimeter of the excavation. The borings were drilled using hollowstem augers and air rotary methods

by Precision Sampling, Inc. (Precision) located in Albuquerque, New Mexico and Scarborough Drilling, Inc. (SDI) located in Lamesa, Texas. Soil samples were collected and analyzed to delineate the vertical and horizontal extent of the historic contamination. Borings BH-1, BH-2 and BH-3 were drilled between approximately 43 (BH-1) and 55 (BH-3) feet below ground surface (bgs) and soil samples were collected using a continuous sampler. Discrete samples were collected from the remaining borings using a jam tube sampler every five (5, 10, 15, 20 and 25) and ten (30, 40 and 50) feet. Headspace samples were collected and analyzed with a Thermal Model 580 photoionization detector (PID). Samples exhibiting readings above 100 parts per million (ppm) were analyzed for BTEX in addition to TPH (SW-846-8015) and chloride (E300). The results of the investigation determined the extent of contamination.

Benzene and BTEX were below the OCD cleanup levels of 10 mg/Kg and 50 mg/Kg, respectively. The TPH is limited to the area of the current excavation and extends vertically to a depth of approximately 47 feet bgs near the center of the excavation. Chloride was reported to be 567 mg/Kg at approximately 55 feet bgs near the center of the excavation at boring BH-3.

On June 10, 2013, a temporary monitoring well (TMW-1) was installed about 100 feet southeast (down gradient) of the excavation. The boring was drilled to about 75 feet bgs using an air rotary rig. The well was constructed with 2 inch threaded schedule 40 PVC casing and about 20 feet of 0.010 inch factory slotted screen. The well screen was positioned across the groundwater surface observed during drilling between approximately 54.77 and 74.72 feet bgs. Groundwater stabilized in TMW-1 at 65.85 feet below top of casing or about 63.07 feet bgs.

On June 11, 2013, after developing the well by pumping with an electric submersible pump, LAI personnel collected groundwater samples using a dedicated disposable polyethylene bailer. The groundwater samples were analyzed by laboratory methods. BTEX was not reported in the samples above the method detection limits (MDL). Chloride and TDS were reported at 263 milligrams per liter (mg/L) and 1,180 mg/L, respectively, and do not suggest that a groundwater impact has occurred.

Legacy proposes to install an engineered cap by placing a geosynthetic liner of at least 20 mills thick at a depth of 4 feet bgs over the area of historic contamination and portion of the non-reportable leak. The geosynthetic liner will encompass an area measuring approximately 37,934 square feet or about .872 acres. The area for the proposed liner, including the current excavation, will be excavated and filled to a depth of about 4 feet bgs. The liner will be installed at a depth of about 4 feet bgs and the remainder of the excavation above the liner will be filled with clean soil to the surrounding topography. The center of the lined area will be crowned slightly for drainage. The surface will be seeded to the landowner's specification. Residual contaminated soil, if any, will be disposed at an OCD approved facility. The monitoring well will be plugged according to the New Mexico State Engineer rules. A final report and C-141 will be submitted to the OCD upon completion of the remediation.

# 2.0 INTRODUCTION

Legacy Reserves, L.P. (Legacy) submits this document to the New Mexico Oil Conservation Division (OCD) to report the investigation and propose a final remediation plan for a non-reportable spill and historical release south of the Chamberlain Tank Battery (Site) located in Lea County, New Mexico. The report was prepared by Larson & Associates, Inc. (LAI) as consultant to Legacy. The Site is located in Unit C (NE 1/4, NW 1/4), Section 14, Township 15 South, and Range 37 East about 20 miles northeast of Lovington, New Mexico. The surface is owned by Angell Ranch Co., LLC. The geodetic position is north

33° 01’ 16.7” and west 103° 10’ 13.6”. Figure 1 presents a location and topographic map. Figure 2 presents an aerial photograph. Figure 3 presents a Site drawing.

## *2.1 Initial Response and Notification*

In 2009, while remediating a non-reportable spill from a flow line south of the Site, a Legacy contractor encountered contamination from a historic release. The contractor excavated soil from the non-reportable spill to a depth of approximately 5 feet below ground surface (bgs) and between about 3 and 10 feet over an area measuring approximately 100 X 135 feet or 15,867 square feet (0.36 acres) in the historic area. About 200 cubic yards of soil was excavated from the non-reportable spill and retained on Site near the east side of the excavation (SP-3). The area of historic contamination is located north of the non-reportable spill area. It was estimated that approximately 1,100 cubic yards of soil was excavated from the historic contamination area. Soil excavated from the historic area was piled along the north side of the excavation.

In May 2010, Legacy retained Basin Environmental Consulting, LLC (Basin) to perform assessment activities that included, among other things, collecting soil samples for laboratory testing from five (5) exploratory trenches (main, east, west, north and south) and six (6) soil borings (SB-1 through SB-6). Boring SB-1 was drilled to approximately 65 feet bgs near the east side of the historic contamination area and encountered groundwater at approximately 61 feet bgs. A temporary monitoring well (TMW-1) was installed in boring SB-1 for collecting groundwater samples. An analysis of the groundwater reported benzene and toluene below the method detection limit (MDL) of 0.001 milligrams per liter (mg/L) and 0.002 mg/L, respectively. Ethylbenzene (0.0021 mg/L) and xylenes (0.0058 mg/L) were below the New Mexico Water Quality Control Commission (WQCC) human health standards for drinking water. Chloride was 286 mg/L and above the WQCC domestic water quality standard (250 mg/L). Total dissolved solids (TDS) was 960 mg/L and below the WQCC domestic water quality standard (1,000 mg/L). Table 1 presents a groundwater analytical data summary for the Basin groundwater sample.

On January 7, 2010, Legacy submitted the initial C-141 for the historic contamination to the OCD District 1 office located in Hobbs, New Mexico. The OCD assigned remediation project number 1RP-2391 to the historic release. Figure 3 presents the non-reportable and historic spill excavation areas.

## *2.2 Setting*

The surface elevation is approximately 3,791 feet above mean sea level (MSL) and slopes gently to the southeast. The soil is designated as “Kimbrough gravelly loam, 0 to 3 percent slopes (Kg)” which occurs on upland areas and is known locally as “scabland.” The soil has a surface layer approximately 6 inches thick of dark grayish brown gravelly loam which is underlain by indurated caliche. The unit is comprised of approximately 85% Kimbrough soil with the remainder being Lea, Sharvana, Stegall and Slaughter soils. The soil is too shallow for cropland therefore its main use is range and wildlife habitat.

According to the New Mexico Bureau of Geology and Mineral Resources, the site is located in the Southern High Plains physiographic province. The Site is underlain by a thin layer of silty clay (loam). The silty clay is underlain by a resilient layer of caliche or caprock. The caliche is a hard, erosion resistant, pedogenic calcrete that between approximately 25 and 30 feet thick. The caliche grades into the Pliocene to Miocene aged Ogallala formation which is comprised of fluvial sand, silt, clay and localized gravel, with indistinct to massive crossbeds. The Ogallala sand is generally fine- to medium-grained quartz sand. The Ogallala formation is underlain by the Triassic-age Chile formation of the

Dockum Group. Figures 4 and 5 present north (A) to south (A') and west (B) to east (B') geological cross sections, respectively. Figure 3 presents the site drawing and geological cross section locations.

LAI personnel supervised installing a temporary monitoring well (TMW-1) about 100 feet southeast of the Site where groundwater was encountered in the Ogallala formation at approximately 62 feet bgs. The Triassic-age Chinle formation is the lower confining unit for the Ogallala formation and occurs at a depth of approximately 120 feet bgs according to well records from the New Mexico Office of the State Engineer (OSE). A well used for livestock watering is located about 1,600 feet southeast of the Site. The regional groundwater flow direction is to the southeast (Nativ, 1988). The groundwater potentiometric surface is depicted on the north (A) to south (A') and west (B) to east (B') geological cross sections presented on Figure 4 and Figure 5, respectively.

## *2.3 Aerial Photographs*

Historical aerial photographs were ordered through GeoSearch located in Austin, Texas. A review of the photographs is presented below in chronological order from most recent to oldest. Appendix A presents the historical aerial photographs.

### 2.3.1 2011 US Geological Survey Color Photograph

This 2011 color photograph has a scale of 1" to 700'. The photograph depicts the Site condition following the initial excavations in 2009. The photograph shows evidence of surface scarring from prior operations or releases at the Site. The surrounding area is similar to what was observed during the current investigation and remediation.

### 2.3.2 1996 US Geological Survey Black and White Photograph

This black and white photograph was taken in 1996, and has a scale of 1" to 700'. This photograph shows evidence of scarring from previous operations or releases at the Site. Adjoining properties to the north, south, east, and west are in similar configuration observed during the current investigations and remediation.

### 2.3.3 1983 US Geological Survey Color Photograph

This color photograph was taken on June 3, 1983, and has a scale of 1" to 700'. The photograph shows evidence of scarring from previous operations or releases at the Site. The square shape of the scarring suggests that release was from a pit. The adjoining properties to the north, south, east, and west are in similar configuration observed during the current investigations and remediation.

### 2.3.4 1978 USGS Black and White Photograph

This black and white photograph was taken on November 17, 1978, and has a scale of 1" to 700'. The photograph shows the Site in similar condition observed in the earlier photograph (June 3, 1983) with the square shape being more pronounced. The square shape of the area suggests that the Site was the location of a pit.

### 2.3.5 1968 USGS Black and White Photograph

This black and white photograph was taken on February 8, 1968, and has a scale of 1" to 700'. This photograph depicts the Site in similar condition observed in the earlier photograph (November 17, 1968) with a square shape that suggests the release was a pit that was covered. This is further supported by the presence of corner post which suggests the area was fenced.

# 3.0 INVESTIGATIONS AND REMEDIATION

The Site was ranked according to OCD criteria published in the document, *"Guidelines for Remediation of Leak, Spill and Releases, August 13, 1993"* to determine cleanup levels for benzene, BTEX (sum of benzene, toluene, ethylbenzene and xylenes) and total petroleum hydrocarbons (TPH). Depth to groundwater occurs at less than 50 feet below the lowest contaminants with a ranking score of 20. The nearest water well and surface water is located about 1,600 feet southeast of the Site with a ranking score of 0 therefore the total ranking score for the Site 20.

| Ranking Criteria | Result | Ranking Score |
|---|---|---|
| Depth-to-Groundwater | <50 feet | 20 |
| Wellhead Protection Area | No | 0 |
| Distance to Surface Water Body | >1000 Horizontal Feet | 0 |
| | **Total Score:** | **20** |

The following cleanup levels for benzene, BTEX and TPH as assigned to the Site based on the total ranking score (20):

| | |
|---|---|
| **Benzene:** | **10 mg/kg** |
| **BTEX:** | **50 mg/kg** |
| **TPH:** | **100 mg/kg** |

The OCD does not have a cleanup level for chloride but requires delineation to the equivalent of the WQCC domestic water quality limit (250 mg/Kg).

## *3.1 Non-Reportable (Flow Line) Leak Investigation*

On April 12, 2013, LAI personnel used a stainless steel hand auger to collect soil samples at 4 locations (HA-1 through HA-4) in the bottom of the flow line excavation south of the historic area. The samples were collected at approximately 5 feet bgs and were analyzed by Trace Analysis, (Trace) located in Midland, Texas, for TPH by method SW-846-8015, including diesel (DRO), gasoline (GRO) and oil (ORO) range organics, and chloride by method E300. Table 2 presents a summary of the laboratory analysis. Appendix B presents the laboratory reports.

Referring to Table 2, TPH was detected in samples HA-1 (144 mg/Kg) and HA-2 (95.5 mg/Kg). The TPH in sample HA-1 exceeds the OCD cleanup level of 100 ppm. Chloride ranges from 45.8 mg/Kg (HA-3) to 5,540 mg/Kg (HA-1). Figure 6 presents the sample locations and chloride concentrations.

## *3.2 Historic Contamination Area*

LAI personnel performed an initial evaluation of the historic area by removing loose soil and rock from the bottom and sides of the excavation and collecting soil samples for laboratory analysis. Approximately 2,320 cubic yards of soil, including soil excavated by the previous contractor, was disposed at the Jay Dan Landfarm, LLC (NM-01-0045) located west of Lovington, New Mexico.

On May 24, 2012, LAI personnel collected discrete soil samples from the sidewalls (SW-A through SW-G) and 5-part composite samples at 3 and 7 feet bgs from the bottom of the excavation. Trace analyzed the samples for BTEX by method SW-846-8021B, TPH, including DRO, GRO and ORO by method SW-846-

8015, and chloride by method E300. Table 3 presents the soil sample analytical data summary for May 24, 2012. Figure 7a presents the excavation and soil sample locations on May 24, 2013. Appendix B presents the laboratory reports.

Referring to Table 3, benzene and BTEX were below the MDL in all samples except sidewall sample SW-A, 2.5 feet which were below the OCD recommended cleanup levels of 10 and 50 milligrams per kilogram (mg/Kg), respectively. Samples SW-A, 2.5 feet and SW-E, 1 and 3.5 feet, exceeded the OCD recommended cleanup level for TPH (100 mg/Kg). The extent of chloride contamination was not determined.

During September and October 2012 LAI personnel supervised excavation of additional soil from the bottom and sides of the excavation. The excavation was deepened to approximately 15 feet bgs. October 4, 2012, LAI personnel collected 19 grab samples from the bottom (BS-1 through BS-19) and 12 grab samples from the sidewalls (SW-1 through SW-12) of the excavation at depths ranging from about 1 (SW-11) to 15 (SB-15) feet bgs (BS-15). In November 2012 soil was excavated to 16 (BS-1, BS-2, BS-3 and BS-4) and 20 (BS-15 and BS-17) feet bgs, respectively. The soil was stockpiled west of the excavation pending disposal. Xenco Laboratories, located in Odessa, Texas, analyzed the samples for BTEX (SW-846-8021B, TPH (SW-846-8015) and chloride (E300).

On November 12, 2012, LAI personnel collected samples from the bottom (BS-1, BS-2, BS-3 and BS-4, BS-15, BS-17) and sidewall (SW-5) and analyzed the samples using a Wilks TPH analyzer and equivalent method to 418.1. Table 4 presents the soil sample analytical data summary for October 4, 2012 and November 12, 2012. Figure 7b presents the excavation and sample locations on October 4 and November 12, 2012. Figure 8a presents TPH concentrations in excavation soil samples on October 4 and November 12, 2012s. Figure 8b presents chloride concentrations in excavation soil samples on October 4 and November 12, 2012. Appendix B presents the laboratory reports.

Referring to Figure 8a, TPH was above the OCD recommended cleanup level in the bottom samples except BS-19 (23.8 mg/Kg). Chloride in the bottom samples ranged from 59 mg/Kg (BS-4) at approximately 10 feet bgs to 3,170 mg/Kg (BS-2) at approximately 8 feet bgs (Figure 8b). The extent of TPH and chloride were not delineated. Benzene was below the MDL and BTEX was below the OCD recommended cleanup level. Approximately 1,900 cubic yards of soil was hauled to the Jay Dan Landfarm, LLC. Appendix C presents photographs.

## *3.3 Soil Borings*

During March, April and June 2013, LAI personnel collected soil samples from nine (9) borings (BH-1 through BH-9) which were drilled to delineate the vertical and horizontal extent of benzene, BTEX, TPH and chloride from the historic release. Precision Sampling, Inc., located in Albuquerque, New Mexico, drilled BH-1, BH-2 and BH-3 in the bottom of the excavation with a CME Model 750 all-terrain hollowstem auger rig and 5-foot long continuous sampler. The continuous sampler collected a 5-foot long soil core from which discrete samples were collected in 1 and 2 foot increments depending on sample recovery. The borings were drilled to approximately 45 (BH-1), 43 (BH-2) and 55 (BH-3) feet bgs. Scarborough Drilling, Inc., located in Lamesa, Texas, used a truck-mounted air rotary rig to drill borings BH-4 through BH-9 around the perimeter of the excavation. Discrete samples were collected at 5 (0, 5, 10, 15, 20 and 25) and 10 (30, 40 and 50 feet) foot intervals using a jam tube sampler. The samples were collected in 4-ounce glass jars and submitted under preservation and chain of custody to Trace. Figure 3 presents the site drawing and soil boring locations. Appendix D presents the boring logs.

Duplicate samples were collected for field headspace analysis. The headspace jars were filled approximately 1/3 full and the opening was sealed with a layer of aluminum foil. The samples were tested by inserting the probe of a calibrated Thermal Model 580 photoionization detector (PID) through the aluminum foil after the samples equilibrated near the ambient temperature. Laboratory samples with field headspace readings above 100 parts per million (ppm) were analyzed for BTEX by method SW-846-8021B. Trace analyzed the samples for TPH, including DRO and GRO, by method SW-846-8015 and chloride by method E300. Table 5 presents the soil boring sample analytical data summary. Appendix B presents the laboratory reports.

Referring to Table 5, none of the samples exceeded the remediation action level for benzene (10 mg/kg) or BTEX (50 mg/kg).TPH in the subsurface is shaped like a T, with the highest levels extending out from BH-3 (2186 mg/Kg) at about 20 feet bgs in a northwest to southeast trend. The area of elevated TPH extends northwest of BH-5 (281.44) and southeast of BH-2 (872 mg/Kg). The TPH plume has a cone-like shape near the center of the area at a depth of 30 feet bgs and becomes concentrated in the vicinity of BH-3 (724 mg/Kg) and BH-1 (163 mg/Kg) where TPH exceeds the OCD cleanup level (100 mg/Kg) to a depth of approximately 50 feet bgs. Figures 9a, 9b and 9c present the TPH concentrations in the soil samples at 20, 30 and 50 feet bgs, respectively.

Chloride was above 250 mg/Kg in the samples collected at approximately 50 feet bgs from BH-3 (455 mg/Kg), BH-5 (1,530 mg/Kg), BH-6 (848 mg/Kg) and BH-7 (582 mg/Kg). Figures 10a, 10b, 10c, and 10d present the chloride concentrations in the soil at 20, 30, 40 and 50 feet bgs.

On April 12 and June 11, 2013, LAI personnel collected 5-part composite samples from three (3) soil piles (SP-1, SP-2 and SP-3). The soil was from excavations performed during May 2009 (SP-3) and October and November 2012 (SP-1 and SP-2). The samples were analyzed for TPH and chloride. TPH ranged from less than the MDL (SP-1) to 2,340 mg/Kg (SP-3). Chloride ranged from 205 mg/Kg (SP-1) to 5,480 mg/Kg (SP-3). Table 5 presents the soil pile analytical data summary. Appendix B presents the laboratory reports.

## *3.4 Monitoring Well*

On June 10, 2013, LAI personnel supervised installing a temporary monitoring well (TMW-1) about 100 feet southeast (down gradient) of the historic area excavation. Scarborough Drilling, Inc., used an air rotary rig to advance the boring to approximately 75 feet bgs. The temporary well was constructed with 2-inch threaded schedule 40 PVC casing and approximately 20 feet of 0.010-inch factory-slotted screen. The screen was installed across the groundwater surface observed during drilling between approximately 54.77 and 74.72 feet bgs. The screen was surrounded with graded silica sand to approximately 2 feet above the screen. A layer of bentonite chips approximately 2 feet thick was placed above the sand and hydrated with potable water. Figure 3 presents the site drawing and well location. Table 6 presents the well drilling and completion summary. Appendix D presents the well completion diagram.

On June 11, 2013, LAI personnel measured the static groundwater in TMW-1 at 65.85 feet below top of casing or approximately 63.07 feet bgs. The well developed by pumping with an electric submersible pump until the water was visibly free of suspended sediment. The purged water was disposed at the Chamberlin Tank Battery. Groundwater samples were collected using a dedicated polyethylene bailer following development. Permian Basin Environmental Lab, located in Midland, Texas, analyzed the

samples for BTEX, anions, cations and total dissolved solids (TDS). Table 7 presents the BTEX analytical data summary. Table 8 presents the anion, cation and TDS analytical data summary. Appendix B presents the laboratory report.

BTEX was below the MDL and WQCC human health standards. Nitrate and sulfate were 8.53 milligrams per liter (mg/L) and 206 mg/L, respectively, and were below the WQCC domestic water quality standards of 10 and 600 mg/L, respectively. Chloride (263 mg/L) and TDS (1,180 mg/L) exceeded the WQCC domestic water quality standards of 250 mg/L and 1,000 mg/L, respectively. Calcium, magnesium, potassium and sodium had values of 94 mg/L, 230 mg/L, 7.20 mg/L and 51 mg/L, respectively.

# 4.0 CONCLUSIONS

- Benzene and BTEX in soil are below the OCD clean-up levels of 10 mg/Kg and 50 mg/Kg, respectively;
- TPH exceeds the OCD cleanup standard of 100 mg/Kg and is concentrated around boring BH-3 between about 20 and 40 feet bgs and extends laterally to the northwest near BH-5 (281.44) to southeast of BH-2 (872 mg/Kg) ;
- Chloride exceeds 250 mg/Kg in samples from 50 feet at locations BH-3 (455 mg/Kg), BH-5 (1,530 mg/Kg), BH-6 (848 mg/Kg) and BH-7 (582 mg/Kg);
- BTEX was below the MDL and WQCC human health standards in groundwater from temporatry monitoring well TMW-1 installed about 100 feet southeast of the historic contamination area;
- Chloride (263 mg/L) and TDS (1,180 mg/L) were slightly above the WQCC domestic water quality standards of 250 mg/L and 1,000 mg/, respectively, and do not suggest a groundwater impact.

# 5.0 RECOMMENDATIONS

Legacy proposes to install a geosynthetic liner (barrier) of at least 20 mills thick at a depth of about 4 feet bgs over the historic contamination area and a portion of the flow line leak as shown on Figure 11. The area proposed for geosynthetic lining equals approximately 37,934 square feet or approximately 0.87 acres. Soil will be excavated from the area outside the current excavation and used to fill the excavation to a depth of about 4 feet bgs. Additional soil may be required to fill the excavation before installing the liner and will be acquired from an area determined by the landowner, if necessary. The soil will be compacted as the excavation is filled to prevent settling. Once the liner is installed the remainder of the excavation will be filled with clean soil acquired from a location determined by the landowner. The excavation will be filled to the surrounding topography and crowned slightly near the center for drainage. The area will be seeded to the landowner's specifications. Residual contaminated soil, if any, will be disposed at an OCD approved facility.

The monitoring well will be plugged according to New Mexico State Engineer rules. A final remediation report including global positioning system (GPS) measurements of the liner and final C-141 will be submitted to the OCD District 1 office, located in Hobbs, New Mexico, following completion of remediation activities. Appendix E presents the initial C-141.

# 6.0 REFERENCES

Nativ, R. (1988). Hydrogeology and Hydrochemistry of the Ogallala Aquifer, Southern High Plains, Texas Panhandle and Eastern New Mexico. Bureau of Economic Geology (Report of Investigations No. 177).

**TABLES**

Table 1
Basin Environmental, LLC Groundwater Analytical Data Summary
Leagacy Reserves - Chamberlin Site
Lea County, New Mexico
1RP-2391

| Sample | Date | Benzene (mg/L) | Toluene (mg/L) | Ethylbenzene (mg/L) | Xylenes (mg/L) | Chloride (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|
| **NMWQCC Standard:** | | **0.01** | **0.75** | **0.75** | **0.62** | **250** | **1,000** |
| **SB-1** | 03/11/2010 | <0.0010 | <0.0020 | **0.0021** | **0.0058** | **286** | **960** |

Notes: Groundwater sample collected from temorary monitoring well (SB-1) by Basin Environmental Consulting, LLC, Lovington, New Mexico
All concentrations are in milligrams per liter (mg/Lg) equivalent to parts per million (ppm).
**Bold denotes analyte detected**

**Table 2**
**Flow Line Leak Soil Sample Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site (1RP-2391)**
**Lea County, New Mexico**

| Sample | Location | Date | Depth (Feet BGS) | Status | PID (ppm) | Benzene (mg/Kg) | BTEX (mg/Kg) | TPH (mg/Kg) | Chloride (mg/Kg |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Limit:** | | | | | | **10** | **50** | **100** | |
| **HA-1** | South Excavation | 04-12-2013 | 0.5 | In-situ | 0.0 | -- | -- | **144** | **5,540** |
| **HA-2** | South Excavation | 04-12-2013 | 0.5 | In-Situ | 0.0 | -- | -- | **95.5** | **306** |
| **HA-3** | South Excavation | 04-12-2013 | 0.5 | In-Situ | 0.0 | -- | -- | <54 | **45.8** |
| **HA-4** | South Excavation | 04-12-2013 | 0.5 | In-Situ | 0.0 | -- | -- | <54 | **47.5** |

Notes: Analysis performed by Trace Analysis, Midland and Lubbock, Texas
Depth is in feet below ground surface
mg/Kg denotes concentration in milligrams per kilogram equivalent to parts per million (ppm)
Exceeds OCD Recommended Remediation Action Level (RRAL)

**Table 3**
**Historic Contamination Area Soil Samples Analytical Summary**
**Legacy Reserves, L.P. Chamberlin Site**
**Lea County, New Mexico**

| sample | Date | Depth Feet BGS | Location | Status | Benzene (mg/Kg) | BTEX (mg/Kg) | DRO (mg/Kg) | GRO (mg/Kg) | ORO | TPH (mg/Kg) | Chloride (mg/Kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **OCD Recommended Cleanup Level:** | | | | | **10** | **50** | | | | **100** | |
| **SW-A** | 05-24-2012 | 2.5 | Sidewall | Excavated | **0.534** | **12.183** | **20,100** | **342** | **5,050** | **25,492** | **1,970** |
| | 05-24-2012 | 4 | Sidewall | Excavated | <0.02 | <0.08 | <50 | **<2.0** | <50 | <50 | **1,350** |
| **SW-B** | 05-24-2012 | 2 | Sidewall | Excavated | <0.02 | <0.08 | <250 | <2.0 | <85.5 | <250 | **4,310** |
| | 05-24-2012 | 4.5 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **664** |
| **SW-C** | 05-24-2012 | 1 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **7,690** |
| | 05-24-2012 | 3 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **783** |
| **SW-D** | 05-24-2012 | 1 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **784** |
| | 05-24-2012 | 3 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **582** |
| **SW-E** | 05-24-2012 | 1 | Sidewall | Excavated | <0.02 | <0.08 | **7,340** | **68.4** | **893** | **8,301.4** | **7,340** |
| | 05-24-2012 | 3.5 | Sidewall | Excavated | <0.02 | <0.08 | **3,280** | **55.7** | <17.1 | **3,335.7** | **1,640** |
| **SW-F** | 05-24-2012 | 1 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **207** |
| **SW-G** | 05-24-2012 | 1 | Sidewall | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **500** |
| **PB** | 05-24-2012 | 3 | Bottom | Excavated | <0.02 | <0.08 | <50 | **5.28** | <17.1 | **5.28** | **252** |
| | | 7 | Bottom | Excavated | <0.02 | <0.08 | <50 | <2.0 | <17.1 | <50 | **161** |
| **Soil Pile SP-E** | 05-24-2012 | -- | -- | Excavated | <0.02 | <0.08 | **1,110** | **4.36** | **315** | **1,429.36** | **929** |

***Notes:*** Samples were analyzed by Xenco Laboratories, Inc., Odessa, Texas and Trace Analysis, Inc., Midland, Texas
Samples analyzed via EPA method SW-8021B (BTEX), SW-8015M (TPH) and E-300 (chloride).
Depth measurements are in feet below ground surface (bgs).
All concentrations are in milligrams per kilogram (mg/Kg) equivalent to parts per million (ppm).

**Bold denotes analyte detected**
**Bold and highlighted denotes analyte detected above OCD recommended cleanup level**

**Table 4**
**Historic Contamination Area Soil Sample Analytical Summary**
**Legacy Reserves, L.P. Chamberlin Site, 1RP-2391**
**Lea County, New Mexico**

| sample | Date | Depth | Status | Benzene | BTEX | GRO (C6 - C10) | DRO (>C10 - C28) | TPH (C6 - C28) | Chloride |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Recommended Cleanup Level:** | | | | **10** | **50** | | | **100** | |
| **Bottom Samples** | | | | | | | | | |
| **BS-1** | 10-04-2012 | 8 | Excavated | <0.00109 | **0.0303** | **117** | **10800** | **11600** | **1480** |
| | 11-12-2012 | 16 | In-Situ | -- | **--** | **---** | **--** | ***2438** | **--** |
| **BS-2** | 10-04-2012 | 8 | Excavated | <0.00108 | **0.141** | <80.9 | **14200** | **14200** | **3170** |
| | 11-12-2012 | 16 | In-Situ | -- | -- | -- | -- | ***2,465** | **--** |
| **BS-3** | 10-04-2012 | 14 | Excavated | <0.217 | **16.4** | **525** | **4310** | **4990** | **1,510** |
| | 11-12-2012 | 16 | In-Situ | -- | -- | -- | -- | -- | -- |
| **BS-4** | 10-04-2012 | 10 | Excavated | <0.00113 | **0.0135** | **68.8** | **5730** | **6020** | **59** |
| | 11-12-2012 | 16 | In-Situ | -- | -- | -- | -- | ***2,483** | **--** |
| **BS-5** | 10-04-2012 | 8 | In-Situ | <0.00117 | <0.00117 | <17.7 | **109** | **109** | **152** |
| **BS-6** | 10-04-2012 | 6 | In-Situ | <0.00116 | <0.00116 | <17.4 | <17.4 | <17.4 | **178** |
| **BS-7** | 10-04-2012 | 4 | In-Situ | <0.00123 | <0.00123 | <18.4 | <18.4 | <18.4 | **18.2** |
| **BS-8** | 10-04-2012 | 6 | In-Situ | <0.00116 | <0.00116 | <17.5 | **1260** | **1260** | **131** |
| **BS-9** | 10-04-2012 | 8 | In-Situ | <0.00117 | **0.0115** | **28.3** | **3170** | **3400** | **664** |
| **BS-10** | 10-04-2012 | 8 | Excavated | <0.00113 | **0.0276** | **103** | **7700** | **8210** | **2420** |
| | 11-12-2012 | 10 | In-Situ | -- | -- | -- | -- | ***2,523** | **--** |
| **BS-11** | 10-04-2012 | 4 | In-Situ | <0.00117 | <0.00117 | <17.6 | **1430** | **1430** | **739** |
| **BS-12** | 10-04-2012 | 5 | In-Situ | <0.00116 | <0.0016 | <17.4 | **662** | **662** | **340** |
| **BS-13** | 10-04-2012 | 3 | In-Situ | <0.00116 | <0.00116 | <17.4 | **813** | **813** | **2190** |
| **BS-14** | 10-04-2012 | 9 | In-Situ | <0.00114 | <0.00114 | <17.1 | **1020** | **1020** | **260** |
| **BS-15** | 10-04-2012 | 15 | Excavated | <0.00111 | **0.00116** | **19.7** | **2690** | **2810** | **369** |
| | 11-12-2012 | 20 | In-Situ | -- | -- | -- | -- | ***2,237** | **--** |
| **BS-16** | 10-04-2012 | 6 | In-Situ | <0.00.119 | <0.00119 | <17.9 | <17.9 | <17.9 | **1900** |
| **BS-17** | 10-04-2012 | 10 | Excavated | <0.0243 | **20.7** | **1220** | **9510** | **11200** | **181** |
| | 11-12-2012 | 20 | In-Situ | -- | -- | -- | -- | ***2,177** | -- |
| **BS-18** | 10-04-2012 | 4 | In-Situ | <0.00111 | <0.00111 | <16.6 | **111** | **111** | **114** |

**Table 4**
**Historic Contamination Area Soil Sample Analytical Summary**
**Legacy Reserves, L.P. Chamberlin Site, 1RP-2391**
**Lea County, New Mexico**

| sample | Date | Depth | Status | Benzene | BTEX | GRO (C6 - C10) | DRO (>C10 - C28) | TPH (C6 - C28) | Chloride |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Recommended Cleanup Level:** | | | | **10** | **50** | | | **100** | |
| **BS-19** | 10-04-2012 | 4 | In-Situ | <0.00121 | <0.00121 | <18.1 | **23.8** | **23.8** | **247** |
| **Sidewall Samples** | | | | | | | | | |
| **SW-1** | 10-04-2012 | 4 | In-Situ | <0.00106 | <0.00106 | <16.0 | **115** | **115** | **540** |
| **SW-2** | 10-04-2012 | 4 | In-Situ | <0.00115 | <0.00115 | <17.4 | **72.3** | **72.3** | **1650** |
| **SW-3** | 10-04-2012 | 4 | In-Situ | <0.00111 | <0.00111 | <16.7 | **26.8** | **26.8** | **417** |
| **SW-4** | 10-04-2012 | 4 | In-Situ | <0.00110 | <0.00110 | <16.6 | **30.4** | **30.4** | **48.5** |
| **SW-5** | 10-04-2012 | 4 | Excavated | <0.00115 | <0.00115 | <17.2 | **94.9** | **94.9** | **369** |
| | 11-12-2012 | 5 | In-Situ | -- | -- | -- | -- | **109** | -- |
| **SW-6** | 10-04-2012 | 4 | In-Situ | <0.00121 | <0.00121 | <18.2 | **19.4** | <19.4 | **531** |
| **SW-7** | 10-04-2012 | 4 | In-Situ | <0.00108 | <0.00108 | **16.8** | **23.7** | **40.5** | **3680** |
| **SW-8** | 10-04-2012 | 4 | In-Situ | <0.00103 | <0.00103 | <15.5 | <15.5 | <15.5 | **22** |
| **SW-9** | 10-04-2012 | 4 | In-Situ | <0.00114 | <0.00114 | <17.2 | **39.8** | **39.8** | **2620** |
| **SW-10** | 10-04-2012 | 3 | In-Situ | <0.00100 | **0.0397** | **66.2** | **4270** | **4500** | **1780** |
| **SW-11** | 10-04-2012 | 1 | In-Situ | <0.00106 | <0.00106 | **22.5** | **1400** | **1530** | **859** |
| **SW-12** | 10-04-2012 | 4 | In-Situ | <0.00108 | <0.00108 | <16.2 | **1870** | **1870** | **3520** |

***Notes:*** Samples were analyzed by Xenco Laboratories, Inc., Odessa, Texas )
Samples analyzed via EPA method SW-8021B (BTEX), SW-8015M (TPH), 418.1 equivelent (TPH) on 11-12-2012 and E-300 (chloride).
* Denotes field analysis by method 418.1 (equivelent).
Depth measurements are in feet below ground surface (bgs).
All concentrations are in milligrams per kilogram (mg/Kg) equivalent to parts per million (ppm).
**Bold denotes analyte detected**
**Bold and highlighted denotes analyte detected above OCD recommended cleanup level**

**Table 5**
**Soil Boring Sample Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site (1RP-2391)**
**Lea County, New Mexico**

| Sample | Location | Date | Depth (Feet BGS) | Status | PID (ppm) | Benzene (mg/Kg) | BTEX (mg/Kg) | TPH (mg/Kg) | Chloride (mg/Kg |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Limit:** | | | | | | **10** | **50** | **100** | |
| BH-1 | Bottom West | 03-12-2013 | 15 - 16 | In-Situ | 54 | <0.01 | **2.945** | **264** | **7,220** |
| | Bottom West | 03-12-2013 | 20 - 22 | In-Situ | 373 | <0.1 | **22.69** | **505** | **856** |
| | Bottom West | 03-12-2013 | 22 - 23 | In-Situ | 164 | <0.2 | **17.136** | **629** | **2,590** |
| | Bottom West | 03-13-2013 | 25 - 26 | In-Situ | 20 | <0.04 | **0.495** | **66.1** | **561** |
| | Bottom West | 03-13-2013 | 30 - 32 | In-Situ | 280 | <0.2 | **2.751** | **163** | **2,550** |
| | Bottom West | 03-13-2013 | 32 - 34 | In-Situ | 167 | <0.02 | **0.1586** | **53.7** | **3,050** |
| | Bottom West | 03-13-2013 | 34 - 35 | In-Situ | 27 | <0.02 | **0.0255** | <54 | **2,550** |
| | Bottom West | 03-13-2013 | 35 - 37 | In-Situ | 108 | -- | -- | **123** | **2,060** |
| | Bottom West | 03-13-2013 | 37 - 38 | In-Situ | 193 | -- | -- | **453.8** | **2,270** |
| | Bottom West | 03-13-2013 | 40 - 42 | In-Situ | 53 | -- | -- | <54 | **2,360** |
| | Bottom West | 03-13-2013 | 42 - 43 | In-Situ | 0.1 | -- | -- | **42.8** | **2,380** |
| BH-2 | Bottom East | 03-13-2013 | 17 - 18 | In-Situ | 87 | <0.02 | **0.02** | **59.1** | **1,150** |
| | Bottom East | 03-13-2013 | 18 - 20 | In-Situ | 182 | <0.1 | **26.59** | **879** | **1,250** |
| | Bottom East | 03-13-2013 | 23 - 25 | In-Situ | 217 | <0.1 | **6.091** | **306** | **1,020** |
| | Bottom East | 03-13-2013 | 28 - 30 | In-Situ | 37.2 | <0.02 | **0.1065** | <54 | **778** |
| | Bottom East | 03-13-2013 | 30 - 31.5 | In-Situ | 2.8 | <0.02 | <0.02 | <54 | **576** |
| | Bottom East | 03-13-2013 | 33 - 35 | In-Situ | 5.7 | <0.02 | <0.02 | <54 | **920** |
| | Bottom East | 03-13-2013 | 35 - 37 | In-Situ | 57 | -- | -- | **62.1** | **1,310** |
| | Bottom East | 03-13-2013 | 38 - 40 | In-Situ | 1.4 | -- | -- | <54 | **1,240** |
| BH-3 | Bottom Center | 03-14-2013 | 5 - 7 | In-Situ | 163 | <0.1 | **0.745** | **2,404** | **1,270** |
| | Bottom Center | 03-14-2013 | 10 - 12 | In-Situ | 571 | <0.1 | **16.94** | **5,867** | **1,280** |
| | Bottom Center | 03-14-2013 | 20 - 21 | In-Situ | 650 | <0.1 | **15.529** | **2,186** | **1.58** |
| | Bottom Center | 03-14-2013 | 25 - 26 | In-Situ | 885 | <0.2 | **32.675** | **3,901** | **1,420** |
| | Bottom Center | 03-14-2013 | 30 - 32 | In-Situ | 929 | <0.1 | **10.606** | **724** | **758** |
| | Bottom Center | 03-14-2013 | 32 - 34 | In-Situ | 580 | <0.1 | **14.715** | **1,064** | **913** |
| | Bottom Center | 03-14-2013 | 35 - 37 | In-Situ | 1500 | <0.1 | **10.11** | **1,579** | **838** |
| | Bottom Center | 03-14-2013 | 40 - 42 | In-Situ | 1484 | <0.1 | **16.692** | **1,059** | **250** |
| | Bottom Center | 03-14-2013 | 45 - 47 | In-Situ | 965 | <0.2 | **8.357** | **1,286** | **1,300** |
| | Bottom Center | 03-14-2013 | 47 - 48 | In-Situ | 153 | <0.04 | <0.04 | **53** | **1,540** |
| | Bottom Center | 03-14-2013 | 50 - 52 | In-Situ | 20 | <0.02 | <0.02 | <54 | **455** |
| | Bottom Center | 03-14-2013 | 52 - 54 | In-Situ | 12.7 | <0.02 | <0.02 | <54 | **1,060** |
| | Bottom Center | 03-14-2013 | 54 - 55 | In-Situ | 8 | <0.02 | <0.02 | <54 | **567** |

**Table 5**
**Soil Boring Sample Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site (1RP-2391)**
**Lea County, New Mexico**

| Sample | Location | Date | Depth (Feet BGS) | Status | PID (ppm) | Benzene (mg/Kg) | BTEX (mg/Kg) | TPH (mg/Kg) | Chloride (mg/Kg |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Limit:** | | | | | | **10** | **50** | **100** | |
| **BH-4** | South | 04-11-2013 | 0 | In-Situ | 0.0 | -- | -- | **307** | <25 |
| | South | 04-11-2013 | 5 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 10 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 15 | In-Situ | | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 20 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 25 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 30 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 40 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| | South | 04-11-2013 | 50 | In-Situ | 0.0 | -- | -- | <54 | <25 |
| **BH-5** | West | 04-11-2013 | 0 | In-Situ | 0.0 | -- | -- | <58 | **37.2** |
| | West | 04-11-2013 | 5 | In-Situ | 0.0 | -- | -- | <54 | **1,990** |
| | West | 04-11-2013 | 10 | In-Situ | 0.0 | -- | -- | **255** | **2,670** |
| | West | 04-11-2013 | 15 | In-Situ | 14.3 | -- | -- | **479** | **2,210** |
| | West | 04-11-2013 | 20 | In-Situ | 67.2 | <0.100 | <0.400 | **281.44** | **1,610** |
| | West | 04-11-2013 | 25 | In-Situ | 140.5 | <0.04 | **0.69** | **857.7** | **884** |
| | West | 04-11-2013 | 30 | In-Situ | 1.4 | -- | -- | <54 | **1,140** |
| | West | 04-11-2013 | 40 | In-Situ | 0.0 | -- | -- | <54 | **1,430** |
| | West | 04-11-2013 | 50 | In-Situ | 0.0 | -- | -- | <54 | **1,530** |
| **BH-6** | North | 04-11-2013 | 0 | In-Situ | 0.0 | -- | -- | **140** | **1,900** |
| | North | 04-11-2013 | 5 | In-Situ | 0.0 | -- | -- | <54 | **1,200** |
| | North | 04-11-2013 | 10 | In-Situ | 0.0 | -- | -- | <54 | **3,870** |
| | North | 04-11-2013 | 15 | In-Situ | 0.0 | -- | -- | <54 | **4,570** |
| | North | 04-11-2013 | 20 | In-Situ | 0.0 | -- | -- | <54 | **2,310** |
| | North | 04-11-2013 | 25 | In-Situ | 0.0 | -- | -- | <54 | **2,010** |
| | North | 04-11-2013 | 30 | In-Situ | 0.0 | -- | -- | <54 | **2,310** |
| | North | 04-11-2013 | 40 | In-Situ | 0.0 | -- | -- | <54 | **1,810** |
| | North | 04-11-2013 | 50 | In-Situ | 0.0 | -- | -- | <54 | **848** |
| **BH-7** | East | 04-11-2013 | 0 | In-Situ | 0.0 | -- | -- | <58 | **126** |
| | East | 04-11-2013 | 5 | In-Situ | 0.0 | -- | -- | <54 | **42.5** |
| | East | 04-11-2013 | 10 | In-Situ | 0.0 | -- | -- | <54 | **315** |
| | East | 04-11-2013 | 15 | In-Situ | 0.0 | -- | -- | <54 | **115** |

**Table 5**
**Soil Boring Sample Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site (1RP-2391)**
**Lea County, New Mexico**

| Sample | Location | Date | Depth (Feet BGS) | Status | PID (ppm) | Benzene (mg/Kg) | BTEX (mg/Kg) | TPH (mg/Kg) | Chloride (mg/Kg |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Limit:** | | | | | | **10** | **50** | **100** | |
| | East | 04-11-2013 | 20 | In-Situ | 0.0 | -- | -- | <54 | **627** |
| | East | 04-11-2013 | 25 | In-Situ | 0.0 | -- | -- | <54 | **850** |
| | East | 04-11-2013 | 30 | In-Situ | 0.0 | -- | -- | <54 | **536** |
| | East | 04-11-2013 | 40 | In-Situ | 0.0 | -- | -- | <54 | **523** |
| | East | 04-11-2013 | 50 | In-Situ | 0.0 | -- | -- | <54 | **582** |
| **BH-8** | West of BH-5 | 04-12-2013 | 0 | In-Situ | 0.0 | -- | -- | <54 | **30.1** |
| | | 04-12-2013 | 5 | In-Situ | 0.0 | -- | -- | <54 | **65.7** |
| | | 04-12-2013 | 10 | In-Situ | 0.0 | -- | -- | <54 | **1,150** |
| | | 04-12-2013 | 15 | In-Situ | 0.0 | -- | -- | <54 | **2,370** |
| | | 04-12-2013 | 20 | In-Situ | 0.0 | -- | -- | <54 | **935** |
| | | 04-12-2013 | 25 | In-Situ | 0.0 | -- | -- | <54 | **853** |
| | | 04-12-2013 | 30 | In-Situ | 0.0 | -- | -- | <54 | **1,650** |
| | | 04-12-2013 | 40 | In-Situ | 0.0 | -- | -- | <54 | **945** |
| | | 04-12-2013 | 50 | In-Situ | 0.0 | -- | -- | <54 | **118** |
| **BH-9** | West of BH-8 | 6/11/2013 | 0 | In-Situ | 1.4 | -- | -- | -- | <25.0 |
| | | 6/11/2013 | 5 | In-Situ | 0.0 | -- | -- | -- | **418** |
| | | 6/11/2013 | 10 | In-Situ | 0.0 | -- | -- | -- | **1,460** |
| | | 6/11/2013 | 15 | In-Situ | 0.0 | -- | -- | -- | 156 |
| | | 6/11/2013 | 20 | In-Situ | 0.0 | -- | -- | -- | 187 |
| | | 6/11/2013 | 25 | In-Situ | 0.0 | -- | -- | -- | 80.8 |
| | | 6/11/2013 | 30 | In-Situ | 0.0 | -- | -- | -- | 51.8 |
| | | 6/11/2013 | 40 | In-Situ | 0.0 | -- | -- | -- | 32.8 |
| | | 6/11/2013 | 50 | In-Situ | 0.0 | -- | -- | -- | <25.0 |
| **TMW-1** | Southeast | 6/10/2013 | 0 | In-Situ | 1.0 | -- | -- | -- | 83.7 |
| | Southeast | 6/10/2013 | 5 | In-Situ | 1.0 | -- | -- | -- | 38.2 |
| | Southeast | 6/10/2013 | 10 | In-Situ | 0.0 | -- | -- | -- | 189 |
| | Southeast | 6/10/2013 | 15 | In-Situ | 0.0 | -- | -- | -- | <25.0 |
| | Southeast | 6/10/2013 | 20 | In-Situ | 0.0 | -- | -- | -- | <25.0 |
| | Southeast | 6/10/2013 | 25 | In-Situ | 0.0 | -- | -- | -- | **309** |
| | Southeast | 6/10/2013 | 30 | In-Situ | 0.0 | -- | -- | -- | <25.0 |
| | Southeast | 6/10/2013 | 40 | In-Situ | 0.0 | -- | -- | -- | <25.0 |

**Table 5**
**Soil Boring Sample Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site (1RP-2391)**

| Sample | Location | Date | Depth (Feet BGS) | Status | PID (ppm) | Benzene (mg/Kg) | BTEX (mg/Kg) | TPH (mg/Kg) | Chloride (mg/Kg |
|---|---|---|---|---|---|---|---|---|---|
| **OCD Limit:** | | | | | | **10** | **50** | **100** | |
| | Southeast | 6/10/2013 | 50 | In-Situ | 0.0 | -- | -- | -- | <25.0 |
| **Soil Pile** | | | | | | -- | -- | | |
| **SP-1** | South | 04-12-2013 | -- | Excavated | 0.0 | -- | -- | <54 | **205** |
| **SP-2** | North | 04-12-2013 | -- | Excavated | 0.0 | -- | -- | **85.2** | **1,440** |
| **SP-3** | Southeast | 6/11/2013 | -- | Excavated | -- | -- | -- | **2340** | **5,480** |

Notes: Analysis performed by Trace Analysis, Midland and Lubbock, Texas
Depth is in feet below ground surface
mg/Kg denotes concentration in milligrams per kilogram equivalent to parts per million (ppm)
Exceeds OCD Recommended Remediation Action Level (RRAL)

**Table 6**
**Monitoring Well Drilling and Completion Summary**
**Legacy Reserves, L.P., Chamberlin Site , 1RP-2391**
**Lea County, New Mexico**

| Well Information | | | | | | | | | Groundwater Data | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | Date Drilled | Drilled Depth (feet bgs) | Well Depth (feet TOC) | Well Diameter (inches) | Surface Elevation | Screen Interval (feet bgs) | Casing Stickup (feet) | TOC Elevation | Date Gauged | Depth to Water (TOC) | Groundwater Elevation |
| TMW-1 | 6/10/2013 | 75.42 | 78.40 | 2 | -- | 54.77 - 74.72 | 2.78 | -- | 06/10/2013<br>06/11/2013 | 65.82<br>65.85 | --<br>-- |

Notes: Monitoring well drilled using air rotary rig by Scarborough Drilling, Inc., Lamesa, Texas and constructed with 2-inch threaded schedule 40 PVC casing and screen
All values are in feet, unless otherwise noted.
bgs - below ground surface
TOC - top of casing

**Table 7**
**Groundwater Organic Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site, 1RP-2391**
**Lea County, New Mexico**

| Sample ID | Date | Benzene | Toluene | Ethylbenzene | Xylene |
|---|---|---|---|---|---|
| **WQCC Limit:** | | **0.01** | **0.75** | **0.75** | **0.62** |
| TMW-1 | 06/11/2013 | <0.001 | <0.001 | <0.001 | <0.003 |

***Notes:*** Analysis performed by Permian Basin Environmental Lab, Midland, Texas

All values except pH reported in milligrams per Liter - (mg/L, parts per million).

**Table 8**
**Groundwater Inorganic Analytical Data Summary**
**Legacy Reserves, L.P., Chamberlin Site, 1RP-2391**
**Lea County, New Mexico**

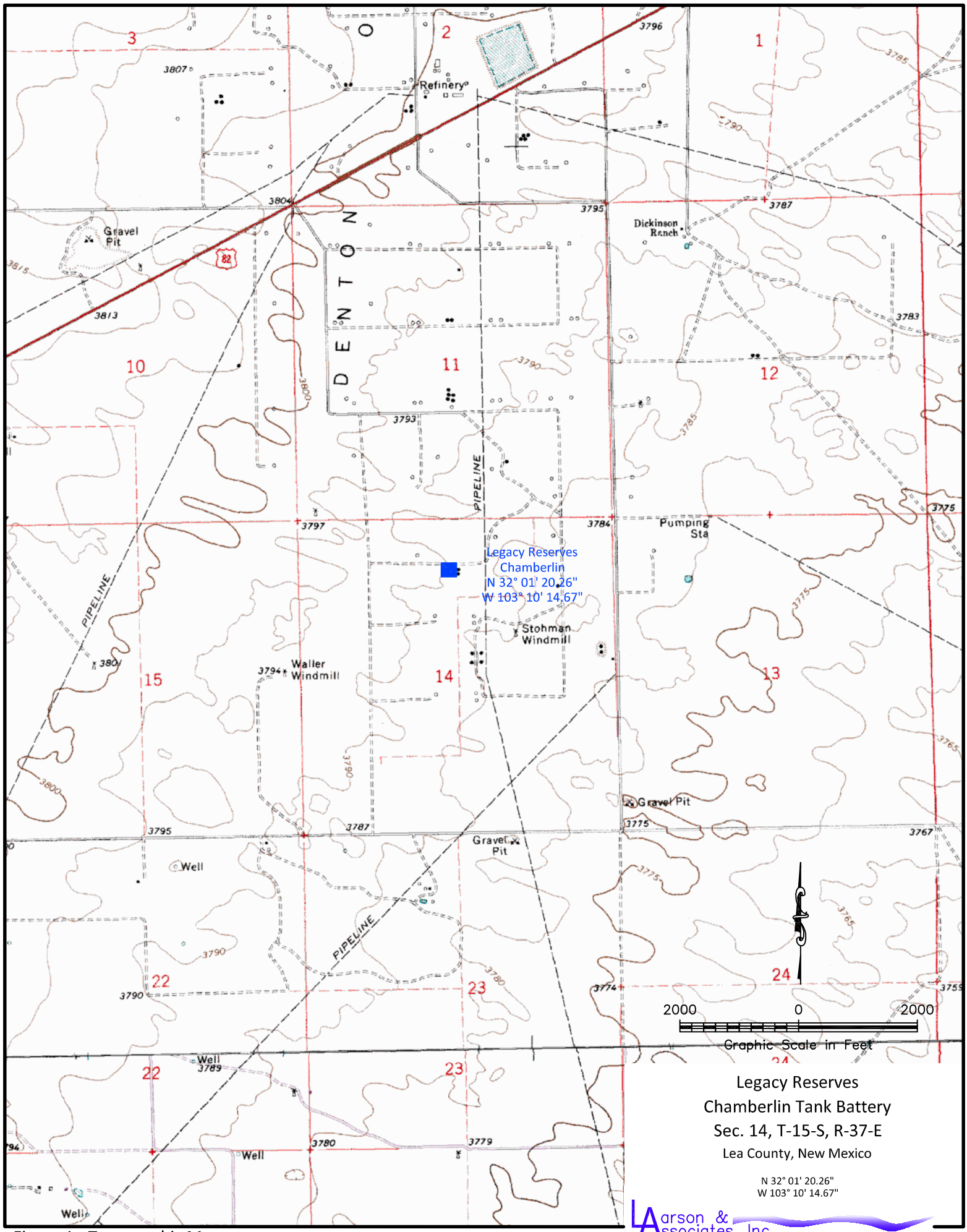
| Sample ID | Date | Alkalinity (mg/L) | Chloride (mg/L) | Nitrate - N (mg/L) | TDS (mg/L) | Sulfate (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Potassium (mg/L) | Sodium (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| **WQCC Limit:** | | | **250** | **10** | **1000** | **600** | | | | |
| TMW-1 | 06/11/2013 | 272 | **263** | 8.53 | 1,180 | 206 | 94 | 230 | 7.20 | 51 |

***Notes:*** Analysis performed by Permian Basin Environmental Lab, Midland, Texas

All values except pH reported in milligrams per Liter - (mg/L, parts per million).

Blue indicates the value exceeds WQCC Domestic Water Quality Standard

**FIGURES**




Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico

N 32° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

Figure 1 - Topographic Map


Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico

N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

Figure 2 - Aerial Map

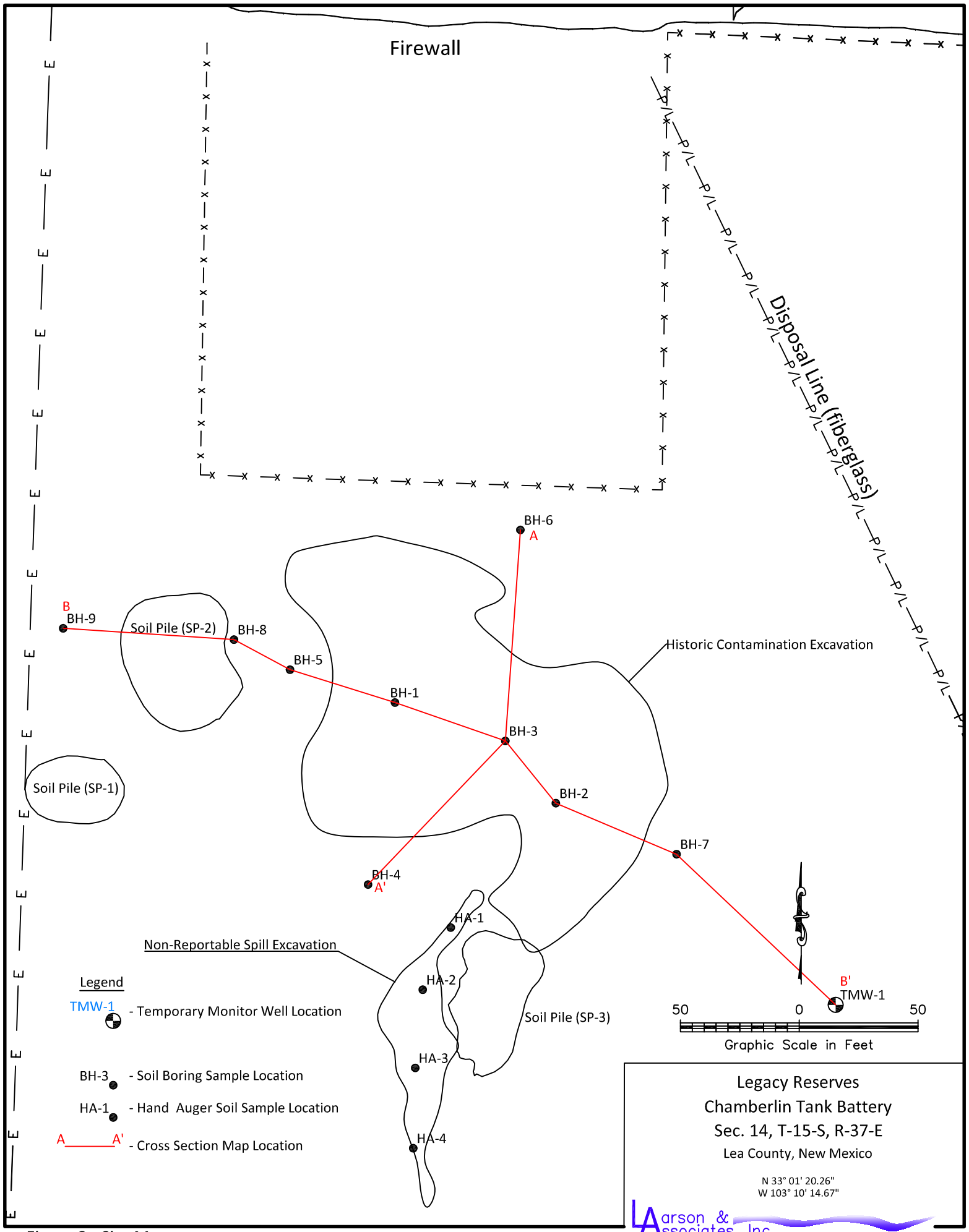
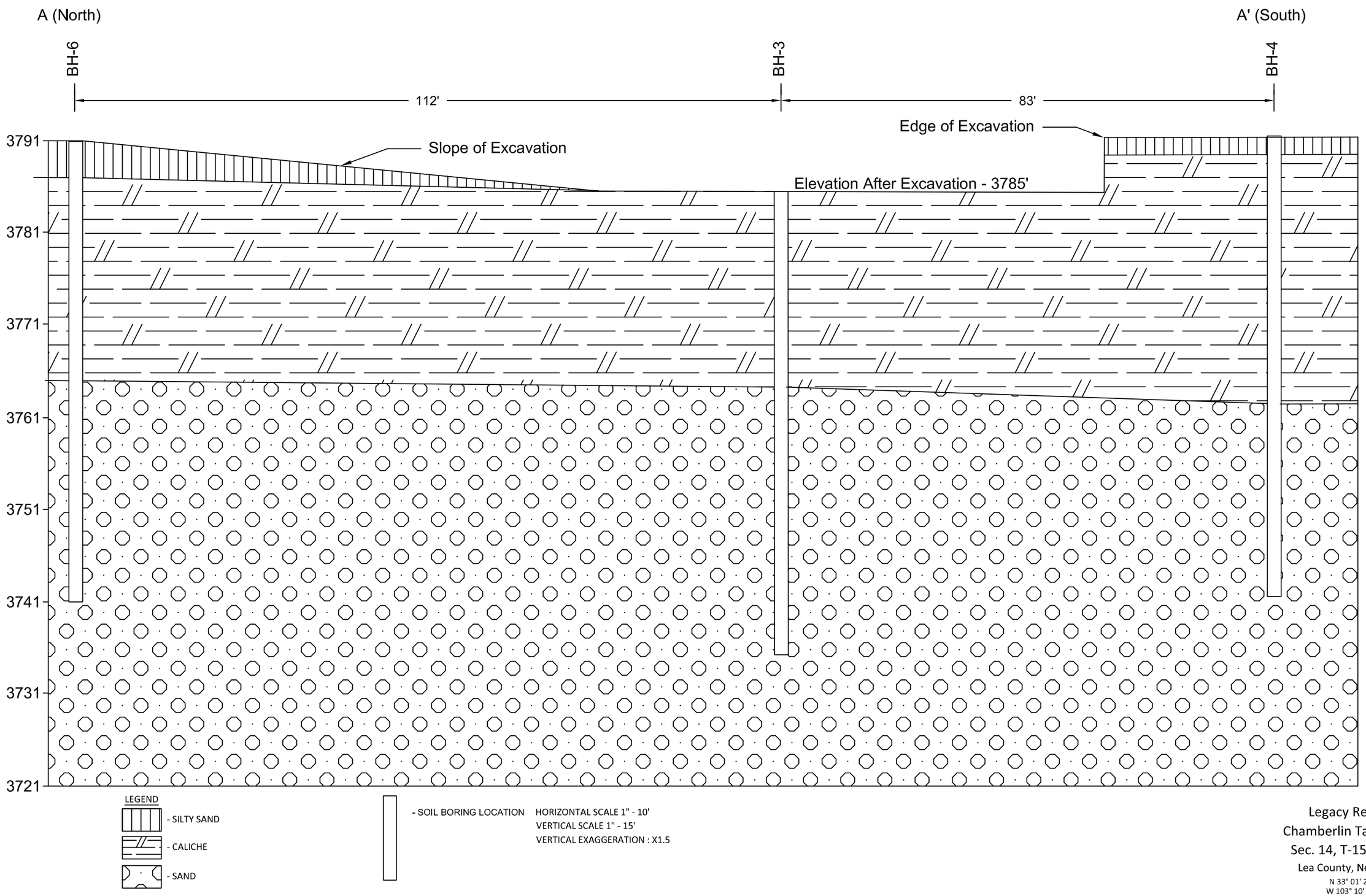



Figure 3 - Site Map




Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

Figure 4 - Geological Cross Section Map A-A'

V:\PROJECTS\Legacy\Cross Section 2013.dwg, 8/1/2013 9:49:58 AM

B (West)

B' (East)

BH-9 | BH-8 | BH-5 | BH-1 | BH-3 | BH-2 | BH-7 | TMW-1

73' | 27' | 48' | 50' | 35' | 56' | 94'

3791
3781
3771
3761
3751
3741
3731
3721
3711

Excavated Soil

Bench

Fill

Fill

LEGEND

- SILTY SAND
- BACKFILL
- CALICHE
- SAND
- SOIL BORING LOCATION
- WELL SCREEN LOCATION

HORIZONTAL SCALE 1" - 10'
VERTICAL SCALE 1" - 26'
VERTICAL EXAGGERATION : X2.6

- GROUNDWATER POTENTIOMETRIC SURFACE
- ESTIMATED GROUNDWATER POTENTIOMETRIC SURFACE

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

Figure 5 - Geological Cross Section Map B-B'

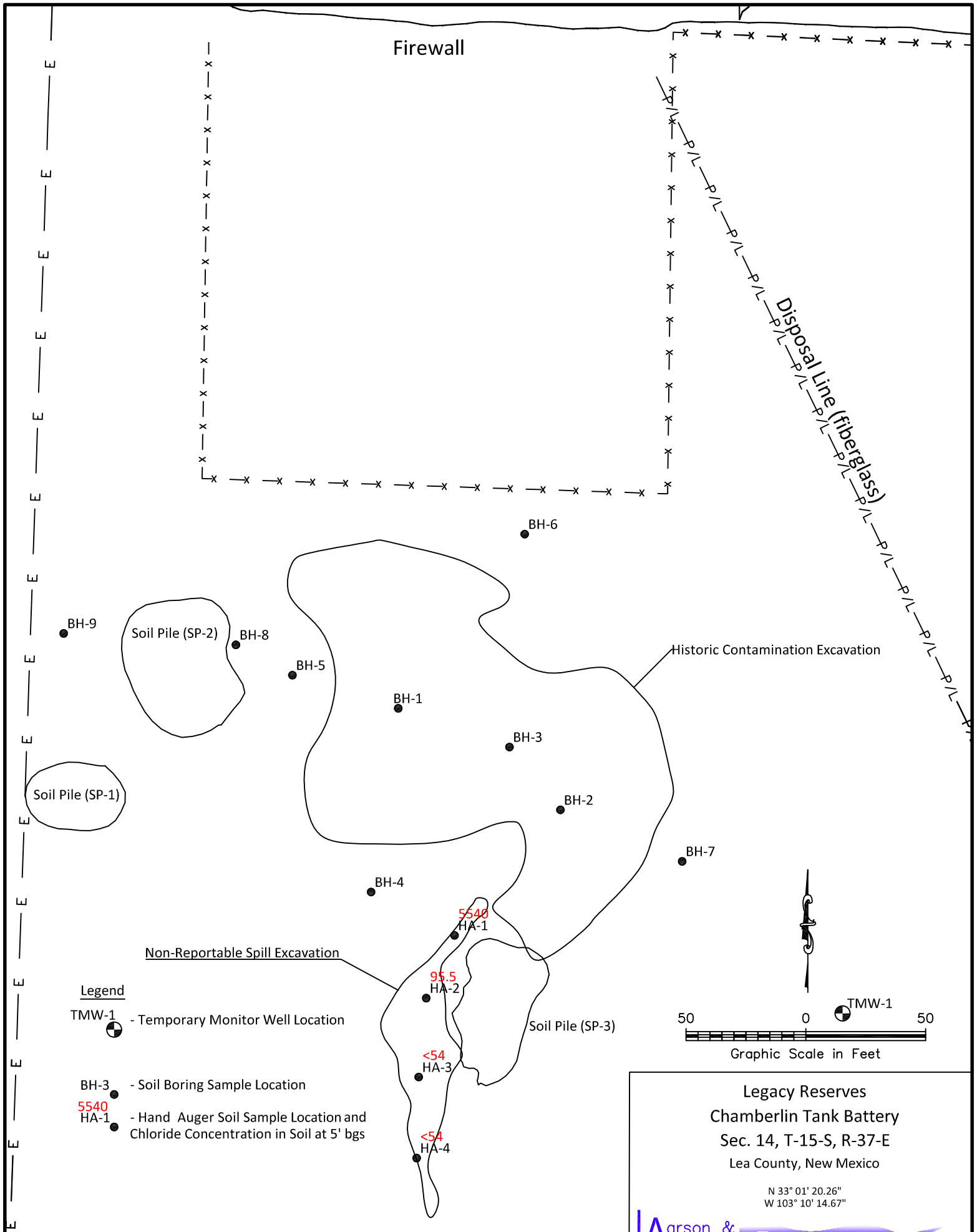



Figure 6 - Chloride Concentrations in Soil at 5' bgs

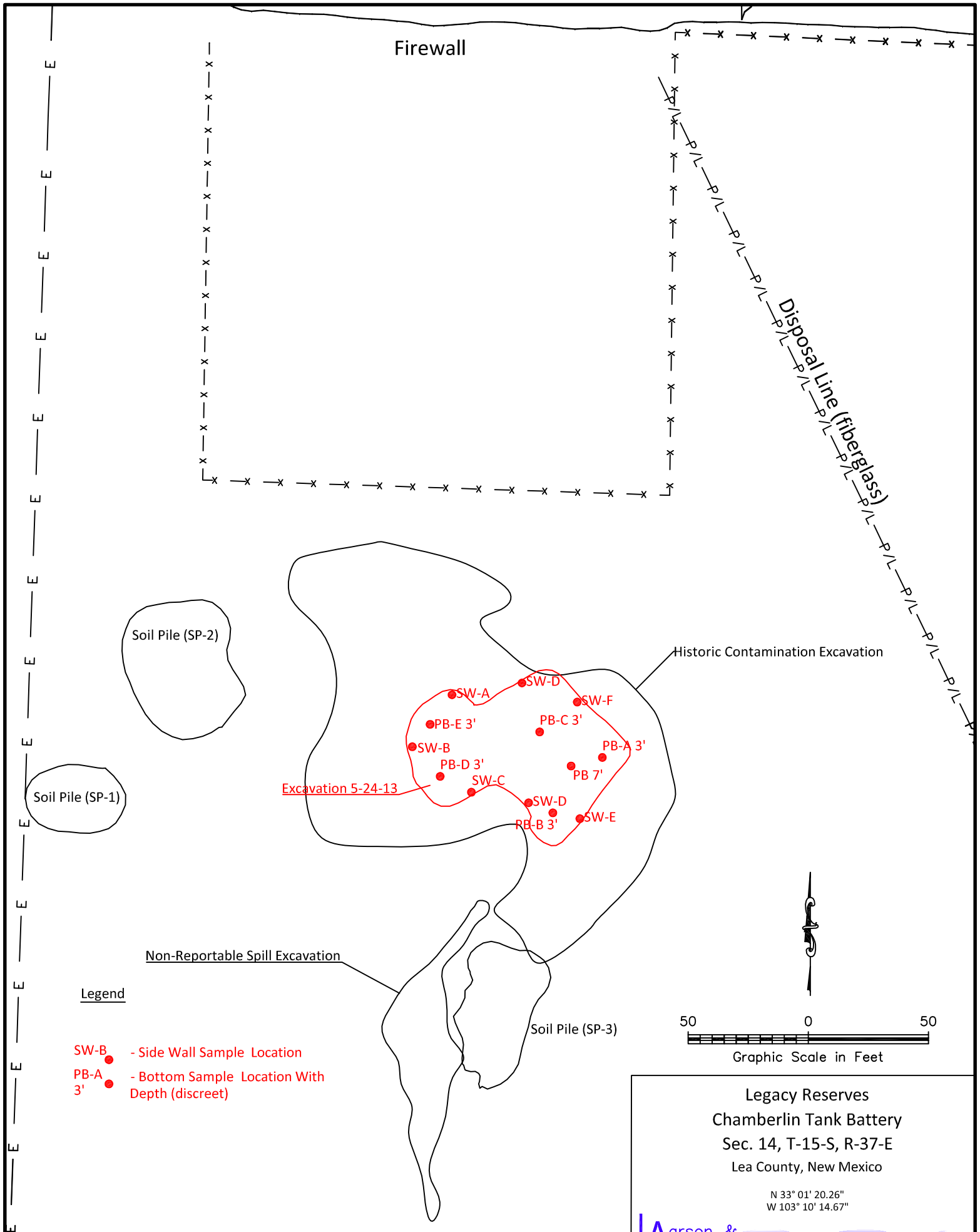



Figure 7a - Excavation Sample Locations Map, May 24, 2012

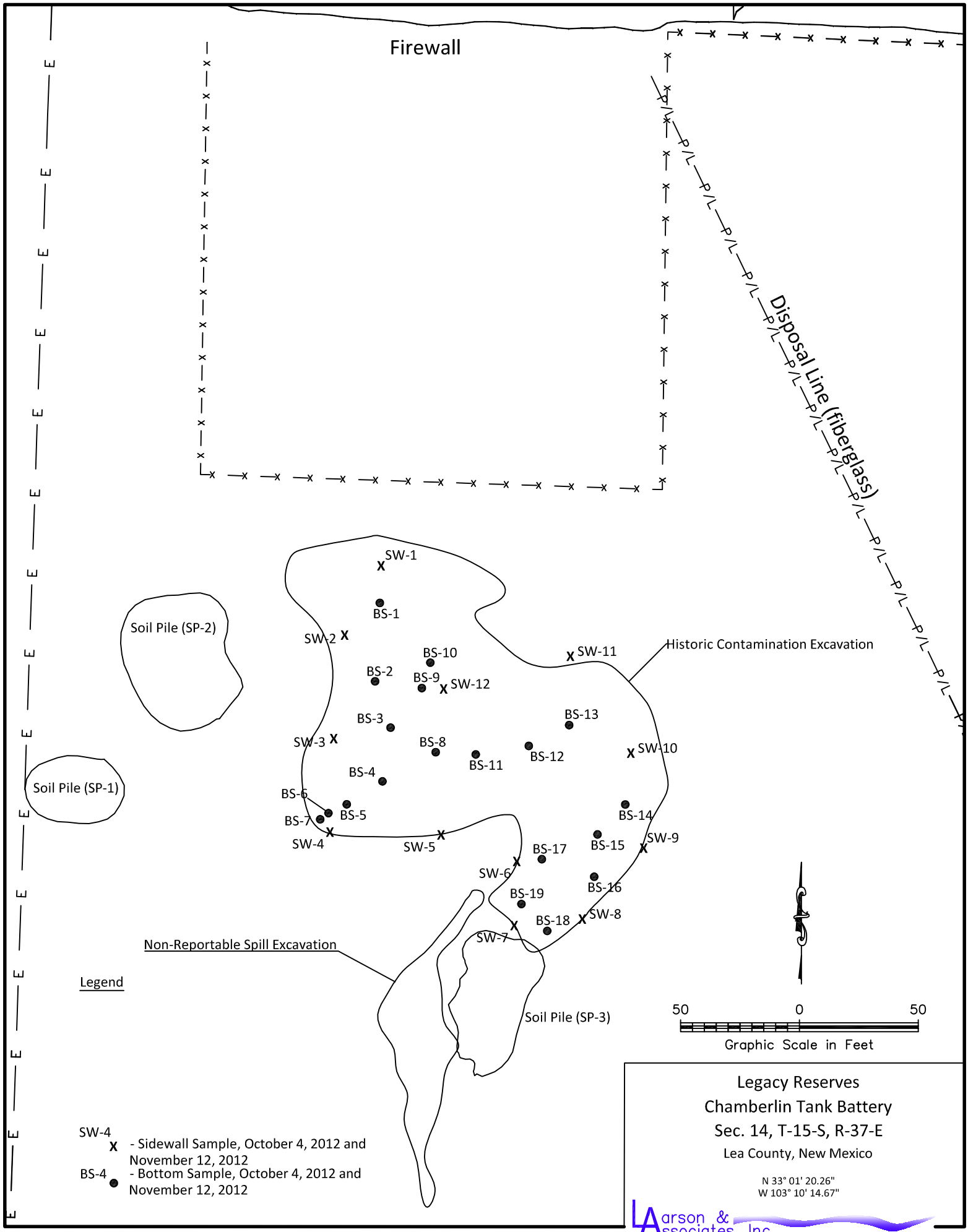



Figure 7b - Excavation Sample Locations Map, October 4, 2012 and November 12, 2012

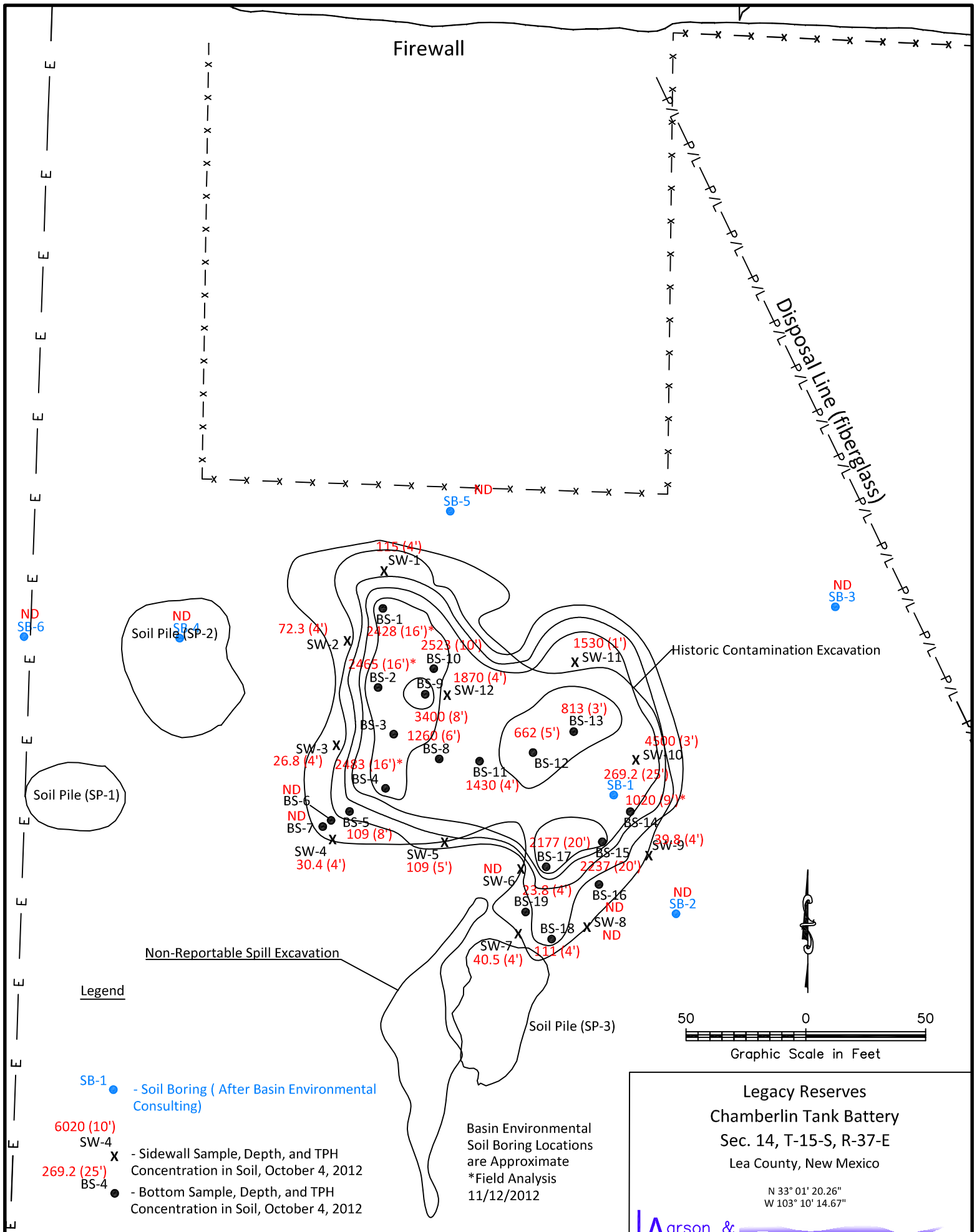



Figure 8a - TPH Concentrations in Excavation Samples, October 4, 2012

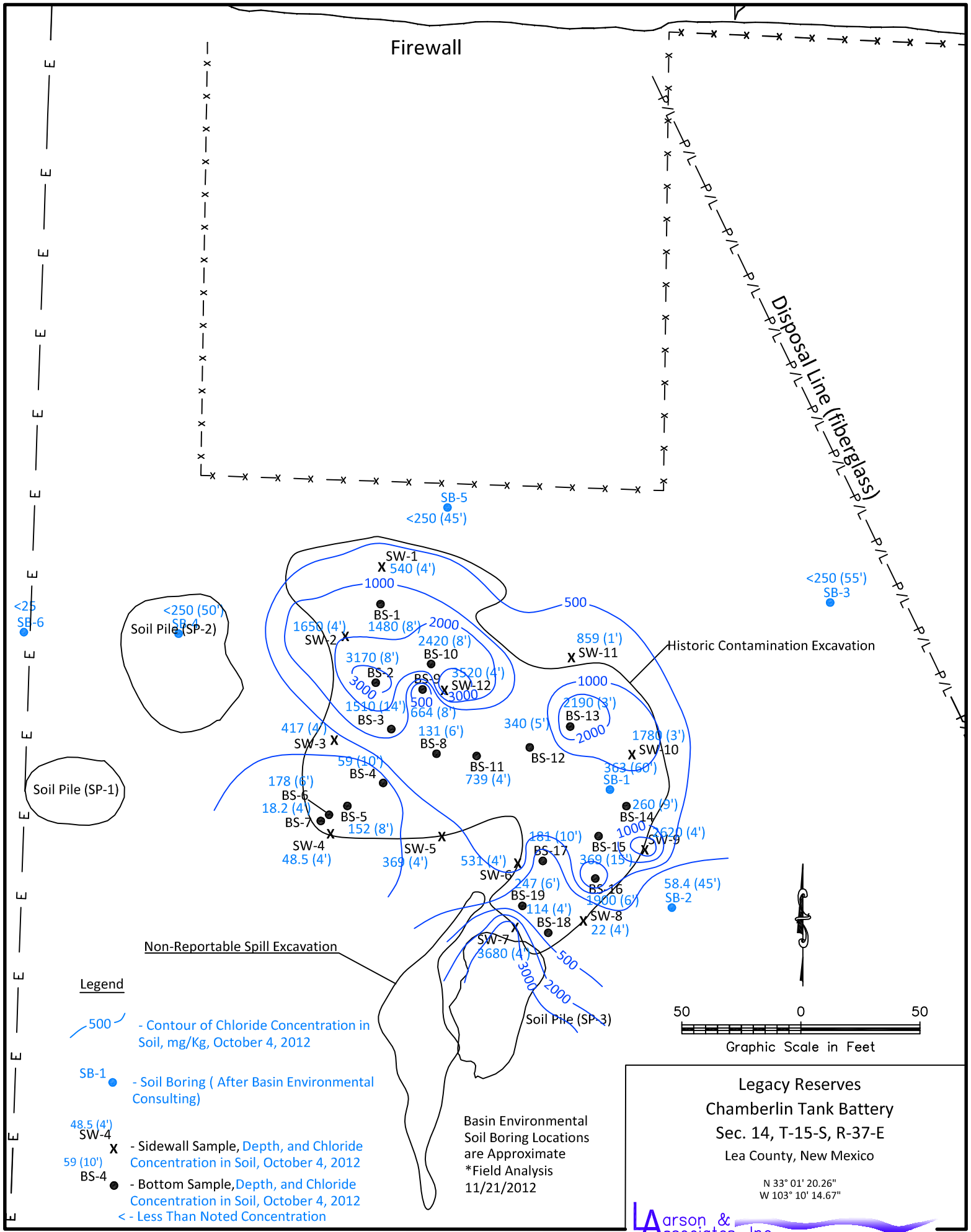



Figure 8b - Chloride Concentrations in Excavation Samples, October 4, 2012

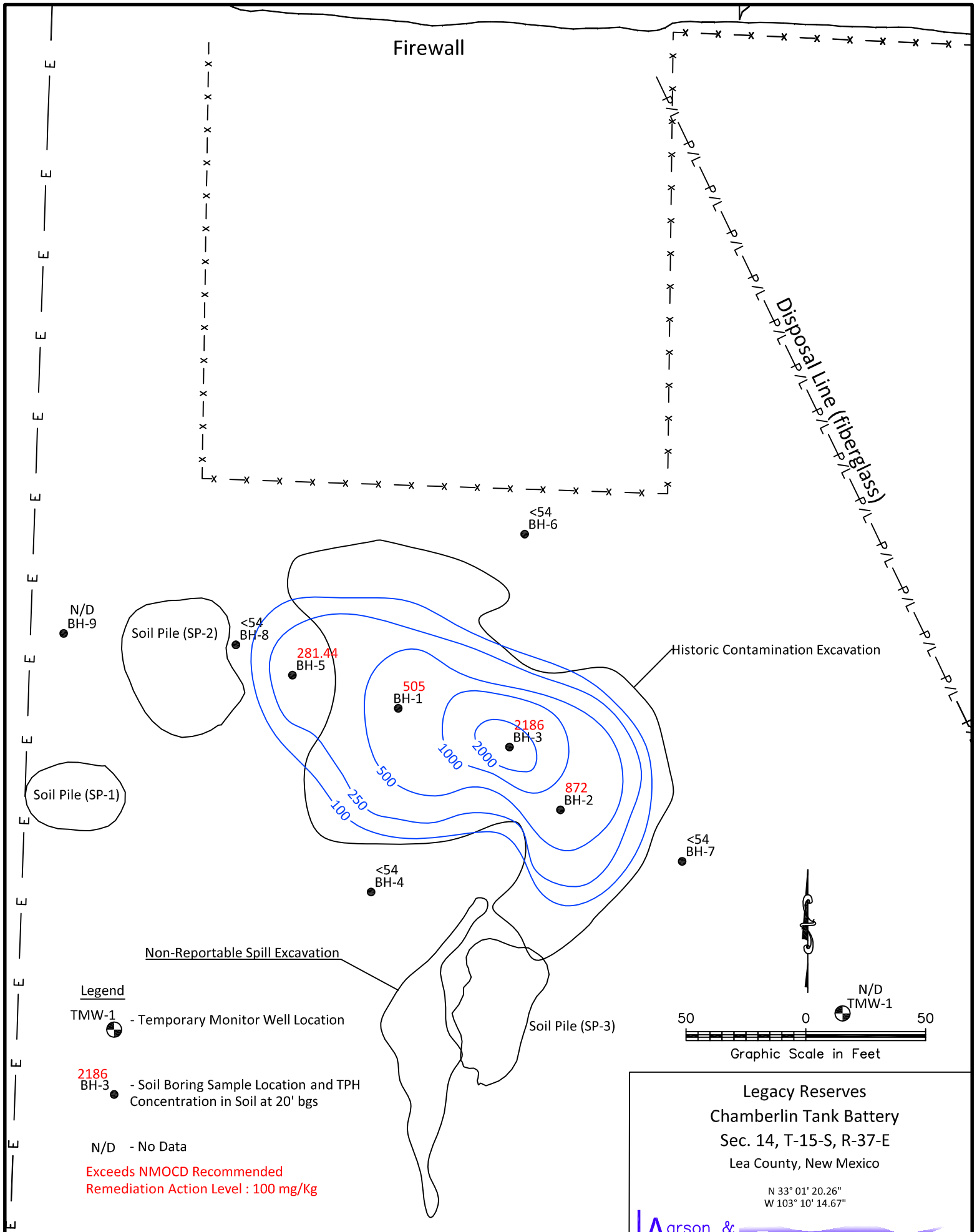



Figure 9a - TPH Concentrations in Soil at 20' bgs

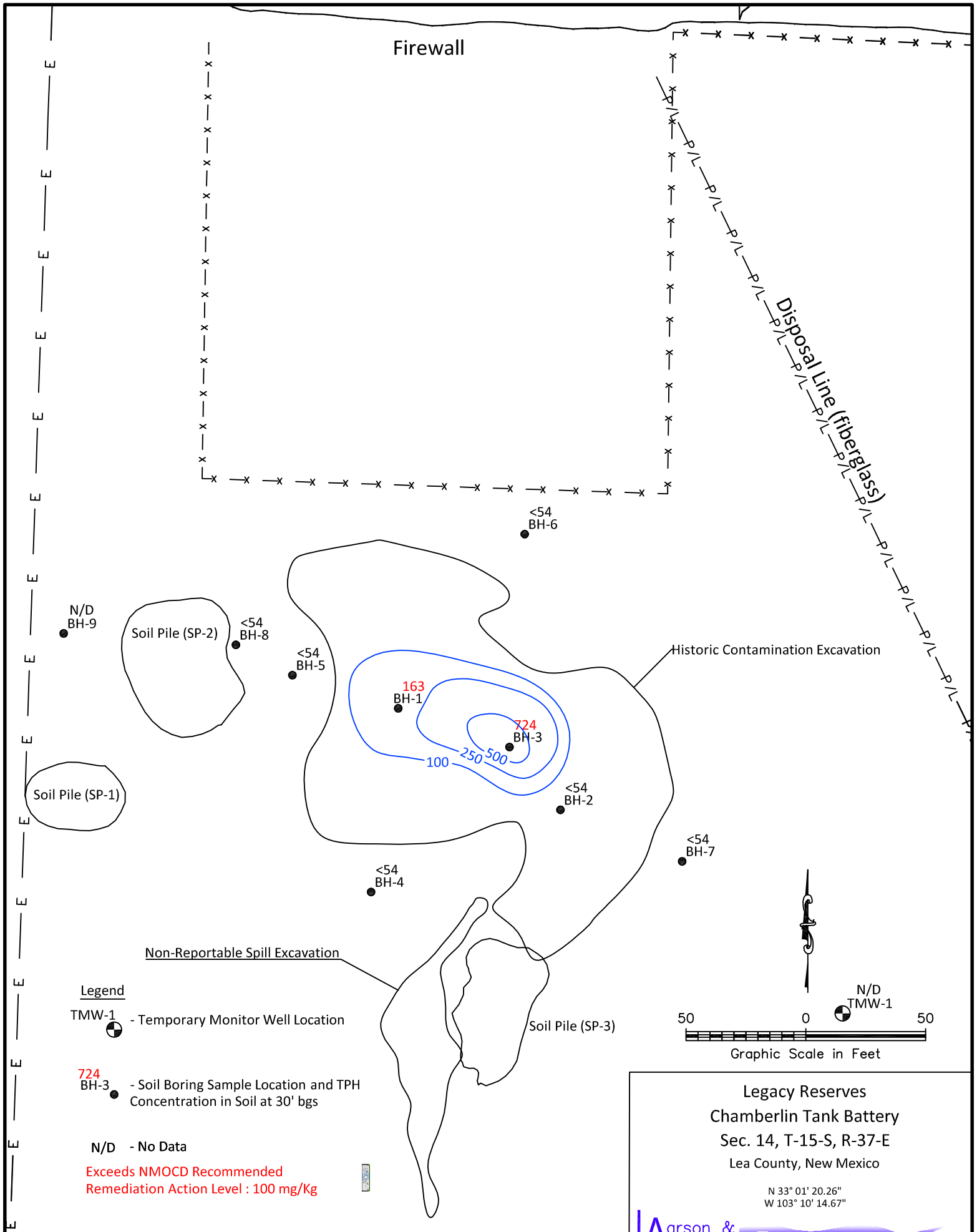



Figure 9b - TPH Concentrations in Soil at 30' bgs

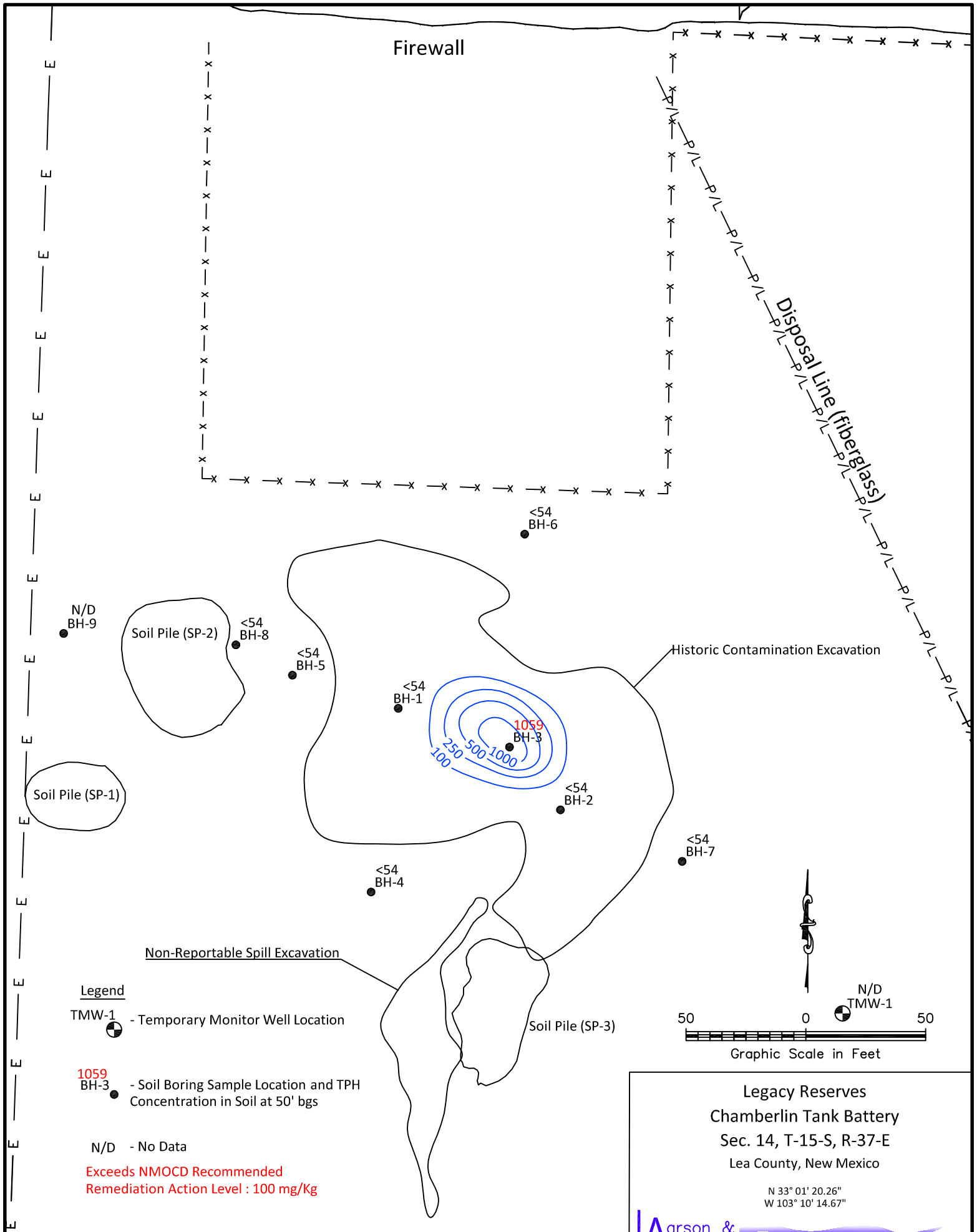



Figure 9c - TPH Concentrations in Soil at 50' bgs

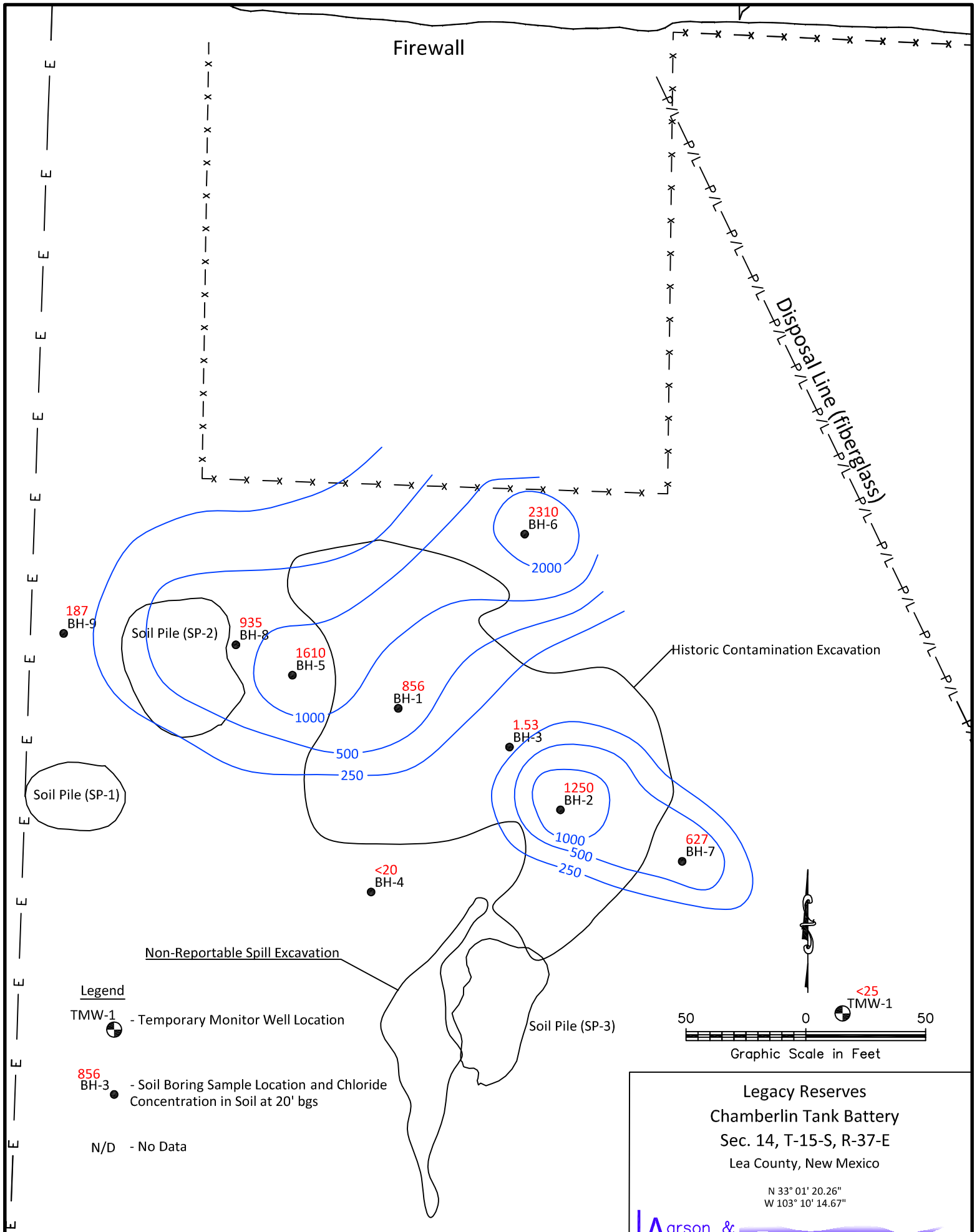



Figure 10a - Chloride Concentrations in Soil at 20' bgs

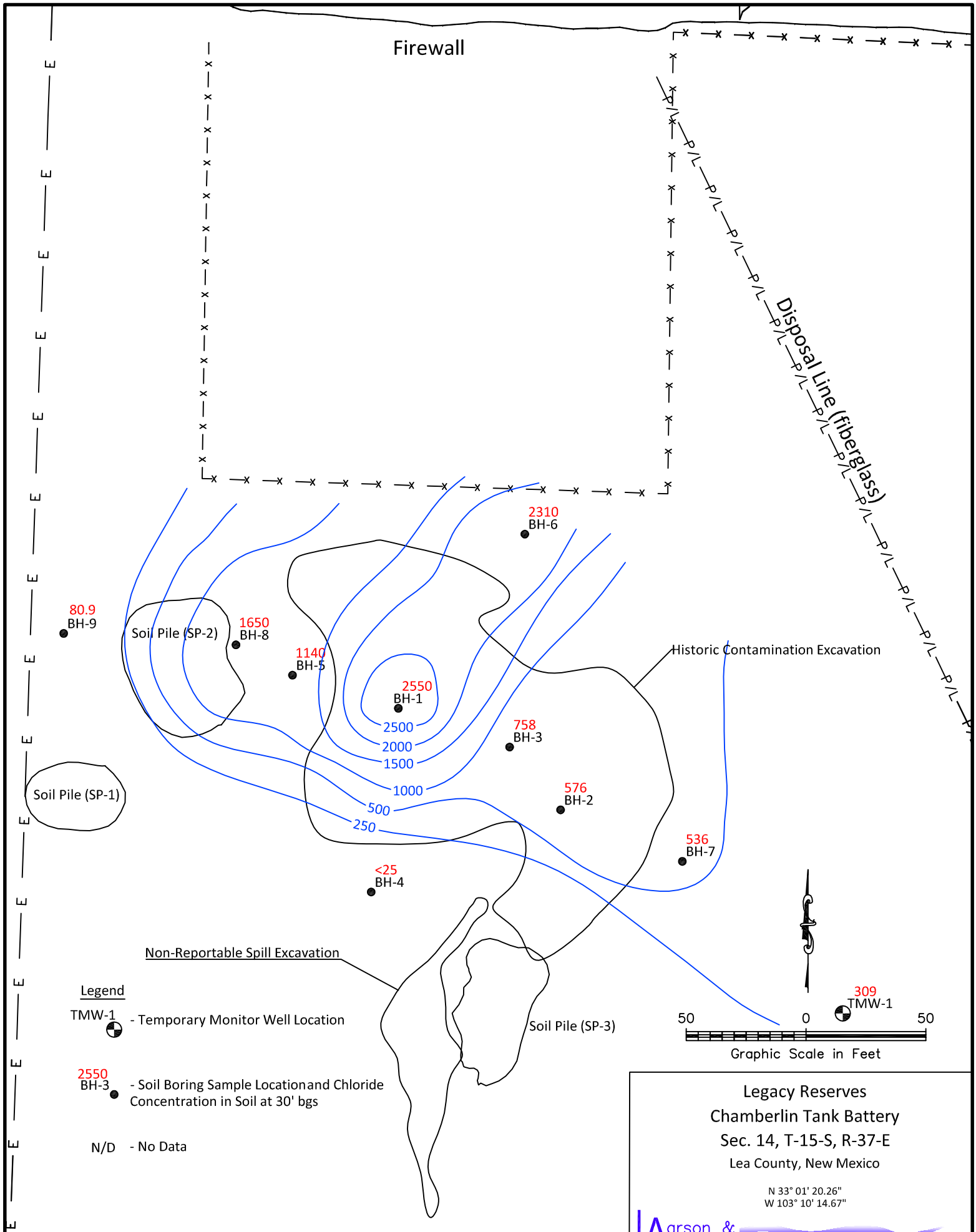



Figure 10b - Chloride Concentrations in Soil at 30' bgs

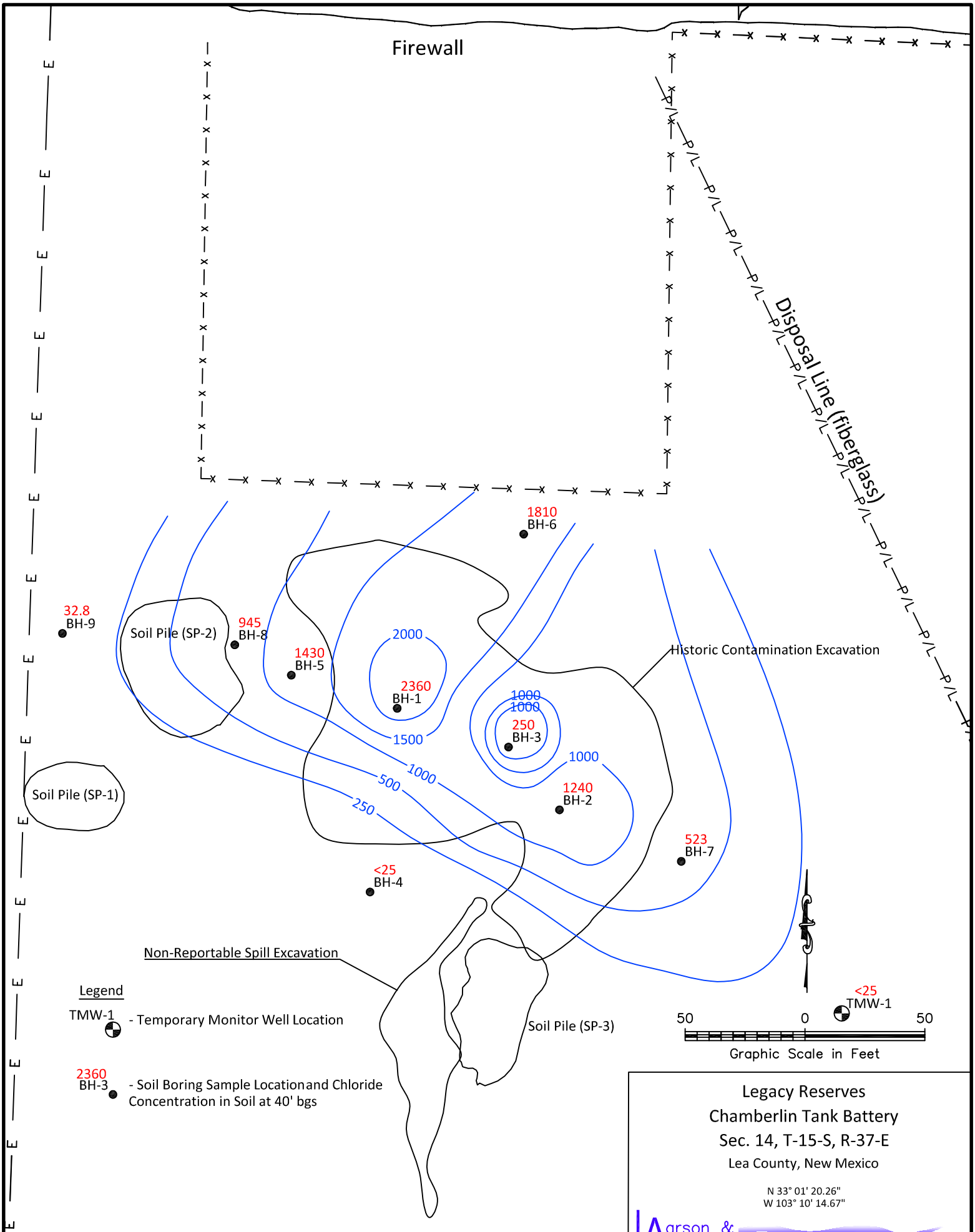
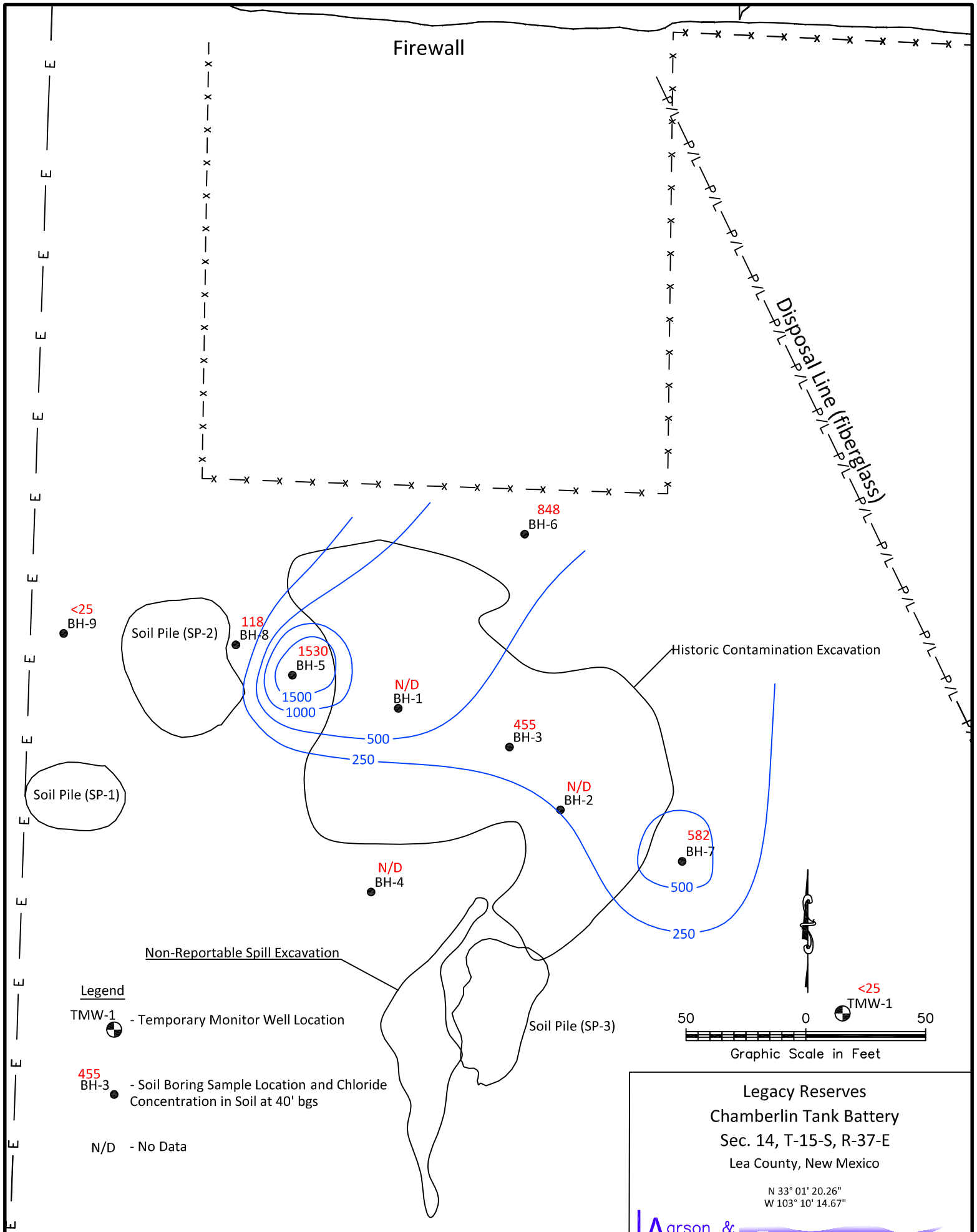



Figure 10c - Chloride Concentrations in Soil at 40' bgs




Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico

N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

Figure 10d - Chloride Concentrations in Soil at 50' bgs

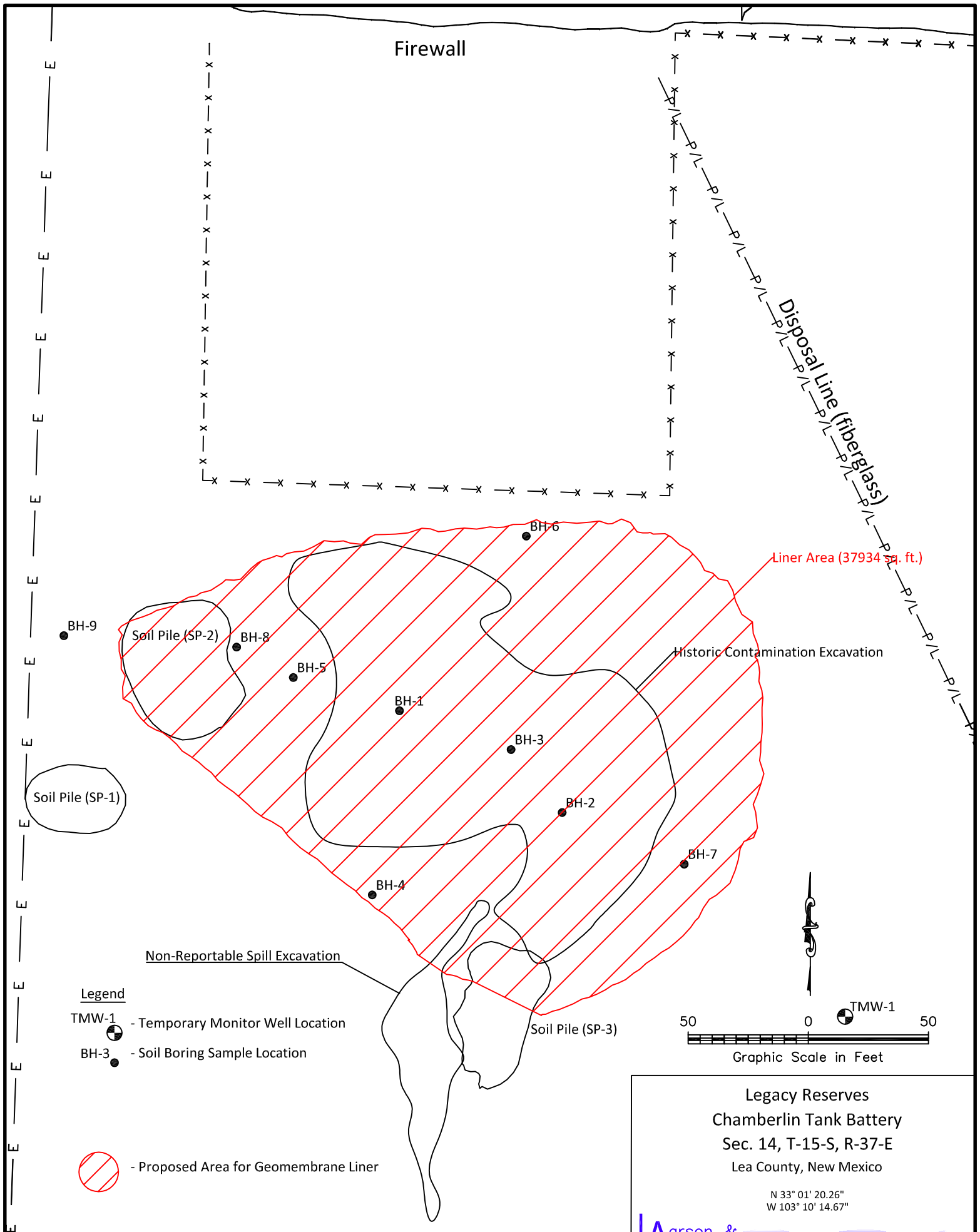



Figure 11 - Area of Geosynthetic Liner

# APPENDIX A

## Historic and Aerial Photographs

V:\PROJECTS\Legacy\LEGACY RESERVES - CHAMBERLIN.dwg, 7/15/2013 4:23:58 PM


N
W E
S

JOB #: 45095 - 8/7/2012

SITE: LEGACY - CHAMBERLIN
SOURCE: USGS
DATE: 2011
COUNTY: LEA, NM
SCALE: 1" = 700'

GeoSearch

V:\PROJECTS\Legacy\LEGACY RESERVES - CHAMBERLIN.dwg, 7/15/2013 4:25:16 PM

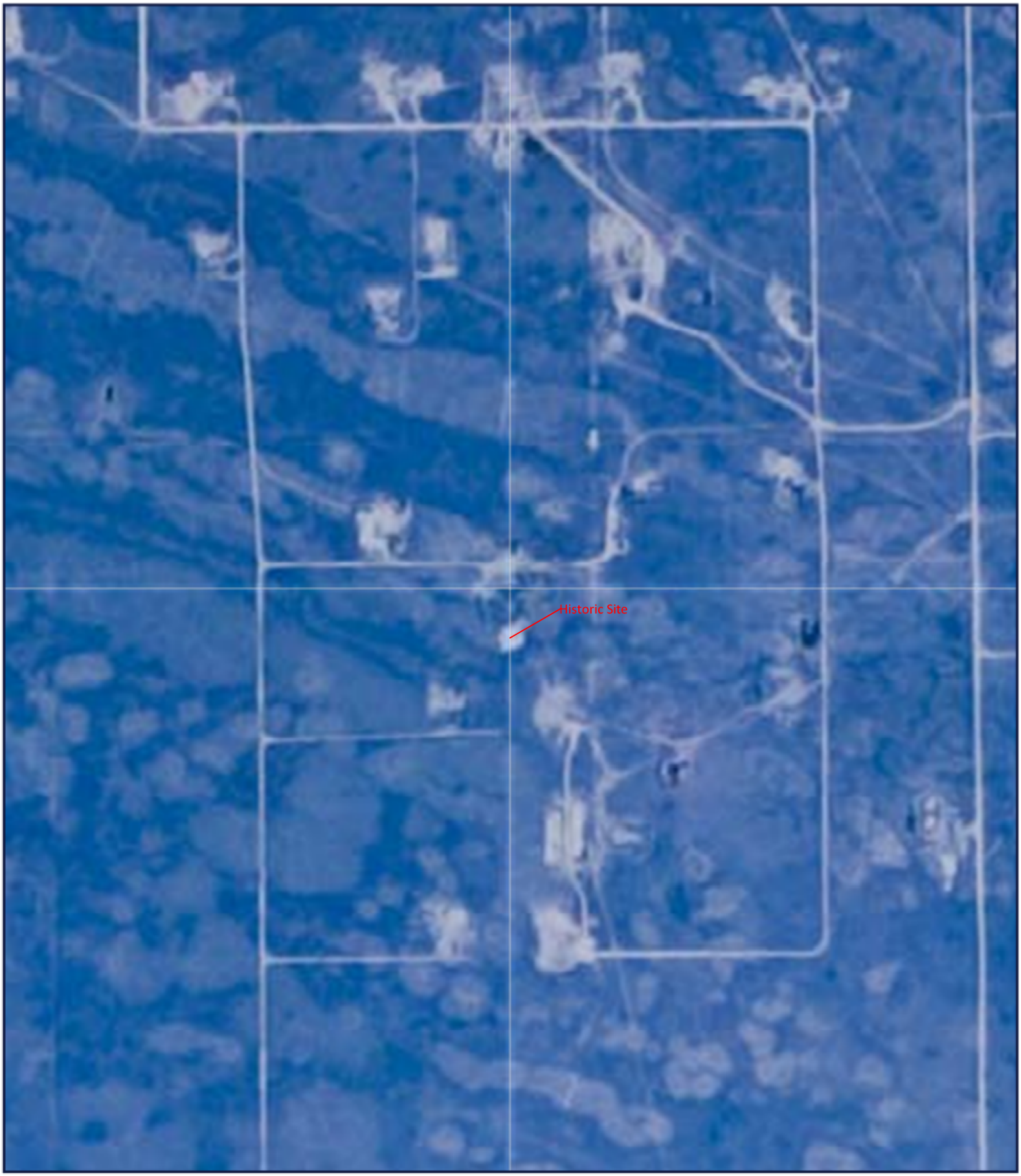

N
W E
S

JOB #: 45095 - 8/7/2012

SITE: LEGACY - CHAMBERLIN
SOURCE: USGS
DATE: 1996
COUNTY: LEA, NM
SCALE: 1" = 700'

GeoSearch

V:\PROJECTS\Legacy\LEGACY RESERVES - CHAMBERLIN.dwg, 7/15/2013 4:26:33 PM



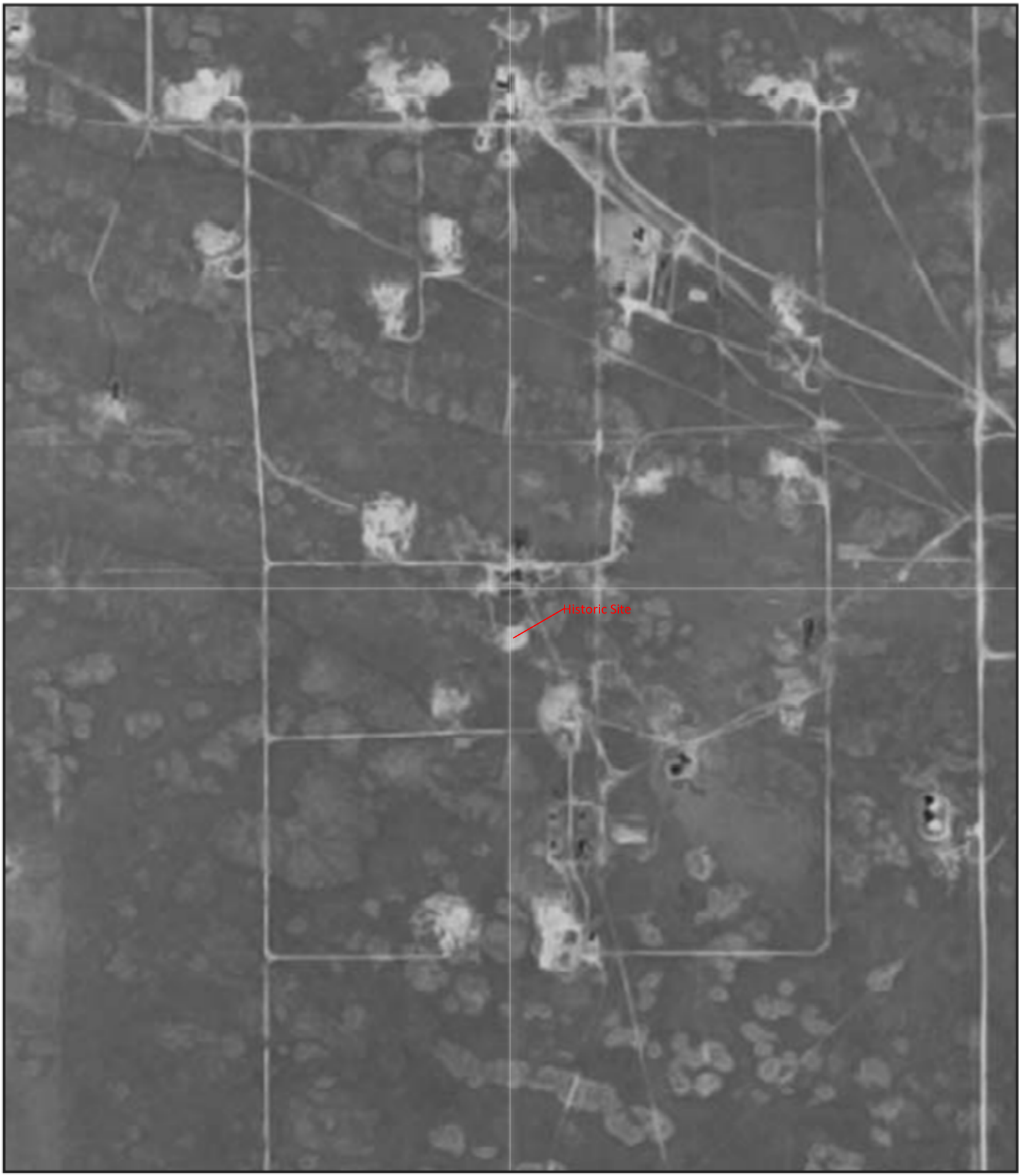

N
W E
S

JOB #: 45095 - 8/7/2012

SITE: LEGACY - CHAMBERLIN
SOURCE: USGS
DATE: 6-3-1983
COUNTY: LEA, NM
SCALE: 1" = 700'

GeoSearch

V:\PROJECTS\Legacy\LEGACY RESERVES - CHAMBERLIN.dwg, 7/15/2013 4:27:22 PM




N
W E
S

JOB #: 45095 - 8/7/2012

SITE: LEGACY - CHAMBERLIN
SOURCE: USGS
DATE: 11-17-1978
COUNTY: LEA, NM
SCALE: 1" = 700'

GeoSearch


N
W E
S

JOB #: 45095 - 8/7/2012

SITE: LEGACY - CHAMBERLIN
SOURCE: USGS
DATE: 2-8-1968
COUNTY: LEA, NM
SCALE: 1" = 700'

GeoSearch

**APPENDIX B**

**Laboratory Reports**

**APPENDIX C**

**Photographs**

**PHOTOGRAPHS**


Legacy Chamberlain Lease Sign, April 4, 2012


Northwest Corner of Excavation (After May 2009) Viewing Northwest, April 4, 2012

**PHOTOGRAPHS**


Northwest Corner of Excavation (After May 2009) Viewing West, April 4, 2012


West Side of Excavation (After May 2009) Viewing Southwest, April 4, 2012

**PHOTOGRAPHS**


East Side of Excavation (After May 2009) Viewing North, April 4, 2012


Northwest Corner of Excavation Viewing North, August 24, 2012

**PHOTOGRAPHS**

Northwest Corner of Excavation Viewing Northwest, August 24, 2012


Northeast Corner of Excavation Viewing East, August 24, 2012

**PHOTOGRAPHS**

Southeast Corner of Excavation Viewing East, August 24, 2012

East Side of Excavation Viewing East, August 24, 2012

**PHOTOGRAPHS**


Northeast Corner of the Initial Soil Excavation Looking North, August 24, 2012

West Side of Excavation Viewing North, October 4, 2012

**PHOTOGRAPHS**

East Side of Excavation Viewing North, October 4, 2012

Southwest Corner of Excavation Viewing Southwest, October 4, 2012

**PHOTOGRAPHS**

Central Area of Excavation Viewing South, October 4, 2012

East Side of Excavation Viewing Southeast, October 4, 2012

**PHOTOGRAPHS**

Northeast Corner of Excavation Viewing Northeast, November 12, 2012

Southeast Corner of Excavation Viewing Southeast, November 12, 2012

**PHOTOGRAPHS**

Drilling at Location BH-2 Viewing South, March 13, 2013

East Side of Excavation Viewing North, July 9, 2013

**PHOTOGRAPHS**

East Side of Excavation Viewing South, July 9, 2013

Central Area of Excavation Viewing South, July 9, 2013

**PHOTOGRAPHS**

Central Area of Excavation Viewing North, July 9, 2013

West Side of Excavation Viewing West, July 9, 2013

**PHOTOGRAPHS**

West Side of Excavation Viewing South, July 9, 2013

Excavation Viewing Southeast, July 9, 2013

**PHOTOGRAPHS**

Flow Line (Non-Reportable Spill) Excavation Viewing South, July 9, 2013

**APPENDIX D**

**Boring Logs and Monitoring Well Record**

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | | | | | NO WELL COMPLETED |
| | 15 | PIT BOTTOM | Caliche | | | |
| | | Caliche : Light Gray (2.5YR 7/2) very fine grained quartz sand, soft to moderately hard, indurated, dry, hydrocarbon stain and odor, very hard from 20', Gray (GLEY 6/0 to 5/0), indurated | | | | |
| | 28.0 | Sandstone : Gray (7.5YR 5/1) from 28' to 32', Pinkish White (7.5YR 8/2) below 32', hydrocarbon stain and odor, very fine grained quartz sand, poorly sorted, moderate to well cemented | SW | | | |
| | 40 | Sandstone : Light Brown (7.5YR 6/4) very fine grained quartz sand, poorly sorted, moderately cemented to 40', poorly cemented below 42', moist | SW | | | |
| | 45 | Total Depth 45' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 03/12/2013 - 03/13/13
Drilling Method - Hollow Stem Auger
Drilled By - Precision Sampling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-1 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | | | | | NO WELL COMPLETED |
| | 13.0 | TOP OF RAMP | Fill | | | |
| | | Fill Material : Ramp top to bottom of excavation | | | | |
| | 17.0 | BOTTOM OF EXCAVATION | | | | |
| | | Caliche : Light Gray to Light Yellowish Brown (10YR 7/1 to 6/4) sandy, very fine grained quartz sand, moderately to very hard, Light Gray to Gray (2.5YR 7/1 to 6/1) below 20', hydrocarbon stain and odor | Caliche | | | |
| | 28.0 | | | | | |
| | | Sandstone : Light Gray (GLEY 1 7/1)very fine grained quartz sand, poorly sorted, round to subangular, weakly to moderately well cemented, dry, Light Brown to Reddish Yellow (7.5YR 6/4 to 6/6) below 38' | SW | | | |
| | | Total Depth 43' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 03/13/13
Drilling Method - Hollow Stem Auger
Drilled By - Precision Sampling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-2 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | | | | | NO WELL COMPLETED |
| | 5 | BOTTOM OF EXCAVATION | Caliche | | | |
| | | Caliche : Pink to Light Brown (7.5YR 7/4 to 6/4) sandy, very fine grained quartz sand, soft to moderately hard, moist, Gray (7.5YR 5/1) hydrocarbon stain and odor, below 11' | | | | |
| | 10 | | | | | |
| | 15 | | | | | |
| | 17.0 | | | | | |
| | 20 | | | | | |
| | 25 | | | | | |
| | 26.0 | Sandstone : Light Gray (GLEY 1 7/1) very fine grained quartz sand, poorly sorted, round to subangular, hydrocarbon odor, weakly to moderately well cemented, dry, Light Gray (10YR 7/1) below 33' | SW | | | |
| | 30 | | | | | |
| | 35 | | | | | |
| | 40 | Sandstone : Light Gray (10YR 7/1) very fine grained quartz sand, poorly sorted, strong hydrocarbon odor, weakly to moderately well cemented, loose below 41', Light Brown (7.5YR 6/4) moderately well cemented below 50', light odor | SW | | | |
| | 45 | | | | | |
| | 50 | | | | | |
| | 55 | Total Depth 55' | | | | |
| | 60 | | | | | |
| | 65 | | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 03/13/13
Drilling Method - Hollow Stem Auger
Drilled By - Precision Sampling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-3 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silt : Brown (10YR 5/3) fine grained quartz sand, dry | ML | | | NO WELL COMPLETED |
| | | Caliche : Pink (7.5YR 7/4) sandy, fine grained quartz sand, moderately hard to indurated, dry | Caliche | | | |
| | 17.0 | | | | | |
| | 29.0 | Sand : Pink (7.5YR 7/3 to 7/4) fine grained quartz sand, poorly sorted, round, weakly cemented, friable, dry | SW | | | |
| | | Light Brown (7.5YR 4/6) below 40' | | | | |
| | 50 | Total Depth 50' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 04/11/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-4 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silt : Brown (10YR 5/3) fine grained quartz sand, dry | ML | | 0.0 | NO WELL COMPLETED |
| | 1.5 | Caliche : Pink (7.5YR 7/4 to 7/3) sandy, fine grained quartz sand, moderately hard to indurated, dry | Caliche | | | |
| | 5 | | | | 0.0 | |
| | | Light Brown to Brown(5YR 6/3 to 5/3) indurated caliche | | | | |
| | 10 | | | | 0.0 | |
| | 15 | | | | 14.3 | |
| | 20 | | | | 67.2 | |
| | 25 | Light Brown to Brown(5YR 6/3 to 5/3) indurated caliche | | | 140.5 | |
| | 28.0 | Sand : Pink (7.5YR 7/4) fine grained quartz sand, poorly sorted, round, weakly cemented, friable, dry | SW | | | |
| | 30 | | | | 1.4 | |
| | 35 | | | | 0.0 | |
| | 40 | | | | 0.0 | |
| | 45 | Interbedded with thin layers of well cemented sandstone below 40', dry | | | | |
| | 50 | Total Depth 50' | | | 0.0 | |
| | 55 | | | | | |
| | 60 | | | | | |
| | 65 | | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 04/11/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-5 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silt : Brown (10YR 5/3) fine grained quartz sand, medium plasticity, moist | ML | | 0.0 | NO WELL COMPLETED |
| | 4.0 / 5 | Caliche : Pink (7.5YR 7/4 to 7/3) sandy, very fine grained quartz sand, soft to moderately well cemented with indurated layers of Light Brown to Brown (7.5YR 6/3 to 5/3) | Caliche | | 0.0 | |
| | 10 | | | | 0.0 | |
| | 15 | | | | 0.0 | |
| | 20 | Hard to very hard below 20' | | | 0.0 | |
| | 25 | | | | 0.0 | |
| | 26.0 | Sand : Pink (7.5YR 7/3 to 7/4) fine grained quartz sand, poorly sorted, round, weakly cemented, friable, dry | SW | | 0.0 | |
| | 30 | | | | 0.0 | |
| | 35 | | | | 0.0 | |
| | 40 | Interbedded with thin layers of very well cemented sandstone below 40', dry | | | 0.0 | |
| | 45 | | | | | |
| | 50 | Total Depth 50' | | | 0.0 | |
| | 55 | | | | | |
| | 60 | | | | | |
| | 65 | | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 04/11/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-6 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silt : Brown (10YR 5/3) fine grained quartz sand, loose, dry | ML | | 0.0 | NO WELL COMPLETED |
| | 1.5 | Caliche : Pink (7.5YR 7/4 to 7/3) sandy, very fine grained quartz sand, moderately well cemented, soft to hard, dry | Caliche | | 0.0 | |
| | 5 | | | | 0.0 | |
| | 10 | | | | 0.0 | |
| | 15 | | | | 0.0 | |
| | 20 | Brown to Light Brown (7.5YR 5/3 to 6/3) indurated and hard below 20' | | | 0.0 | |
| | 25 | | | | 0.0 | |
| | 27.0 | Sand : Pink (7.5YR 7/3 to 7/4) very fine grained quartz sand, poorly sorted, round, weakly cemented, friable, dry | SW | | 0.0 | |
| | 30 | | | | 0.0 | |
| | 35 | | | | 0.0 | |
| | 40 | Interbedded with thin layers of very well cemented sandstone below 40', dry | | | 0.0 | |
| | 45 | | | | | |
| | 50 | Total Depth 50' | | | 0.0 | |
| | 55 | | | | | |
| | 60 | | | | | |
| | 65 | | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 04/11/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-7 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silt : Brown (10YR 5/3) fine grained quartz sand, loose, dry | ML | | 0.0 | NO WELL COMPLETED |
| | 1.5 | Caliche : Pink (7.5YR 7/4 to 7/3) sandy, very fine grained quartz sand, moderately well cemented to indurated, very hard, dry | Caliche | | 0.0 | |
| | 5 | | | | 0.0 | |
| | 10 | | | | 0.0 | |
| | 15 | | | | 0.0 | |
| | 20 | | | | 0.0 | |
| | 25 | | | | 0.0 | |
| | 27.0 | Sand : Pink to Light Brown (7.5YR 7/3 to 6/3) very fine grained quartz sand, poorly sorted, round, moderately well cemented, friable, dry | SW | | 0.0 | |
| | 30 | | | | 0.0 | |
| | 35 | | | | 0.0 | |
| | 40 | Interbedded with thin layers of very well cemented sandstone below, very hard, dry | | | 0.0 | |
| | 45 | | | | | |
| | 50 | Total Depth 50' | | | 0.0 | |
| | 55 | | | | | |
| | 60 | | | | | |
| | 65 | | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 04/12/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-8 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silty Clay : Brown (7.5YR 4/2) semiconsolidated | CL | | | No Well Completed |
| | 4.0 | Caliche : White to Gray (7.5YR 8/1 to 6/1) poorly sorted, unconsolidated, fine grained sand to gravel size, angular, dry | Caliche | | | |
| | 10 | Caliche : White to Gray (7.5YR 8/1 to 6/1) gravel/ cobble to sand sized, moderately cemented, poorly sorted, subround to subangular, unconsolidated, dry | Caliche | | | |
| | 15 | Caliche : Light Brown to Pinkish White (7.5YR 6/3 to 8/2) sand, poorly sorted, angular to subround, dry | Caliche | | | |
| | 20 | Caliche : Pinkish White to Pinkish Gray (5YR 8/1 to 6/1) coarse grained sand, angular to subround, poorly sorted, unconsolidated, dry | Caliche | | | |
| | 25 | Caliche : White to Gray (7.5YR 8/1 to 6/1) gravel to coarse grained size sand, unconsolidated, subround to subangular, moderately cemented, dry | Caliche | | | |
| | 28.0 | Caliche to Sand : Pink (7.5YR 7/3) medium to fine grained quartz sand, unconsolidated, sub angular to subround, poorly sorted, dry | SP | | | |
| | 40 | Sand : Pink to Pinkish Gray (7.5YR 7/3 to 7/2) fine grained quartz sand, some caliche, subangular to subround, poorly sorted, unconsolidated, dry | SP | | | |
| | 50 | Sand : Light Brown (7.5YR 6/4) unconsolidated, poorly cemented, fine to medium grained quartz sand, subround to round, well sorted, dry to moist | SP | | | |
| | | Total Depth 50' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 06/11/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson / S. Rehman
Checked By - M. Larson / S. Rehman

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

BH-9 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silty Clay : Dark Gray to Black (10YR 4/1 to 2/1) very fine grained quartz sand, moist, hydrocarbon stain and odor | CL | | | NO WELL COMPLETED |
| | 17.0 | | | | | |
| | 21.0 | Sandstone : Pink to Light Reddish Brown (5YR 7/4 to 6/4) very fine grained quartz sand, poorly sorted, subangular, weak to moderately cemented, dry, no odor or stain, Pinkish White (5YR 8/2) below 30' | SW | | | |
| | 40 | Total Depth 40' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 03/15/13
Drilling Method - Hollow Stem Auger
Drilled By - Precision Sampling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

TB-1 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading | Well Completion Detail |
|---|---|---|---|---|---|---|
| | 0 | Silty Clay : Dark Gray to Black (10YR 4/1 to 2/1) very fine grained quartz sand, moist, hydrocarbon stain and odor | CL | | | NO WELL COMPLETED |
| | 17.0 | | | | | |
| | 21.0 | Sandstone : Pink to Light Reddish Brown (5YR 7/4 to 6/4) very fine grained quartz sand, poorly sorted, subangular, weak to moderately cemented, dry, no odor or stain, Pinkish White (5YR 8/2) below 30' | SW | | | |
| | 40 | Total Depth 40' | | | | |

Legend

- Water Table (Time of Boring)

Date Drilled - 03/15/13
Drilling Method - Hollow Stem Auger
Drilled By - Precision Sampling Inc.
Logged By - M. Larson
Checked By - M. Larson

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

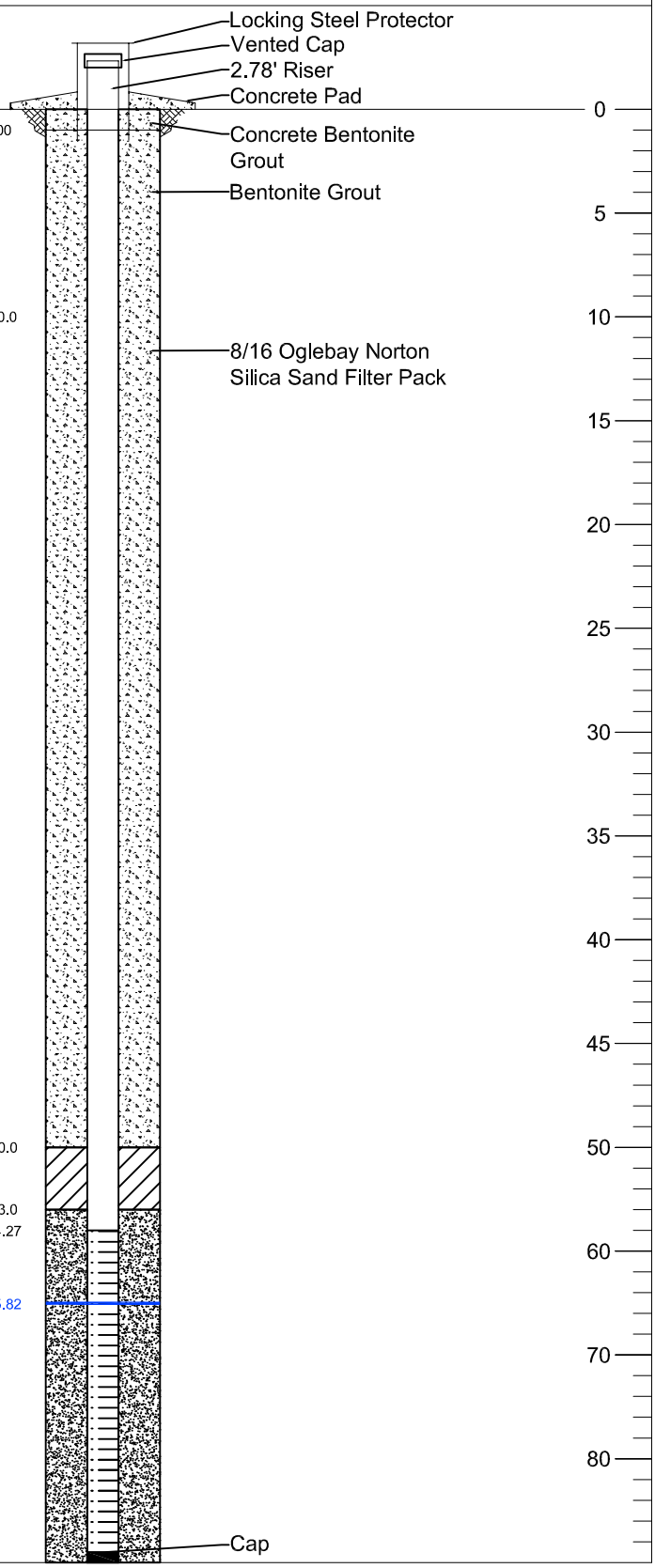
Larson & Associates, Inc.
Environmental Consultants

TB-1 Boring Log

# Well Completion Record

| Geolog. Unit | Depth (Feet) | Lithologic Description | Unified Soil Classification | Graphic Log | PID Reading |
|---|---|---|---|---|---|
| | 0 | | | | |
| | 1.5 | Silty Clay : Brown (5YR 4/2) very fine grained quartz sand, moist, (recent rain) | CL | | |
| | | Caliche : Pink (5YR 7/3) very fine grained to coarse grained quartz sand, subround to subangular, low cement | Caliche | | |
| | 5 | | | | |
| | 10 | Caliche : Pinkish White to Gray(7.5YR 8/2 to 6/1) sand, gravel to fine grained quartz sand, angular to sub angular, poorly sorted | Caliche | | |
| | 15 | | | | |
| | 20 | | | | |
| | 25 | Caliche : White to Light Gray(7.5YR 8/2 to 6/1) gravel some sand, poorly sorted | Caliche | | |
| | 28.0 | Sand : Pink (7.5YR 7/3) somewhat consolidated to loosely cemented sand and gravel, slightly moist to dry, subround quartz sand, well to moderately well sorted | SP | | |
| | 30 | | | | |
| | 35 | Sand : Pink (7.5YR 7/3) somewhat consolidated somewhat moist quartz grained sand, hard sandstone at 42', very well cemented, 1' thick, rounded | SP | | |
| | 40 | | | | |
| | 45 | | | | |
| | 50 | Sand : Light Brown (7.5YR 6/4) poorly cemented, subround, moderately to well sorted quartz grained sand, some small caliche, unconsolidated, dry | SW-SP | | |
| | 60 | Sand : Light Reddish Brown to Light Brown (5YR 6/4 to 7.5YR 6/4) medium to fine grained quartz sand, well rounded, unconsolidated, poorly cemented, wet at 60' | SW-SP | | |
| 65.82 | | | | | |
| | 70 | Sandy Clay : Brown (7.5YR 5/4) mostly wet, some caliche, somewhat cons but viscous mud | GC | | |
| | 75.0 | Sand : Brown (7.5YR 5/4) mostly wet, some caliche, somewhat cons but viscous mud | SP | | |
| | 80 | Total Depth 78.4' | | | |

## Well Completion Detail




Legend

- Water Table (Time of Boring)

Date Drilled - 06/10/13
Drilling Method - Air Rotary
Drilled By - Scarborough Drilling Inc.
Logged By - M. Larson / S. Rehman
Checked By - M. Larson / S. Rehman

Legacy Reserves
Chamberlin Tank Battery
Sec. 14, T-15-S, R-37-E
Lea County, New Mexico
N 33° 01' 20.26"
W 103° 10' 14.67"

Larson & Associates, Inc.
Environmental Consultants

TMW-1 Boring and Completion Log

**APPENDIX E**

**Initial C-141**

District I
1625 N. French Dr., Hobbs, NM 88240
District II
1301 W. Grand Avenue, 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

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-141
Revised October 10, 2003

Submit 2 Copies to appropriate District Office in accordance with Rule 116 on back side of form

# Release Notification and Corrective Action

## OPERATOR

☒ Initial Report  Final Report

| | |
|---|---|
| Name of Company Legacy Reserves, LP | Contact Kevin Bracey |
| Address P. O. Box 10848, Midland, Texas 79702 | Telephone No. 432-238-2856 |
| Facility Name **Chamberlain Historical** | Facility Type Tank Battery |

| | | |
|---|---|---|
| Surface Owner Darr Angell | Mineral Owner | Lease No. |

## LOCATION OF RELEASE

| Unit Letter | Section | Township | Range | Feet from the | North/South Line | Feet from the | East/West Line | County |
|---|---|---|---|---|---|---|---|---|
| C | 14 | 15S | 37E | | | | | Lea |

Latitude 33° 01 16.7" North  Longitude 103° 10 13.6" West

## NATURE OF RELEASE

| | | |
|---|---|---|
| Type of Release Produced Water and crude oil | Volume of Release Unknown | Volume Recovered Unknown |
| Source of Release Unknown | Date and Hour of Occurrence Historical | Date and Hour of Discovery Historical |
| Was Immediate Notice Given? Yes No Not Required | If YES, To Whom? | |
| By Whom? | Date and Hour | |
| Was a Watercourse Reached? ☐ Yes ☒ No | If YES, Volume Impacting the Watercourse. | |

If a Watercourse was Impacted, Describe Fully.*

Describe Cause of Problem and Remedial Action Taken: Historical impact discovered during remediation of non-reportable release. The site will be remediated to NMOCD guidelines.

Describe Area Affected and Cleanup Action Taken. Release impacted approximately 20,000 square feet.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

## OIL CONSERVATION DIVISION

| | | |
|---|---|---|
| Signature: Kevin Bracey | Approved by District Supervisor: | |
| Printed Name: Kevin Bracey | Approval Date: | Expiration Date: |
| Title: Production Foreman | Conditions of Approval: | |
| E-mail Address: kbracey@legacylp.com | | |
| Date: 1/7/2010 Phone: 432-238-2856 | | |