

AP - 102

CLOSURE
PLAN

09 / 29 / 2015



September 29, 2015

Reference No. 086242

Mr. Glenn Von Gonten
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Dear Mr. Von Gonten:

**Re: Thoreau Compressor Station 5
McKinley County, New Mexico
2015 Workscope Items**

GHD (formerly Conestoga Rovers & Associates) submits this proposed work scope to the Navajo Nation Environmental Protection Agency (NNEPA) to assist in the development of a closure strategy for the Thoreau Compressor Station 5 facility (Site) in McKinley County, New Mexico. The facility is located on the Navajo Nation within Section 20, Township 14 North, Range 13 West (see Figure 1). The Site is regulated by the NNEPA and the New Mexico Oil Conservation Division (NMOCD).

This proposed work scope has been prepared in response to observations and data collected during groundwater sampling, a groundwater pumping test, and a confirmation drilling event conducted by GHD during 2014. GHD also discussed the proposed work scope with NNEPA and they are in general agreement with the proposed work scope.

1. Project Understanding

GHD understands that the facility is owned by Energy Transfer Company (ETC), although the surrounding property is owned by the Navajo Nation. Based on a review of records, the Site has been in active assessment and remediation since 1989.

Contaminates of concern (COCs) consist of benzene, xylene and polychlorinated biphenyls (PCBs). The New Mexico Water Quality Control Commission (NMWQCC) regulatory limits for the site are:

Constituent	NMWQCC Regulatory Limit (micrograms per Liter [µg/L])
Benzene	10
Xylenes	620
PCB	1

Concentrations of benzene range from below the detection limit to 5400 ppb. Concentrations of total xylenes range from below the detection limit to 3500 ppb. Concentrations of PCBs range from below the detection limit to 1.2 ppb.

Generally, concentrations of benzene, xylenes and PCBs have been steadily decreasing with time. However, concentrations of benzene and xylenes appear to be increasing in monitoring wells 5-35B, SVE-3 and 5-16B. Subsequently, GHD conducted a confirmation drilling event during November 2014 that concentrated on this area. Findings from the assessment indicated that the majority of the hydrocarbon mass appears to be located in the vicinity of monitor well 5-35B and the air sparge wells (see Figures 2, 3, and 4).

1.1 November Subsurface Assessment

The November 2014 drilling found that the depth to groundwater is approximately 55 to 60 feet below ground surface (bgs). The soil type observed in soil samples and drill cuttings collected from ground surface to approximately 40 feet bgs consisted primarily of reddish brown sand with silt and sandy clay. GHD observed hard drilling at approximately 40 feet bgs in borings B-1, B-2, and B-3 (Figure 2). It is possible that this may consist of a localized caliche layer.

Between 55 and 60 feet bgs, soils consisted primarily of sand to sandy clay. Trace to minor gravel was observed just above the shale at the top of the Chinle Formation (Chinle), encountered at 60 feet bgs. This interval was observed to be moist to damp but not saturated. Below the gravel, the Chinle appeared to be hard, dry, red clay with blue mottling.

Soil analytical data and field screening readings indicate that the majority of petroleum hydrocarbon concentrations were present in the upper portion of the Chinle and three to four feet of soil above this formation. Cross sections of the Site are provided as Figures 3 and 4.

A review of groundwater fluctuations and phase separated hydrocarbon (PSH) thickness suggests that there may be trapped free phase hydrocarbons below the water table. Evidence of this was observed during initial groundwater sampling events conducted by GHD in April 2014. While gauging monitor well 5-2C with an interface probe, the presence of PSH was not indicated.

However, during the attempted low-flow sampling of this well, PSH were observed in the discharge tube of the sampling system. GHD duplicated this result with a pumping test performed during November 2014. During gauging activities, PSH was not detected in monitor well 5-02C. However, during pumping activities, an eighth-inch thick sheen was observed in the purge bucket. The well went dry after approximately 2 gallons had been pumped out of the well. After pumping, the well was allowed to recharge for approximately one hour. After recharge, the well was gauged again, at which time a 0.72 foot thick layer of PSH was detected.

1.2 Proposed Site Remediation

The Site has been in active assessment and remediation since 1989. Remediation systems that were installed at the site include:

- Soil vapor extraction (halted in 2012)
- Air sparging (compressor never installed)
- Pump and treat (halted)

Current soil and groundwater data indicate that the above listed remediation techniques were not effective. GHD had proposed the use of mobile dual phase extraction (MDPE) pending confirmation of drilling results. However, after discussions with GHD's Innovative Technology Group (ITG), it was felt that the November 2014 drilling data indicated that chemical oxidation would be a more effective option for remediation than MDPE for the following reasons:

- MDPE will be limited in its effectiveness due to the relatively thin (3 to 4 feet thick) impacted zone that overlies the Chinle;
- The chemical oxidant could be injected into existing air sparge and monitoring wells, reducing the cost of remediation;
- The relatively thin (3 to 4 feet thick) impacted zone will reduce the amount of chemical oxidant required;
- Chemical oxidation would have a better chance of remediating the surface and shallow fractures found in the Chinle; and
- The relatively impermeable Chinle will act as a lower confining unit for the chemical oxidant and help to spread the material throughout the more permeable impacted zone above the Chinle.

The use of chemical oxidation may include an increase in sulfate and total metals in the groundwater. GHD will discuss this and any other potential issues with the NNEPA and NMOCD and obtain approval from these agencies prior to moving forward.

Based on this information, GHD proposes to evaluate the effectiveness of chemical oxidation in a phased approach. The phases would consist of:

- Phase 1: Collect subsurface samples and submit for bench scale testing;
- Phase 2: Pilot test in localized area to assess effectiveness; and
- Phase 3: Full scale implementation and monitoring.

The tasks to be performed under Phase 1 would consist of:

- Preparation of a work plan to be submitted to the NNEPA and NMOCD for their approval;
- Collection of one groundwater sample and one soil sample for analysis of a bench-scale chemical oxidation injection feasibility;
- Conduct a bench-scale feasibility study;
- Conduct annual groundwater sampling;
- Collect a waste characterization sample and dispose of three carbon vessels remaining onsite; and
- Prepare a report of findings.

2. Proposed Scope of Work

Based upon review of the existing site data, our understanding of the various regulatory programs and conversations with ETC personnel, GHD has prepared the following scope of services.

2.1 PHASE I: Work Plan Preparation and Discussions with NNEPA and NMOCD

Bench-scale Feasibility Study

GHD proposes to conduct a bench-scale groundwater treatability study to assess the viability of a sodium persulfate injection to reduce the petroleum hydrocarbon concentration.

Monitor wells 5-02C, 5-16B, 5-35B, and soil vapor extraction well SVE-3 will be gauged using an oil/water interface probe and the data recorded. A down-hole pump will be installed in each of the monitor wells, and at least three well volumes of groundwater will be purged from each well prior to sampling. Groundwater samples will be packed on ice and shipped under chain of custody to the GHD ITG group located in Niagara Falls, NY.

In order to obtain a soil sample for the bench-scale analysis, GHD will oversee the advancement of one soil boring to the water table. The boring will be installed using a hollow stem auger drill rig. The boring will be placed in the vicinity of the historical soil concentrations. The boring will be advanced to a depth of 58 feet bgs, at which point one sample will be collected using a modified California sampler. Cuttings will be logged according to the Unified Soil Classification System. The soil sample collected will be packed on ice and shipped under chain of custody to the GHD ITG group.

A project kickoff meeting will be held prior to any drilling activities to brief the contractor employees on site conditions and discuss safety aspects. The project HASP, applicable JSAs, and stop work authority will be reviewed and discussed. Tailgate safety meetings will be conducted daily at the beginning of the day and as conditions change.

Prior to drilling activities, New Mexico One Call will be contacted to help locate subsurface utilities on the project. In addition, GHD will coordinate drilling activities with on-Site staff to have them review the drilling locations for the presence of subsurface utilities.

Once at the ITG laboratory, the samples will be visually examined on arrival at the laboratory. The soil and groundwater samples will be analyzed for:

1. pH
2. Volatile organic compounds
3. Total and dissolved metals
4. Ammonia nitrogen
5. Orthophosphate phosphorus
6. Dehalococoides presence/absence by Polymerase Chain Reaction

The analytical results will provide a characterization of baseline conditions for the treatability study.

Annual Groundwater Sampling

GHD will perform an annual groundwater monitoring event to monitor ongoing conditions at the Site. An oil/water interface probe will be used to measure groundwater depths and check for the presence of LNAPL in each of the Site monitor wells. Before and after each use, the oil/water interface probe will be cleaned with an Alconox®/de-ionized water solution and rinsed with de-ionized water. Monitor wells will be purged and sampled using a dedicated, disposable polyethylene bailer. Field parameters including groundwater temperature, pH, total dissolved solids, conductivity, and oxidation/reduction potential will be collected using an appropriate multi-parameter sonde. The wells to be sampled will include monitor wells 5-02C, 5-06C, 5-16B, 5-18B, 5-20B, 5-35B, 5-59, and soil vapor extraction well SVE-3.

Following collection, groundwater samples will be labeled, placed on ice, and submitted to Hall Environmental Analysis Laboratory for analyses of benzene, toluene, ethylbenzene, and total xylenes (collectively BTEX) by EPA Method 8260. The information obtained from this sampling will be included in the 2015 Annual Report.

The purge water will be sampled for the presence of PCBs. If laboratory analyses do not indicate the presence of PCBs, the water will be disposed of in the oil waste water tank used for facility processes. If the analytical results show evidence of PCBs in the pumped water, the water will be containerized and stored on site with proper labeling until an ET-approved waste facility is contracted to accept the waste water.

GHD appreciates the opportunity to work with NNEPA and NMOCD on the assessment and closure of the Thoreau project. Please feel free to contact Bernard Bockisch at 505-884-0672 if you have questions or comments

Sincerely,

GHD



Cassie Brown
Geologist/ Project Coordinator



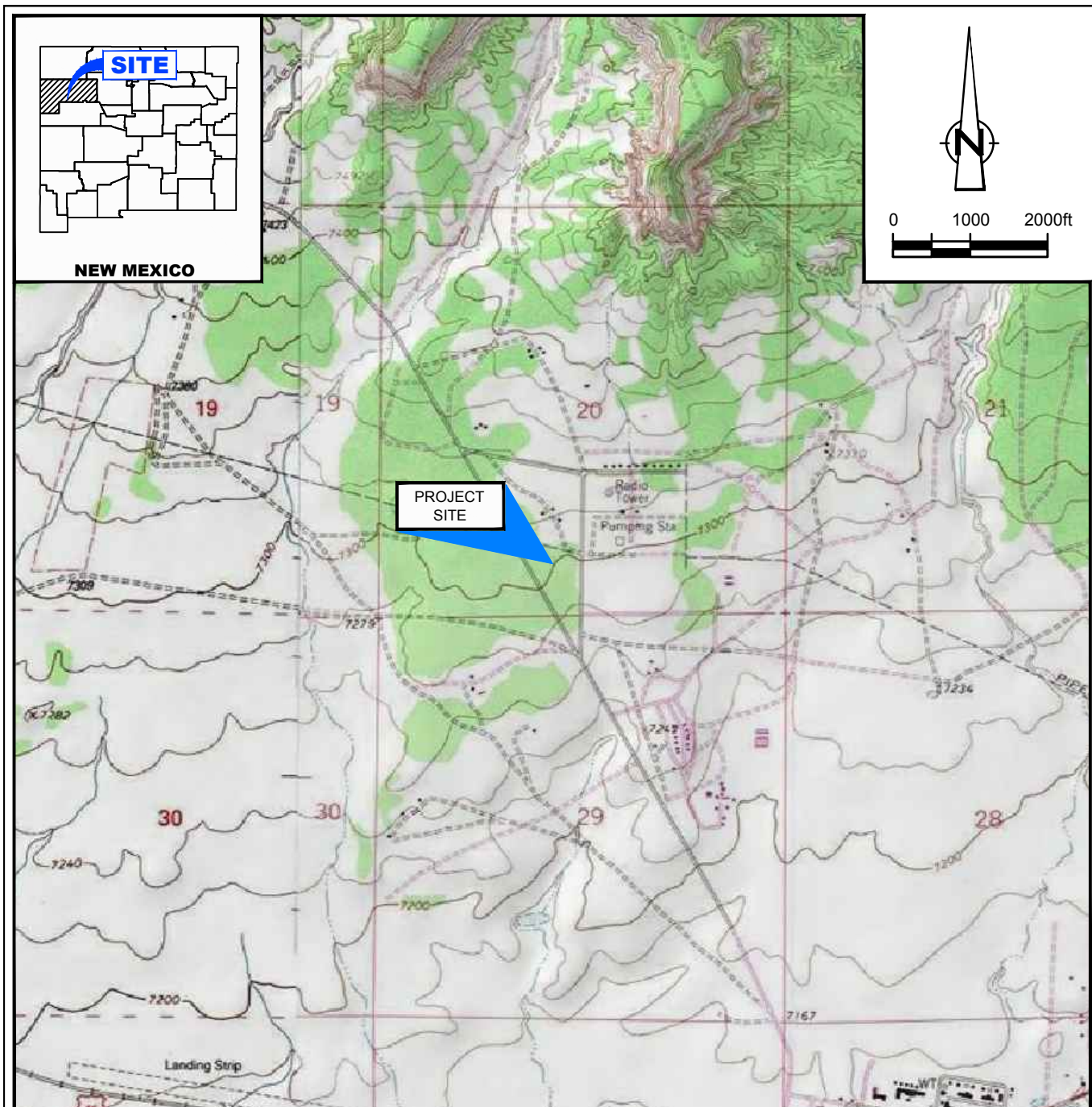
Bernard Bockisch, PMP
Senior Project Manager

CMB/mc/1

Encl. (4)

cc:

Figures



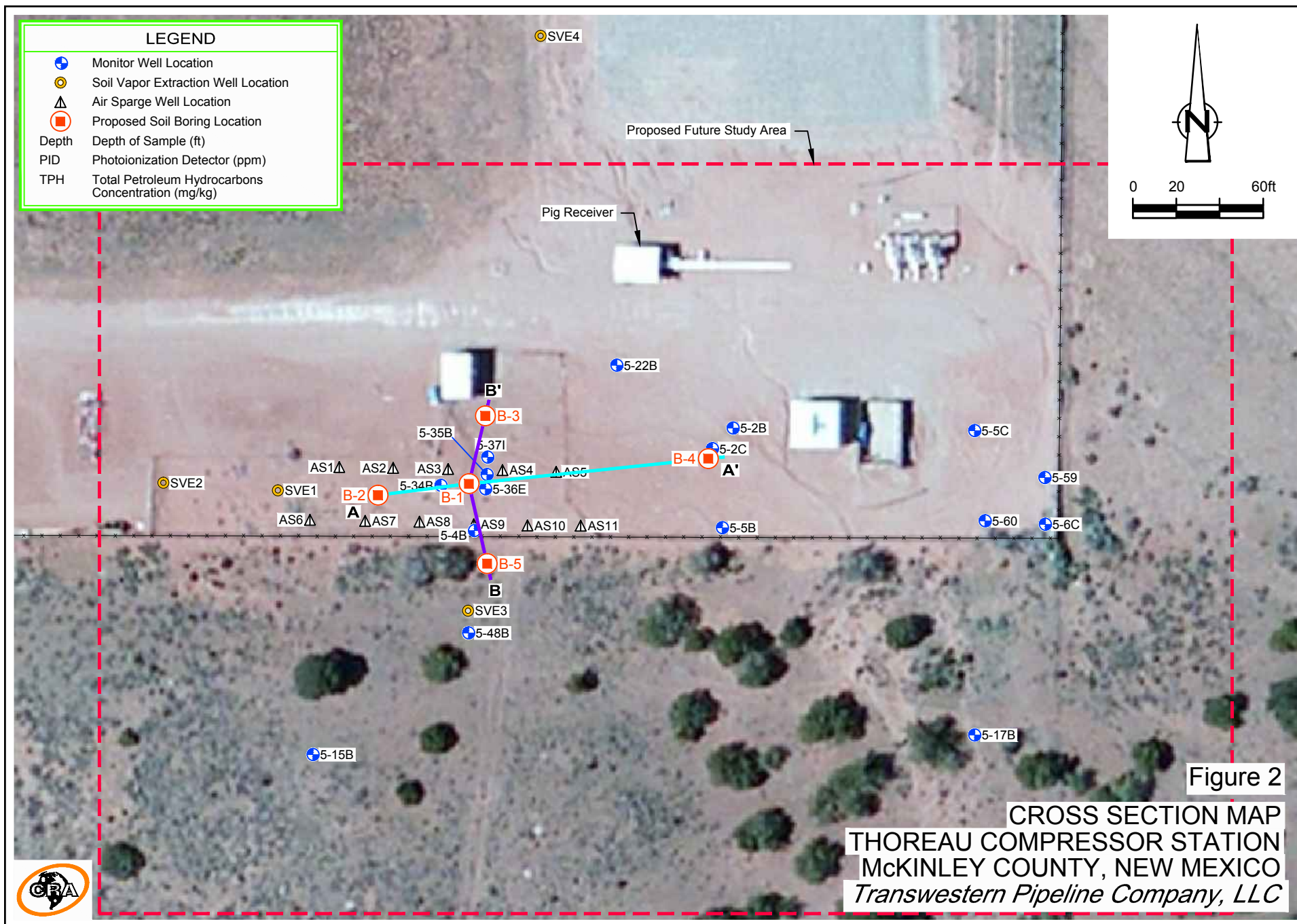
SOURCE: USGS 7.5 MINUTE QUAD
 "BELL LAKE AND TIP TOP WELLS, NEW MEXICO"

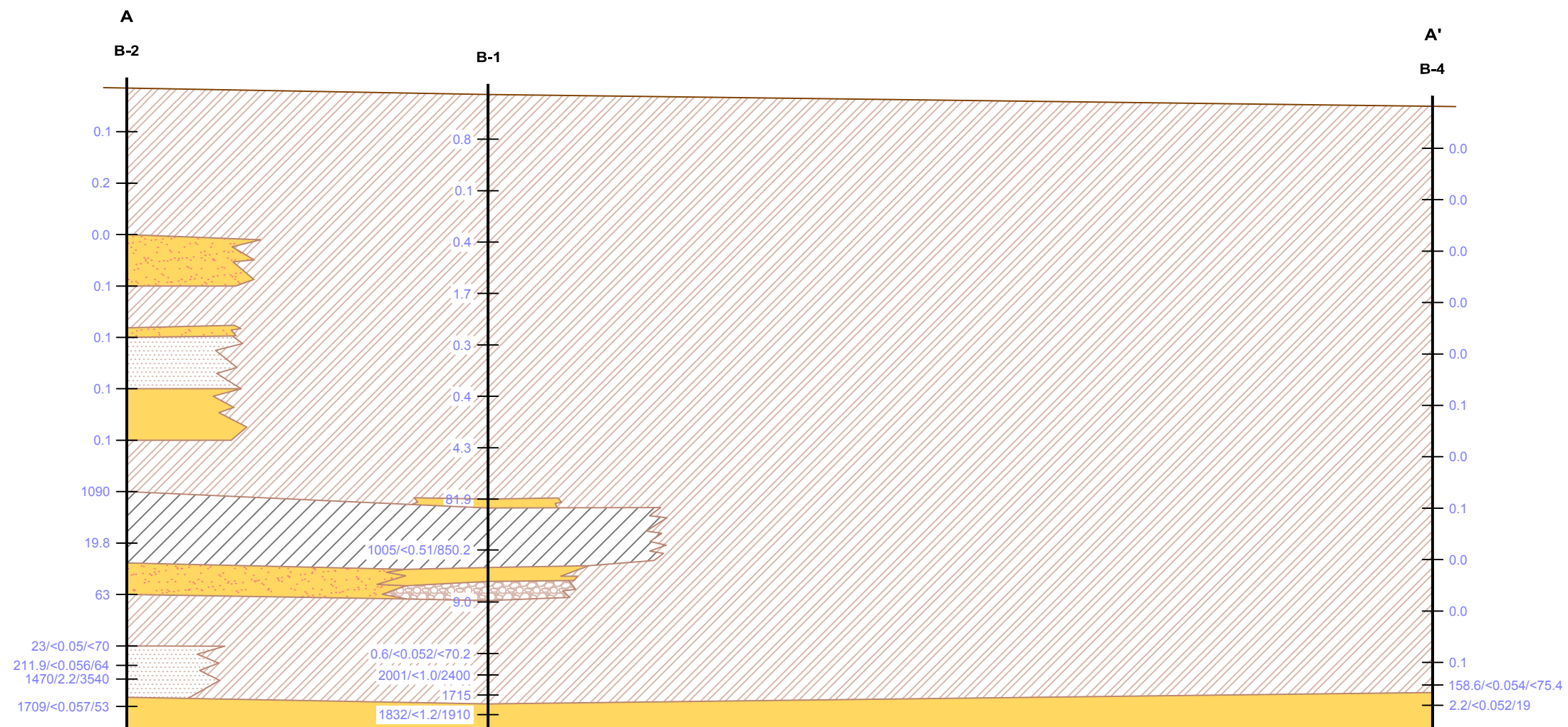
LAT/LONG: 35.4262° NORTH, 108.2360° WEST
 COORDINATE: NAD83 DATUM, U.S. FOOT
 STATE PLANE ZONE - NEW MEXICO WEST

Figure 1

SITE LOCATION MAP
 THOREAU COMPRESSOR STATION
 MCKINLEY COUNTY, NEW MEXICO
Transwestern Pipeline Company, LLC







NOTE:

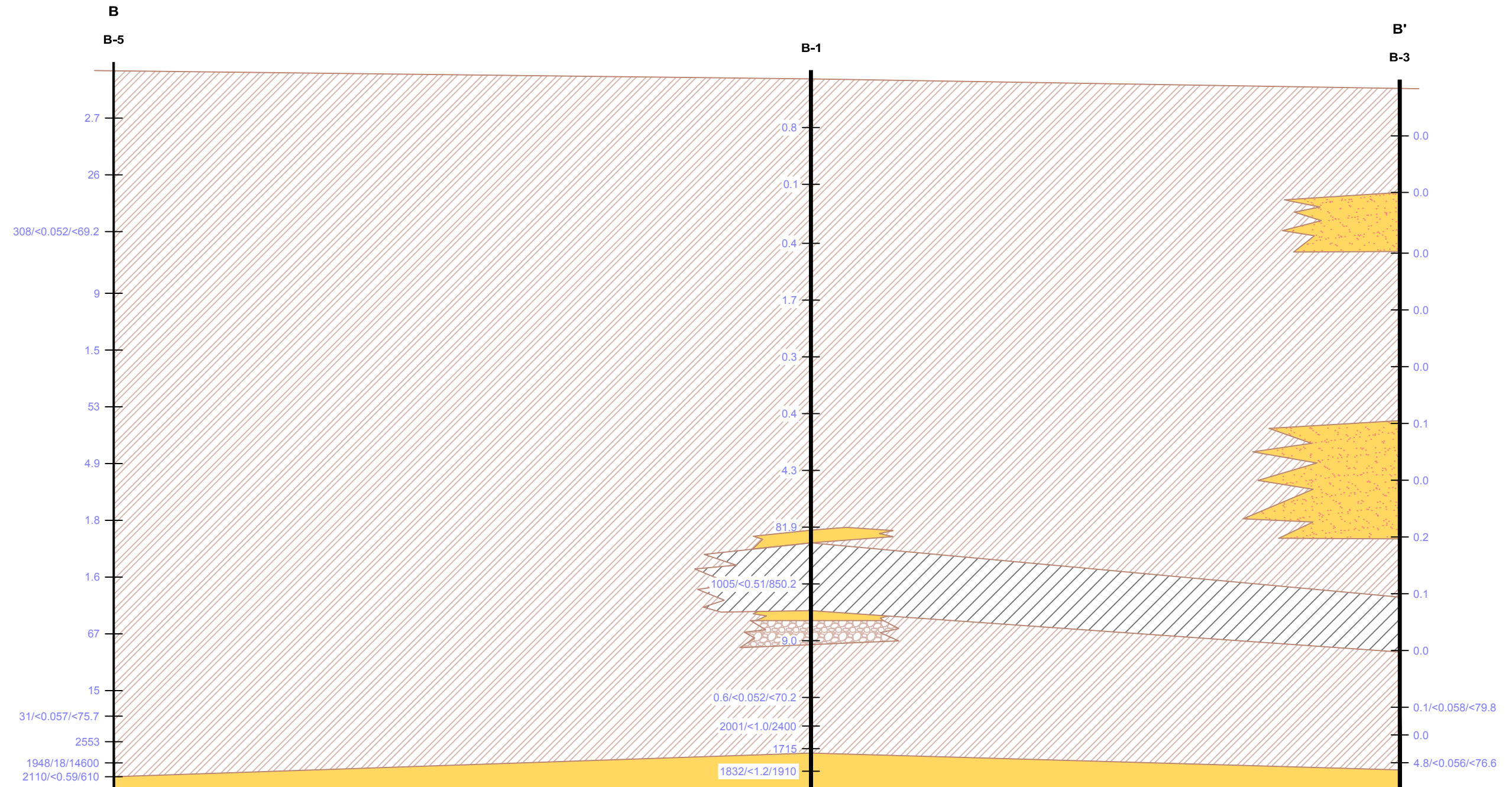
1. Sample locations from top to bottom in feet BGS are 4', 9', 14', 19', 24', 29', 34', 39', 44', 49', 54', 56', 58', 60'.

LEGEND	
110	PID Concentrations (ppm)
1709/<0.057/53	PID (ppm)/Benzene (mg/kg)/Total TPH (mg/kg)
	Encountered Hard Drilling - Potential Caliche
	CL
	SC
	ML
	GM
	SW/SP/SM

Vertical Scale: 1" = 20'
Horizontal Scale: 1" = 40'



Figure 3
CROSS SECTION A-A'
THOREAU COMPRESSOR STATION
McKINLEY COUNTY, NEW MEXICO
Transwestern Pipeline Company, LLC



LEGEND	
110	PID Concentrations (ppm)
2110/<0.59/610	PID (ppm)/Benzene (mg/kg)/Total TPH (mg/kg)
	Encountered Hard Drilling - Potential Caliche
	CL
	SC
	GM
	SW/SP/SM

Vertical Scale: 1" = 10'
Horizontal Scale: 1" = 10'

NOTE:

1. Sample locations from top to bottom in feet BGS are 4', 9', 14', 19', 24', 29', 34', 39', 44', 49', 54', 56', 58', 60'.

Figure 4
CROSS SECTION B-B'
THOREAU COMPRESSOR STATION
McKINLEY COUNTY, NEW MEXICO
Transwestern Pipeline Company, LLC

