1.0 Executive Summary

SKA Consulting, L.P. (SKA) was retained by Linn Operating, Inc. (LINN) to complete the site assessment at the Turner B South Tank Battery (Site) located at Section 29, Township 17 South, Range 31 East near Loco Hills in Eddy County, New Mexico (***Figure 1***). This Site Investigation Report summarizes the results of that assessment and provides an Abatement Plan in accordance with New Mexico Administrative Code 20.6.2.4106.

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

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

The BLM determined the release impacted previously documented cultural resources. Since the site and produced water release lie within federal lands managed by the BLM Carlsbad Field Office (CFO), an Archeological Data Recovery Plan was first required by the BLM as part of any future environmental site assessment and/or remediation efforts. Therefore, in March 2013 an Archeological Data Recovery Plan was prepared for the site and submitted to the BLM-CFO for review and approval. SKA received confirmation from the BLM (Mr. Martin Stein) on July 23, 2013 that the Plan had been approved. Specifically the BLM approval cited a review of the report *"Archaeological Data Recovery Plan for LA 117293 and LA 171726, Linn Energy Turner "B" South Tank Battery Produced Water Release Cleanup, Eddy County, New Mexico,"* has been completed. This report was reviewed by the BLM Data Recovery Review Team and a copy was provided to the seven Indian tribes and pueblos that have ancestral ties to land within the Carlsbad Field Office boundaries. No major questions or criticisms of the plan were raised by any of the reviewers. As a result, the required permit for an archeological investigation to run concurrent with environmental site assessment and/or remediation activities was then requested from the BLM under the Archaeological Resources Protection Act (ARPA). A Cultural Resource Use Permit (Permit No. 110-8152-13-6) was then issued by the BLM on July 24, 2013 (expiration date: December 31, 2014).

In August 2013, SKA completed a site assessment by installing twenty-six (26) soil borings (SB-1 through SB-26) at the site in an effort to assess the magnitude and extent of soil impacts from the October 2012 produced water release. The sampling locations are shown on ***Figure 3***. A total of twelve soil borings were installed within the limits of the produced water release as previously mapped by the BLM to assess the magnitude of impacts and obtain vertical delineation, while fourteen soil borings were installed beyond the extent of the produced water release as previously mapped by the BLM for the purpose of horizontal delineation. SKA selected a total of fifty-nine (59) soil samples to be analyzed in the testing laboratory for selected chemicals of concern (COCs) including total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, and total xylenes (BTEX); and/or chlorides.

Based on the New Mexico OCD *Guidelines for Remediation of Leaks, Spills, and Releases*, the risk ranking for the Turner B South Tank Battery is a zero (0) based on a depth to groundwater of over 100 feet, no water sources within 1,000 feet, and no surface water bodies within 1,000 feet of the Turner B South Tank Battery. Based on this ranking, benzene would have a soil remediation action level of 10 milligrams per kilogram (mg/Kg); BTEX would have a soil remediation action level of 50 mg/Kg; and total petroleum hydrocarbons (TPH) would have a soil remediation action level of 5,000 mg/Kg. In its guidance, the OCD does not publish chloride remediation action levels for various risk rankings. Based on the low risk ranking for the site, SKA recommends a site-specific chloride remediation action level of 1,000 mg/kg to the OCD.

Based on the analytical testing results, a vast majority of the soil samples reported TPH concentrations below the laboratory's sample detection limit (SDL). Only two soil samples reported TPH concentrations above the OCD remediation action level of 5,000 mg/Kg. Nearly all of the soil samples reported detectable chloride concentrations in soil; however, only twelve soil samples reported concentrations above 1,000 mg/Kg (site-specific soil remediation action level). Based on field screening results and TPH analysis, six selected soil samples were further analyzed in the testing laboratory for BTEX. All of the soil samples selected for BTEX analysis reported concentrations below their respective laboratory SDLs with the exception of two soil samples; however, both samples reported concentrations well below the OCD remediation action levels of 10 mg/Kg for benzene and 50 mg/Kg for total BTEX.

SKA obtained delineation of chlorides in soil to a concentration of 1,000 mg/Kg and ultimately, less than 250 mg/Kg in all areas outside the tank battery except for one soil boring location. In addition, SKA obtained delineation of TPH in soil to a concentration of 5,000 mg/Kg. As a result, only three areas of concern (AOCs) were identified at the site where chloride and TPH concentrations were reported in shallow soil above OCD regulatory standards and/or guidelines:

- AOC No. 1: SB-1, SB-3, and SB-5 (Chlorides; uppermost 10 feet);
- AOC No. 2: SB-7 and SB-8 (Chlorides; uppermost 5 feet); and
- AOC No. 3: SB-4 (TPH; uppermost 2 feet)

Based on these findings, SKA concludes that corrective actions are warranted at the site.

The proposed Abatement Plan is to remove, for off-site disposal, the soil that is most highly impacted by chlorides and TPH in proximity to the tank battery. Since the tank battery is still currently active, no corrective actions (i.e., soil abatement) will occur within the limits of the secondary containment berms at the tank battery. Only those impacts to soil reported beyond the secondary containment berms at the tank battery are addressed in this Abatement Plan.

SKA proposes a total of three excavations will be required at the site, located at AOC Nos. 1, 2, and 3. The depths of the excavations will vary from 5 to 10 feet below ground surface (ft-bgs) in selected areas with elevated chloride concentrations in soil (>1,000 mg/Kg), and only 2 ft-bgs in the one area with an elevated TPH concentration in soil (>5,000 mg/Kg). The proposed soil abatement will be a typical “dig and haul” operation using a hydraulic excavator, rubber-tired loader, and belly-dump or end-dump trucks. Confirmation soil samples will be collected from the excavations (AOCs) and analyzed in the testing laboratory to confirm attainment of respective soil cleanup standards. The excavated soil will be transported off-site for disposal at an OCD-approved or permitted facility. The open excavations will then be backfilled and machine compacted to surrounding grade with similar imported select-fill soils.