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# WORKPLANS

Date:
4-9-10

**Hansen, Edward J., EMNRD**

**From:** Bob Lang [bobl@chaparralenergy.com]
**Sent:** Wednesday, June 16, 2010 4:48 PM
**To:** Hansen, Edward J., EMNRD
**Subject:** Gladiola SWD System, Eddy County, NM Proposal
**Attachments:** 20100409 Chaparral Gladiola SWD Investigation Proposal.doc

Mr. Hansen,

Attached is a copy of a letter from Mike Griffin, Whole Earth Environmental, regarding what they propose to do to delineate the problems on the Gladiola SWD System. Our Legal Department wanted you to see it and possibly comment on it if you see anything amiss. As soon as Chaparral obtains the right to start work on the system we propose to have Mike and company move in and start. Either he or I, or both, will call you ahead of time to let you know when we start.

Sincerely,

Bob Lang

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April 9, 2010

Mr. Robert Lang
Chaparral Energy Co., LLC
701 Cedar Lake Blvd.
Oklahoma City, OK 73114

**RE: Produced Water Leaks, Gladiola Salt Water System,**
**Kinsolving North, Kinsolving South, Burris 2, Burris 3, Burris 4, Burris 5 and Burris Central, Eddy County, New Mexico**
**Proposed Sampling Plan to Evaluate Impact on Range Land**

Dear Mr. Lang:

This letter is intended to provide you with a proposed work plan and cost proposal to investigate the quality of soil and shallow groundwater impacted by the produced water leaks onto the subject property listed above. The volume of water leaked at each location is unknown. While it's possible to ascribe acreage of impact to surface soils associated with some of the seasoned spills, such as the Kinsolving North site and the Burris #3, the degree of impact and effort required to restore the property is much more difficult to assess. Investigative work has been done at the Kinsolving North, Kinsolving South and the Burrus #4 leak sites. The impact area at these sites has been estimated at 1.4 acre, 0.46 acre and 0.54 acre, respectively. No investigative work has been done at the other locations. The spill footprint for the Burrus #3 was estimated from aerial photography at 1.6 acre. There are no dimensions available or that can be readily discerned from aerial photography (due in part to complications associated with other site features including land use or the recent nature of the spill) for the Burris #1, Burrus #2, Burrus #5 or Kinsolving Central. Site GPS coordinates are listed in Table 1, with the locations shown graphically in Figure 1.

## Kinsolving North

Land resources impacted by the produced water spills were identified from the Lea County Soil Survey available from the Natural Resource Conservation Service (NRCS) soil survey website. Soils at the Kinsolving North location are identified as Stegall and Slaughter soils (Figure 2). Both soils are classed as Petrocalcic Paleustolls. The main difference is the depth to indurated caliche. Stegall loam soils have a root zone ranging from 20 to 40 inches in depth. Slaughter loam soils are shallower with the depth to indurated caliche defining the root zone at about 15 inches. Stegall soils make up about 40 percent of the mapping unit with about 15 percent inclusions as a silty clay loam. Slaughter soils make up about 35 percent of the mapping unit. Minor inclusions of other soils make up about 10 percent of the unit.

Areas are typically either Stegall and similar soils or Slaughter and similar soils. Both soils are well drained, with moderately slow permeability above and below the very slowly permeable petrocalcic horizon. Construction and burial of the pipeline disrupts this feature and increases the potential for vertical migration of salt in the vicinity of the pipeline. The investigation at this site suggested that the more recent spill event impacted about 0.7 acres within the historic 1.4 acre spill area. The mass of salt and sodicity were identified as limitations requiring treatment. Extreme variability in chloride between sample locations with depth reflects the need for additional samples to evaluate soil quality and potential impact on shallow groundwater. The greatest concern is the lack of data between 1 and 5-ft.

**Burrus #4**

The land impacted by the release of produced water at this site was identified from the Lea County Soil Survey as a Kimbrough-Lea complex (Figure 3). Soils are mapped as a complex when two or more kinds of component soils are too intermingled to differentiate at the normal soil mapping scale of 1:24,000. Kimbrough gravelly loam soils (Ustic Petrocalcids) make up about 50 percent of the unit. Lea loam soils (Petrocalcic Paleustolls) comprise about 30 percent of the unit. The complex has about 20 percent inclusions of Stegall loam (Petrocalcic Paleustolls), Arvana fine sandy loam (Petrocalcic Paleustalfs) , Slaughter loam (Petrocalcic Paleustolls) and Sharvana fine sandy loam (Ustic Petroargids) soils. Kimbrough soils are very shallow underlain by indurated caliche at a depth of 6 to 16 inches. Lea soils are deeper with the petrocalcic horizon between 20 and 40 inches. The common feature in the minor soils is the petrocalcic layer. Kimbrough and Lea soils do not have an argillic horizon and contain less than 35 percent clay. Kimbrough and similar soils are difficult to reclaim after disturbance owing to the shallow profile and rock. Salt spills to this soil are a complicating factor and are very difficult to reclaim. Characterization done to date is inadequate both in terms of quantity and quality. A review of the data generated for shallow borings at this site suggests that sodium is under reported by several orders of magnitude.

It was determined that the land resource at the other Burrus locations is mapped as a Kimbrough-Lea complex. There have been no site investigations conducted at the other Burrus leak sites.

**Kinsolving South**

The land resource at the Kinsolving south leak site was identified from the Lea County Soil Survey as an Arvana-Lea association (Figure 4). Arvana loam soils (Petrocalcic Paleustalfs) make up about 45 percent of the map unit, Lea loam soils (Petrocalcic Paleustolls) about 40 percent of the map unit with about 15 percent minor soil inclusions. The main difference in these soils is the Arvana has an argillic horizon and an ochric rather than mollic epipedon. A review of chloride data at this site show considerable variability between sample locations and reflect the need for more samples. There is no data presenting the speciation of ions and distribution of sodium necessary to evaluate soil quality. Also there is no information regarding salt distribution with depth apart from one boring constructed to 3-ft and another to 4-ft.

The Kinsolving central location is a new site located approximately 600-ft northeast of the Kinsolving south. The Lea County Soil Survey shows the part of the Arvana-Lea association. There is no other information available on this site

## SCOPE OF WORK

The most significant chemical parameter associated with produced water that potentially impacts soils and intended land use is salt. Typically the salt is sodium chloride which can impact soils from an osmotic affect robbing plants of available moisture, causing a breakdown in soil structure or causing nutrient imbalances by flooding the soil solution with sodium. Electrical conduction in soils is primarily through the pore water because soil minerals are effectively insulators and conduct small but constant amounts of current. Salts spilled to soils increases the concentration of solutes in the pore water and thus the electrical conductivity of the soil. Remote sensing instrumentation that can measure soil electrical conductivity is ideally suited to defining those areas that are different than background and delineating gradients (areas of different concentration).

Electromagnetic induction (EM), specifically the Geonics EM-38 is a remote sensing device that can measure salt in the soil from surface to a depth of 5-ft when placed at ground level in vertical configuration. This same instrument is used to measure salt in the soil from the surface to a depth of 2.5-ft when placed on the ground in horizontal configuration. It should be noted that the EM-38 device measures profile conductivities similar to the way plants extract moisture and salt from soils. The EM-38 reading in the vertical mode is readily correlated to a profile EC calculated from saturated paste EC values.

The Geonics EM-31 tool provides a means of accessing the electrical conductivity of the entire volume of soil in a survey area to a depth of 20-ft when placed at ground level in the vertical configuration and to a depth of 10-ft when placed on the ground in the horizontal configuration. Contour maps are prepared from the readings to chart salinity in soil profile and establish both vertical and horizontal distributions within the survey area. Contour plots also serve as a guide to place soil borings necessary to ground truth remote sensing instrumentation and to direct the placement of deep soil borings and if indicated monitoring wells to evaluate the quality of shallow groundwater. The resulting maps also serve as a field guide in remedial action plans where different treatments or a gradation of treatments are indicated. Although soil borings have been constructed and samples collected at the Burrus #4, Kinsolving North and Kinsolving South locations the magnitude of the variability in chloride levels with depth and between sample points within a given site point to uncontrolled variability and a high probability that the extremes and depth of occurrence are not known. There have been no investigations conducted at the Burrus 2, Burrus 3, Burrus 5 and Burrus Central locations.

### Proposed Soil Sampling and Laboratory Program

It typically requires a minimum of 5 soil borings to provide a sufficient data base to correlate EM-38 values and profile EC. Boring locations are selected to provide a range of values from high to low. The low is usually the background location used to set the instrument. Borings used to correlate the EM-38 device will be constructed to a total depth of 5-ft. Discreet samples will be collected in 1-ft intervals and placed in 'zip loc' bags labeled as to location, depth interval, date and time. Samples will be transported under chain of custody to Texas A & M University Soil, Water and Forage Testing Laboratory located in College Station, Texas.

Samples will be analyzed for detailed salinity parameters including pH, EC, sodium, potassium, calcium, magnesium and chloride using a 1:1 soil:water extract. The report includes the sodium adsorption ratio (SAR) which can be used to estimate the exchangeable sodium percentage (ESP). Additionally, samples will be analyzed for routine fertility parameters including plant available nitrogen, phosphorus, potassium, calcium, magnesium, sodium and sulfur.

A minimum of 3 deep borings will be constructed at each site corresponding to the area yielding the highest EM-31 vertical response value, the area corresponding to mid range values and in the area corresponding to the low range values. Discreet samples will be collected at intervals of 0-1 ft, 4-5 ft, 9-10 ft, 14-15 ft and 19-20 ft.

A portion of the 19-20 ft interval and two other depth intervals from each deep boring will be titrated in the field for chlorides using a 1:1 soil:water by volume extraction technique. These analyses will be compared to EM response values to determine if additional deep borings are necessary to manage site variability or if borings need to be advanced deeper to properly characterize subsurface conditions including potential impact to shallow groundwater. These borings will not go to water. Groundwater monitoring wells may be installed at a later date after a review of all the data.

**Data Interpretation and Report**

The results of the field and laboratory program will be presented in a narrative report to Chaparral for each site and will include conclusions and recommended remedial action to restore the land to its intended use, comparable to the speciation and percent ground cover for similar soils in the pipeline corridor not impacted by leaks. Revegetation on disturbed Kimbrough-Lea complex soils is difficult without the complications of excess salt because of high temperatures, restricted root zone and insufficient precipitation during the growing season. The goal is to achieve an acceptable restoration while minimizing the removal of native soil material.

## SCHEDULE

The work described in this plan can be scheduled within a matter of days following approval by Chaparral. The proposed field work will vary depending on the size of the site. It is anticipated that the EM-survey data will be processed in the field to allow for the location of shallow and deep boring. The construction of borings and sample collection will commence soon after the location is selected. All shallow borings will be constructed and samples collected at a given site before starting on the deep borings. It is anticipated that the laboratory work will require between 10 and 15 working days to complete. The report correlating the EM-38 survey and laboratory sample results and proposed remedial action will be submitted to Chaparral within 20 working days following receipt of the laboratory test results. More time may be necessary to negotiate performance criteria with the NMOCD and the affected land owner regarding groundwater if it is an issue.

Costs to implement the proposed site investigation are detailed in the attached cost proposal:

Warmest personal regards,

Mike Griffin
President
Whole Earth Environmental, Inc.