A SITE INVESTIGATION REPORT

CHAPARRAL ENERGY, LLC
Gladiola Salt Water Disposal System
NW1/4 SW1/4 Section 19, T12S, R38E

Houston No. 1-A SWD and Tank Battery
ACO-271

Submitted to:

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

The purpose of this Executive Summary is to present the findings of the site investigation conducted by Whole Earth Environmental, Inc. (Whole Earth) on behalf of Chaparral Energy, LLC (Chaparral) at the Houston No. 1-A SWD and tank battery (Houston SWD) associated with the Gladiola salt water disposal system. The site is located in the NW1/4 SW1/4 Section 19, T12S, R38E of Northern Lea County about 350 feet east of Shults RD and about 0.5 mile north of US Hwy 380 at the approximate latitude 33.26355 N and longitude 103.14424 W (Figure 1).

The land resource at the Houston SWD was identified from the Lea County Soil Survey as a Kimbrough-Lea complex (Figure 2). Kimbrough gravelly loam (Ustic Petrocalcids) makes up about 50 percent of the map unit, Lea loam (Petrocalcic Paleustolls) makes up about 30 percent of the map unit, with 20 percent minor inclusions of Stegall loam (Petrocalcic Paleustolls), Arvana fine sandy loam (Petrocalcic Paleustalfs), Slaughter loam (Petrocalcic Paleustolls) and Sharvana fine sandy loam (Petrocalcic Paleustalfs). All of these soils are underlain by indurated caliche that restricts root penetration. Web Soil Survey information presented in Appendix A and in surface photographs presented in Appendix B.

Field and Laboratory Program

Whole Earth began the field work for the site investigation on June 25, 2011 to determine the lateral and vertical extent of salt contaminates, assess the impact on soil quality and develop a remediation plan if necessary. Salt was identified as the principal constituent of concern based on the fact the Houston SWD functions to collect and dispose of salt water produced by active oil wells serviced by the system. Tanks were relocated from north side of the facility to the south side. This process included the removal of obsolete equipment and flow lines exposing surfaces that had been subject to occasional tank overflows, leaks and spills by the previous operator.

The initial work element performed at the Houston SWD was to conduct an EM-38 survey. The EM-38 device positioned on the ground and read in the vertical mode provides for the remote sensing of large volumes of soil to a depth of 5 feet with a response weighted similarly to the way plants take up water and salt from soil. There was too much metal interference at the location to conduct an EM-31 survey which typically allows for vertical distribution evaluation to a depth of 20 feet when read in the vertical mode. In lieu of an EM-31 survey soil borings were constructed to a depth ranging from 20 to 25 feet. EM-38 survey results were reviewed and 4 soil boring locations selected to provide a range of EM-38 response values as represented of the location (Table 1).

Soil borings were constructed initially using a hollow stem auger to a depth of 6 feet, collecting samples in 2-ft intervals with a stainless steel split spoon. The hole was advanced after 6 feet using a solid stem bit and air to lift the cuttings. The hole was drilled to the respective sample depth, cleaned out with air then advanced to the desired depth collecting the discreet sample as returns using a fine mesh basket. All samples were analyzed in the field for chloride and screened for volatile organics using a hand held PID vapor analyzer. Samples were also analyzed for electrical conductivity (EC) using a 1:1 soil:water extract. Additionally, 4 sample intervals (B1 0-2 ft, B1 22-22.3 ft, B3 23-23.5 ft, B4 24-24.4 ft) were collected into 8-oz glass jars, placed on ice and delivered to Cardinal Laboratories in Hobbs, NM for chloride (Cl) confirmation using Standard Method 4500 Cl-B and total petroleum hydrocarbon (TPH) fractions C6-C10 (gasoline range organics, GRO) and >C10-C28 (diesel range organics, DRO) using EPA Method 8015M.

Results and Discussion

The EM-38 salinity contour map is presented in Figure 3. This data shows two anomalous high areas >200 mS/m. The one on the north end corresponds to the old tank battery location and the one east of the SWD well head corresponds to a recent spill site. Soil borings were constructed at the locations listed in Table 1 and shown graphically in Figure 4 to evaluate both the vertical extent of contaminants and soil quality with respect to the potential post closure root zone. EM-38 response contours correspond reasonably well with the analytical test results summarized in Table 2 and presented in Appendix B. Comparative analyses between field and laboratory tests are given in Table 3.

The boring identified as B1 in Figure 4 was located just outside of a boot cellar used by the previous operator of the Gladiola salt water gathering system as a vent on a daily basis. Test results shown in Tables 2 and 3 reflected a significant increase in salinity for the 10-12 ft depth interval with elevated values extending to the 22-22.3 ft sample interval. TPH as both GRO and DRO were also detected in the 22-23.3 ft sample interval. Salinity levels were abruptly lower in the next sample interval collected from 24-25 ft. In order to compare EC readings to the water-uptake-weighted conductivity we first calculated the saturated paste EC from the measured 1:1 using paste moisture equivalents of 35%, 45% and 50% for the 0-2 ft, 2-4 ft and 4-6 ft sample intervals, respectively ($EC_{sat\ \theta}$, mmhos/cm = 1:1 EC x 100/paste moisture, θ). Based on water use research we can expect dryland crops to remove soil moisture in proportions of 43:21:10:6:10:10 percent corresponding to 0-1, 1-2, 2-3, 3-4, 4-5 and 5-6 ft depth intervals.[1] We calculated the profile EC using 64, 16 and 20 percent proportions

[1] Rhoades, J.D. and J.D. Oster. 1982. Solute Content. In Arnold Klute, ed. Methods of Soil Analyses. Part 1. Physical and Mineralogical Methods. 2nd ed. Agron. Monogr. 9. ASA, Madison, WI.

to reflect the current site investigation sample intervals of 0-2, 2-4 and 4-6 ft, respectively. The computing formula is as follows:

Profile EC, mmhosc/m = $0.64*EC_{sat\ \theta,\ 0\text{-}2ft} + 0.16*EC_{sat\ \theta,\ 2\text{-}4ft} + 0.2*EC_{sat\ \theta,\ 4\text{-}6ft}$

The profile EC for boring B1 was EC 8.0 mmhos/cm with a corresponding EM-38 value of 150 mS/m.

Soil boring B2 was located just east of the lease road servicing the Houston SWD (Figure 4). The EM-38 survey and test results (Tables 2 and 3) for this boring show nothing remarkable in the way of salinity or petroleum hydrocarbon at this location. The profile EC for boring B2 was EC 0.5 mmhos/cm, with an EM-38 value of 50 mS/m.

Soil boring B3 was located about 45 feet southwest of boring B1and about 42 feet northwest of the Houston SWD well head (Figure 4). Soil Cl values were generally low throughout the profile with a high value of 372 mg/kg (Tables 2 and 3). Soil EC was somewhat higher with a high of EC 3.37 in the 0-2 ft sample interval and average of EC 2.18 mmhos/cm to a depth of 12 feet. Soil EC values were essentially background below a depth of 15 feet. The profile EC for boring B3 was EC 7.7 mmhos/cm, with an EM-38 reading of 100 mS/cm.

Soil boring B4 was located about 40 feet east of the Houston SWD well head (Figure 4). Test results given in Tables 2 and 3 shows Cl and EC levels highest in the 0-2 ft sample interval, decreasing slightly in the 2-4 ft sample interval then more abruptly in the 4-6 ft and 10-12 ft sample intervals. Salinity levels were approaching background below a depth of 15 feet. It was noted that PID readings, while not high in terms of OCD action thresholds, were significant especially in the 0-2 ft sample interval and 2-4 ft sample interval compared to the results obtained for the other borings. The profile EC for boring B4 was EC 34.9 mmhos/cm with a corresponding EM-38 value of 250 mS/m.

Profile EC values were correlated statistically to the EM-38 readings. Regression analysis revealed that the data best fit a multiplicative model (Y= a*X^b) where profile EC = 0.000036382*EM-38 reading$^{\wedge 2.51273}$ with an r^2 = 92.9 percent.

TABLES

TABLE 1 – GPS COORDINATES FOR SOIL BORINGS
CHAPARRAL ENERGY, LLC
Houston No. 1-A SWD and Tank Battery

Sample Point ID	GPS Coordinate WGS84 Projection	
	Latitude	Longitude
Boring 1	33.26355415	103.14424163
Boring 2	33.26334698	103.14373694
Boring 3	33.26341863	103.14433821
Boring 4	33.26333680	103.14407185

TABLE 2 - SOIL CL AND LITHOLOGY BY SAMPLE POINT AND DEPTH
CHAPARRAL ENERGY, LLC
Houston No.1-A SWD and Tank Battery

7/28/2011								
Sample pt.	DEPTH	SOIL	WATER	CF	AGNO3	CL-	PID	SOIL LITHOLOGY
BORE 1	0'>2'	18.5	28.8	1.56	0.39	607	0.0	7.5YR-4/2 Pinkish Gray caliche, Dry
	2'>4'	16.1	27	1.68	0.56	939	0.0	7.5YR-7/4 Pink non cemented with caliche rock, Dry
	4'>6'	16.8	31.3	1.86	0.4	745	0.0	7.5YR-8/2 Pinkish white, non cemented with caliche rock, Dry
	10'>12'	14.2	27.6	1.94	2.77	5372	0.0	7.5YR-8/2 Pinkish white, caliche rock, Dry
	15'>17'	11.8	33.1	2.8	0.78	2183	0.0	7.5YR-8/2 Pinkish white, caliche rock, Dry
	22'>22'4"	18.3	27.7	1.51	1	1510	0.0	7.5YR-6/4 Light brown caliche, some rock, Very Moist
	24'>25'	15.3	28.8	1.88	0.14	263	0.0	7.5YR-6/4 Light brown gravelly caliche, some rock, Wet
7/29/2011								
BORE 2	0'>2'	19.4	27.3	1.41	0.06	84	0.0	10YR-5/2 dark grayish brown loam mixed with caliche rock, Dry
	2'>4'	13.8	25.6	1.85	0.05	92	0.0	10YR-8/2 White non cemented with caliche rock, Dry
	4'>6'	13.8	25.6	1.86	0.08	149	0.0	7.5YR-8/2 Pinkish White non cemented caliche Dry
	10'>12'	14.6	29.2	2	0.11	220	0.0	7.5YR-8/2 Pinkish white, caliche rock, Dry
	15'>17'	12.7	27.3	2.15	0.06	129	0.0	7.5YR-8/2 Pinkish white, caliche rock, Dry
	21'>22'	15.4	27.2	1.76	0.07	123	0.0	7.5YR-8/2 Pinkish white, caliche rock, Damp
BORE 3	0'>2'	13.9	25.5	1.83	0.08	147	0.0	7.5YR-4/2 Pinkish Gray caliche, Dry
	2'>4'	13.5	29.6	2.19	0.17	373	0.0	7.5YR-7/4 Pink non cemented with caliche rock, Dry
	4'>6'	15.7	26.7	1.70	0.15	255	0.0	7.5YR-8/2 Pinkish White non cemented caliche Dry
	10'>12'	12.2	26	2.13	0.15	320	0.0	7.5YR-7/4 Pink cemented caliche, with caliche rock, Dry
	15'>17'	15.6	28.1	1.80	0.16	288	0.0	7.5YR-7/4 Pink cemented caliche, with caliche rock, Damp
	20'>22'	17.2	28.1	1.63	0.17	277	0.0	10YR-8/1 White cemented caliche, with caliche rock, Slightly moist
	23'>23.5'	14.3	32.7	2.28	0.1	228	0.0	7.5YR-6/4 Light brown caliche, some rock, Very Moist

TABLE 2 - SOIL CL AND LITHOLOGY BY SAMPLE POINT AND DEPTH (Continued)
CHAPARRAL ENERGY, LLC
Houston No.1-A SWD and Tank Battery

7/29/2011								
BORE 4	0'>2'	10.5	30.3	2.89	2.3	6635	32.8	7.5YR-4/2 Pinkish Gray caliche, Dry
	2'>4'	11.5	30.5	2.65	1.7	4507	6.7	7.5YR-7/4 Pink non cemented with caliche rock, Dry
	4'>6'	15.9	27.3	1.71	1.25	2137	0.4	7.5YR-8/2 Pinkish White non cemented caliche Dry
	10'>12'	10.3	27.7	2.69	0.27	726	0.4	7.5YR-7/4 Pink cemented caliche, with caliche rock, Dry
	15'>17'	12.6	25.9	2.06	0.11	227	0.0	7.5YR-7/4 Pink cemented caliche, with caliche rock, Dry
	20'>22'	13	29.2	2.50	0.12	300	0.0	10YR-8/1 White cemented caliche, with caliche rock, Moist
	24'>24'5"	14	28.3	2.02	0.11	222	0.0	7.5YR-6/4 Light brown caliche, some rock, Very Moist

TABLE 3 – COMPARISON OF FIELD TEST PARAMETERS AND LABORATORY CONFIRMATION SAMPLES
CHAPARRAL ENERGY, LLC
Houston No.1-A SWD and Tank Battery

Soil Boring ID	Depth Interval	Field Parameter†			Laboratory Parameter‡		
		Cl	1:1 EC	Calc Cl	Cl	TPH-GRO	TPH-DRO
	ft	mg/kg	mS/cm	mg/kg	mg/kg	mg/kg	mg/kg
B1	0-2	608	3.0	1065	736	<10	18.3
	2-4	941	3.27	1161			
	4-6	744	3.21	1140			
	10-12	5372	12.6	4473			
	15-17	2183	7.2	2556			
	22-22.3	1510	5.0	1775	2120	19.3	526
	24-25	263	0.41	145			
B2	0-2	85	0.19	67.5			
	2-4	93	0.17	60.4			
	4-6	149	0.21	74.5			
	10-12	220	0.15	53.3			
	15-17	133	0.23	81.7			
	21-22	123	0.28	99.4			
B3	0-2	146	3.37	1196			
	2-4	372	2.65	941			
	4-6	255	1.26	447			
	10-12	319	1.43	508			
	15-17	288	0.24	85.2			
	20-22	277	0.27	95.9			
	23-23.5	228	0.23	81.7	64	<10	<10
B4	0-2	6645	15.0	5325			
	2-4	4504	14.5	5148			
	4-6	2137	5.8	2059			
	10-12	726	3.8	1349			
	15-17	225	0.44	157			
	22	300	0.67	238			
	24-24.4	222	0.32	114	176	<10	<10

Notes:

†Calculated Cl = 1:1 EC, mS/cm x 355; since EC mS/cm x 10 = ∑ anion, meq/L

‡TPH refers to total petroleum hydrocarbon; GRO refers to gas range organics; DRO refers to diesel range organics

FIGURES

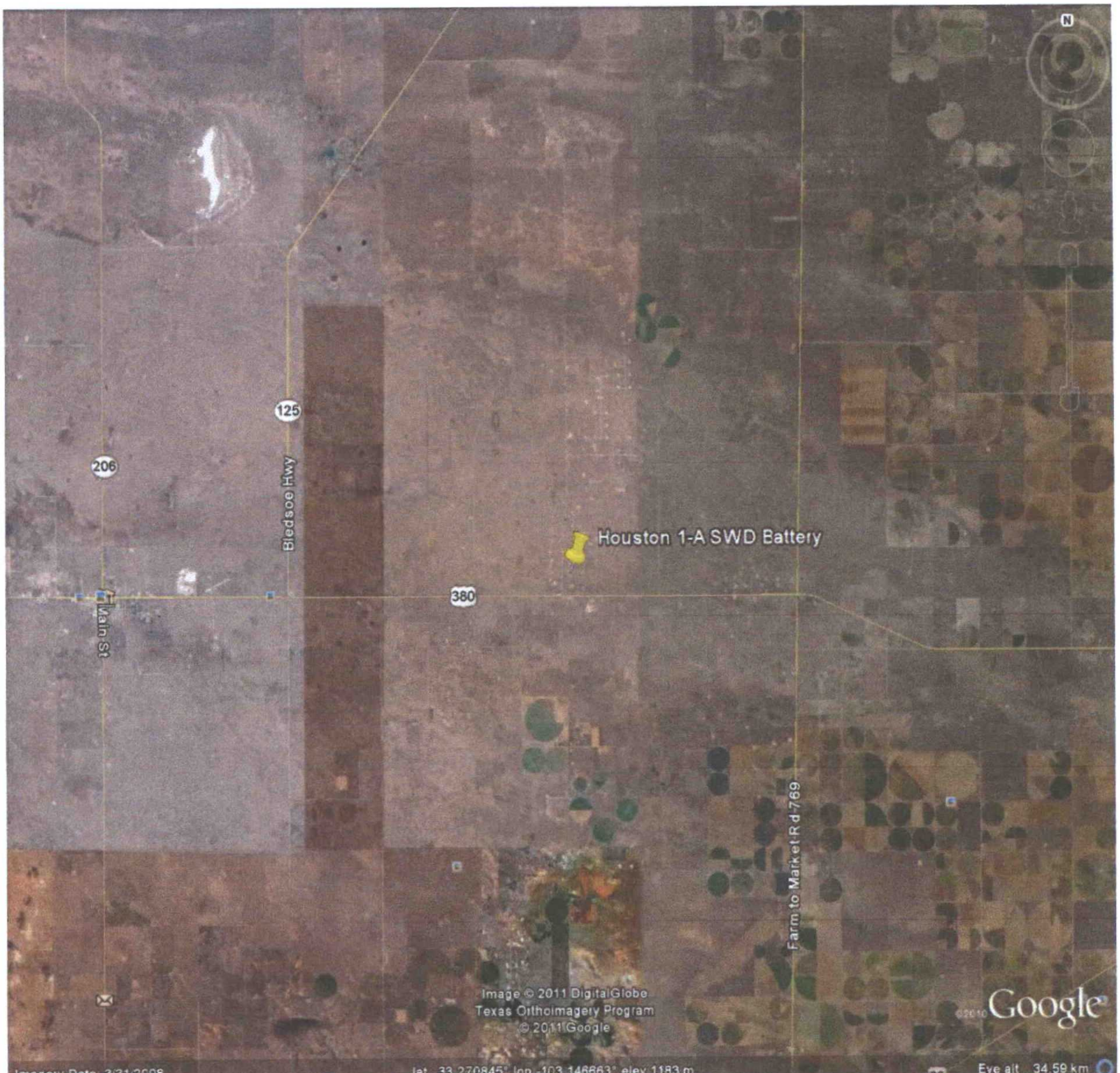


Figure 1 – Houston 1-A SWD Battery Site

Custom Soil Resource Report
Soil Map

Figure 2 – Soil Resource Map

Chaparral
Houston1-A Gladiaola SWD Battery
6-25-11 EM38 SURVEY
SITE MAP

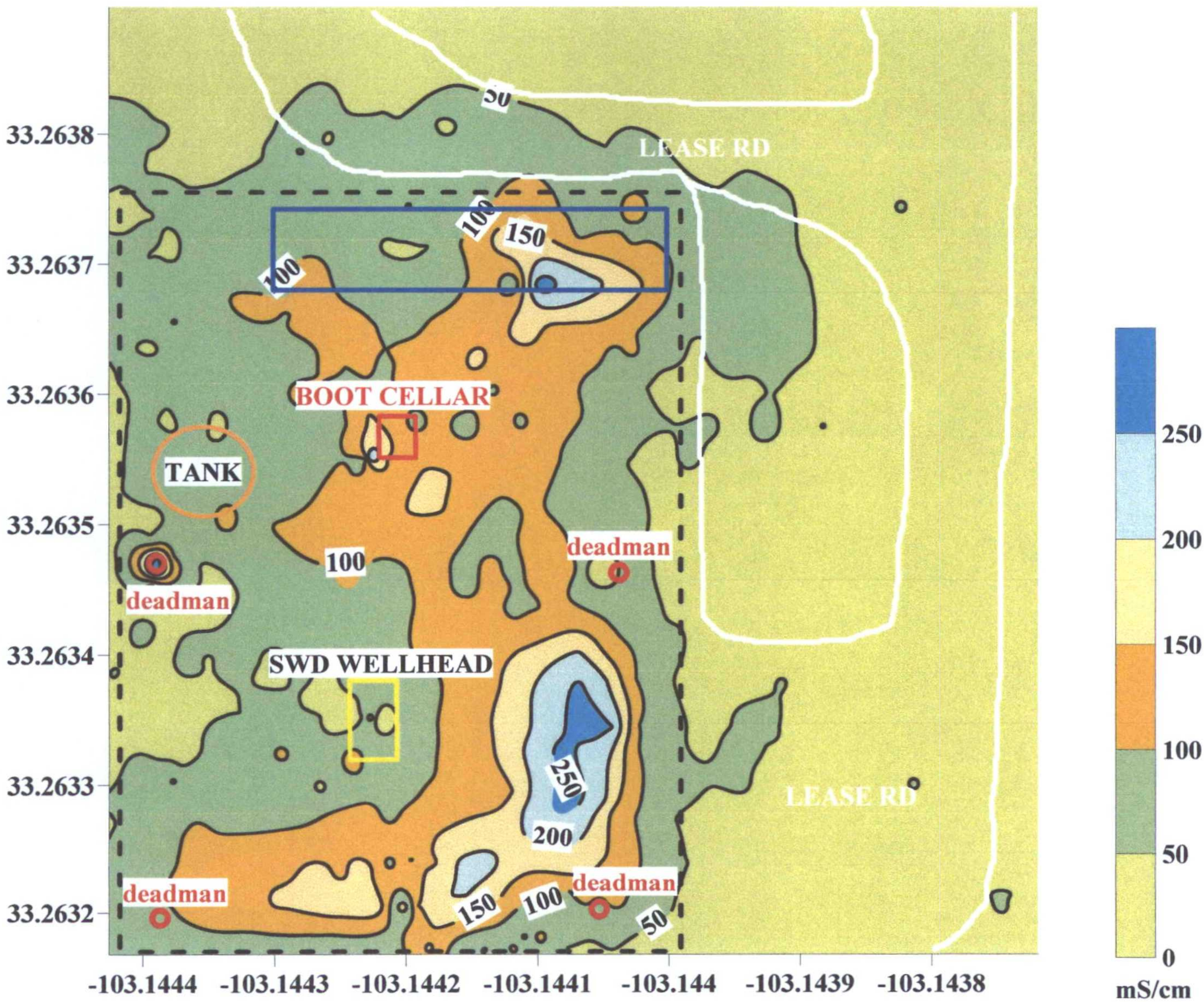


Figure 3 - EM-38 Vertical Dipole Survey

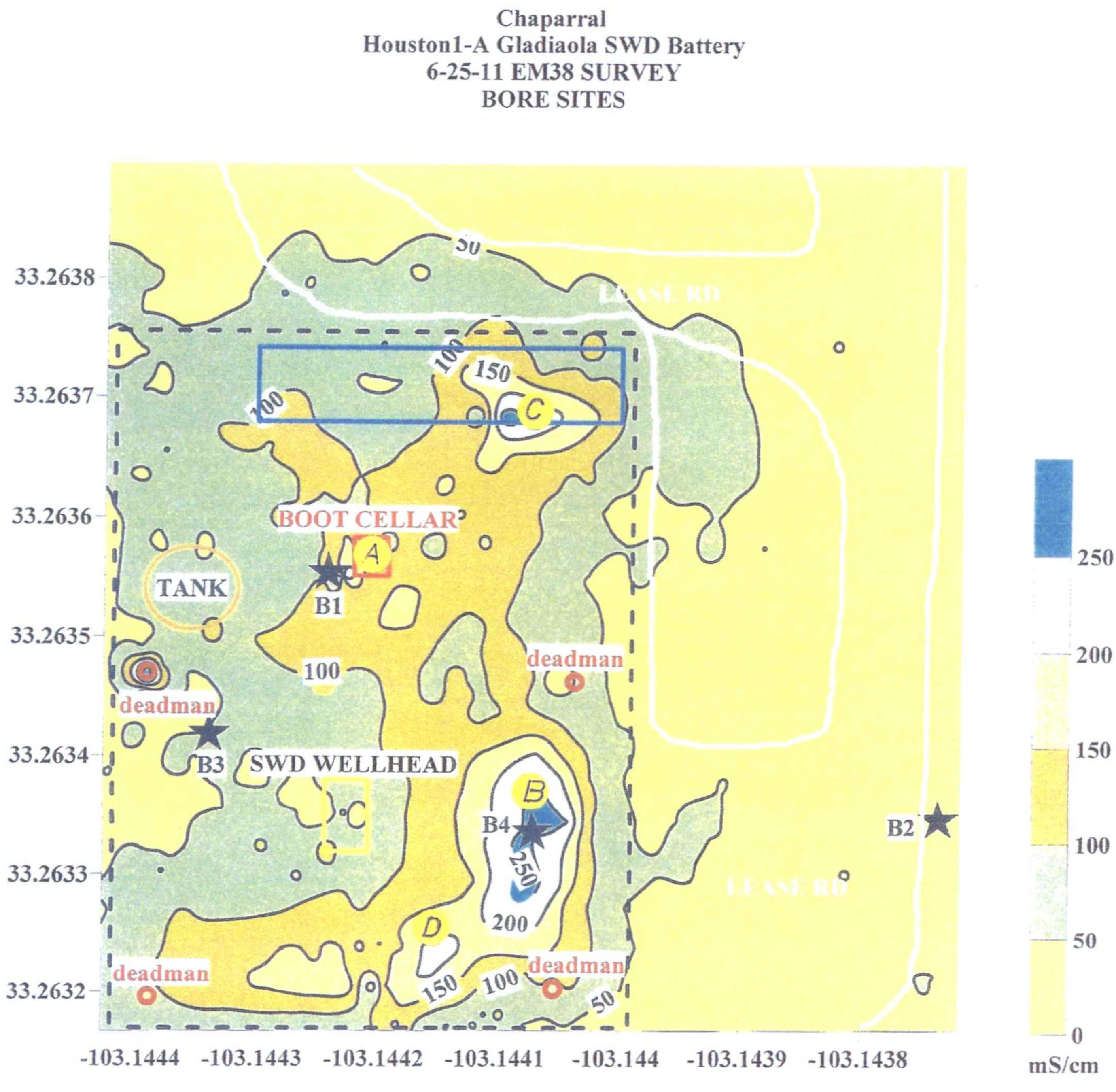


Figure 4 - Soil Boring Locations Identified on EM-38 Survey

APPENDICES

APPENDIX A

Lea County Soil Survey Information

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Lea County, New Mexico

October 9, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

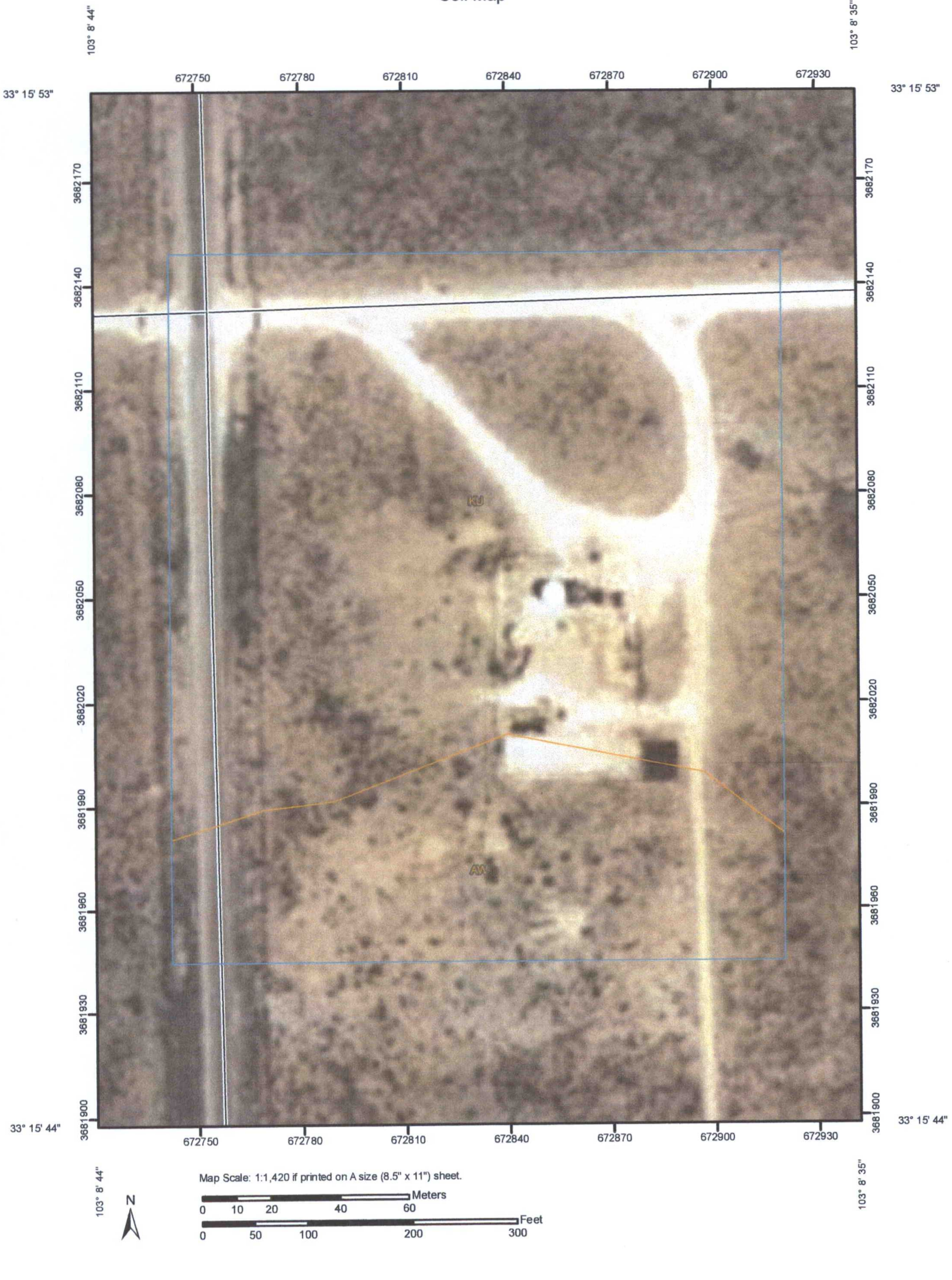
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:1,420 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Lea County, New Mexico (NM025)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AW	Arvana-Lea association	2.3	25.8%
KU	Kimbrough-Lea complex	6.7	74.2%
Totals for Area of Interest		**9.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Lea County, New Mexico

AW—Arvana-Lea association

Map Unit Setting

Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 58 to 60 degrees F
Frost-free period: 195 to 205 days

Map Unit Composition

Arvana and similar soils: 45 percent
Lea and similar soils: 40 percent

Description of Arvana

Setting

Landform: Plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 6e
Ecological site: Sandy 16-21" PZ (R077CY035TX)

Typical profile

0 to 6 inches: Loam
6 to 28 inches: Sandy clay loam
28 to 38 inches: Cemented material
38 to 60 inches: Sandy clay loam

Description of Lea

Setting

Landform: Plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Loamy alluvium derived from sedimentary rock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability (nonirrigated): 4e
Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Typical profile

0 to 10 inches: Loam
10 to 26 inches: Loam
26 to 36 inches: Cemented material

KU—Kimbrough-Lea complex

Map Unit Setting

Elevation: 3,600 to 4,200 feet
Mean annual precipitation: 12 to 15 inches
Mean annual air temperature: 58 to 60 degrees F
Frost-free period: 195 to 205 days

Map Unit Composition

Kimbrough and similar soils: 50 percent
Lea and similar soils: 30 percent

Description of Kimbrough

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 4 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 0.8 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Very Shallow 16-21" PZ (R077CY037TX)

Typical profile

0 to 6 inches: Gravelly loam
6 to 16 inches: Cemented material

Description of Lea

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability (nonirrigated): 4s
Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Typical profile

0 to 10 inches: Loam
10 to 26 inches: Loam
26 to 36 inches: Cemented material

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APPENDIX B

Cardinal Laboratories Analytical Report

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

August 08, 2011

ROY R. RASCON

WHOLE EARTH ENVIRONMENTAL, INC.

2103 ARBOR COVE

KATY, TX 77494

RE: CHAPARRAL HOUSTON BATTERY A-1 SWD

Enclosed are the results of analyses for samples received by the laboratory on 08/05/11 12:45.

Cardinal Laboratories is accredited through Texas NELAP for:

Method SW-846 8021	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method SW-846 8260	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method TX 1005	Total Petroleum Hydorcarbons

Certificate number T104704398-08-TX. Accreditation applies to solid and chemical materials and non-potable water matrices.

Cardinal Laboratories is accreditated through the State of Colorado Department of Public Health and Environment for:

Method EPA 552.2	Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.4	Regulated VOCs (V2, V3)

Accreditation applies to public drinking water matrices.

This report meets NELAP requirements and is made up of a cover page, analytical results, and a copy of the original chain-of-custody. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Celey D. Keene

Celey D. Keene

Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

WHOLE EARTH ENVIRONMENTAL, INC.
ROY R. RASCON
2103 ARBOR COVE
KATY TX, 77494
Fax To: (281) 394-2051

Received:	08/05/2011	Sampling Date:	07/28/2011
Reported:	08/08/2011	Sampling Type:	Soil
Project Name:	CHAPARRAL HOUSTON BATTERY A-1 SW	Sampling Condition:	** (See Notes)
Project Number:	NONE GIVEN	Sample Received By:	Aaron Berry
Project Location:	LEA COUNTY, NM		

Sample ID: HB1 0'>2' (H101640-01)

Chloride, SM4500Cl-B mg/kg **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**736**	16.0	08/05/2011	ND	432	108	400	0.00	

TPH 8015M mg/kg **Analyzed By: ab**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	08/06/2011	ND	190	95.2	200	1.22	
DRO >C10-C28	**18.3**	10.0	08/06/2011	ND	172	85.9	200	1.73	
Surrogate: 1-Chlorooctane	*90.4 %*	*70-130*							
Surrogate: 1-Chlorooctadecane	*88.2 %*	*70-130*							

Sample ID: HB1 22' > 22'4" (H101640-02)

Chloride, SM4500Cl-B mg/kg **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**2120**	16.0	08/05/2011	ND	432	108	400	0.00	

TPH 8015M mg/kg **Analyzed By: ab**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	**19.3**	10.0	08/06/2011	ND	190	95.2	200	1.22	
DRO >C10-C28	**526**	10.0	08/06/2011	ND	172	85.9	200	1.73	
Surrogate: 1-Chlorooctane	*102 %*	*70-130*							
Surrogate: 1-Chlorooctadecane	*105 %*	*70-130*							

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

WHOLE EARTH ENVIRONMENTAL, INC.
ROY R. RASCON
2103 ARBOR COVE
KATY TX, 77494
Fax To: (281) 394-2051

Received:	08/05/2011	Sampling Date:	07/29/2011
Reported:	08/08/2011	Sampling Type:	Soil
Project Name:	CHAPARRAL HOUSTON BATTERY A-1 SW	Sampling Condition:	** (See Notes)
Project Number:	NONE GIVEN	Sample Received By:	Aaron Berry
Project Location:	LEA COUNTY, NM		

Sample ID: HB3 23'>23.5' (H101640-03)

Chloride, SM4500Cl-B mg/kg **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**64.0**	16.0	08/05/2011	ND	432	108	400	0.00	

TPH 8015M mg/kg **Analyzed By: ab**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	08/06/2011	ND	190	95.2	200	1.22	
DRO >C10-C28	<10.0	10.0	08/06/2011	ND	172	85.9	200	1.73	

Surrogate: 1-Chlorooctane	*99.2 %*	*70-130*
Surrogate: 1-Chlorooctadecane	*113 %*	*70-130*

Sample ID: HB4 24'>24'5" (H101640-04)

Chloride, SM4500Cl-B mg/kg **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**176**	16.0	08/05/2011	ND	432	108	400	0.00	

TPH 8015M mg/kg **Analyzed By: ab**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	08/06/2011	ND	190	95.2	200	1.22	
DRO >C10-C28	<10.0	10.0	08/06/2011	ND	172	85.9	200	1.73	

Surrogate: 1-Chlorooctane	*99.3 %*	*70-130*
Surrogate: 1-Chlorooctadecane	*114 %*	*70-130*

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference
**	Samples not received at proper temperature of 6°C or below.
***	Insufficient time to reach temperature.
-	Chloride by SM4500Cl-B does not require samples be received at or below 6°C
	Samples reported on an as received basis (wet) unless otherwise noted on report

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

CARDINAL LABORATORIES
2111 Beechwood, Abilene, TX 79603 101 East Marland, Hobbs, NM 88240
(325) 673-7001 FAX (325)673-7020 (505) 393-2326 FAX (505) 393-2476

		BILL TO	
Company Name:	WHOLE EARTH ENVIRONMENTAL INC.	P.O. #:	
Project Manager:	ROY R. RASCON	Company:	
Address:		Attn:	
City:	State: Zip:	Address:	
Phone #:	Fax #:	City:	
Project Owner:		State: Zip:	
Project Name:	CHAPARRAL HOUSTON BATTERY A-1 SWD	Phone #:	
Project Location:		Fax #:	
Sampler Name:	ROY RASCON		

FOR LAB USE ONLY LAB ID # 40	SAMPLE I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	PRESERV.: ACID/BASE:	ICE / COOL	OTHER :	SAMPLING: DATE	TIME	ANALYSIS REQUEST: CATS & ANS	PH	BTEX	CL-	TPH 418.1	8015M						
H101639-1	HB1 0'>2'	C	1			X					X		7/28/11	1130				X		X						
-2	HB1 22'>22'4"	C	1			X					X		7/28/11	1255				X		X						
8-5-11 RRR	~~HB1 24'>25'~~	~~C~~	~~1~~			~~X~~					~~X~~		~~7/28/11~~	~~115~~				~~X~~		~~X~~						
-3	HB3 23'>23.5'	C	1			X					X		7/29/11	1000				X		X						
-4	HB4 24'>24'5"	C	1			X					X		7/29/11	1230				X		X						

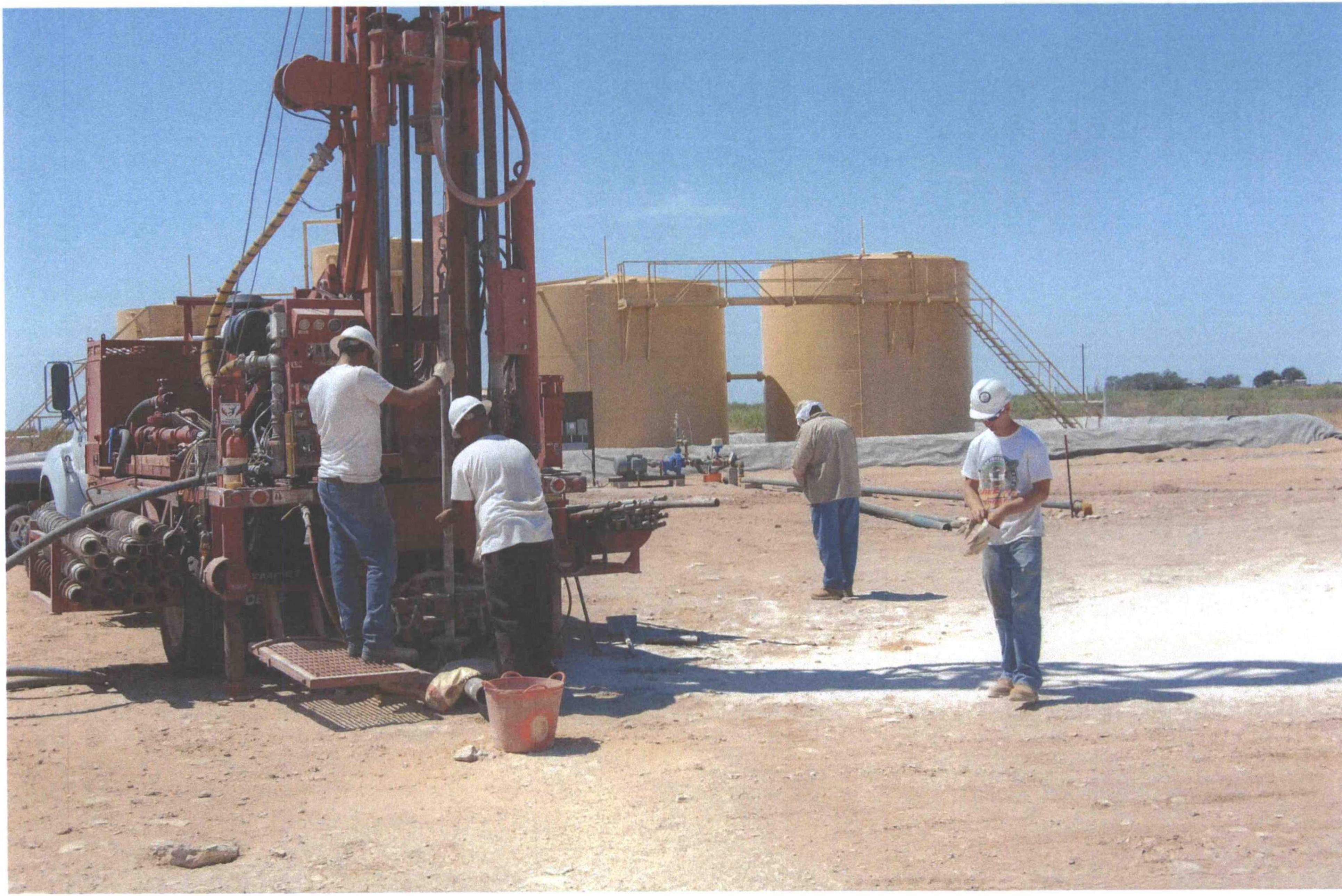
PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising whether based in contract or tort, shall be limited to the amount paid by the client for the analyses. All claims including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within 30 days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequental damages, including without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above stated reasons or otherwise.

Relinquished By: ROY RASCON *Roy R. Rascon*	Date: 8-5-11 Time: 1245	Received By: *CB*	Phone Result: Yes No Add'l Phone #: Fax Result: Yes No Add'l Fax #:
Relinquished By:	Date: Time:	Received By:	REMARKS: PLEASE E-MAIL TO: royr , mikeg, elliotw, & elir@vadose.us
Delivered By: (Circle One) Sampler - UPS - Bus - Other: #26 16°C	Sample Condition Cool Yes (No) Intact (Yes) No	CHECKED BY: (Initials)	Rush

† Cardinal cannot accept verbal changes. Please fax written changes to 505-393-2476

APPENDIX C

Surface Photographs of Houston Battery Site



APPENDIX D
Atkins Engineering Boring Logs

Atkins ENGINEERING ASSOCIATES

Log of Boring Chaparral Houston Battery SB-1

Whole Earth Environmental, Inc.
2103 Arbor Cove
Katy TX 77494

Contact: Mike Griffin

Job#: WECHOUS.MWD.11

Date	: 07/29/11	Auger Type	: 3¼ Hollow
Drill Start	: 14:00	Logged By	: K. Bates
Drill End	: 14:45		
Boring Location	: SB-1		
Site Location	: Chaparral Houston Battery		

Depth in Feet	GRAPHIC	USCS	Sample	DESCRIPTION
0				Caliche
		CL		Sandy clay, light brown, loose, dry
		SC		Clayey sand, light tan, loose, dry
				Caliche, light tan, loose, dry
20				Caliche, light tan, moist, damp

SB-1

Depth scale: 0, 5, 10, 15, 20, 25

Log of Boring Chaparral Houston Battery SB-2

Atkins ENGINEERING ASSOCIATES

Whole Earth Environmental, Inc.
2103 Arbor Cove
Katy TX 77494
Contact: Mike Griffin
Job#: WECHOUS.MWD.11

Date	: 07/29/11	Auger Type	: Air rods
Drill Start	: 07:30	Logged By	: K. Bates
Drill End	: 08:00		
Boring Location	: SB-2		
Site Location	: Chaparral Houston Battery		

SB-2

Depth in Feet	GRAPHIC	USCS	Sample	DESCRIPTION
0				Caliche, white tan
5, 10		CL		Sandy clay, light tan, loose, dry
15		SC		Clayey sand, light tan, loose, dry
				Caliche, light tan, loose, dry
20				Caliche, light tan, moist, damp
25				

08-08-2011 C:\Users\Paddy\Documents\Whole Earth\Chaparral Houston Battery\sb2.bor

Log of Boring Chaparral Houston Battery SB-3

ATKINS ENGINEERING ASSOCIATES

Whole Earth Environmental, Inc.
2103 Arbor Cove
Katy TX 77494

Contact: Mike Griffin

Job#: WECHOUS.MWD.11

Date	: 07/29/11	Auger Type	: Air rods
Drill Start	: 08:50	Logged By	: K. Bates
Drill End	: 09:20		
Boring Location	: SB-3		
Site Location	: Chaparral Houston Battery		

SB-3

Depth in Feet	GRAPHIC	USCS	Sample	DESCRIPTION
0				Caliche, tan
		CL		Sandy clay, light tan, loose, dry
		SC		Clayey sand, light tan, loose, dry
				Caliche whiteish tan, loose, dry
20				Caliche, light brown, moist, damp
25				

08-08-2011 C:\Users\Paddy\Documents\Whole Earth\Chaparral Houston Battery\sb3.bor

Atkins ENGINEERING ASSOCIATES

Log of Boring Chaparral Houston Battery SB-4

Whole Earth Environmental, Inc.
2103 Arbor Cove
Katy TX 77494

Contact: Mike Griffin

Job#: WECHOUS.MWD.11

Date	: 07/29/11	Auger Type	: Air rods
Drill Start	: 09:40	Logged By	: K. Bates
Drill End	: 10:15		
Boring Location	: SB-4		
Site Location	: Chaparral Houston Battery		

SB-4

Depth in Feet	GRAPHIC	USCS	Sample	DESCRIPTION
0				Caliche, white
		CL		Sandy clay, light tan, loose, dry
		SC		Clayey sand, light tan, loose, dry
				Caliche, whiteish tan, loose, dry
20				Caliche, whiteish tan, moist, damp

Depth scale: 0, 5, 10, 15, 20, 25

08-08-2011 C:\Users\Paddy\Documents\Whole Earth\Chaparral Houston Battery\sb4.bor

ATKINS ENGINEERING ASSOCIATES

Log of Boring Chaparral Houston Battery SB-5

Whole Earth Environmental, Inc.
2103 Arbor Cove
Katy TX 77494

Contact: Mike Griffin

Job#: WECHOUS.MWD.11

Date	: 07/29/11	Auger Type	: Air rods
Drill Start	: 10:30	Logged By	: K. Bates
Drill End	: 11:15		
Boring Location	: SB-5		
Site Location	: Chaparral Houston Battery		

SB-5

Depth in Feet	GRAPHIC	USCS	Sample	DESCRIPTION
0				Caliche, white
		CL		Sandy clay, light tan, loose, dry
		SC		Clayey sand, light tan, loose, dry
				Caliche, light tan, loose, dry
20				Caliche, light tan, moist, damp
				Sand, saturated

Depth scale: 0, 5, 10, 15, 20, 25

08-08-2011 C:\Users\Paddy\Documents\Whole Earth\Chaparral Houston Battery\sb5.bor

PR-150

Surface Remediation Protocol
Chaparral Energy Houston 1A SWD
ACO-271

1.0 Purpose

This protocol is to provide a detailed outline of the steps to be employed in the remediation of the Chaparral Energy Houston 1A Battery situated on Chaparral's fee land in Lea County, New Mexico.

2.0 Scope

This protocol is site specific for the Houston Battery remediation project.

3.0 Preliminary

Prior to any field operations, Whole Earth Environmental shall conduct the following activities:

3.1 Client Review

3.1.1 Whole Earth shall meet with assigned personnel within NMSWD and the NMOCD to review and approve this protocol.

3.1.2 Changes to this protocol will be documented and submitted for final review by all parties prior to the initiation of actual field work.

4.0 Safety

4.1 Prior to work on the site, Whole Earth shall obtain the location and phone numbers of the nearest emergency medical treatment facility. We will review all safety related issues with the appropriate client personnel, sub-contractors and exchange phone numbers.

4.2 A tailgate safety meeting shall be held and documented each day. All sub-contractors must attend and sign the daily log-in sheet.

4.3 Anyone allowed on to location must be wearing sleeved shirts, steel toed boots, and long pants. Each vehicle must be equipped with two way communication capabilities.

4.4 Prior to any excavation or boring, New Mexico One Call will be notified. If lines are discovered within the area to be excavated they shall be marked with pin flags on either side of the line at maximum five-foot intervals.

5.0 Boot Cellar Remediation

5.1 Remove all surface piping and structures surrounding the boot cellar. Transport to the Gandy/Marley commercial Disposal facility located near Caprock, New Mexico.

5.2 Excavate the area surrounding the boot cellar to remove all stained soils. The excavation should be extended laterally to a distance sufficient to achieve VOC concentrations <100 ppm in accordance with WEQP-18A.

5.3 Each side wall of the boot cellar excavation shall be sampled in a minimum five-point composite in accordance with WEQP-77 and transported to Cardinal Laboratories in Hobbs, New Mexico for the presence and concentrations of the following COC's:

- Benzene in accordance with 8021B or 8260B
- Total BTEX accordance with 8021B or 8260B
- DRO and GRO in accordance with 8015M
- Chlorides in accordance with 300.1, 300.0, or SM 4500B

5.4 The final clean-up standards for each of the COC's are as follows:

- Benzene: 10 mg/Kg
- Total BTEX: 50 mg/Kg
- DRO and GRO: 100 mg/Kg
- Chlorides: 1,000 mL/L

5.5 The boot cellar shall be excavated to a depth sufficient to remove all stained soils and backfilled with clean topsoil to a minimum depth of four feet below ground surface. The bottom of the excavation will be compacted and inspected to insure that no sharp rocks are present.

5.6 A bentonite liner shall be installed atop the compacted bottom and the excavation backfilled with fresh topsoils to grade.

6.0 Surface Remediation

6.1 All areas showing an EM-38 conductivity reading >200 mS/M shall be excavated to a maximum depth of 4' below ground surface. The excavated soils shall be transported to the Gandy/Marley disposal facility and backfilled with fresh topsoil.

6.2 The entire affected area will be disked to a minimum depth of 6" and seeded with BLM seed mixture No.1.

9.0 Closure Report

At the conclusion of the project, Whole Earth shall prepare a closure report that contains the following minimum information:

- Photographs of the location prior to remediation
- Copies of this protocol
- Laboratory analytical reports
- Copies of all field testing protocols
- Seed bag certification
- Disposal manifests
- Photographs of the location at time of final closure

QP-18A

WHOLE EARTH ENVIRONMENTAL
QUALITY PROCEDURE

Sampling and Testing Protocol
VOC in Soil

Completed By: Approved By: Effective Date: / /

1.0 Purpose

This procedure is to be used to determine the concentrations of Volatile Organic Compounds in soils.

2.0 Scope

This procedure is to be used as the standard field measurement for soil VOC concentrations. It is not to be used as a substitute for full spectrographic speciation of organic compounds.

3.0 Procedure

3.1 Sample Collection and Preparation

3.1.1 Collect at least 500 g. of soil from the sample collection point. Take care to insure that the sample is representative of the general background to include visible concentrations of hydrocarbons and soil types. If necessary, prepare a composite sample of soils obtained at several points in the sample area. Take care to insure that no loose vegetation, rocks or liquids are included in the sample(s).

3.1.2 The soil sample(s) shall be immediately inserted into a one quart or larger polyethylene freezer bag and sealed. When sealed, the bag should contain a nearly equal space between the soil sample and trapped air. Record the sample name and the time that the sample was collected on the Field Report Form.

QP-77

WHOLE EARTH ENVIRONMENTAL
QUALITY PROCEDURE

Procedure for Obtaining
Soil Samples for Transportation to a Laboratory

Completed By: Approved By: Effective Date: / /

1.0 Purpose

This procedure outlines the methods to be employed when obtaining soil samples to be taken to a laboratory for analysis.

2.0 Scope

This procedure is to be used when collecting soil samples intended for ultimate transfer to a testing laboratory.

3.0 Preliminary

3.1 Obtain sterile sampling containers from the testing laboratory designated to conduct analyses of the soil. The shipment should include a Certificate of Compliance from the manufacturer of the collection bottle or vial and a Serial Number for the lot of containers. Retain this Certificate for future documentation purposes.

3.2 If collecting TPH, BTEX, RCRA 8 metals, cation / anions or O&G, the sample jar may be a clear 4 oz. container with Teflon lid. If collecting PAH's, use an amber 4 oz. container with Teflon lid.

4.0 Chain of Custody

4.1 Prepare a Sample Plan. The plan will list the number, location and designation of each planned sample and the individual tests to be performed on the sample. The sampler will check the list against the available inventory of appropriate sample collection bottles to insure against shortage.

4.2 Transfer the data to the Laboratory Chain of Custody Form. Complete all sections of the form except those that relate to the time of delivery of the samples to the laboratory.

4.3 Pre-label the sample collection jars. Include all requested information except time of collection. (Use a fine point Sharpie to insure that the ink remains on the label). Affix the labels to the jars.

5.0 Sampling Procedure

5.1 Go to the sampling point with the sample container. If not analyzing for ions or metals, use a trowel to obtain the soil. Do not touch the soil with your bare hands. Use new latex gloves with each sample to help minimize any cross-contamination. Try to avoid collecting rocks or vegetation.

5.2 Pack the soil tightly into the container leaving the top slightly domed. Screw the lid down tightly. Enter the time of collection onto the sample collection jar label.

5.3 Place the sample directly on ice for transport to the laboratory.

5.4 Complete the Chain of Custody form to include the collection times for each sample. Deliver all samples to the laboratory.

6.0 Documentation

6.1 The testing laboratory shall provide the following minimum information:

A. Client, Project and sample name.
B. Signed copy of the original Chain of Custody Form including data on the time the sample was received by the lab.
C. Results of the requested analyses
D. Test Methods employed
E. Quality Control methods and results

Groundwater Investigation Protocol
Chaparral Energy Houston 1A SWD
ACO-271

1.0 Purpose

This protocol is to provide a detailed outline of the steps to be employed in the investigation of potential groundwater contamination at the Chaparral Energy Houston 1A Battery situated on Chaparral's fee land in Lea County, New Mexico.

2.0 Scope

This protocol is site specific for the Houston Battery remediation project.

3.0 Preliminary

Prior to any field operations, Whole Earth Environmental shall conduct the following activities:

3.1 Client Review

3.1.1 Whole Earth shall meet with assigned personnel within NMSWD and the NMOCD to review and approve this protocol.

3.1.2 Changes to this protocol will be documented and submitted for final review by all parties prior to the initiation of actual field work.

4.0 Safety

4.1 Prior to work on the site, Whole Earth shall obtain the location and phone numbers of the nearest emergency medical treatment facility. We will review all safety related issues with the appropriate client personnel, sub-contractors and exchange phone numbers.

4.2 A tailgate safety meeting shall be held and documented each day. All sub-contractors must attend and sign the daily log-in sheet.

4.3 Anyone allowed on to location must be wearing sleeved shirts, steel toed boots, and long pants. Each vehicle must be equipped with two way communication capabilities.

QP-28

WHOLE EARTH ENVIRONMENTAL
QUALITY PROCEDURE

Procedure for Developing Cased Water Monitoring Wells

Completed By: Approved By: Effective Date: / /

1.0 Purpose

This procedure outlines the methods to be employed to develop cased monitoring wells.

2.0 Scope

This procedure shall be used for developed, cased water monitoring wells. It is not to be used for standing water samples such as ponds or streams.

3.0 Preliminary

3.1 Prior to development, the static water level and height of the water column within the well casing will be measured with the use of an electric D.C. probe or a steel engineer's tape and water sensitive paste.

3.2 All measurements will be recorded within a field log notebook and subsequently reported within the driller's boring log report.

3.3 All equipment used to measure the static water level will be decontaminated after each use by means of Alconox, a phosphate free laboratory detergent, and water to reduce the possibility of cross-contamination. The volume of water in each well casing will be calculated.

4.0 Purging

4.1 Wells will be purged by removing a minimum of three well casing volumes by using a 2" decontaminated submersible pump or dedicated one liter Teflon bailer.

4.2 If a submersible is used the pump will be decontaminated prior to use by scrubbing the outside surface of tubing and wiring with an Alconox-water mixture, pumping an Alconox-water mixture through the pump, and a final flush with fresh water.

5.0 Water Disposal

5.1 All purge and decontamination water will be temporarily stored within a 60 gallon portable tank and then pumped into a permanent storage tank to be later disposed of in an appropriate manner.

6.0 Records

6.1 Whole Earth will record the amount of water removed from the well during development procedures. The purge volume will be reported to the appropriate regulatory authority when filing the closure report.

QP-78

WHOLE EARTH ENVIRONMENTAL
QUALITY PROCEDURE

Procedure for Obtaining Water Samples (Cased Wells)
Using Enviro-Tech ES-60 Pump

Completed By: Approved By: Effective Date: / /

1.0 Purpose

This procedure outlines the methods to be employed in obtaining water samples from cased monitoring wells.

2.0 Scope

This procedure shall be used for developed, cased water monitoring wells. It is not to be used for standing water samples such as ponds or streams.

3.0 Preliminary

3.1 Obtain sterile sampling containers from the testing laboratory designated to conduct analyses of the water. The shipment should include a Certificate of Compliance from the manufacturer of the collection bottle or vial and a Serial Number for the lot of containers. Retain this Certificate for future documentation purposes.

3.2 The following table shall be used to select the appropriate sampling container, preservative method and holding times for the various elements and compounds to be analyzed.

Compound to be Analyzed	Sample Container Size	Sample Container Description	Cap Requirements	Preservative	Maximum Hold Time
BTEX	40 ml.	VOA Container	Teflon Lined	HCl	7 days
TPH	1 liter	clear glass	Teflon Lined	HCl	28 days
PAH	1 liter	clear glass	Teflon Lined	Ice	7 days
Cation / Anion	1 liter	clear glass	Teflon Lined	None	48 Hrs.
Metals	1 liter	HD polyethylene	Any Plastic	Ice / HNO_3	28 Days
TDS	300 ml.	clear glass	Any Plastic	Ice	7 Days

4.0 Chain of Custody

4.1 Prepare a Sample Plan. The plan will list the well identification and the individual tests to be performed at that location. The sampler will check the list against the available inventory of appropriate sample collection bottles to insure against shortage.

4.2 Transfer the data to the Laboratory Chain of Custody Form. Complete all sections of the form except those that relate to the time of delivery of the samples to the laboratory.

4.3 Pre-label the sample collection jars. Include all requested information except time of collection. (Use a fine point Sharpie to insure that the ink remains on the label). Affix the labels to the jars.

5.0 Bailing Procedure

5.1 Identify the well from the site schematics. Place pre-labeled jar(s) next to the well. Remove the bolts from the well cover and place the cover with the bolts nearby. Remove the plastic cap from the well bore by first lifting the metal lever and then unscrewing the entire assembly.

5.2 Lower the ES-60 pump into the monitor well bore taking care to insure that the pump and first 10' of hose and cable does not touch the ground or become cross-contaminated by contact with anything containing hydrocarbon residues. When the pump reaches the bottom of the well bore you will feel the hose and cable assembly go slack. Lift the pump a minimum distance of 18" above the bottom of the well bore and clamp the hose assembly to the top of the well bore by means of vice grips. (Take care to insure that the vice grips are adjusted so as not to "choke" the hose).

5.3 Attach the electrical cable leads to an automobile battery and begin pumping the well bore. If the pump does not bring fluid to the surface within one minute, disconnect the electrical leads, and re-connect for four seconds three times to remove air cavitation.

5.4 The pump has a minimum volume of 2.8 gallons per minute at 60'. Purge the well by pumping for a minimum of 10 minutes before taking a sample.

6.0 Sampling Procedure

6.1 Once the well has been bailed in accordance with 5.2 of this procedure, a sample may be decanted into the appropriate sample collection jar directly from the bailer. The collection jar should be filled to the brim. Once the jar is sealed, turn the jar over to detect any bubbles that may be present. Add additional water to remove all bubbles from the sample container.

6.2 Note the time of collection on the sample collection jar with a fine Sharpie.

6.3 Place the sample directly on ice for transport to the laboratory. The preceding table shows the maximum hold times between collection and testing for the various analyses.

6.4 Complete the Chain of Custody form to include the collection times for each sample. Deliver all samples to the laboratory.

7.0 Decontamination

7.1 After removing the pump from the well, use an aerosol spray pump bottle filled with denatured isopropyl alcohol to clean the pump and first 10' of the cable and hose assembly. Rinse the sprayed portion with distilled water to remove the alcohol and dry with a clean rag. Discard the rag after each use. During transport, the pump assembly should be carried in a 2" PVC protective sleeve.

8.0 Documentation

8.1 The testing laboratory shall provide the following minimum information:

A. Client, Project and sample name.
B. Signed copy of the original Chain of Custody Form including data on the time the sample was received by the lab.
C. Results of the requested analyses
D. Test Methods employed
E. Quality Control methods and results