1R - 428-56

# WORKPLANS

Date:
11-2-10

## Hansen, Edward J., EMNRD

**From:** Katie Jones [kjones@riceswd.com]
**Sent:** Tuesday, December 14, 2010 2:41 PM
**To:** Hansen, Edward J., EMNRD
**Cc:** Hack Conder; Katie Lee
**Subject:** Hobbs Jct. F-31-2 (1R428-56) CAP Addendum
**Attachments:** Hobbs Jct. F-31-2 proposed liner.jpg

Mr. Hansen:

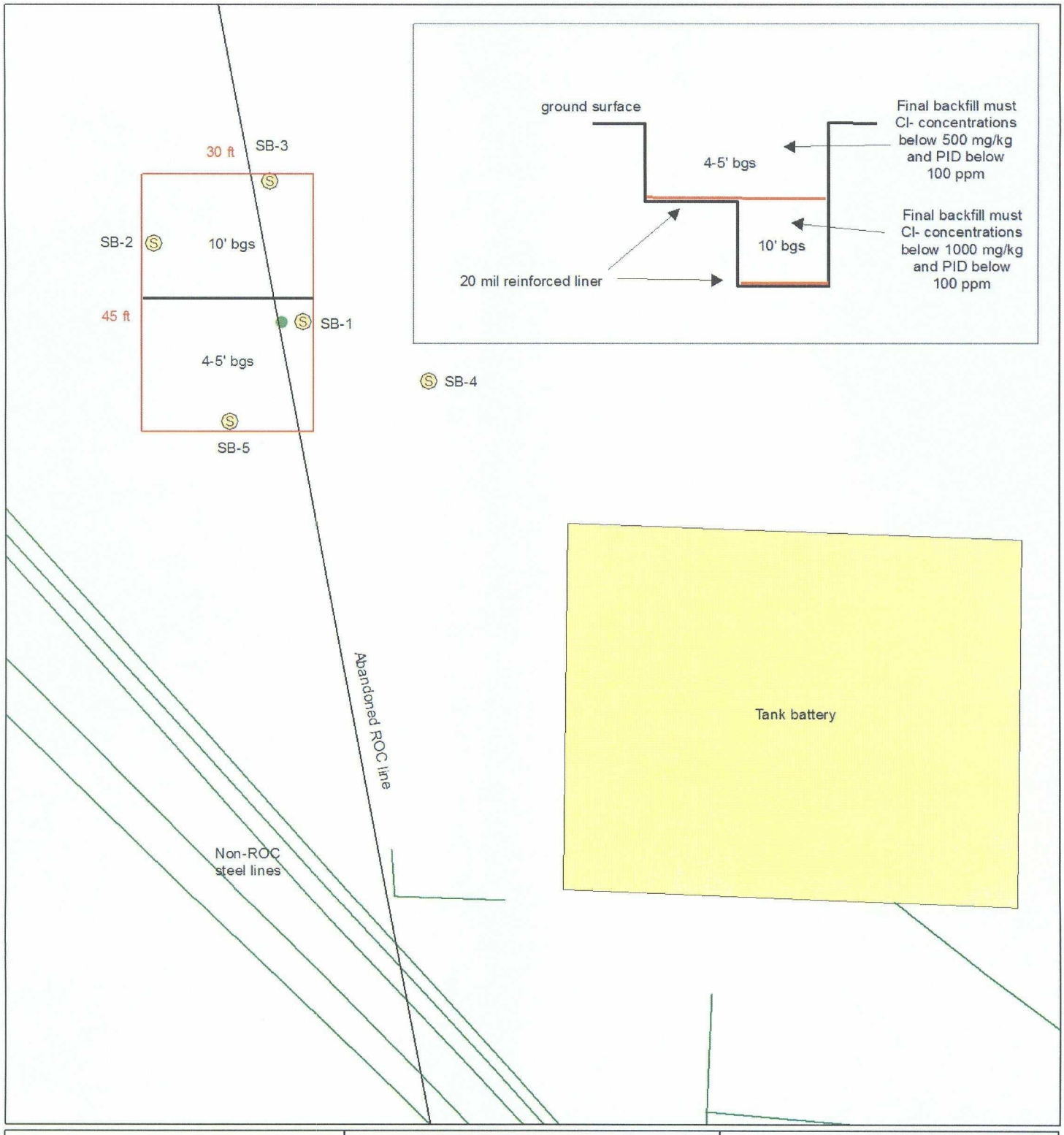
The following is an Addendum to the Hobbs Jct. F-31-2 (1R428-56) CAP submitted to the NMOCD on November 2, 2010. Page 4, section: Recommendations, paragraph 2; red lettering will be deleted from the paragraph and blue lettering should be added to the paragraph. If you need any other information, please let me or Hack Conder know.

"~~Our recommended corrective action for the site is installation of a 30 x 30 foot synthetic liner 4-5 feet below ground surface centered over the former junction box and backfilling with soil containing no more than 500 mg/kg chloride and with a field screening less than 100 using a PID.~~ Our recommended corrective action for the site is installing double liners. First, a 30 x 22.5 foot synthetic liner 10 feet below ground surface will be installed based on the attached Figure. Backfill above this liner will contain soil with no more than 1,000 mg/kg chloride and a field screening less than 100 using a PID. Second, a 30 x 45 foot synthetic liner 4 feet below ground surface will be installed based on the attached Figure. Backfill above this liner will contain soil with no more than 500 mg/kg chloride and a field screening less than 100 using a PID. We also recommend revegetation of the ground surface to limit infiltration of precipitation and the subsequent migration of constituents of concern to ground water. A synthetic liner installed below the root zone as proposed will inhibit the downward migration of water through the subsurface, slowing movement of chloride or soluble hydrocarbons toward ground water. Plants capture water through their roots, thereby reducing the volume of water infiltrating below the root zone. This natural "infiltration barrier" also helps protect ground water. Upon documentation of installation of the liner and re-seeding of the site with an appropriate mix of native grasses we will submit a Termination Request for this site's regulatory file."

Thank you.

Katie Jones
Environmental Project Coordinator
RICE *Operating Company*

# Proposed liner




## *Hobbs jct. F-31-2*

**Legals: UL/F sec. 31**
**T18S R38E**

**Case #: 1R428-56**

N
W E
S

0 10 20 40
Feet

Drawing date: 10-22-10
Drafted by: L. Weinheimer

R. T. HICKS CONSULTANTS, LTD.
901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266.0745

November 2, 2010

Mr. Edward J. Hansen
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: **Rice Operating Company, Hobbs SWD System Junction F-31-2 Site**
**T-18-S, R-38-E, Section 31, Unit F, Lea County, New Mexico,**
**NMOCD CASE #1R428-56**
**Correction Action Plan**



Mr. Hansen:

On behalf of Rice Operating Company (ROC), R.T. Hicks Consultants, Ltd. is submitting this Correction Action Plan for the Hobbs Junction F-31-2 site. The investigation demonstrates that residual chloride and hydrocarbons in the vadose zone will not with reasonable probability contaminate ground water or surface water, in excess of the standards in Subsections B and C of 19.15.30.9 NMAC through leaching, percolation or other transport mechanisms, or as the water table elevation fluctuates. Our recommended corrective action for the site is installation of a 30 x 30 foot synthetic liner 4-5 feet below ground surface centered over the former junction box and backfilling with soil containing no more than 500 mg/kg chloride and with a field screening less than 100 using a PID. We also recommend re-vegetation of the site. Our recommended corrective action meets the mandate of NMOCD Rules for protection of surface water and the environment.

**Background**

The Hobbs Junction F-31-2 is located west of the city of Hobbs, New Mexico at T-18-S, R-38-E, Section 31, in Unit F. An initial 4-foot deep excavation was installed on November 13, 2002, which identified chloride- and hydrocarbon-impacted soil. The NMOCD-approved Investigation Characterization Plan (ICP), dated January 20, 2010 (Attachment A) was prepared to address the further delineation of the site. It includes background information, a site vicinity map, and a regional ground water gradient map.

**Field Programs**

As a part of the approved ICP, ROC planned to install and sampled at least five 12-foot deep backhoe trenches. However, attempts to excavate the initial trench at the site verified that the near surface rock was too hard to penetrate with a backhoe.

Hicks Consultants supervised a deep soil sampling program to delineate the extent and magnitude of media impact. On April 21 and 22, 2010, five 45- to

55-foot deep soil borings were drilled near the original junction box location (SB-1) and the surrounding area (SB-2 to SB-5). ROC conducted field analysis of soil samples for chloride and volatile hydrocarbon vapors for the boring program. Most of the samples were recovered from drill cuttings because the soil was too hard to recover material with a split spoon sampler.

Plate 1 is a summary map that includes results of the field chloride analyses and hydrocarbon screening data as well as laboratory results for the soil samples used to verify the ROC field data. Attachment B provides the soil lithology logs for the soil borings, which includes the field chloride and hydrocarbon screening data and laboratory results. Attachment C provides the laboratory reports and chain of custody documents for all of the soil verification samples.

**Results: Chloride**

The initial ROC source area excavation, conducted in 2002, encountered a maximum chloride concentration of 319 mg/kg at 3 feet below the surface.

The soil borings were installed to delineate the depth and extent of chloride-impacted soil relative to the NMOCD guideline target level. Generally, the highest chloride concentrations were observed adjacent to the inactive pipeline (SB-1 and SB-3) at depths of 20 to 40 feet below the surface. The maximum chloride concentrations were identified in SB-1 at 20 feet below the surface (1,250 mg/kg) and in SB-3 at 35 feet below the surface (1,140 mg/kg). Concentrations decrease with depth in each of the borings but remain above target level in SB-1 (336 mg/kg). A summary of the chloride laboratory results from all of the soil borings relative to the regulatory screening guideline is provided on Table 1.

**Results: Hydrocarbons**

The initial ROC source area excavation, conducted in 2002, encountered visible indications of hydrocarbon-impacted soil with "slight" odors. The excavation was fenced and left open.

Field screening of hydrocarbon vapors in the soil from the soil borings identified concentrations greater than 1,000 ppm only in SB-1 near the source area. The maximum reading (1,233 ppm) was observed at 20 feet below the surface from a split spoon sample. Laboratory analysis of this sample indicated concentrations of benzene (<0.05 mg/kg), toluene (4.63 mg/kg), ethylbenzene (9.61 mg/kg), and total xylenes (47.7 mg/kg). In addition, the sample contained gas and diesel range organics which are essentially non-soluble with respect to leaching. A summary of the hydrocarbon laboratory results from all of the soil borings relative to the regulatory screening guidelines is provided on Table 1 below.

***Table 1***
**Rice Operating Hobbs Jct. F-31-2 Site**
Laboratory Data - Soil Samples

| Sample Location | Depth (feet) | Sample Date | PID (ppm) | Chloride (mg/kg) | Benzene (mg/kg) | Toluene (mg/kg) | Ethylbenzene (mg/kg) | Xylenes (mg/kg) | BTEX (mg/kg) | GRO (mg/kg) | DRO (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SB-1 | 20 | 4/21/10 | 1,233 | **1,250** | <0.05 | 4.63 | 9.61 | **47.70** | **62.0** | 1,700 | 3,910 |
| | 25 | 4/21/10 | 720 | **976** | 0.084 | 1.14 | 2.04 | 13.00 | 16.3 | 479 | 2,850 |
| | 55 | 4/21/10 | 13 | **336** | -- | -- | -- | -- | -- | <10 | 389 |
| SB-2 | 10 | 4/21/10 | 106 | **832** | <0.05 | 0.210 | 0.361 | 2.58 | 3.20 | <10 | 256 |
| | 15 | 4/21/10 | 297 | **432** | <0.05 | 0.198 | 0.695 | 3.07 | 4.01 | <50 | 1,890 |
| | 55 | 4/21/10 | 146 | 128 | <0.05 | <0.05 | <0.05 | 0.378 | 0.53 | <10 | <10 |
| SB-3 | 5 | 4/22/10 | 353 | 32 | 0.211 | 3.71 | 1.14 | 15.40 | 20.5 | 897 | 13,800 |
| | 35 | 4/22/10 | 222 | **1,140** | <0.05 | 0.707 | 0.226 | 2.34 | 3.32 | <50 | 2,150 |
| | 55 | 4/22/10 | 35 | 144 | <0.05 | 0.442 | 0.165 | 2.16 | 2.82 | <50 | 316 |
| SB-4 | 20 | 4/22/10 | 6 | **288** | -- | -- | -- | -- | -- | <10 | <10 |
| | 45 | 4/22/10 | 27 | 208 | -- | -- | -- | -- | -- | <10 | 412 |
| SB-5 | 20 | 4/22/10 | 712 | **624** | <0.05 | 0.438 | 1.20 | 8.29 | 10.0 | 362 | 4,350 |
| | 55 | 4/22/10 | 12 | 208 | -- | -- | -- | -- | -- | <10 | 81 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **NMOCD Guideline Remediation Levels** | **250** | **10** | -- | -- | -- | **50** | **No regulatory standards have been established** |
| **2006 NMED Soil Com./Indus. Vapor Exposure Risk** | | **25.8** | **252** | **128** | **82** | -- | |
| **Screening Guidelines** | | 0.0201 | 21.7 | 20.2 | 2.06 | -- | |
| **Site Specific GW Protective Levels ($DAF_{299}$)** | | **0.300** | **324** | **302** | **30.8** | -- | |

Elevated concentrations of chloride, benzene, and xylenes in the soil require further evaluation to insure the protection of the underlying ground water; therefore a conservative estimate of 6,400 $ft^2$ (80 ft x 80 ft) was used in the simulation modeling evaluations.

## Simulation Modeling

We used the AMIGO tool (HYDRUS-1D model) to determine if un-saturated chloride transport through the vadose zone would cause the underlying ground water to exceed 250 mg/L chloride in the future. The input to the model employed field data from the site, nearby locations, and conservative input data for parameters that were not measured at or near the site.

In the absence of any corrective action by ROC, the simulation indicates that a maximum ground water chloride concentration of 170 mg/L will occur in the year 2057. Attachment D provides an explanation of the data used and results from the chloride model simulation at the site.

We used the VLEACH vadose zone model to determine if the benzene and xylenes identified during the site assessment would cause the underlying ground water to exceed the regulatory standard. The input to the model employed field data from the site, nearby locations, and conservative default values for parameters that were not measured at or near the site.

The simulation results indicate that if no further actions are taken the maximum ground water impact will occur in 240 years for benzene (0.0011 mg/L) and 700 years for xylenes (0.019 mg/L). During this time neither the benzene nor xylenes mass input to the ground water will be sufficient to cause the water concentrations below the site to exceed the New Mexico water quality standards.

VLEACH is conservative of ground water quality because the model does not take into account the natural biological degradation of the hydrocarbons. Attachment D provides an explanation of the data used and results from the simulation at the Hobbs Junction F-31-2 Vent site. A detailed description of the model and a free windows-based program download is available from the USEPA at http://www.epa.gov/ada/csmos/models/vleach.html.

**Recommendations**

The site data that documents the residual mass of chloride and hydrocarbons in the vadose zone permit a conclusion that these constituents in the vadose zone will not with reasonable probability contaminate ground water or surface water in excess of the standards in Subsection B and C of the 19.15.30.9 NMAC through leaching, percolation or other transport mechanisms, or as the water table elevation fluctuates.

Our recommended corrective action for the site is installation of a 30 x 30 foot synthetic liner 4-5 feet below ground surface centered over the former junction box and backfilling with soil containing no more than 500 mg/kg chloride and with a field screening less than 100 using a PID. We also recommend re-vegetation of the ground surface to limit infiltration of precipitation and the subsequent migration of constituents of concern to ground water. A synthetic liner installed below the root zone as proposed will inhibit the downward migration of water through the subsurface, slowing movement of chloride or soluble hydrocarbons toward ground water. Plants capture water through their roots, thereby reducing the volume of water infiltrating below the root zone. This natural "infiltration barrier" also helps protect ground water. Upon documentation of installation of the liner and re-seeding of the site with an appropriate mix of native grasses we will submit a Termination Request for this site's regulatory file.

ROC is the service provider (agent) for the Hobbs Salt Water Disposal System and has no ownership of any portion of pipeline, well or facility. The Hobbs SWD System is owned by a consortium of oil producers, System Parties, who provide all operating capital on a percentage ownership/usage basis.

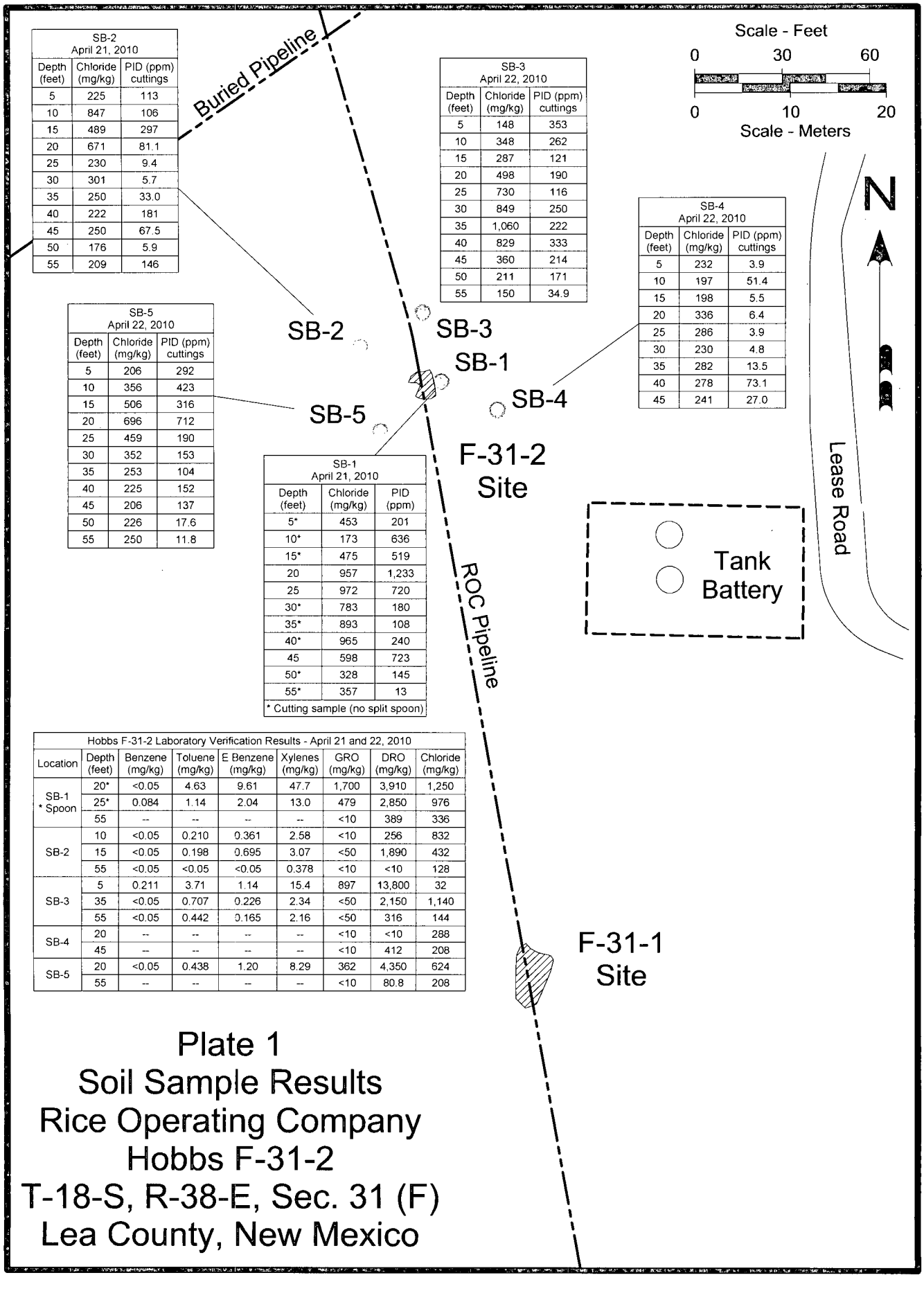
Please contact Hack Conder of ROC at 575-393-9174 if you have any questions concerning this submission. Thank you for your time and consideration.

Sincerely,
R.T Hicks Consultants, Ltd.

Dale T. Littlejohn

Dale T Littlejohn
Geologist

Copy: Hack Conder, ROC




| SB-2 April 21, 2010 | | |
|---|---|---|
| Depth (feet) | Chloride (mg/kg) | PID (ppm) cuttings |
| 5 | 225 | 113 |
| 10 | 847 | 106 |
| 15 | 489 | 297 |
| 20 | 671 | 81.1 |
| 25 | 230 | 9.4 |
| 30 | 301 | 5.7 |
| 35 | 250 | 33.0 |
| 40 | 222 | 181 |
| 45 | 250 | 67.5 |
| 50 | 176 | 5.9 |
| 55 | 209 | 146 |

| SB-3 April 22, 2010 | | |
|---|---|---|
| Depth (feet) | Chloride (mg/kg) | PID (ppm) cuttings |
| 5 | 148 | 353 |
| 10 | 348 | 262 |
| 15 | 287 | 121 |
| 20 | 498 | 190 |
| 25 | 730 | 116 |
| 30 | 849 | 250 |
| 35 | 1,060 | 222 |
| 40 | 829 | 333 |
| 45 | 360 | 214 |
| 50 | 211 | 171 |
| 55 | 150 | 34.9 |

| SB-4 April 22, 2010 | | |
|---|---|---|
| Depth (feet) | Chloride (mg/kg) | PID (ppm) cuttings |
| 5 | 232 | 3.9 |
| 10 | 197 | 51.4 |
| 15 | 198 | 5.5 |
| 20 | 336 | 6.4 |
| 25 | 286 | 3.9 |
| 30 | 230 | 4.8 |
| 35 | 282 | 13.5 |
| 40 | 278 | 73.1 |
| 45 | 241 | 27.0 |

| SB-5 April 22, 2010 | | |
|---|---|---|
| Depth (feet) | Chloride (mg/kg) | PID (ppm) cuttings |
| 5 | 206 | 292 |
| 10 | 356 | 423 |
| 15 | 506 | 316 |
| 20 | 696 | 712 |
| 25 | 459 | 190 |
| 30 | 352 | 153 |
| 35 | 253 | 104 |
| 40 | 225 | 152 |
| 45 | 206 | 137 |
| 50 | 226 | 17.6 |
| 55 | 250 | 11.8 |

| SB-1 April 21, 2010 | | |
|---|---|---|
| Depth (feet) | Chloride (mg/kg) | PID (ppm) |
| 5* | 453 | 201 |
| 10* | 173 | 636 |
| 15* | 475 | 519 |
| 20 | 957 | 1,233 |
| 25 | 972 | 720 |
| 30* | 783 | 180 |
| 35* | 893 | 108 |
| 40* | 965 | 240 |
| 45 | 598 | 723 |
| 50* | 328 | 145 |
| 55* | 357 | 13 |
| * Cutting sample (no split spoon) | | |

| Hobbs F-31-2 Laboratory Verification Results - April 21 and 22, 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Location | Depth (feet) | Benzene (mg/kg) | Toluene (mg/kg) | E Benzene (mg/kg) | Xylenes (mg/kg) | GRO (mg/kg) | DRO (mg/kg) | Chloride (mg/kg) |
| SB-1 * Spoon | 20* | <0.05 | 4.63 | 9.61 | 47.7 | 1,700 | 3,910 | 1,250 |
| | 25* | 0.084 | 1.14 | 2.04 | 13.0 | 479 | 2,850 | 976 |
| | 55 | -- | -- | -- | -- | <10 | 389 | 336 |
| SB-2 | 10 | <0.05 | 0.210 | 0.361 | 2.58 | <10 | 256 | 832 |
| | 15 | <0.05 | 0.198 | 0.695 | 3.07 | <50 | 1,890 | 432 |
| | 55 | <0.05 | <0.05 | <0.05 | 0.378 | <10 | <10 | 128 |
| SB-3 | 5 | 0.211 | 3.71 | 1.14 | 15.4 | 897 | 13,800 | 32 |
| | 35 | <0.05 | 0.707 | 0.226 | 2.34 | <50 | 2,150 | 1,140 |
| | 55 | <0.05 | 0.442 | 0.165 | 2.16 | <50 | 316 | 144 |
| SB-4 | 20 | -- | -- | -- | -- | <10 | <10 | 288 |
| | 45 | -- | -- | -- | -- | <10 | 412 | 208 |
| SB-5 | 20 | <0.05 | 0.438 | 1.20 | 8.29 | 362 | 4,350 | 624 |
| | 55 | -- | -- | -- | -- | <10 | 80.8 | 208 |

# Plate 1
# Soil Sample Results
# Rice Operating Company
# Hobbs F-31-2
# T-18-S, R-38-E, Sec. 31 (F)
# Lea County, New Mexico

# Attachment A

## Previous Submissions

**R.T. Hicks Consultants, Ltd.**
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

# R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266.0745


January 20, 2010

Mr. Edward J. Hansen
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: **Investigation & Characterization Plan**
**Hobbs Jct. F-31-2 NMOCD Case # 1R428-56**
**Township 18S, Range 38E, Section 31, Unit F**

Dear Mr. Hansen:

On behalf of Rice Operating Company (ROC), R.T. Hicks Consultants, Ltd. is pleased to submit this Investigation & Characterization Plan (ICP) for the Hobbs Jct. F-31-2 site. Plate 1 is a map showing the site relative to major roads in the area. Plate 2 shows the site, nearby USGS monitoring wells, and a regional potentiometric surface map.

The work elements proposed below will allow us to characterize this site and develop an appropriate corrective action plan.

1. ROC will identify and document the location of all current and historic equipment and pipelines associated with the site.
2. ROC will use a backhoe with a 12-foot vertical reach to install a series of sampling trenches in order to recover soil samples and delineate the lateral extent (and potentially the vertical extent) of impacted soil.
3. If characterization by the backhoe is insufficient to define the extent and magnitude of past releases, ROC and Hicks Consultants will use a drilling rig to drill one soil boring at the center of the source area to delineate the vertical extent of chloride in the soil.
4. Soil samples obtained by the backhoe or drilling rig will be obtained from regular intervals below ground surface.
5. Representative soil samples will be sent to a laboratory to allow for verification of the field chloride and PID results.
6. General soil texture descriptions will be provided for each sample trench or boring.
7. The criteria to delineate the extent of impact during trenching as well as in a soil boring is 5 point chloride decline vs. depth, or:
    a. After three consecutive samples demonstrate <250 ppm chloride using field analyses and <100ppm total hydrocarbon vapors using the headspace method, or
    b. After five consecutive samples show a decreasing trend of chloride and hydrocarbons and the last sample shows chloride < 250 ppm and total hydrocarbon vapors <100ppm.
    c. Soil boring to capillary fringe should neither (a) or (b) apply.
8. If the boring penetrates the capillary fringe, a monitoring well will be considered for completion with a 2 or 4" diameter casing down gradient from

confirmed impact for use during possible corrective actions. Plate 2 presents a potentiometric surface map for the site area.

9. If field analysis of hydrocarbon vapors and observations of staining show that hydrocarbon impact is unlikely at the site or below 20-feet, collection of samples from cuttings may be substituted for split spoon sampling (chloride only).

The ROC trench characterization will be employed to identify the lateral extent of chloride at the site, if possible. If trenching does not fully characterize the lateral extent of chloride at the site, boreholes will be advanced 20 feet beyond the furthest trenches where the soil data has an average chloride concentration greater than 1,000 mg/kg. The total depth of borings drilled to characterize lateral extent shall be 20 feet below ground surface with soil samples for delineation taken at 5 foot intervals.

Rice Operating Company (ROC) is the service provider (agent) for the Hobbs Saltwater Disposal System and has no ownership of any portion of pipeline, well, or facility. A consortium of oil producers who own the Hobbs System (System Parties) provide all operating capital on a percentage ownership/usage basis. Major projects require System Parties' authorization for expenditures (AFE) approval and work begins as funds are received. We will implement the work outlined herein after NMOCD approval and subsequent authorization from the System Parties. The Hobbs SWD system is in abandonment.

For all environmental projects, ROC will choose a path forward that:

1. Protects public health,
2. Provides the greatest net environmental benefit,
3. Complies with NMOCD Rules,
4. Is supported by good science.

Following the site characterization described above, a Corrective Action Plan with the data and analysis supportive of a procedure for site file termination, or a termination request will be submitted, depending on characterization findings.

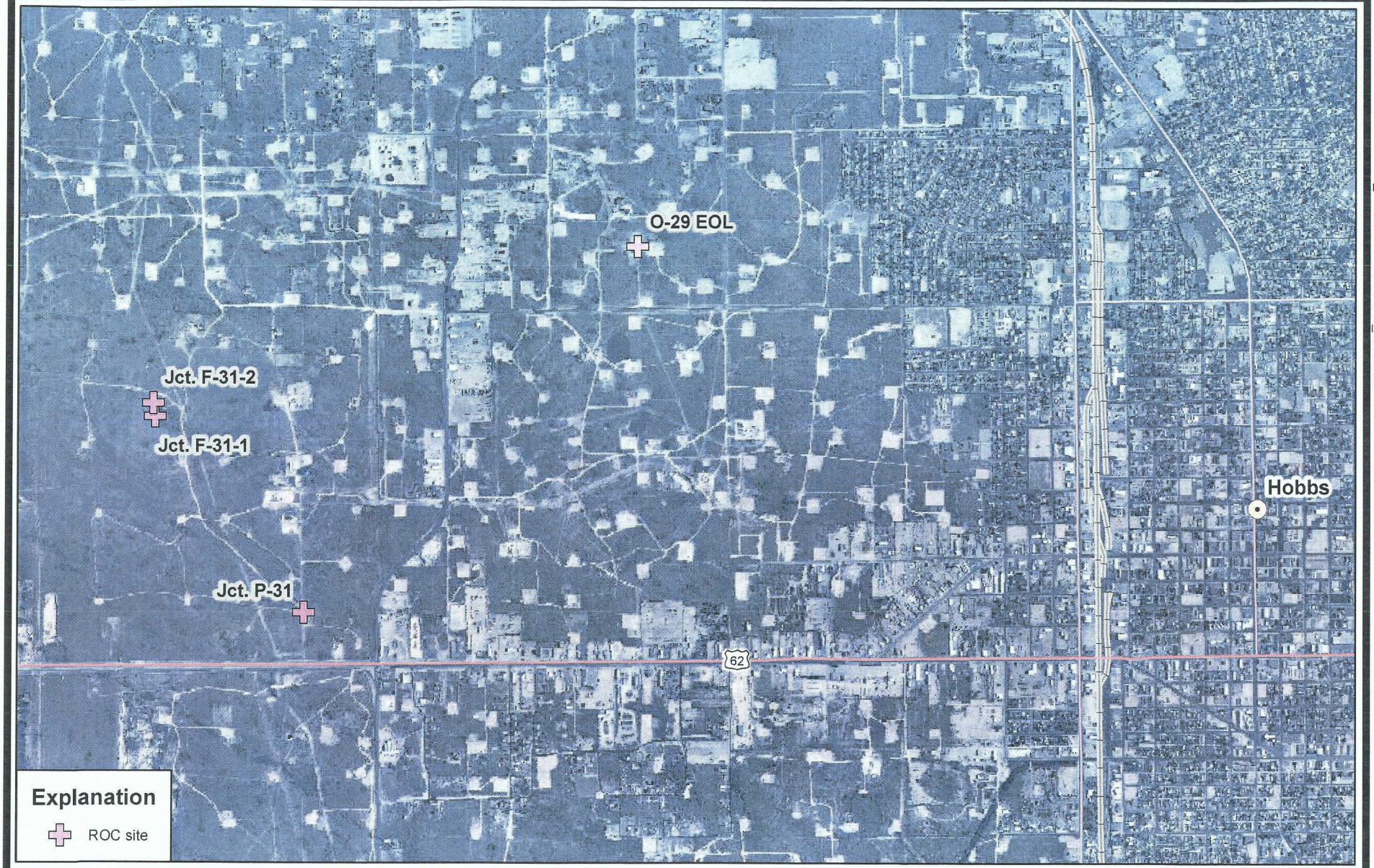
Please contact Hack Conder of ROC at 575-393-9174 if you have any questions concerning this submission. Thank you for your time and consideration.

Sincerely,
R.T Hicks Consultants, Ltd.

Katie Lee

Katie Lee
Project Scientist

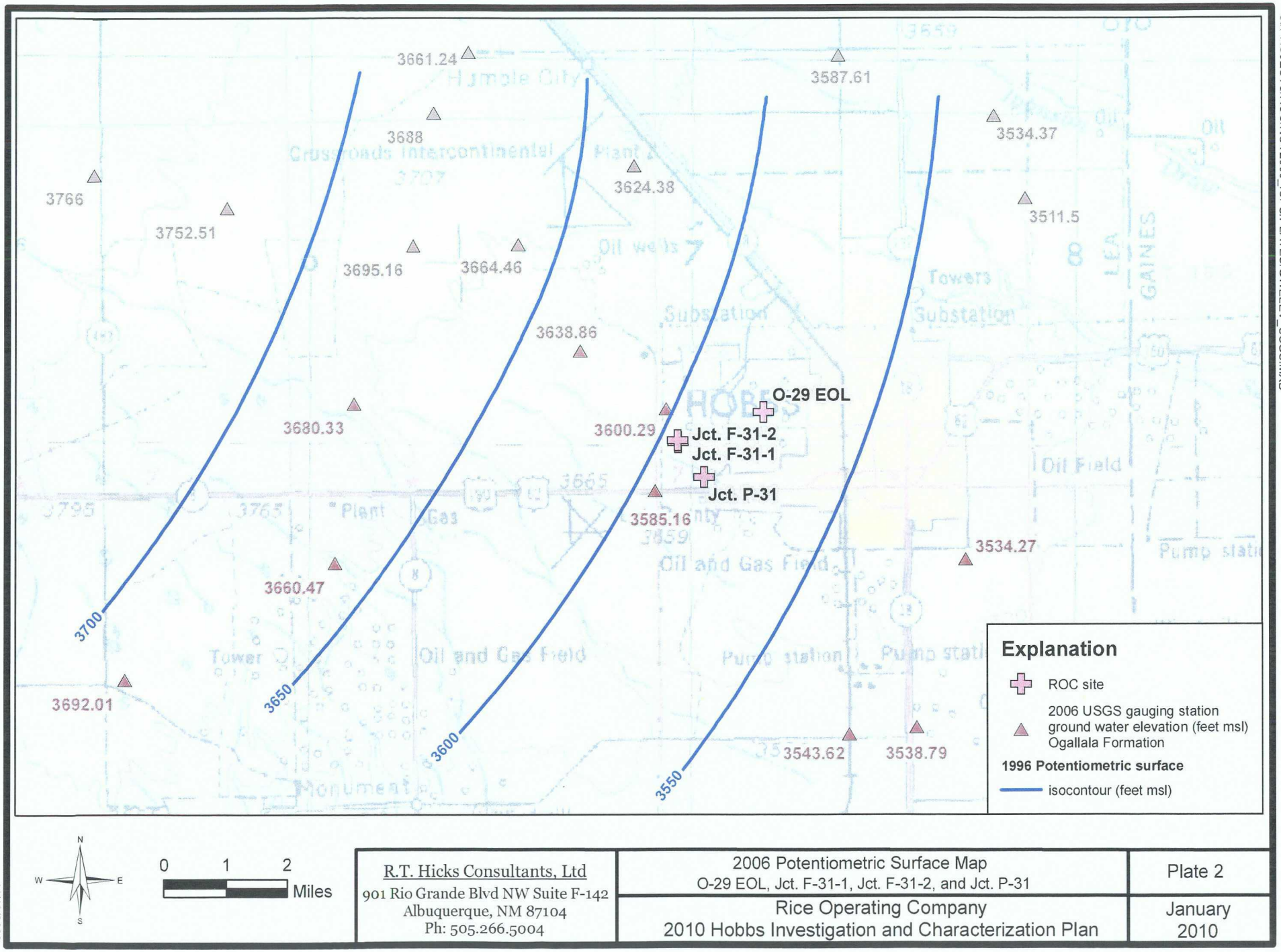
Copy: Hack Conder, ROC




S:/PROJECTS/ROC/NOV2009_ICPS/PLATES/AERIAL_2005.MXD

11/19/2009

| | | |
|---|---|---|
| R.T. Hicks Consultants, Ltd<br>901 Rio Grande Blvd NW Suite F-142<br>Albuquerque, NM 87104<br>Ph: 505.266.5004 | Site Map - 2005 Aerial Photo (RGIS)<br>O-29 EOL, Jct. F-31-1, Jct. F-31-2, and Jct. P-31 | Plate 1 |
| | Rice Operating Company<br>2010 Hobbs Investigation and Characterization Plan | January<br>2010 |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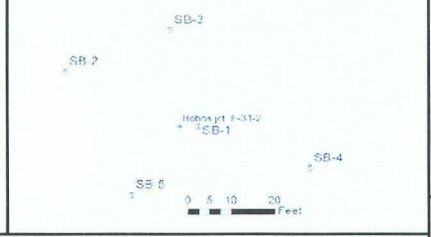
3695.16
3664.46
3624.38
3587.61
3534.37
3511.5
3638.86
3680.33
3600.29
O-29 EOL
Jct. F-31-2
Jct. F-31-1
Jct. P-31
3585.16
3660.47
3534.27
3692.01
3543.62
3538.79
3700
3650
3600
3550
Explanation
ROC site
2006 USGS gauging station ground water elevation (feet msl) Ogallala Formation
1996 Potentiometric surface
isocontour (feet msl)
N
W
E
S
0 1 2
Miles
R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004
2006 Potentiometric Surface Map
O-29 EOL, Jct. F-31-1, Jct. F-31-2, and Jct. P-31
Plate 2
Rice Operating Company
2010 Hobbs Investigation and Characterization Plan
January 2010
11/19/2009
S:/PROJECTS/ROC/NOV2009_ICPS/PLATES/GWELEV_USGS.MXD

# Attachment B

## Soil Lithology

**R.T. Hicks Consultants, Ltd.**
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

| | | | |
|---|---|---|---|
| **Logger:** | Dale Littlejohn |  | RICE OPERATING COMPANY ROC SINCE 1955 |
| **Driller:** | Harrison & Cooper, Inc. Drilling | | |
| **Consultant:** | R.T. Hicks | | |
| **Drilling Method:** | Air rotary | | |
| **Start Date:** | 4/21/2010 | | |
| **End Date:** | 4/21/2010 | | |



**Comments:** Split spoon sampling from 20,25,45 ft. All others were from cuttings. Located at the source of the former jct. box.

**Drafted by: Lara Weinheimer**

TD = 55 ft GW = 63 ft

**Project Name:** Hobbs Jct. F-31-2 **Well ID:** SB-1

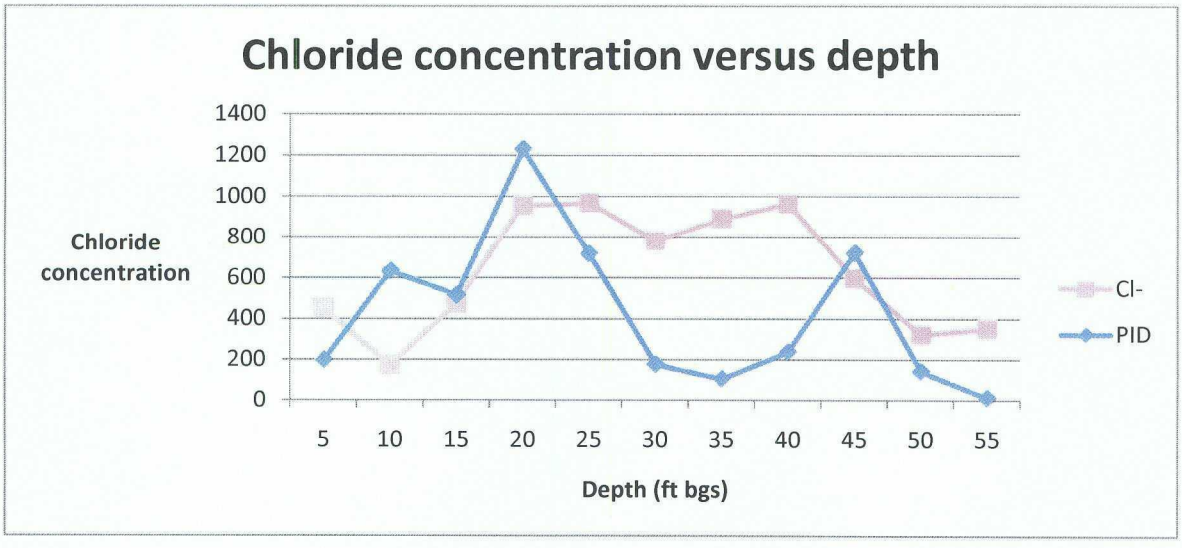
**Location:** UL/F Sec. 31 T18S R38E

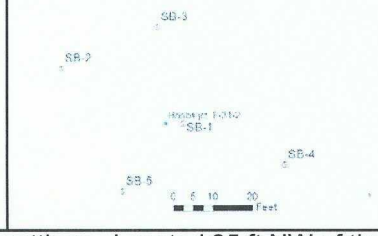
**Lat:** 32°42'26.882"N **County:** Lea

**Long:** 103°11'24.837" W **State:** NM

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| | | | | 0 - 1.5<br>SILTY CLAY<br>dark brown (top soil) | | |
| 5 | 453 | | 200.6 | 1.5 - 8 ft<br>CALICHE; SILT<br>light gray to grayish brown (hard drilling), with interbedded light brown silt, hydrocarbon odor | | |
| 10 | 173 | | 636.0 | 8 - 14 ft<br>CALICHE; SILT<br>white to gray, with interbedded gray (discolored) to light brown silt, hydrocarbon odor | | |
| 15 | 475 | | 519.0 | 14 - 18 ft<br>SAND; CALICHE; SANDSTONE<br>light grayish brown to light brown, very fine grained, well sorted, interbedded gray sandstone and caliche, hydrocarbon odor | | |
| 20 | 957 | | 1233.0 | 18 - 29 ft<br>SAND<br>brown, medium to fine grained, well sorted, angular, hydrocarbon odor | | |
| 25 | 972 | | 720.0 | | | |
| 30 | 783 | | 179.5 | 29 - 32 ft<br>SAND; QUARTZITE<br>brown to light brown, medium grained, well sorted, angular with had interbedded quartzite, hydrocarbon odor | | bentonite seal |
| 35 | 893 | | 107.5 | | | |

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| | | | | 32 - 43 ft<br>SAND<br>light brown, fine grained, well sorted, angular, hydrocarbon odor | | |
| 40 | 965 | | 240.0 | | | |
| | | | | | | |
| | | | | | | |
| 45 | 598 | | 723.0 | 43 - 55 ft<br>SAND; SANDSTONE<br>brown to light brown, fine to medium grained, moderately sorted, sub-rounded, with interbedded cemented sandstone, hydrocarbon odor | | |
| | | | | | | |
| | | | | | | |
| 50 | 328 | | 144.5 | | | |
| | | | | | | |
| | | | | | | |
| 55 | 357 | | 13.1 | | | |
| | | | | | | |
| | | | | | | |



| | | | |
|---|---|---|---|
| **Logger:** | Dale Littlejohn |  | |
| **Driller:** | Harrison & Cooper, Inc. Drilling | | |
| **Consultant:** | R.T. Hicks | | |
| **Drilling Method:** | Air rotary | | |
| **Start Date:** | 4/21/2010 | | |
| **End Date:** | 4/21/2010 | | |



**Comments:** All samples from cuttings. Located 25 ft NW of the former junction box site.

**Drafted by: Lara Weinheimer**

TD = 55 ft GW = 63 ft

**Project Name:** Hobbs Jct. F-31-2 **Well ID:** SB-2

**Location:** UL/F Sec. 31 T18S R38E

**Lat:** 32°42'27.018"N **County:** Lea

**Long:** 103°11'25.139" W **State:** NM

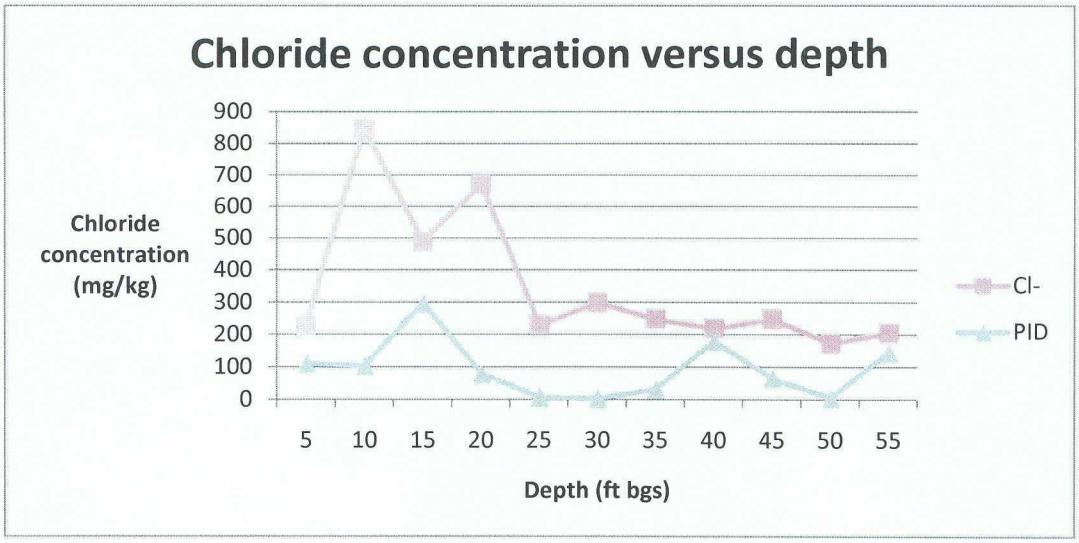
| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description |
|---|---|---|---|---|
| | | | | 0 - 1 ft |
| | | | | SILTY CLAY |
| | | | | dark brown (top soil) |
| | | | | 1 - 4 ft |
| | | | | CALICHE |
| 5 | 225 | | 112.8 | gray to white (hard drilling) |
| | | | | 4 - 14 ft |
| | | | | CALICHE; SILT |
| 10 | 847 | | 105.5 | white to gray, with interbedded gray (discolored) to light brown silt, slight hydrocarbon odor |
| 15 | 489 | | 296.5 | |
| | | | | 14 - 18 ft |
| | | | | SILTY SAND; CALICHE |
| 20 | 671 | | 81.1 | grayish brown, very fine grained, well sorted with some interbedded gray caliche |
| | | | | 18 - 23 ft |
| | | | | SAND |
| | | | | light brown, very fine grained, poorly sorted, angular |
| | | | | 23 - 25 ft |
| | | | | SAND; QUARTZITE |
| 25 | 230 | | 9.4 | light brown, very fine grained, poorly sorted, angular, interbedded with dark brown, fine crystalline quartzite |

Lithology

Bore Construction

bentonite seal

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| | | | | 25 - 44 ft<br>SAND<br>light brown, very fine grained, poorly sorted, angular | | |
| 30 | 301 | | 5.7 | | | |
| | | | | | | |
| | | | | | | |
| 35 | 250 | | 33.0 | | | |
| | | | | | | |
| | | | | | | |
| 40 | 222 | | 181.1 | | | |
| | | | | | | |
| | | | | | | |
| 45 | 250 | | 67.5 | | | |
| | | | | 44 - 55<br>SAND<br>brown, fine to medium grained, moderately sorted, sub-rounded | | |
| | | | | | | |
| 50 | 176 | | 5.9 | | | |
| | | | | | | |
| | | | | | | |
| 55 | 209 | | 145.6 | | | |
| | | | | | | |
| | | | | | | |



| | | | |
|---|---|---|---|
| **Logger:** | Dale Littlejohn |  | |
| **Driller:** | Harrison & Cooper, Inc. Drilling | | |
| **Consultant:** | R.T. Hicks | | |
| **Drilling Method:** | Air rotary | | |
| **Start Date:** | 4/22/2010 | | |
| **End Date:** | 4/22/2010 | | |



RICE OPERATING COMPANY ROC SINCE 1955

**Project Name:** Hobbs Jct. F-31-2 **Well ID:** SB-3

**Location:** UL/F Sec. 31 T18S R38E
**Lat:** 32°42'27.124"N **County:** Lea
**Long:** 103°11'24.902" W **State:** NM

**Comments:** All samples from cuttings. Located 25 ft N of the former junction box site.

**Drafted by: Lara Weinheimer**

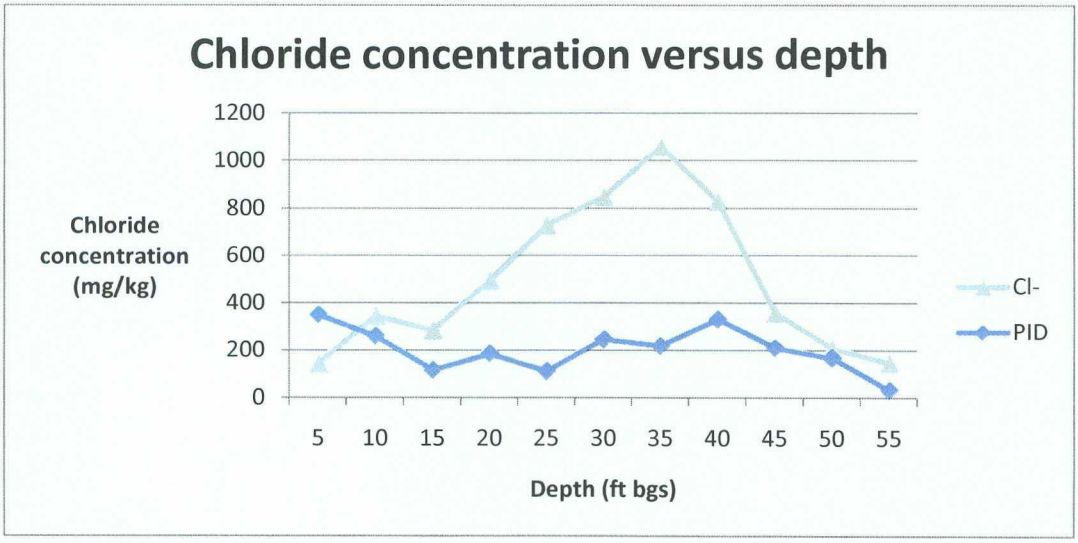
TD = 55 ft GW = 63 ft

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description |
|---|---|---|---|---|
| | | | | 0 - 1.5 ft<br>SILTY CLAY<br>dark brown (top soil) |
| | | | | 1.5 - 4 ft<br>CALICHE<br>gray to white (hard drilling) |
| 5 | 148 | | 353.4 | |
| | | | | 4 - 12 ft<br>CALICHE; SILT<br>white to gray, with interbedded olive to light brown silt, with some gray discoloration below 7 ft, slight hydrocarbon odor |
| 10 | 348 | | 262.2 | |
| | | | | 12 - 18 ft<br>SILT; CALICHE<br>grayish to white, with some interbedded quartzite |
| 15 | 287 | | 121.1 | |
| 20 | 498 | | 189.7 | 18 - 23 ft<br>SILTY SAND; SANDSTONE; QUARTZITE<br>light olive brown, very fine grained, well sorted, with interbedded (thin) sandstone and quartzite |
| 25 | 730 | | 115.7 | 23 - 48 ft<br>SAND; SANDSTONE |
| 30 | 849 | | 249.8 | |

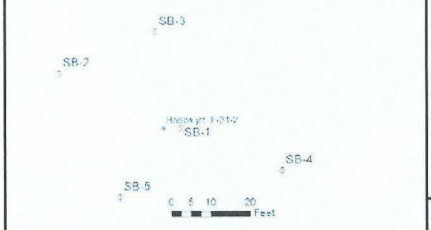
Lithology

Bore Construction: bentonite seal

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| | | | | sand, brown, fine grained, well sorted, angular, with thin sandstone bed between 29 and 48 ft | | |
| 35 | 1060 | | 222.3 | | | |
| | | | | | | |
| | | | | | | |
| 40 | 829 | | 333.1 | | | |
| | | | | | | |
| | | | | | | |
| 45 | 360 | | 214.1 | | | |
| | | | | | | |
| | | | | 48 - 55 ft<br>SAND<br>brown, medium grained, moderately sorted, sub-rounded | | |
| 50 | 211 | | 170.9 | | | |
| | | | | | | |
| | | | | | | |
| 55 | 150 | | 34.9 | | | |
| | | | | | | |
| | | | | | | |



| | |
|---|---|
| **Logger:** | Dale Littlejohn |
| **Driller:** | Harrison & Cooper, Inc. Drilling |
| **Consultant:** | R.T. Hicks |
| **Drilling Method:** | Air rotary |
| **Start Date:** | 4/22/2010 |
| **End Date:** | 4/22/2010 |




RICE OPERATING COMPANY ROC SINCE 1955

**Project Name:** Hobbs jct. F-31-2 **Well ID:** SB-4

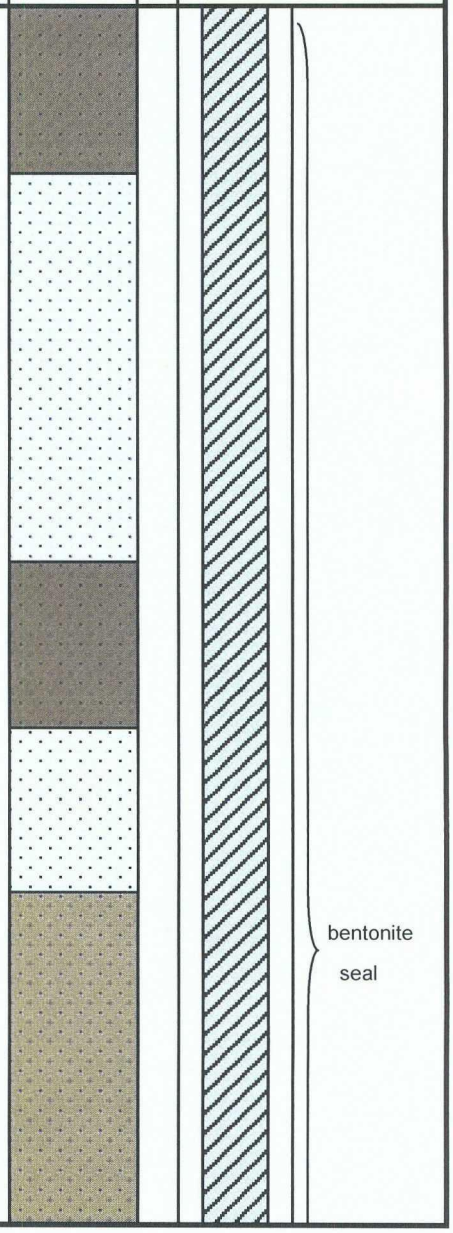
**Location:** UL/F sec. 31 T18S R38E
**Lat:** 32°42'26.778"N **County:** Lea
**Long:** 103°11'24.586" W **State:** NM

**Comments:** All samples from cuttings. Located 27 ft ESE of the former junction box site.

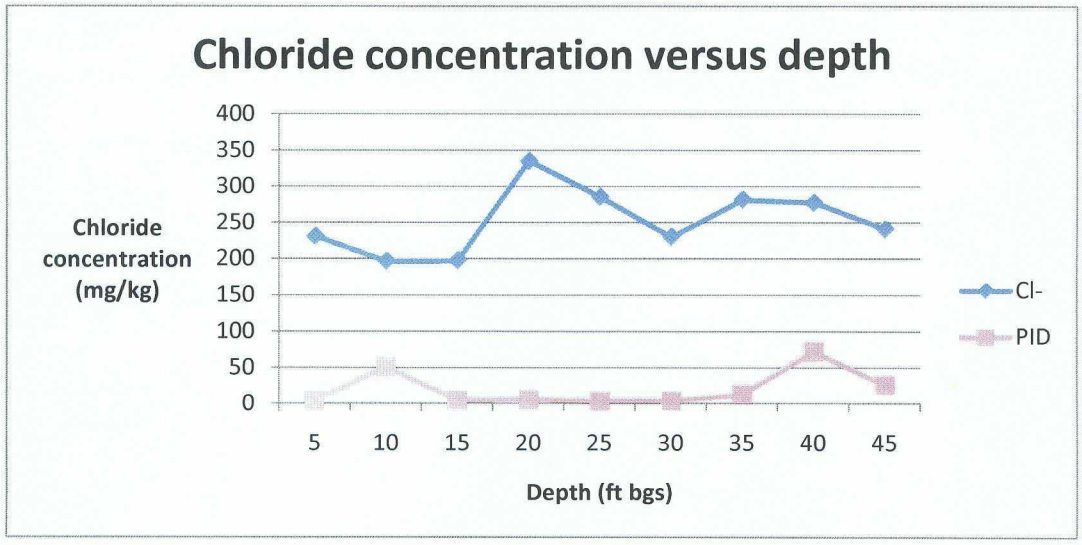
**Drafted by: Lara Weinheimer**

TD = 45 ft GW = 63 ft

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description |
|---|---|---|---|---|
| | | | | 0 - 2 ft<br>SILTY CLAY<br>dark brown (top soil) |
| 5 | 232 | | 3.9 | 2 - 12 ft<br>CALICHE; SILT<br>white to gray brown (hard drilling), with interbedded brown silt, hydrocarbon odor |
| 10 | 197 | | 51.4 | |
| 15 | 198 | | 5.5 | 12 - 14 ft<br>QUARTZITE; CALICHE<br>interbedded, quartzite brown to dark brown, fine crystalline |
| 20 | 336 | | 6.4 | 14 - 18 ft<br>CALICHE; SILT<br>white to light gray with interbedded light brown silt |
| 25 | 286 | | 3.9 | 18 - 36 ft<br>SAND; SANDSTONE<br>brown to light brown, fine grained, well sorted, angular, with interbedded thin sandstone from 29 to 34 ft |
| 30 | 230 | | 4.8 | |



| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| 35 | 282 | | 13.5 | | | |
| | | | | 36 - 45 ft<br>SAND; SANDSTONE<br>light brown, very fine grained, well sorted, angular with some interbedded thin sandstone | | |
| | | | | | | |
| | | | | | | |
| 40 | 278 | | 73.1 | | | |
| | | | | | | |
| | | | | | | |
| 45 | 241 | | 27 | | | |
| | | | | | | |
| | | | | | | |



| | |
|---|---|
| **Logger:** | Dale Littlejohn |
| **Driller:** | Harrison & Cooper, Inc. Drilling |
| **Consultant:** | R.T. Hicks |
| **Drilling Method:** | Air rotary |
| **Start Date:** | 4/22/2010 |
| **End Date:** | 4/22/2010 |


RICE OPERATING COMPANY ROC SINCE 1955

**Project Name:** Hobbs Jct. F-31-2 **Well ID:** SB-5

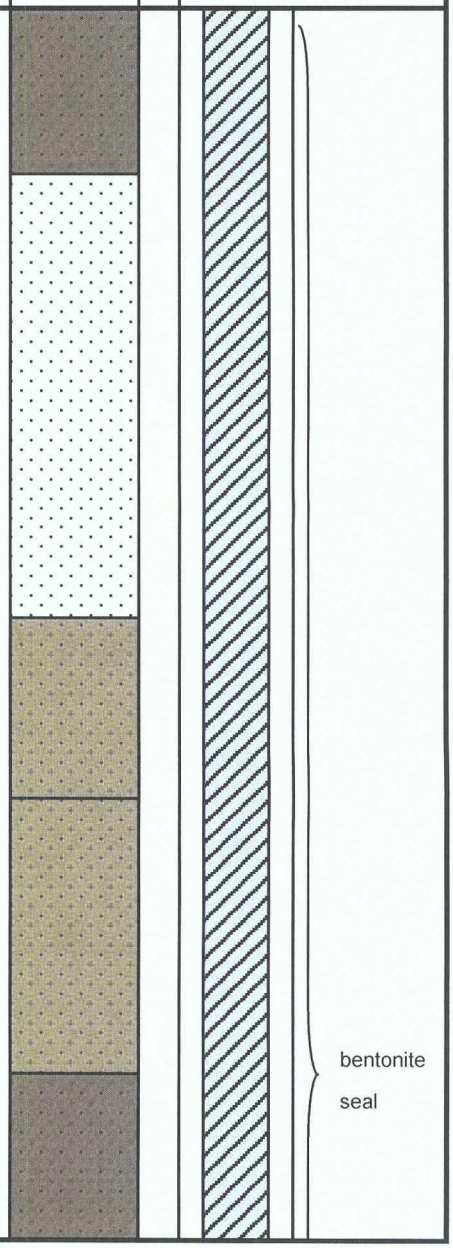
**Location:** UL/F Sec. 31 T18S R38E
**Lat:** 32°42'26.712"N **County:** Lea
**Long:** 103°11'24.989" W **State:** NM

**Comments:** All samples from cuttings. Located 20 ft WSW of the former junction box site.

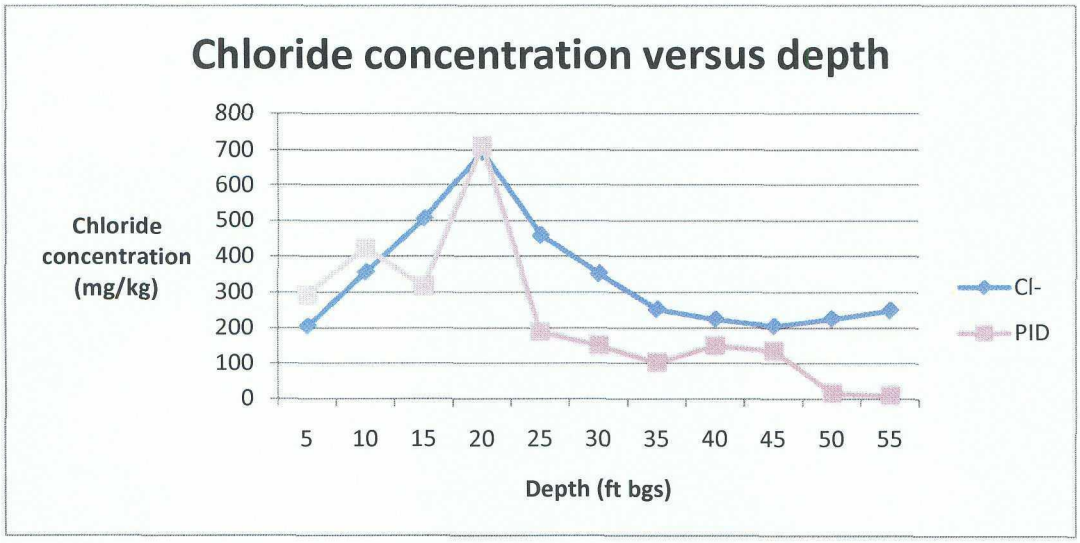
**Drafted by: Lara Weinheimer**

TD = 55 ft GW = 63 ft

| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description |
|---|---|---|---|---|
| | | | | 0 - 2 ft<br>SILTY CLAY<br>dark brown (top soil) |
| 5 | 206 | | 291.6 | 2 - 14 ft<br>CALICHE; SILT<br>white to gray (hard drilling), with interbedded olive to light brown silt, discolored (gray) at 10 to 11 feet, hydrocarbon odor |
| 10 | 356 | | 422.5 | |
| 15 | 506 | | 316.0 | |
| 20 | 696 | | 712.2 | 14 - 19 ft<br>SAND; SANDSTONE<br>light brown,very fine grained, well sorted, angular, with thin interbedded sandstone layers, hydrocarbon odor |
| 25 | 459 | | 189.8 | 19 - 27 ft<br>SAND; SANDSTONE; QUARTZITE<br>light brown,very fine grained, well sorted, angular, with thin interbedded thin sandstone and dark brown fine crystalline quartzite |
| 30 | 352 | | 152.7 | |



| Depth (feet) | chloride field tests (ppm) | LAB | PID | Description | Lithology | Bore Construction |
|---|---|---|---|---|---|---|
| 35 | 253 | | 104.4 | 27 - 55 ft<br>SAND<br>brown, fine to medium grainded, moderately sorted, sub-rounded interbedded (thick) with light brown very fine grained, well sorted, angular sand | | |
| | | | | | | |
| | | | | | | |
| 40 | 225 | | 152.3 | | | |
| | | | | | | |
| | | | | | | |
| 45 | 206 | | 136.8 | | | |
| | | | | | | |
| | | | | | | |
| 50 | 226 | | 17.6 | | | |
| | | | | | | |
| | | | | | | |
| 55 | 250 | | 11.8 | | | |
| | | | | | | |
| | | | | | | |



# Attachment C

## Laboratory Analyses

**R.T. Hicks Consultants, Ltd.**
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

CARDINAL LABORATORIES

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

April 30, 2010

Hack Conder
Rice Operating Company
112 West Taylor
Hobbs, NM 88240

Re: Hobbs Jct. F-31-2

Enclosed are the results of analyses for sample number H19734, received by the laboratory on 04/23/10 at 8:05 am.

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 Hydrocarbons |

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

Cardinal Laboratories is accredited though 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 524.2 | Regulated VOCs (V2, V3) |

Accreditation applies to public drinking water matrices.

Total Number of Pages of Report: 5 (includes Chain of Custody)

Sincerely,

Celey D. Keene
Laboratory Director

This report conforms with NELAP requirements.

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: HACK CONDER
112 W. TAYLOR
HOBBS, NM 88240

Receiving Date: 04/23/10
Reporting Date: 04/27/10
Project Number: NOT GIVEN
Project Name: HOBBS JCT. F-31-2
Project Location: HOBBS JCT. F-31-2

Sampling Date: 04/21/10 & 04/22/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: AB/HM

| LAB NUMBER | SAMPLE ID | GRO ($C_6$-$C_{10}$) (mg/kg) | DRO (>$C_{10}$-$C_{28}$) (mg/kg) | Cl* (mg/kg) |
|---|---|---|---|---|
| ANALYSIS DATE | | 04/26/10 | 04/26/10 | 04/26/10 |
| H19734-1 | SB-1 @ 20' | 1,700 | 3,910 | 1,250 |
| H19734-2 | SB-1 @ 25' | 479 | 2,850 | 976 |
| H19734-3 | SB-1 @ 55' | <10.0 | 389 | 336 |
| H19734-4 | SB-2 @ 10' | <10.0 | 256 | 832 |
| H19734-5 | SB-2 @ 15' | <50.0 | 1,890 | 432 |
| H19734-6 | SB-2 @ 55' | <10.0 | <10.0 | 128 |
| H19734-7 | SB-3 @ 5' | 897 | 13,800 | 32 |
| H19734-8 | SB-3 @ 35' | <50.0 | 2,150 | 1,140 |
| H19734-9 | SB-3 @ 55' | <50.0 | 316 | 144 |
| H19734-10 | SB-4 @ 20' | <10.0 | <10.0 | 288 |
| H19734-11 | SB-4 @ 45' | <10.0 | 412 | 208 |
| H19734-12 | SB-5 @ 20' | 362 | 4,350 | 624 |
| H19734-13 | SB-5 @ 55' | <10.0 | 80.8 | 208 |
| | | | | |
| Quality Control | | 546 | 538 | 490 |
| True Value QC | | 500 | 500 | 500 |
| % Recovery | | 109 | 108 | 98.0 |
| Relative Percent Difference | | 1.2 | 1.1 | 2.0 |

METHODS: TPH GRO & DRO: EPA SW-846 8015 M; Cl: Std. Methods 4500-Cl B
*Analyses performed on 1:4 w:v aqueous extracts.
Reported on wet weight.

Chemist

04/30/10
Date

H19734 TCL RICE

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: HACK CONDER
112 W. TAYLOR
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 04/23/10
Reporting Date: 04/30/10
Project Number: NOT GIVEN
Project Name: HOBBS JCT. F-31-2
Project Location: HOBBS JCT. F-31-2

Sampling Date: 04/21/10 & 04/22/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: ZL

| LAB NUMBE | SAMPLE ID | BENZENE (mg/kg) | TOLUENE (mg/kg) | ETHYL BENZENE (mg/kg) | TOTAL XYLENES (mg/kg) |
|---|---|---|---|---|---|
| ANALYSIS DATE | | 04/28/10 | 04/28/10 | 04/28/10 | 04/28/10 |
| H19734-1 | SB-1 @ 20' | <0.050 | 4.63 | 9.61 | 47.7 |
| H19734-2 | SB-1 @ 25' | 0.084 | 1.14 | 2.04 | 13.0 |
| H19734-4 | SB-2 @ 10' | <0.050 | 0.210 | 0.361 | 2.58 |
| H19734-5 | SB-2 @ 15' | <0.050 | 0.198 | 0.695 | 3.07 |
| H19734-6 | SB-2 @ 55' | <0.050 | <0.050 | <0.050 | 0.378 |
| H19734-7 | SB-3 @ 5' | 0.211 | 3.71 | 1.14 | 15.4 |
| H19734-8 | SB-3 @ 35' | <0.050 | 0.707 | 0.226 | 2.34 |
| H19734-9 | SB-3 @ 55' | <0.050 | 0.442 | 0.165 | 2.16 |
| H19734-12 | SB-5 @ 20' | <0.050 | 0.438 | 1.20 | 8.29 |
| | | | | | |
| | | | | | |
| | | | | | |
| Quality Control | | 0.053 | 0.047 | 0.043 | 0.131 |
| True Value QC | | 0.050 | 0.050 | 0.050 | 0.150 |
| % Recovery | | 106 | 94.0 | 86.0 | 87.3 |
| Relative Percent Difference | | 1.8 | <1.0 | 4.2 | 8.4 |

METHOD: EPA SW-846 8021B

TEXAS NELAP CERTIFICATION T104704398-08-TX FOR BENZENE, TOLUENE, ETHYL BENZENE, AND TOTAL XYLENES. Reported on wet weight.

Chemist

04/30/10
Date

# CARDINAL LABORATORIES

## CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

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

| | |
|---|---|
| Company Name: Rice Operating Company | **BILL TO** |
| Project Manager: Hack Conder | P.O. #: |
| Address: 122 West Taylor | Company: |
| City: Hobbs State: NM Zip: 88240 | Attn: |
| Phone #: 393-9174 Fax #: 397-1471 | Address: |
| Project #: Project Owner: | City: |
| Project Name: Hobbs jct. F-31-2 | State: Zip: |
| Project Location: Hobbs jct F-31-2 | Phone #: |
| Sampler Name: Lara Weinheimer | Fax #: |

| FOR LAB USE ONLY Lab I.D. | 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 | Chlorides | TPH 8015 M | BTEX | Texas TPH | Complete Cations/Anions | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H19734-1 | SB-1 @ 20' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 2:16 | ✓ | ✓ | ✓ | | | | | | | | | |
| 2 | SB-1 @ 25' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 2:26 | ✓ | ✓ | ✓ | | | | | | | | | |
| 3 | SB-1 @ 55' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 2:56 | ✓ | ✓ | | | | | | | | | | |
| 4 | SB-2 @ 10' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 3:39 | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | SB-2 @ 15' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 3:38 | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | SB-2 @ 55' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 4:17 | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | SB-3 @ 5' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 8:28 | ✓ | ✓ | ✓ | | | | | | | | | |
| 8 | SB-3 @ 35' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 8:45 | ✓ | ✓ | ✓ | | | | | | | | | |
| 9 | SB-3 @ 55' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 8:53 | ✓ | ✓ | ✓ | | | | | | | | | |
| 10 | SB-4 @ 20' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 9:42 | ✓ | ✓ | | | | | | | | | | |



| | | | |
|---|---|---|---|
| Relinquished By: L. Weinheimer | Date: 9/23/10 Time: 36 | Received By: | Phone Result: ☐ Yes ☑ No Add'l Phone #: |
| Relinquished By: | Date: 9/23/10 Time: 805 | Received By: Jodi Henson | Fax Result: ☐ Yes ☑ No Add'l Fax #: |
| Delivered By: (Circle One) Sampler - UPS - Bus - Other: | Sample Condition Cool: ☑ Yes ☐ No Intact: ☑ Yes ☐ No | CHECKED BY: (Initials) HH | REMARKS: email results<br>Hconder@riceswd.com; jpurvis@riceswd.com; Lweinheimer@riceswd.com |

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

#26

NEED SAMPLES BACK, PLEASE

# CARDINAL LABORATORIES

## CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

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

| | |
|---|---|
| Company Name: Rice Operating Company | **BILL TO** |
| Project Manager: Hack Conder | P.O. #: |
| Address: 122 West Taylor | Company: |
| City: Hobbs State: NM Zip: 88240 | Attn: |
| Phone #: 393-9174 Fax #: 397-1471 | Address: |
| Project #: Project Owner: | City: |
| Project Name: Hobbs jct F-31-2 | State: Zip: |
| Project Location: Hobbs jct F-31-2 | Phone #: |
| Sampler Name: Lara Weinheimer | Fax #: |

| FOR LAB USE ONLY Lab I.D. | 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 | Chlorides | TPH 8015 M | BTEX | Texas TPH | Complete Cations/Anions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H19734- | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | SB-4 @ 45' | G | 1 | | | ✓ | | | | | ✓ | | 4-21-10 | 9:55 | ✓ | ✓ | | | | | | | | | | | |
| 12 | SB-5 @ 20' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 10:30 | ✓ | ✓ | ✓ | | | | | | | | | | |
| 13 | SB-5 @ 55' | G | 1 | | | ✓ | | | | | ✓ | | 4-22-10 | 10:46 | ✓ | ✓ | | | | | | | | | | | |



| | | | |
|---|---|---|---|
| Relinquished By: L. Weinheimer | Date: 4/23/10 Time: 7:30 | Received By: | |
| Relinquished By: | Date: 4/23/10 Time: 8:05 | Received By: Jodi Henson | |
| Delivered By: (Circle One) Sampler - UPS - Bus - Other: | Sample Condition Cool: ☑ Yes ☐ No Intact: ☑ Yes ☐ No | CHECKED BY: (Initials) | |

Phone Result: ☐ Yes ☑ No Add'l Phone #:
Fax Result: ☐ Yes ☑ No Add'l Fax #:
REMARKS:

email results

Hconder@riceswd.com; jpurvis@riceswd.com; Lweinheimer@riceswd.com

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

NEED SAMPLES BACK, PLEASE

#26

# Attachment D

## VLEACH and AMIGO Model Explanations

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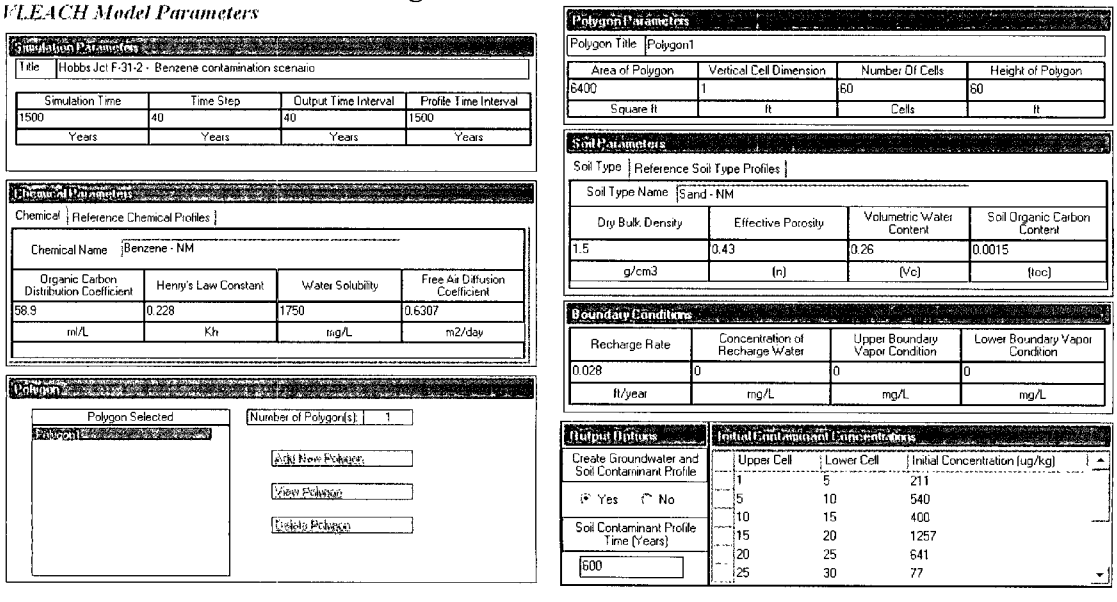
# Input and Results of the VLEACH Simulation Performed at the Rice Operating Co. Hobbs Junction F-31-2 Site

The specific parameters used in the simulation and diffusion to ground water equation at the site are presented in the table and figures below.

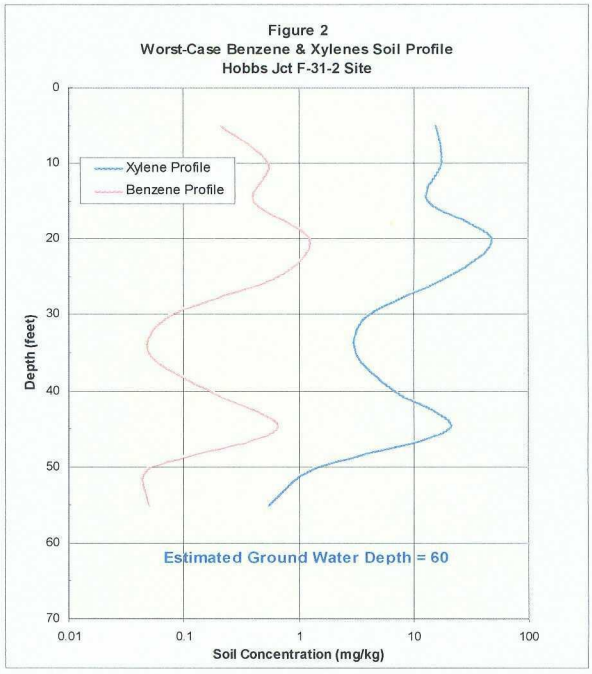
Table 1 – Common Parameters Employed in the VLEACH model for the Hobbs Junction F-31-2 Site

| Model Parameter | Value | Source of Value |
|---|---|---|
| Benzene & Xylene Chemical Parameters | Chemical Specific | NMED June 2006 Soil Screening Levels Document |
| Spill Area ($ft^2$) | 6,400 | Site Measurement (Estimate) |
| Groundwater Table Depth (ft) | 60 | Estimate from Soil Boring Data and Regional Data |
| Vadose Zone Soil Bulk Density ($g/cm^3$) | 1.5 | NMED June 2006 Document |
| Vadose Zone Porosity (unitless) | 0.43 | NMED June 2006 Document |
| Volumetric Water Content (%) | 0.26 | NMED June 2006 Document |
| Vadose Zone Soil Organic Content ($f_{oc}$) | 0.0015 | NMED June 2006 Document |
| Recharge Rate (ft/year) | 0.028 | Musharrafieh 1999 |
| Benzene & Xylene Concentrations (ug/kg) | Chemical Specific | Worst-Case Hydrocarbon Profile (Excavations & SB-1) |
| Slope of Water Table | 0.0034 | Regional Map (Attachment A) |
| Hydraulic Conductivity (ft/d) | 81 | Musharrafieh 1999 |
| Max width perpendicular to direction of GW flow (ft) | 80 | Site Measurement |
| Aquifer Porosity (unitless) | 0.25 | Prof. Judgment Conservative Assumption |
| Mixing zone depth in aquifer | 6.6 | Prof. Judgment Conservative Assumption |

Figure 1 - Actual Input Screens from the VLEACH Model Program for the Benzene Run



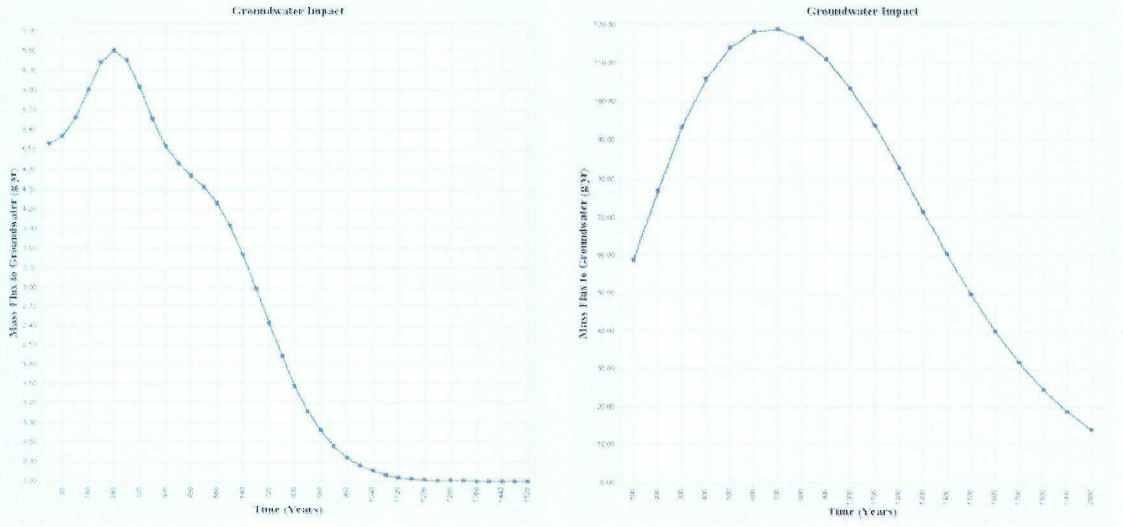
As a conservative measure, a "worst-case" hydrocarbon soil profile was constructed by taking the highest benzene and xylenes concentration from each sampled depth as shown in Figure 2. Sampling depths for which laboratory results were not available were estimated from the field screening data. The benzene and xylenes values from this profile were conservatively assumed to be present across the entire 6,400 ft² area.




The results from the VLEACH modeling relative to this assessment are provided as a graph that presents the subsurface impact as Mass Flux to Ground Water in grams/year (g/yr) as a function of future time as shown in Figure 3.

Simulation Time, Time Step, Output Time Interval, and Profile Time Interval were adjusted to provide the clearest presentation of the results based on the time required to identify the maximum impact to groundwater. The model results show the highest benzene impact to ground water will occur about 250 years from now and the highest xylene impact to ground water will occur about 700 years from now.

Figure 3
Results of VLEACH Vadose Model for Benzene (left) and Xylenes (right)




In order to compare the modeled results to the NMED ground water standard, the VLEACH output data required a conversion from g/yr to mg/L. This was performed by calculating the annual recharge (flux) volume from the spill area and the annual ground water flow volume below the spill area as shown:

Recharge is defined as: $Flux_{flow}(L/yr) = A \times R \times 29.317$ where,

A = spill area ($ft^2$)
R = recharge rate (ft/yr), and
29.317 = conversion factor from $ft^3$ to liters

Groundwater flow is defined as: $GW_{flow}(L/yr) = \left(\frac{k \times i}{\theta_T}\right) \times T_{aq} \times W \times 29.317$ where,

$k$ = hydraulic conductivity of the aquifer (ft/yr)
$i$ = groundwater gradient (ft/ft)
$\theta_T$ = porosity of the aquifer
$T_{aq}$ = aquifer mixing zone thickness (ft) and,
$W$ = length of the spill area (ft) perpendicular to the ground water gradient direction

The relationship between the annual recharge volume and the annual ground water flow volume was used to calculate the predicted ground water concentration for the initial (year zero) time and the maximum impact year time for the constituent of concern as demonstrated on the table below:

| | Present Impact Data | | | | Maximum Impact Data | | | | NM |
|---|---|---|---|---|---|---|---|---|---|
| Chemical of Concern | Year | Impact (g/yr) | Leachate Conc. (mg/L) | GW Conc. (mg/L) | Year | Impact (g/yr) | Leachate Conc. (mg/L) | GW Conc. (mg/L) | Water Quality (mg/L) |
| Benzene | 0 | 5.15 | 1.0 | 0.0008 | 240 | 6.61 | 1.3 | 0.0011 | 0.01 |
| Total Xylenes | 0 | 40 | 8 | 0.006 | 700 | 119 | 23 | 0.019 | 0.6 |

text values indicate concentrations that exceed the NMED Water Quality Standard values for groundwater.

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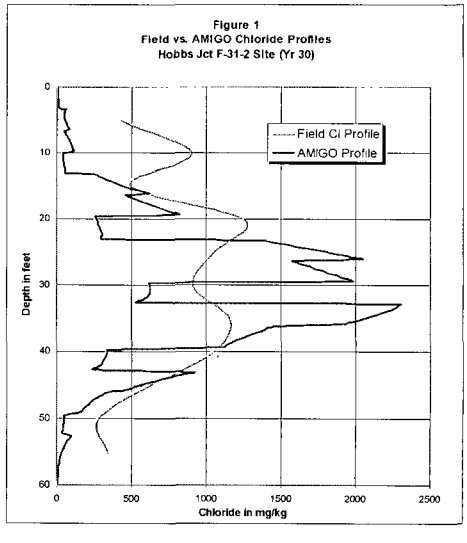
# Input and Results of the AMIGO Simulation Performed at the Rice Operating Co. Hobbs Jct. F-31-2 Site

Table 1 - Parameters Employed in AMIGO tool for the Hobbs Junction F-31-2 Site

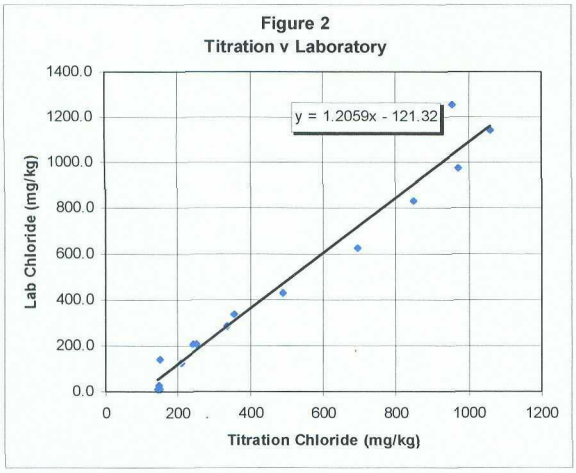
| Model Parameter | Value | Source of Value |
|---|---|---|
| Climate (non-smoothed) | 1946 - 1992 | Pearl, NM Station |
| Input for distant or hypothetical well (ft) | NA | Not Required |
| Background Chloride in Aquifer (mg/L) | 60 | PTTC/PRRC Data |
| Aquifer Porosity (unitless) | 0.25 | Prof. Judgment Conservative Assumption |
| Groundwater Table Depth (ft) | 60 | Estimate from Soil Borings and Regional Data |
| Aquifer Thickness (ft) | 30 | Professional Judgment Conservative Assumption |
| Slope of Water Table | 0.0034 | Regional Map (Attachment A) |
| Hydraulic Conductivity (ft/d) | 81 | Musharrafieh 1999 |
| Average Chloride Load (kg/m$^2$) | 18.0 | Worst-Case Profile Match to Measured Site Data |
| Max length of spill in dir. of GW flow (ft) | 80 | Site Data |
| Plant Uptake Trigger (%) | 1.0 | Prof. Judgment Conservative Assumption |
| Surface Layer | Med. Sand | Site Data |
| Soil Profile | Sandy Clay (1/3) Caliche (1/3) Sand (1/3) | Site Data (Soil Borings) and Model Calibration to Chloride Levels in the Soil |

Musharrafieh and Chudnoff (1999) predict that the saturated thickness of the aquifer beneath the site will remain at least 50 feet until the year 2040. Data from similar sites show that, unlike hydrocarbons, chloride that enters the upper portion of an aquifer will become distributed throughout the entire saturated thickness within a relatively short travel distance from the source. The arbitrary selection of a 10-foot thick mixing zone (used as a default value for hydrocarbon sites) is unrealistic where the constituent of concern is chloride. In our opinion, a simulation using the 30-foot thickness of the aquifer is conservative for this site.

The AMIGO tool assumes a single surface spill is the initial source of chloride that is observed in the subsurface. In order to ensure an accurate calibration of the model to the historic spill which occurred at the Hobbs Junction F-31-2 site, we compared each year of the simulated profile with the field data until a conservative match was achieved. A favorable but conservative match to the field data was achieved using the year 30 simulation and the calculated chloride mass-load for the worst-case area of the release as demonstrated in Figure 1.




The red curve on Figure 1 is the profile using the maximum field chloride analysis for each depth sampled from the soil borings. The field (titration) concentrations were then adjusted based on a correction determined




by comparing the field chloride concentrations with the duplicate laboratory sample concentrations as shown in Figure 2.

The blue curve in Figure 1 is the predicted chloride profile at year 30 of the simulation using a chloride load of 18.0 kg/m$^2$ (calculated from site data). Because the AMIGO simulation used the highest chloride area to represent the entire site it is considered a conservative input parameter.

The results of the simulation are shown below on the AMIGO ground water output chart which has been copied directly from the model results screen. It indicates that chloride concentrations in the ground water below the site, using the "worst-case" chloride load, will reach a maximum concentration of 170 mg/L (below standards) in 77 years from the release date if no further corrective actions are taken. If we assume the release date occurred 30 years ago, based on the profile match from Figure 1, then the maximum impact to the ground water will occur in 2057. We believe the simulated concentration in ground water is a "worst-case" prediction because of the conservative input parameters used in the model.

Figure 3
AMIGO Ground Water Output Chart for Hobbs Junction F-31-2 Site