1R - 426-153

WORKPLANS

Date:
1-10-12

ARCADIS
Infrastructure, environment, buildings

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ARCADIS U.S., Inc.
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Environmental

Sent Certified Mail
Return Receipt No. 7002 2410 0001 5813 0417

Mr. Ed Hansen
New Mexico Energy, Minerals, & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 S. St. Francis Drive
Santa Fe, New Mexico 87505

Subject:

Corrective Action Plan
Blinebry-Drinkard (BD) N-32 Vent
Unit N, SEC. 32, T21S, R37E, Eunice, Lea County, New Mexico
NMOCD CASE # 1R426-153

Date:
January 10, 2012

Contact:
Sharon Hall

Phone:
432.687.5400

Email:
sharon.hall@arcadis-us.cor

Our ref:
MT001015.0001

ARCADIS U.S., Inc.
TX Engineering License # F-533

Mr. Hansen:

RICE Operating Company (ROC) has retained ARCADIS U.S., Inc. (ARCADIS) to address potential environmental concerns at the above-referenced site. ROC is the service provider (agent) for the Blinebry-Drinkard (BD) SWD System and has no ownership of any portion of the pipeline, well, or facility. The System is owned by a consortium of oil producers, System Parties, who provide all operating capital on a percentage ownership/usage basis. Environmental projects of this magnitude require System Party AFE approval and work begins as funds are received.

On behalf of ROC, ARCADIS respectfully submits this Corrective Action Plan (CAP) for the above-referenced site.

SITE HISTORY AND BACKGROUND

The site is located west of the town of Eunice, New Mexico. Elevated chlorides in this area have been reported since early 1952 *(Geology and ground-water conditions in southern Lea County, New Mexico* [Groundwater Report 6 by A. Nicholson, Jr. and A. Clebsch, Jr.; United States Geological Society]). The depth to groundwater at this site is approximately 96 feet below ground surface (bgs).

The junction was eliminated and replaced with a new junction box located 80 feet northeast of the former junction box location. Initial delineation began in August 2007

and was completed on November 2, 2007. A backhoe was used to collect soil samples five, ten and fifteen feet north, south, east and west of the junction box locations at one foot intervals to a depth of 12 ft bgs. Soil samples were analyzed in the field for chlorides using field-adapted Standard Method 4500-Cl⁻B and screened in the field using a photoionization detector (PID).

A backhoe was used to excavate soils from an excavation around the former junction box measuring 30 feet by 30 feet by 12 feet deep. A four-point wall composite sample was collected from each of the four walls and a five-point composite sample was collected from the bottom of the excavation and submitted to Cardinal Laboratories for gasoline range organics (GRO) and diesel range organics (DRO) and chloride analysis. Some elevated PID readings were observed near the source. DRO was detected at a concentration of 57.8 milligrams per kilogram (mg/kg) in the four-point wall composite sample and at a concentration of 36 mg/kg in the five-point bottom composite sample. GRO was not detected.

Based on the results of the soil sampling analytical results, elevated chloride concentrations are present at the subject site.

The excavated soils were blended on-site and returned to the excavation to a depth six feet below grade. A six-foot deep shelf extending five-feet from the north, south and west walls and ten-feet from the east wall was excavated to prepare the excavation for a clay barrier. A 40x45x1-foot thick clay barrier was installed at a depth of five to six feet bgs. The clay layer was compacted to a dry density of 93.4% and 14% moisture. The remaining fill was used to backfill the excavation to ground surface and to contour the surrounding area. An identification plate was placed on the surface at the location of the former junction box to mark the presence of the clay liner.

A sample of the blended backfill material was submitted to Cardinal Laboratories for GRO, DRO and chloride analysis. DRO was detected at a concentration of 517 mg/kg and chlorides were detected at a concentration of 1,090 mg/kg.

To further investigate the depth of chloride impacts a soil boring (SB-1) was drilled to a depth of 90 feet bgs at a location five-feet north of the former junction box. Soil samples were collected every five-feet and analyzed in the field for chlorides using field-adapted Standard Method 4500-Cl⁻B and screened in the field using a PID. One sample, collected from a depth of 90 feet bgs was submitted to Cardinal Laboratories

and analyzed for chlorides. Laboratory analysis confirmed the presence of an elevated chloride concentration (1,296 mg/kg) at a depth of 90 feet bgs.

ROC disclosed potential groundwater impact at the site to New Mexico Oil Conservation Division (NMOCD) via e-mail on December 6, 2007. A disclosure report was submitted to NMOCD with all of the ROC 2007 Junction Box Reports in March 2008 per the ROC Junction Box Upgrade Work plan.

On behalf of ROC, ARCADIS submitted an ICP to NMOCD on May 21, 2008.

The proposed ICP was approved by NMOCD on May 28, 2008. On June 2, 2008, NMOCD was informed by email that an electromagnetic (EM) survey would be performed at this site to assist on placement of the proposed monitoring well and soil borings. On July 30, 2008 ARCADIS emailed NMOCD the results of the EM survey and informed NMOCD that there were no proposed changes to the approved monitoring well and soil boring locations as a result of the EM survey.

ICP INVESTIGATION RESULTS

Four soil borings (SB 2 through SB 5) and one monitoring well (MW-1) were drilled at the site on October 6 and 7, 2008. The soil borings were each drilled to a depth of 80 feet and the monitoring well was drilled to a depth of 100 feet. Soil samples were collected every five-feet and analyzed in the field for chlorides using field-adapted Method 4500-Cl-B and screened in the field using a PID. Two samples from each boring were submitted to Cardinal Laboratories and analyzed for chlorides.

Laboratory and field analysis confirm that elevated chloride concentrations are present in soils at the site. Soil boring laboratory and field analytical results are summarized on the attached figure.

One upgradient (MW-3) and one downgradient (MW-2) monitoring well was installed at the site to assess groundwater quality. The monitor wells were drilled on July 9, 2009. Two additional monitoring wells, one upgradient (MW-4) and one downgradient (MW-5) of the wells drilled in July, were drilled on September 21 and 22, 2009. These wells were installed to further assess regional groundwater conditions in order to evaluate a groundwater remedy. Groundwater sampling results are shown in the attached table.

The laboratory analytical results from groundwater samples collected from MW-3 confirm that elevated chlorides are present in groundwater upgradient of the site. Based on the fact that elevated chloride concentrations in groundwater have been reported in the area since the early 1950s and that elevated chloride concentrations occur in the monitoring well upgradient of the site we propose a chloride mass estimation and removal plan.

CHLORIDE MASS ESTIMATION

Estimate of Chloride Mass in Groundwater

Calculations used to estimate the chloride mass in groundwater that may have resulted from the former junction box are detailed in the table below. The size of the impacted area is conservatively assumed based on chloride concentrations in soil samples collected from monitoring wells and soil borings multiplied by a factor of 10 (the estimated horizontal dispersivity factor). This total area is then multiplied by the thickness of the aquifer (15 feet) and the estimated porosity (25%) resulting in a total saturated pore volume.

The increase in chloride concentrations in groundwater is calculated by subtracting the average elevated upgradient chloride concentration at the site (MW-3, 2,356 milligrams per Liter {mg/L}) from the average chloride concentration identified at the site (near source monitoring well MW-1, 2,572 mg/L). This net difference in chloride concentrations conservatively reflects the net impact to groundwater at the site resulting from the former junction box.

The net difference in the concentration of chlorides is multiplied by the total saturated pore space volume resulting in the estimated chloride mass as shown in the following table.

Estimate of Chloride Mass in Groundwater

Parameter	Value	Description of equations used
Impact Area	6,640 ft^2	Physical measurement of junction box excavation
Longitudinal Dispersivity	10	Professional estimate for factoring the plume length
Aquifer Thickness	15 ft	Based on regional groundwater data*
Porosity	25%	Professional estimate of pore volume
Volume of impacted groundwater below former junction boxes	249,000 ft^3	Multiplication of parameters listed above
Volume of impacted groundwater below former junction boxes	7,050,895 L	Unit conversion of above value to liters
Averaged increase in on-site chloride concentrations	216 mg/L	Difference between the average concentrations in MW-1 (near source) and MW-3 (upgradient)
Total Chloride Mass	**1,523 kg**	Multiplication of two parameters above

* Ground-Water Report 6; Geology and Ground-Water Conditions in Southern Lea County, New Mexico; Nicholson and Clebsch

Estimate of Chloride Concentration Contributed From Vadose Zone

Since chloride impacts to soil are too deep to feasibly excavate impacted soils, ROC proposes installing a 20-mil, reinforced liner at approximately 25 ft bgs, as shown in the attached figure. Impacted soils will be excavated to an approximate depth of 25 feet bgs and a modified 75 foot by 90 foot 20-mil reinforced poly liner will be installed and properly seated. Backfill soils will be placed over the liner and graded to prevent infiltration of rainwater. Backfill soils will not exceed a chloride concentration of 500 mg/kg or PID reading of 100 ppm. The site will be seeded with native grasses. Note that a liner is not proposed for the northwest corner of the site. This area of the site is well vegetated and the proposed infiltration barrier was designed to avoid disturbing this well vegetated area of the site

In light of the fact that an infiltration barrier is proposed, an exposure assessment was run for this site using the United States Environmental Protection Agency Exposure Assessment Multimedia Model (MULTIMED Version 1.5, 2005). Data

inputs and model outputs are attached. The model output concludes that the peak increased concentration of chlorides in groundwater contributed by soils in the vadose zone would be approximately 123.4 mg/L in 226 years. Since the estimated increase in chloride concentrations in groundwater would not result in a groundwater background concentration exceedance, vadose zone chloride mass removal estimates are not warranted for this site.

CHLORIDE MASS REMOVAL

ROC proposes the installation of a groundwater recovery system at the former junction box location. A solar-driven pump will be placed in an existing 4-inch monitor well with the highest chloride concentration. The pump will operate 8-10 hours per day and the groundwater recovered from the well will be utilized for pipeline and well maintenance or landowner usage (cow trough).

At a pumping rate of one gallon per minute the groundwater recovery system could extract 5.62 kg per day. At that rate it will take approximately 3,090 barrels and approximately 271 days to remove the 1,523 kg of chloride mass. Additionally, a second pump may be placed in another well.

Thank you for your consideration concerning this proposed CAP. If you have any questions, do not hesitate to contact Hack Conder or me.

Sincerely,

ARCADIS U.S., Inc.

Sharon E. Hall

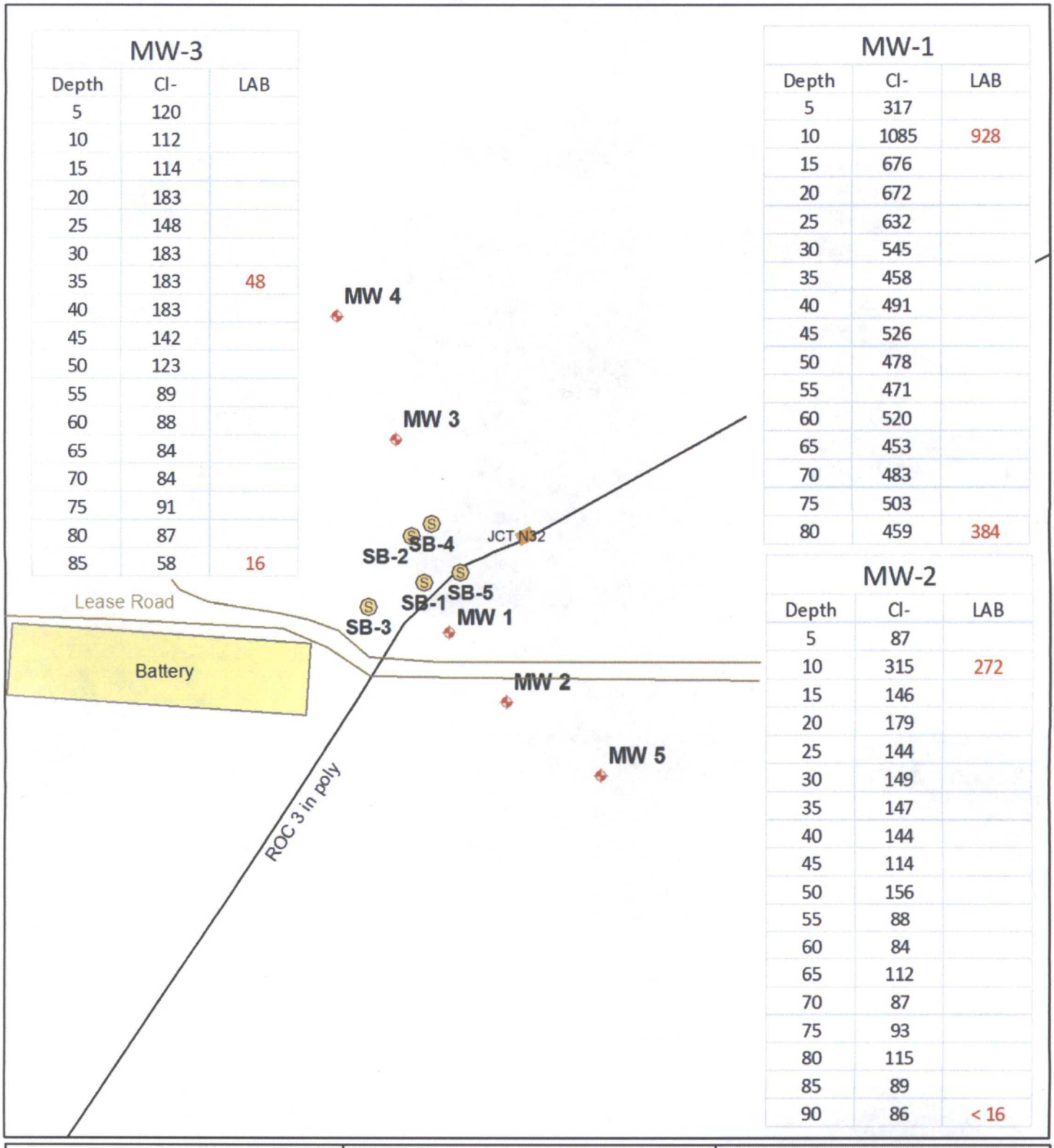
Sharon E. Hall
Associate Vice President

Copies:
Hack Conder, ROC

Attachments:

Monitor Well Soil Data Figure
Soil Bore Data Figure
Proposed Infiltration Barrier Figure
Groundwater Data Summary Table
November 2011 Groundwater Analytical Results
Monitoring Well Logs
MULTIMED Model Inputs and Output

Monitor Well Soil Data



MW-3		
Depth	Cl-	LAB
5	120	
10	112	
15	114	
20	183	
25	148	
30	183	
35	183	48
40	183	
45	142	
50	123	
55	89	
60	88	
65	84	
70	84	
75	91	
80	87	
85	58	16

MW-1		
Depth	Cl-	LAB
5	317	
10	1085	928
15	676	
20	672	
25	632	
30	545	
35	458	
40	491	
45	526	
50	478	
55	471	
60	520	
65	453	
70	483	
75	503	
80	459	384

MW-2		
Depth	Cl-	LAB
5	87	
10	315	272
15	146	
20	179	
25	144	
30	149	
35	147	
40	144	
45	114	
50	156	
55	88	
60	84	
65	112	
70	87	
75	93	
80	115	
85	89	
90	86	< 16

RICE ENVIRONMENTAL RECS CONSULTING & SAFETY, LLC

BD N-32 vent

Legals: UL/N sec. 32
T21S R37E
NMOCD Case #: 1R426-153

N W E S

0 25 50 100 150 200 Feet

Drawing date: 12/30/2011
Drafted by: Lara Weinheimer

Soil Bore Data

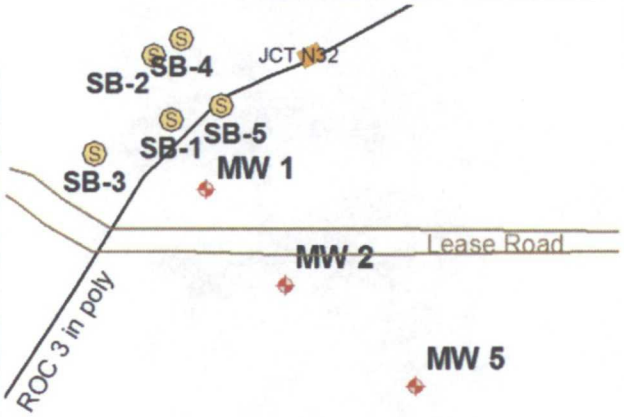
SB-1		
Depth	Cl-	LAB
15	1042	
20	968	
25	2102	
30	2960	
35	2449	
40	1368	
45	1883	
50	1393	
55	1405	
60	1437	
65	1349	
70	1315	
75	1505	
80	1412	
85	1247	
90	1285	1296

SB-2		
Depth	Cl-	LAB
5	1196	
10	1806	
15	2633	
20	3009	3240
25	1794	
30	1428	
35	969	
40	1006	
45	1330	
50	1076	
55	975	
60	824	
65	936	
70	1097	
75	1143	
80	1363	1260

SB-3		
Depth	Cl-	LAB
5	454	
10	826	
15	1934	
20	2033	1960
25	1667	
30	1363	
35	1169	
40	1060	
45	1090	
50	834	
55	938	
60	869	
65	993	
70	785	656

SB-4		
Depth	Cl-	LAB
5	208	
10	427	
15	587	
20	662	
25	906	
30	1402	1330
35	1198	
40	1140	
45	1129	
50	918	
55	844	
60	579	
65	566	
70	481	
75	426	
80	1307	1250

SB-5		
Depth	Cl-	LAB
5	282	
10	585	
15	445	
20	729	
25	2204	
30	2380	2000
35	2191	
40	1684	
45	2003	
50	1503	
55	1200	
60	1378	
65	1543	
70	1332	
75	1398	
80	1407	1330



RICE ENVIRONMENTAL RECS CONSULTING & SAFETY, LLC

BD N-32 vent

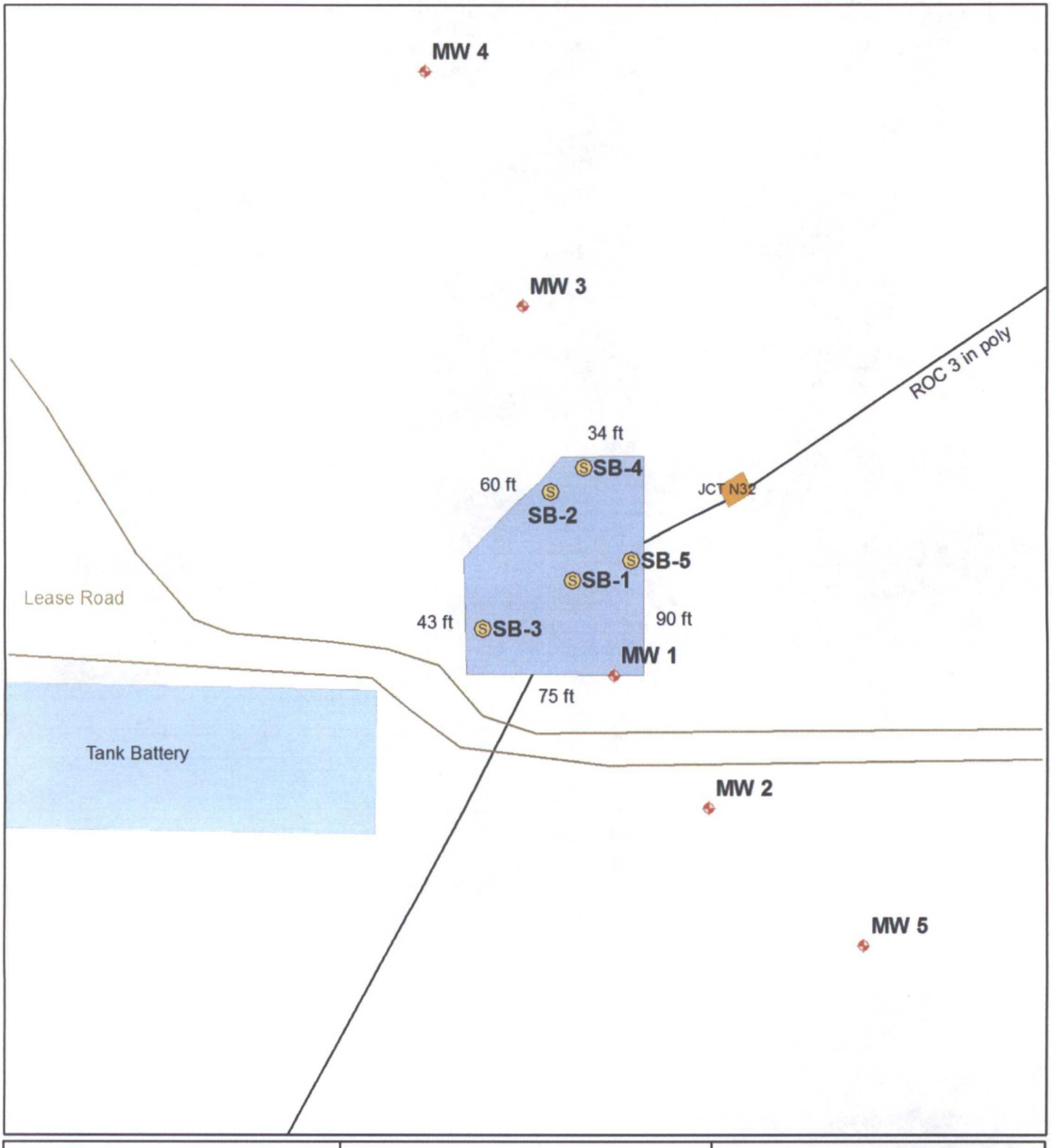
Legals: UL/N sec. 32
T21S R37E
NMOCD Case #: 1R426-153

N W E S

0 25 50 100 150 200 Feet

Drawing date: 12/30/2011
Drafted by: Lara Weinheimer

Proposed Infiltration Barrier



RICE ENVIRONMENTAL RECS CONSULTING & SAFETY, LLC

BD N-32 vent

Legals: UL/N sec. 32
T21S R37E
NMOCD Case #: 1R426-153

N
W E
S

0 25 50 100 Feet

Drawing date: 12-30-11
Drafted by: L. Weinheimer

ROC BD N-32 vent

MW	Depth to Water (feet)	Total Depth (feet)	Well Volume (gallons)	Volume Purged (gallons)	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate
1	97.17	102.6	3.5	15	11/13/2008	2500	4970	<0.001	<0.001	<0.001	<0.003	187
1	97.18	102.68	3.6	15	1/21/2009	1540	3010	<0.001	<0.001	<0.001	<0.003	130
1	97.13	102.58	3.5	15	4/22/2009	1020	2210	<0.001	<0.001	<0.001	<0.003	119
1	97.1	102.58	3.6	15	7/24/2009	930	2090	<0.001	<0.001	<0.001	<0.003	112
1	97.05	102.58	3.6	15	10/2/2009	1230	2440	<0.001	<0.001	<0.001	<0.003	120
1	96.99	102.63	3.7	15	1/25/2010	2120	4680	<0.001	<0.001	<0.001	<0.003	127
1	96.98	102.63	3.7	15	4/23/2010	2800	4870	<0.001	<0.001	<0.001	<0.003	184
1	96.91	102.63	3.7	15	7/23/2010	3350	6170	<0.001	<0.001	<0.001	<0.003	168
1	96.9	102.63	3.7	15	10/21/2010	3250	5530	<0.001	<0.001	<0.001	<0.003	132
1	96.84	102.65	3.8	15	2/10/2011	4400	7310	<0.001	<0.001	<0.001	<0.003	171
1	96.8	102.65	3.8	15	5/12/2011	4000	6830	<0.001	<0.001	<0.001	<0.003	212
1	96.74	102.65	3.8	15	8/8/2011	3200	5600	<0.001	<0.001	<0.001	<0.003	142
1	96.77	102.65	3.8	15	11/2/2011	3100	5510	<0.001	<0.001	<0.001	<0.003	170

MW	Depth to Water (feet)	Total Depth (feet)	Well Volume (gallons)	Volume Purged (gallons)	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate
2	99.78	105.96	1	4	7/24/2009	800	1920	<0.001	<0.001	<0.001	<0.003	190
2	98.73	105.96	1.2	4	10/2/2009	770	1970	<0.001	<0.001	<0.001	<0.003	186
2	98.69	105.85	1.1	4	1/25/2010	820	1940	<0.001	<0.001	<0.001	<0.003	214
2	98.69	105.85	1.1	4	4/23/2010	780	1760	<0.001	<0.001	<0.001	<0.003	243
2	98.61	105.85	1.2	4	7/23/2010	840	2120	<0.001	<0.001	<0.001	<0.003	238
2	98.55	105.85	1.2	4	10/21/2010	790	2170	<0.001	<0.001	<0.001	<0.003	214
2	98.54	105.93	1.2	5	2/10/2011	850	2070	<0.001	<0.001	<0.001	<0.003	361
2	98.51	105.93	1.2	5	5/11/2011	900	2130	<0.001	<0.001	<0.001	<0.003	341
2	98.46	105.93	1.2	5	8/8/2011	880	1970	<0.001	<0.001	<0.001	<0.003	249
2	98.48	105.93	1.2	5	11/2/2011	860	1900	<0.001	<0.001	<0.001	<0.003	208

Sample results in milligrams per liter (mg/L)

ROC BD N-32 vent

MW	Depth to Water (feet)	Total Depth (feet)	Well Volume (gallons)	Volume Purged (gallons)	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate
3	99.74	138.48	25.2	150	7/24/2009	2340	5220	<0.001	<0.001	<0.001	<0.003	106
3	99.74	138.48	25.2	200	10/2/2009	6400	12,400	<0.001	<0.001	<0.001	<0.003	127
3	99.65	138.58	25.3	150	1/25/2010	2020	3,900	<0.001	<0.001	<0.001	<0.003	116
3	99.67	138.58	25.3	150	4/23/2010	2500	4,640	<0.001	<0.001	<0.001	<0.003	193
3	99.58	138.58	25.4	80	7/23/2010	1800	3300	<0.001	<0.001	<0.001	<0.003	86
3	99.5	138.58	25.4	80	10/21/2010	940	2110	<0.001	<0.001	<0.001	<0.003	74.9
3	99.49	138.58	25.4	80	2/10/2011	3250	5680	<0.001	<0.001	<0.001	<0.003	115
3	99.47	138.58	25.4	80	5/12/2011	2650	4630	<0.001	<0.001	<0.001	<0.003	114
3	99.44	138.58	25.4	80	8/8/2011	1000	1900	<0.001	<0.001	<0.001	<0.003	93.2
3	99.38	138.58	25.5	80	11/2/2011	660	1480	<0.001	<0.001	<0.001	<0.003	94.3

MW	Depth to Water (feet)	Total Depth (feet)	Well Volume (gallons)	Volume Purged (gallons)	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate
4	98.90	138.80	25.9	200	10/2/2009	420	1170	<0.001	<0.001	<0.001	<0.003	115
4	98.84	138.80	26	150	1/25/2010	216	807	<0.001	<0.001	<0.001	<0.003	126
4	98.86	138.80	26	150	4/23/2010	72	492	<0.001	<0.001	<0.001	<0.003	93.2
4	98.8	138.8	26	80	7/23/2010	148	607	<0.001	<0.001	<0.001	<0.003	82
4	98.64	138.8	26.1	80	10/21/2010	72	489	<0.001	<0.001	<0.001	<0.003	90.3
4	98.62	138.8	26.1	80	2/10/2011	204	795	<0.001	<0.001	<0.001	<0.003	87
4	98.6	138.8	26.1	80	5/12/2011	64	484	<0.001	<0.001	<0.001	<0.003	97.9
4	98.53	138.8	26.2	80	8/8/2011	72	478	<0.001	<0.001	<0.001	<0.003	86
4	98.47	138.8	26.2	80	11/2/2011	92	595	<0.001	<0.001	<0.001	<0.003	91.8

MW	Depth to Water (feet)	Total Depth (feet)	Well Volume (gallons)	Volume Purged (gallons)	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate
5	98.09	110.2	1.9	6	10/2/2009	164	706	<0.001	<0.001	<0.001	<0.003	83.7
5	98.05	110.14	1.9	6	1/25/2010	132	623	<0.001	<0.001	<0.001	<0.003	104
5	98.08	110.14	1.9	6	4/23/2010	128	580	<0.001	<0.001	<0.001	<0.003	91.7
5	98.01	110.14	1.9	6	7/23/2010	120	615	<0.001	<0.001	<0.001	<0.003	94.6
5	97.91	110.14	2	6	10/21/2010	116	561	<0.001	<0.001	<0.001	<0.003	99.5
5	97.89	110.19	2	8	2/10/2011	120	542	<0.001	<0.001	<0.001	<0.003	82.9
5	97.88	110.19	2	8	5/11/2011	108	573	<0.001	<0.001	<0.001	<0.003	89.7
5	97.91	110.19	2	8	8/8/2011	124	559	<0.001	<0.001	<0.001	<0.003	75.5
5	97.89	110.19	2	8	11/2/2011	108	554	<0.001	<0.001	<0.001	<0.003	89.2

Sample results in milligrams per liter (mg/L)

CARDINAL Laboratories

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

November 14, 2011

Hack Conder

Rice Operating Company

112 W. Taylor

Hobbs, NM 88240

RE: BD N-32-VENT

Enclosed are the results of analyses for samples received by the laboratory on 11/07/11 13:48.

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:

Rice Operating Company
Hack Conder
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	11/07/2011	Sampling Date:	11/02/2011
Reported:	11/14/2011	Sampling Type:	Water
Project Name:	BD N-32-VENT	Sampling Condition:	Cool & Intact
Project Number:	BD N-32 VENT	Sample Received By:	Celey D. Keene
Project Location:	T21S R37E SEC32 N - LEA CTY., NM		

Sample ID: MONITOR WELL #1 (H102412-01)

BTEX 8021B mg/L Analyzed By: MS

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	<0.001	0.001	11/09/2011	ND	0.047	93.9	0.0500	3.46	
Toluene*	<0.001	0.001	11/09/2011	ND	0.046	92.6	0.0500	2.91	
Ethylbenzene*	<0.001	0.001	11/09/2011	ND	0.054	108	0.0500	3.22	
Total Xylenes*	<0.003	0.003	11/09/2011	ND	0.151	101	0.150	2.45	

Surrogate: 4-Bromofluorobenzene (PIL *98.7 %* *70.7-118*

Chloride, SM4500Cl-B mg/L Analyzed By: HM

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**3100**	4.00	11/14/2011	ND	104	104	100	3.77	

Sulfate 375.4 mg/L Analyzed By: HM

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Sulfate	**170**	10.0	11/14/2011	ND	17.2	86.0	20.0	6.61	

TDS 160.1 mg/L Analyzed By: HM

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
TDS	**5510**	5.00	11/08/2011	ND	245	102	240	0.186	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
Hack Conder
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	11/07/2011	Sampling Date:	11/02/2011
Reported:	11/14/2011	Sampling Type:	Water
Project Name:	BD N-32-VENT	Sampling Condition:	Cool & Intact
Project Number:	BD N-32 VENT	Sample Received By:	Celey D. Keene
Project Location:	T21S R37E SEC32 N - LEA CTY., NM		

Sample ID: MONITOR WELL #2 (H102412-02)

BTEX 8021B mg/L **Analyzed By: MS**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	<0.001	0.001	11/09/2011	ND	0.047	93.9	0.0500	3.46	
Toluene*	<0.001	0.001	11/09/2011	ND	0.046	92.6	0.0500	2.91	
Ethylbenzene*	<0.001	0.001	11/09/2011	ND	0.054	108	0.0500	3.22	
Total Xylenes*	<0.003	0.003	11/09/2011	ND	0.151	101	0.150	2.45	

Surrogate: 4-Bromofluorobenzene (PIL *99.4 %* *70.7-118*

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

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**860**	4.00	11/14/2011	ND	104	104	100	3.77	

Sulfate 375.4 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Sulfate	**208**	10.0	11/14/2011	ND	17.2	86.0	20.0	6.61	

TDS 160.1 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
TDS	**1900**	5.00	11/08/2011	ND	245	102	240	0.186	

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
Hack Conder
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	11/07/2011	Sampling Date:	11/02/2011
Reported:	11/14/2011	Sampling Type:	Water
Project Name:	BD N-32-VENT	Sampling Condition:	Cool & Intact
Project Number:	BD N-32 VENT	Sample Received By:	Celey D. Keene
Project Location:	T21S R37E SEC32 N - LEA CTY., NM		

Sample ID: MONITOR WELL #3 (H102412-03)

BTEX 8021B mg/L **Analyzed By: MS**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	<0.001	0.001	11/09/2011	ND	0.047	93.9	0.0500	3.46	
Toluene*	<0.001	0.001	11/09/2011	ND	0.046	92.6	0.0500	2.91	
Ethylbenzene*	<0.001	0.001	11/09/2011	ND	0.054	108	0.0500	3.22	
Total Xylenes*	<0.003	0.003	11/09/2011	ND	0.151	101	0.150	2.45	

Surrogate: 4-Bromofluorobenzene (PIL *98.0 %* *70.7-118*

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

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**660**	4.00	11/14/2011	ND	104	104	100	3.77	

Sulfate 375.4 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Sulfate	**94.3**	10.0	11/14/2011	ND	17.2	86.0	20.0	6.61	

TDS 160.1 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
TDS	**1480**	5.00	11/08/2011	ND	245	102	240	0.186	

Cardinal Laboratories

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Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
Hack Conder
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	11/07/2011	Sampling Date:	11/02/2011
Reported:	11/14/2011	Sampling Type:	Water
Project Name:	BD N-32-VENT	Sampling Condition:	Cool & Intact
Project Number:	BD N-32 VENT	Sample Received By:	Celey D. Keene
Project Location:	T21S R37E SEC32 N - LEA CTY., NM		

Sample ID: MONITOR WELL #4 (H102412-04)

BTEX 8021B mg/L **Analyzed By: MS**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	<0.001	0.001	11/09/2011	ND	0.047	93.9	0.0500	3.46	
Toluene*	<0.001	0.001	11/09/2011	ND	0.046	92.6	0.0500	2.91	
Ethylbenzene*	<0.001	0.001	11/09/2011	ND	0.054	108	0.0500	3.22	
Total Xylenes*	<0.003	0.003	11/09/2011	ND	0.151	101	0.150	2.45	

Surrogate: 4-Bromofluorobenzene (PIL *99.2 %* *70.7-118*

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

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**92.0**	4.00	11/14/2011	ND	104	104	100	3.77	

Sulfate 375.4 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Sulfate	**91.8**	10.0	11/14/2011	ND	17.2	86.0	20.0	6.61	

TDS 160.1 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
TDS	**595**	5.00	11/08/2011	ND	245	102	240	0.186	

Cardinal Laboratories

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Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
Hack Conder
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	11/07/2011	Sampling Date:	11/02/2011
Reported:	11/14/2011	Sampling Type:	Water
Project Name:	BD N-32-VENT	Sampling Condition:	Cool & Intact
Project Number:	BD N-32 VENT	Sample Received By:	Celey D. Keene
Project Location:	T21S R37E SEC32 N - LEA CTY., NM		

Sample ID: MONITOR WELL #5 (H102412-05)

BTEX 8021B mg/L **Analyzed By: MS**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	<0.001	0.001	11/09/2011	ND	0.047	93.9	0.0500	3.46	
Toluene*	<0.001	0.001	11/09/2011	ND	0.046	92.6	0.0500	2.91	
Ethylbenzene*	<0.001	0.001	11/09/2011	ND	0.054	108	0.0500	3.22	
Total Xylenes*	<0.003	0.003	11/09/2011	ND	0.151	101	0.150	2.45	

Surrogate: 4-Bromofluorobenzene (PIL *99.6 %* *70.7-118*

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

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**108**	4.00	11/14/2011	ND	104	104	100	3.77	

Sulfate 375.4 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Sulfate	**89.2**	10.0	11/14/2011	ND	17.2	86.0	20.0	6.61	

TDS 160.1 mg/L **Analyzed By: HM**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
TDS	**554**	5.00	11/08/2011	ND	245	102	240	0.186	

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

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, Lab Director/Quality Manager

101 East Marland - Hobbs, New Mexico 88240
Tel (575) 393-2326
Fax (575) 393-2476

Cardinal Laboratories, Inc.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

LAB Order ID # _____

Company Name:	BILL TO Company:	PO#
RICE Operating Company	RICE Operating Company	
Project Manager:	**Address:** (Street, City, Zip)	
Hack Conder	122 W Taylor Street ~ Hobbs, New Mexico 88240	
Address: (Street, City, Zip)	**Phone#:**	**Fax#:**
122 W Taylor Street ~ Hobbs, New Mexico 88240	(575) 393-9174	(575)397-1471
Phone #:	**Fax #:**	
(575) 393-9174	(575) 397-1471	
Project #:	**Project Name:**	
	BD N-32 Vent	
Project Location:	**Sampler Signature:** Rozanne Johnson (575)631-9310	
T21S R37E Sec32 N ~ Lea County New Mexico	rozanne@valornet.com	

LAB # (LAB USE ONLY)	FIELD CODE	(G)rab or (C)omp	# CONTAINERS	MATRIX: WATER	SOIL	AIR	SLUDGE	PRESERVATIVE METHOD: HCL (2 40ml VOA)	HNO_3	$NaHSO_4$	H_2SO_4	ICE (1-1Liter HDPE)	NONE	SAMPLING: DATE (2011)	TIME	MTBE 8021B/602	BTEX 8021B/602	TPH 418.1/TX1005 / TX1005 Extended (C35)	PAH 8270C	Total Metals Ag As Ba Cd Cr Pb Se Hg 6010B/200.7	TCLP Metals Ag As Ba Cd Cr Pb Se Hg	TCLP Volatiles	TCLP Semi Volatiles	TCLP Pesticides	RCI	GC/MS Vol. 8260B/624	GC/MS Semi. Vol. 8270C/625	PCB's 8082/608	Pesticides 8081A/608	BOD, TSS, pH	Moisture Content	Cations (Ca, Mg, Na, K)	Anions (Cl, SO4, CO3, HCO3)	Sulfates	Total Dissolved Solids	Chlorides	Turn Around Time ~ 24 Hours
H10242																																					
1	Monitor Well #1	G	3	X				2				1		11-2	16:05		X																X	X	X	
2	Monitor Well #2	G	3	X				2				1		11-2	10:10		X																X	X	X	
3	Monitor Well #3	G	3	X				2				1		11-2	14:55		X																X	X	X	
4	Monitor Well #4	G	3	X				2				1		11-2	12:25		X																X	X	X	
5	Monitor Well #5	G	3	X				2				1		11-2	9:05		X																X	X	X	

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Rozanne Johnson	11/7/11	3:47			
Relinquished by:	Date:	Time:	Received By: (Laboratory Staff)	Date:	Time:
				11/7/11	1:48p

Phone Results	Yes	No	
Fax Results	Yes	No	Additional Fax Number:

Delivered By: (Circle One)
Sampler - UPS - Bus - Other:

Sample Condition: Cool: Yes ✓ / No; Intact: Yes ✓ / No

CHECKED BY: (Initials) CH

REMARKS:

Email Results to: hconder@riceswd.com
lweinheimer@rice-ecs.com
klones@ricesswd.com
rozanne@valornet.com

#26

ARCADIS U.S., Inc.

8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-01

WELL DEPTH: 101 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 10/7/08
DATE COMPLETED: 10/7/08
SAMPLE METHOD: Split spoon and air rotary
DRILLING CO.: Harrison & Cooper, Inc. Drilling
DRILLER:
DRILLING METHOD: Rotary

LOCATION INFORMATION

TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING:
EASTING:
DEPTH TO WATER: 95 ft bgs
GW ELEVATION:
DATE MEASURED: 10/7/08
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 100 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 4 inch

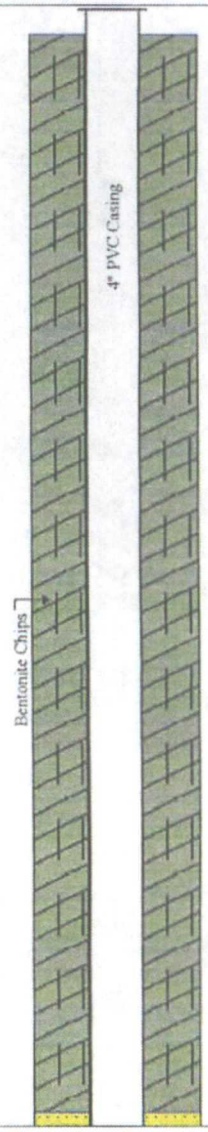
WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 4 inches
Screen Opening: 0.010 inches
Screened Interval: 80 - 100

ANNULUS SEAL
Seal Material: Bentonite

GROUT
Grout Material: Portland Cement

SAND PACK
Filter Material: Silica Sand

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)	WELL CONSTRUCTION
0		SP		**Fine Sand** Reddish-orange, very fine to fine sand, slightly clayey, dry		Field Chlorides			
5		SP		**Fine Sand** Light brown, very fine to fine sand, caliche, dry		317	0	5	
10		SP		**Fine Sand** Light brown, very fine to fine sand, dry		Lab 928 1085	0	10	
15		SP		**Fine Sand** Light brown, very fine to fine sand, caliche, dry		676	0	15	
20		SP		**Fine Sand** Light brown, very fine to fine sand, rocky, dry		672	0	20	
25						632		25	
30						545		30	
35						458		35	
40		SP		**Fine Sand** Orangey-brown, very fine to fine sand, slightly moist		491		40	
45						526		45	
50		SP		**Fine Sand** Orangey-brown, very fine to fine sand, rocky, slightly moist		478		50	
55						471		55	
60		SS		**Sandstone** Orangey-brown, very fine to fine sandstone, slightly moist		520		60	
65						453		65	
70		SP		**Fine Sand** Orangey-brown, very fine to fine sand, rocky, slightly moist		483		70	
75						503		75	



Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: MW-01

Monitoring Well Log Prepared By: Jasmin Talbert

ARCADIS U.S., Inc.
8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-01

WELL DEPTH: 101 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 10/7/08
DATE COMPLETED: 10/7/08
SAMPLE METHOD: Split spoon and air rotary
DRILLING CO.: Harrison & Cooper, Inc. Drilling
DRILLER:
DRILLING METHOD: Rotary

LOCATION INFORMATION

TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING:
EASTING:
DEPTH TO WATER: 95 ft bgs
GW ELEVATION:
DATE MEASURED: 10/7/08
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 100 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 4 inch

ANNULUS SEAL
Seal Material: Bentonite

GROUT
Grout Material: Portland Cement

SAND PACK
Filter Material: Silica Sand

WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 4 inches
Screen Opening: 0.010 inches
Screened Interval: 80 - 100

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)	WELL CONSTRUCTION
80				Not Logged		Lab 384 459		80	8/16 Silica Sand; 4" 20 Slot Screen
85							0	85	
90							0	90	
95							0	95	
100							0	100	
105								105	
110								110	
115								115	
120								120	
125								125	
130								130	
135								135	
140								140	
145								145	
150								150	

Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: MW-01

Monitoring Well Log Prepared By: Jasmin Talbert

ARCADIS U.S., Inc.

8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-02

WELL DEPTH: 104 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 7/9/09
DATE COMPLETED: 7/9/09
SAMPLE METHOD: Splitspoon and Rotary cuttings
DRILLING CO.: Harrison Cooper Inc.
DRILLER:
DRILLING METHOD: Air Rotary

LOCATION INFORMATION

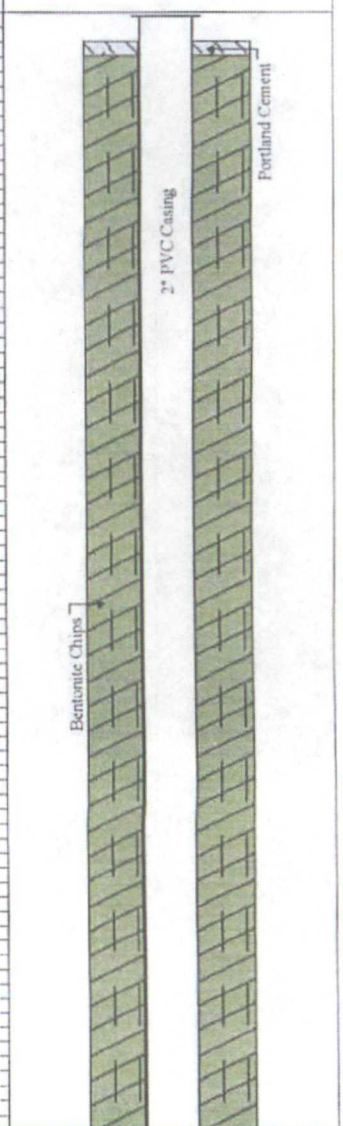
TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING: N32 25.877'
EASTING: W103 11.286'
DEPTH TO WATER: 90 ft bgs
GW ELEVATION:
DATE MEASURED: 7/9/09
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 104 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 2 inch
ANNULUS SEAL
Seal Material: Bentonite
GROUT
Grout Material: Portland Cement
SAND PACK
Filter Material: Silica Sand 8/16

WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 2 inches
Screen Opening: 0.010 inches
Screened Interval: 84-104

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)	WELL CONSTRUCTION
0–10		SP		**Fine Sand** Reddish-orange, very fine to fine sand, dry, no odor		Field Chlorides 87 Lab 272 315	0.1 0	5 10	
10–40		SP		**Fine Sand** Reddish-tan, very fine to fine sand with caliche, dry, no odor		146 179 144 149 147 144	0 0	15 20 25 30 35 40	
40–75		SP		**Fine Sand** Reddish-brown, very fine to fine sand with consolidated rock, dry, no odor		114 156 88 84 112 87 93		45 50 55 60 65 70 75	



Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: K27-MW-05

Monitoring Well Log Prepared By: Jasmin Talbert

ARCADIS U.S., Inc.
8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-02

WELL DEPTH: 104 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 7/9/09
DATE COMPLETED: 7/9/09
SAMPLE METHOD: Splitspoon and Rotary cuttings
DRILLING CO.: Harrison Cooper Inc.
DRILLER:
DRILLING METHOD: Air Rotary

LOCATION INFORMATION

TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING: N32 25.877'
EASTING: W103 11.286'
DEPTH TO WATER: 90 ft bgs
GW ELEVATION:
DATE MEASURED: 7/9/09
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 104 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 2 inch

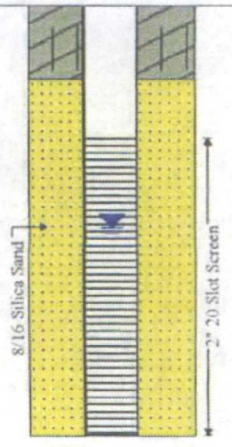
ANNULUS SEAL
Seal Material: Bentonite

GROUT
Grout Material: Portland Cement

SAND PACK
Filter Material: Silica Sand 8/16

WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 2 inches
Screen Opening: 0.010 inches
Screened Interval: 84-104

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)	WELL CONSTRUCTION
80						115		80	
85		SP		**Fine Sand** Orangey-brown, very fine to fine sand, slightly moist, no odor		89		85	
90				**No Recovery**		Lab <16 86		90	
95								95	
100								100	
105								105	
110								110	
115								115	
120								120	
125								125	
130								130	
135								135	
140								140	
145								145	
150								150	



Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: K27-MW-05

Monitoring Well Log Prepared By: Jasmin Talbert

ARCADIS U.S., Inc.
8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-03

WELL DEPTH: 135 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 7/9/09
DATE COMPLETED: 7/9/09
SAMPLE METHOD: Split Spoon and Air Rotary
DRILLING CO.: Harrison & Cooper, Inc. Drilling
DRILLER:
DRILLING METHOD: Rotary

LOCATION INFORMATION

TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING: N32 25.915
EASTING: W103 11.302
DEPTH TO WATER: 90 ft bgs
GW ELEVATION:
DATE MEASURED: 7/9/09
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 135 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 4 inch

WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 4 inches
Screen Opening: 0.030 inches
Screened Interval: 85-125

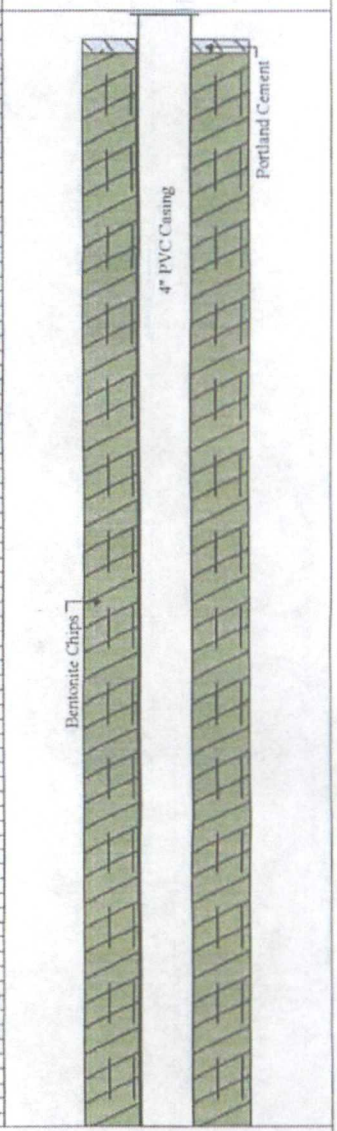
ANNULUS SEAL
Seal Material: Bentonite

GROUT
Grout Material: Portland Cement

SAND PACK
Filter Material: Silica Sand

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)
0						Field Chlorides		
5		SP		**Fine Sand** Reddish-orange, very fine to fine sand, dry, no odor		120	0.5	5
10						112	0.1	10
15		SP		**Fine Sand** Orangey-tan very fine to fine sand with caliche, dry, no odor		114	0.1	15
20						183	0	20
25		SP		**Fine Sand** Tan, very fine to fine sand with caliche, dry, no odor		148	0	25
30						183	0	30
35						Lab 48 183	0	35
40				**Fine Sand** Reddish-brown, very fine to fine sand with consolidated rock, dry, no odor		183	0	40
45						142		45
50						123		50
55						89		55
60		SP				88		60
65						84		65
70						84		70
75						91		75

WELL CONSTRUCTION



Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: MW-03

Monitoring Well Log Prepared By: Jasmin Talbert

ARCADIS U.S., Inc.
8725 Rosehill
Suite 350
Lenexa, Kansas 66215

MONITORING WELL LOG

WELL IDENTIFICATION: MW-03

WELL DEPTH: 135 ft

PROJECT INFORMATION

PROJECT: Rice Operating
SITE LOCATION: BD-N-32 Vent
PROJECT NUMBER: MT000834.0001
GEOLOGIST: Lara Weinheimer
DATE STARTED: 7/9/09
DATE COMPLETED: 7/9/09
SAMPLE METHOD: Split Spoon and Air Rotary
DRILLING CO.: Harrison & Cooper, Inc. Drilling
DRILLER:
DRILLING METHOD: Rotary

LOCATION INFORMATION

TOC ELEVATION:
DATUM CP:
CP ELEVATION.:
NORTHING: N32 25.915
EASTING: W103 11.302
DEPTH TO WATER: 90 ft bgs
GW ELEVATION:
DATE MEASURED: 7/9/09
BORING DIAMETER: 7 3/8 inches
BORING DEPTH: 135 feet

WELL CONSTRUCTION

WELL CASING
Casing Material: Sch 40 PVC
Casing Diameter: 4 inch

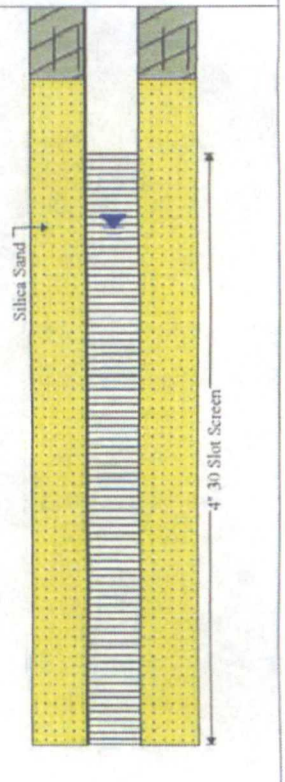
ANNULUS SEAL
Seal Material: Bentonite

GROUT
Grout Material: Portland Cement

SAND PACK
Filter Material: Silica Sand

WELL SCREEN
Screen Material: Sch 40 PVC
Screen Diameter: 4 inches
Screen Opening: 0.030 inches
Screened Interval: 85-125

DEPTH (ft bgs)	RECOVERY (ft)	LITHOLOGY: USCS	LITHOLOGY: SYMBOL	LITHOLOGY: SOIL DESCRIPTION	SAMPLING DETAIL: SAMPLE COLLECTED	SAMPLING DETAIL: ANALYTES	SAMPLING DETAIL: PID (ppm)	SAMPLING DETAIL: DEPTH (ft bgs)	WELL CONSTRUCTION
80						87		80	
85				No Recovery		Lab 16 58		85	
90								90	
95								95	
100								100	
105								105	
110								110	
115								115	
120								120	
125								125	
130								130	
135								135	
140								140	
145								145	
150								150	



Notes: in - inches, ft bgs - feet below ground surface, ppm - parts per million
USCS - United Soil Classification System Datum
CP - Datum Control Point, GW - Groundwater

Monitoring Well: MW-03

Monitoring Well Log Prepared By: Jasmin Talbert

Logger:	Lara Weinheimer
Driller:	Harrison & Cooper, Inc. Drilling
Consultant:	Arcadis
Drilling Method:	Air rotary
Start Date:	9-21-2009
End Date:	9-21-2009

RICE OPERATING COMPANY ROC SINCE 1955

Project Name: BD N-32 vent

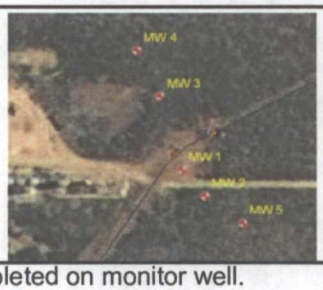
Well ID: MW-4

Comments: No sampling completed on monitor well.
Located 222 ft NW of former junction box site.
4 inch monitor well
TD = 138 ft GW = 98 ft

Location: UL/N sec. 32 T21S R37E
Lat: N32°25'56.242" County: LEA
Long: W103°11'19.725" State: NM

Depth (feet)	chloride field tests (ppm)	LAB	PID	Description	Lithology	Well Construction
				NO SAMPLES TAKEN		3 x 3 ft concrete pad on surface; bentonite seal; 4 in diameter PVC; sand pack; screen = 0.03"
20						
40						
60						
80						
100						
120						
140						

Logger:	Lara Weinheimer
Driller:	Harrison & Cooper, Inc. Drilling
Consultant:	Arcadis
Drilling Method:	Air rotary
Start Date:	9-22-2009
End Date:	9-22-2009



RICE OPERATING COMPANY ROC SINCE 1955

Project Name: BD N-32 vent

Well ID: MW-5

Comments: No sampling completed on monitor well.
Located 190 ft SE of former junction box site.
2 inch monitor well
TD = 107 ft GW = 98 ft

Location: UL/N sec. 32 T21S R37E
Lat: N32°25'52.662" County: LEA
Long: W103°17'19.648" State: NM

Depth (feet)	chloride field tests (ppm)	LAB	PID	Description	Lithology	Well Construction
				NO SAMPLES TAKEN		2 x 2 ft concrete pad; bentonite seal; 2 in diameter PVC; sand pack; screen = 0.01"
20						
40						
60						
80						
100						

MULTIMED V1.01 DATE OF CALCULATIONS: 30-DEC-2011 TIME: 10: 4:16

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.50, 2005)

Switched to Stehfest algorithm to avoid numerical problems
with Convolution algorithm. Problems were caused by
high source decay rate. Everything ok now, execution continuing...

1

Run options
--- -------

Chemical simulated is Chloride

Option Chosen Saturated and unsaturated zone models
Run was DETERMIN
Infiltration Specified By User: 3.050E-02 m/yr
Run was transient
Well Times: Entered Explicitly
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

1
1

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	29.26	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	3.60	-999.	-999.	-999.
Unsaturated zone porosity	--	CONSTANT	0.250	-999.	-999.	-999.
Air entry pressure head	m	CONSTANT	0.700	-999.	-999.	-999.
Depth of the unsaturated zone	m	CONSTANT	29.3	0.000	0.000	0.000

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.116	-999.	-999.	-999.
Brook and Corey exponent,EN	--	CONSTANT	-999.	-999.	-999.	-999.
ALFA coefficient	1/cm	CONSTANT	0.500E-02	-999.	-999.	-999.
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	-999.	-999.

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	- Number of different layers used		1
NTSTPS	- Number of time values concentration calc		40
DUMMY	- Not presently used		1
ISOL	- Type of scheme used in unsaturated zone		1
N	- Stehfest terms or number of increments		18
NTEL	- Points in Lagrangian interpolation		3
NGPTS	- Number of Gauss points		104
NIT	- Convolution integral segments		2
IBOUND	- Type of boundary condition		3
ITSGEN	- Time values generated or input		1
TMAX	- Max simulation time	--	0.0
WTFUN	- Weighting factor	--	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Exponentially decaying continuous source
Computer generated times for computing concentrations

1

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	29.3	-999.	-999.	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	-999.	-999.
Percent organic matter	--	CONSTANT	0.000	-999.	-999.	-999.
Bulk density of soil for layer	g/cc	CONSTANT	1.83	-999.	-999.	-999.
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	-999.	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	-999.	-999.
Reference temperature	C	CONSTANT	25.0	-999.	-999.	-999.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	-999.	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	-999.	-999.
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Air diffusion coefficient	cm2/s	CONSTANT	-999.	-999.	-999.	-999.
Reference temperature for air diffusion	C	CONSTANT	-999.	-999.	-999.	-999.
Molecular weight	g/M	CONSTANT	-999.	-999.	-999.	-999.
Mole fraction of solute	--	CONSTANT	-999.	-999.	-999.	-999.
Vapor pressure of solute	mm Hg	CONSTANT	-999.	-999.	-999.	-999.
Henry's law constant	atm-m^3/M	CONSTANT	-999.	-999.	-999.	-999.
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Not currently used		CONSTANT	0.000	0.000	0.000	0.000
Not currently used		CONSTANT	0.000	0.000	0.000	0.000

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.305E-01	-999.	-999.	-999.
Area of waste disposal unit	m^2	DERIVED	628.	-999.	-999.	-999.
Duration of pulse	yr	DERIVED	50.0	-999.	-999.	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	-999.	-999.
Recharge rate	m/yr	CONSTANT	0.000	-999.	-999.	-999.
Source decay constant	1/yr	CONSTANT	0.500E-01	0.000	0.000	0.000
Initial concentration at landfill	mg/l	CONSTANT	828.	-999.	-999.	-999.

Length scale of facility	m	CONSTANT	27.4	-999.	-999.	-999.
Width scale of facility	m	CONSTANT	22.9	-999.	-999.	-999.
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

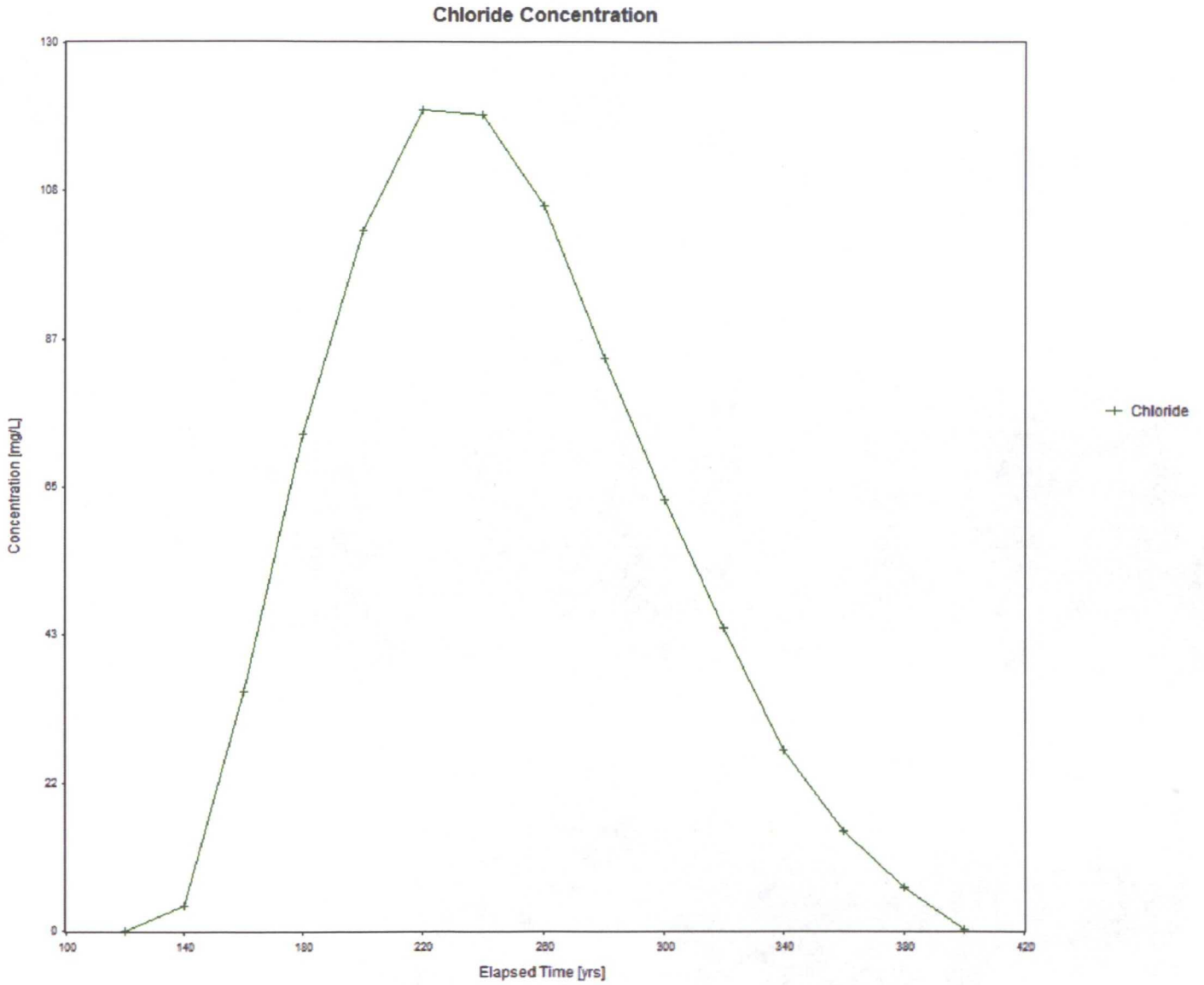
1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	-999.	-999.	-999.	-999.
Aquifer porosity	--	CONSTANT	0.300	-999.	-999.	-999.
Bulk density	g/cc	CONSTANT	1.70	-999.	-999.	-999.
Aquifer thickness	m	CONSTANT	23.0	-999.	-999.	-999.
Source thickness (mixing zone depth)	m	DERIVED	3.00	-999.	-999.	-999.
Conductivity (hydraulic)	m/yr	CONSTANT	30.0	-999.	-999.	-999.
Gradient (hydraulic)		CONSTANT	0.300E-02	-999.	-999.	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	-999.	-999.
Retardation coefficient	--	DERIVED	-999.	-999.	-999.	-999.
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	20.0	-999.	-999.	-999.
pH	--	CONSTANT	7.00	-999.	-999.	-999.
Organic carbon content (fraction)		CONSTANT	0.000	-999.	-999.	-999.
Well distance from site	m	CONSTANT	1.00	-999.	-999.	-999.
Angle off center	degree	CONSTANT	0.000	-999.	-999.	-999.
Well vertical distance	m	CONSTANT	0.000	-999.	-999.	-999.

1

TIME	CONCENTRATION
0.120E+03	0.00000E+00
0.140E+03	0.36615E+01
0.160E+03	0.35151E+02
0.180E+03	0.72791E+02
0.200E+03	0.10262E+03
0.220E+03	0.12026E+03
0.240E+03	0.11949E+03
0.260E+03	0.10618E+03
0.280E+03	0.83886E+02
0.300E+03	0.63194E+02
0.320E+03	0.44438E+02
0.340E+03	0.26509E+02
0.360E+03	0.14715E+02
0.380E+03	0.63175E+01
0.400E+03	0.25588E+00


Chloride Concentration
130
108
87
65
43
22
0
Concentration [mg/L]
100
140
180
220
260
300
340
380
420
Elapsed Time [yrs]
Chloride