1R - 426-169

REPORTS

DATE:

5-22-08

Hansen, Edward J., EMNRD

From: David Hamilton [david@rthicksconsult.com]
Sent: Friday, May 23, 2008 9:50 AM
To: Hansen, Edward J., EMNRD
Cc: Kristin Pope; Randy Hicks
Subject: BD System B-29, NMOCD Case #: Not Assigned
Attachments: B29Activities.pdf

Dear Mr. Hansen,

On behalf of Rice Operating Company, R.T. Hicks Consultants, Ltd. is pleased to submit the attached letter concerning activities for the above-referenced site.

If you have any questions or concerns about the enclosed report, please let us know. Thank you for your time.

Sincerely,
R.T. Hicks Consultants, Ltd.
David Hamilton
Project Scientist

R. T. HICKS CONSULTANTS, LTD.
901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

May 22, 2008

Edward Hansen
NMOCD
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
Via E-mail

RE: NMOCD Case #: Not Assigned
BD System B-29, Section 29 T21S, R37E, Unit B
Characterization Activity Report

Dear Mr. Hansen,

This letter summarizes recent characterization activities at the B-29 site and additional characterization steps planned. Plate 1 shows the location of the site about 1.5 miles northwest of Eunice New Mexico.

On November 30, 2007, R T Hicks Consultants and Rice Operating Company (ROC) submitted an amendment to the July 2003 Investigation/Characterization Plan proposing the installation of two four-inch monitoring wells at the site including a protocol of chloride concentration measurement.

In December 2007, Rice Operating Company installed the proposed two monitoring wells at the B-29 site. Plate 2 shows the locations of MW-1 and MW-2. MW-1 is about 100 feet southeast of the junction box in an area not affected by the 2002 release. MW-2 is located about 5 feet southeast of SB-1 in the area affected by the release. Chloride concentrations were collected in accordance with the proposed protocol. The lithologic logs for these wells and analytical results are included in Appendix A.

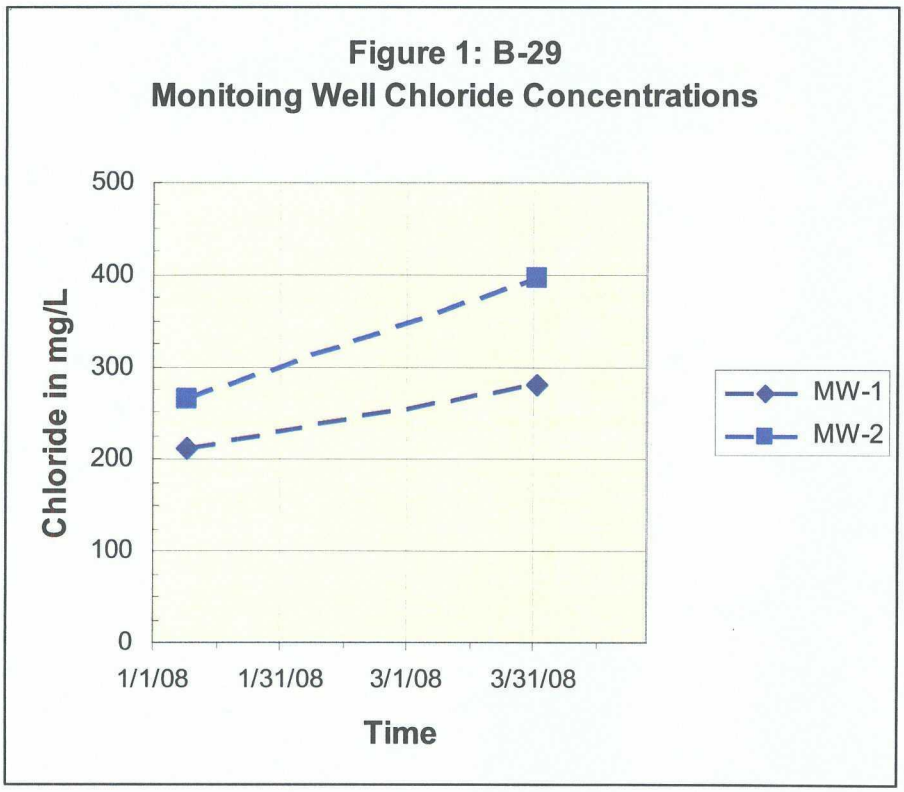
An inspection of the lithologic logs shows two quartzite layers were encountered in both borings accounting for most of the material in the depth interval from about 75 feet to 90 feet (ground water is about 95 feet). Appendix B presents chloride concentration profiles from all of the borings at the site. Comparisons of adjacent profiles drilled at different times allows for estimates of chloride migration rate. Considering these estimates and observations of depths of higher chloride concentrations, the site exhibits evidence of past oil field activities. Ground water samples from MW-1 and MW-2 will help define to what extent the quartzite layers impede chloride migration to ground water.

During drilling, both MW-1 and MW-2 required addition of fresh water and polymer due to borehole instability. MW-1 received 15,000 gallons of water with some polymer and MW-2 received 2,500 gallons of water and polymer. These volumes likely caused a ground water

mound at the time of drilling. Ground water samples were collected and analyzed for the initial 2008 quarterly sampling event in January, about four weeks after the wells were installed. These results show chloride levels in MW-1 and MW-2 of 212 and 264 mg/L respectively. It is unknown whether these chloride levels are a result of dilution of ground water from the water used to complete the borings, or if they reflect the true aquifer conditions.

Since installation of MW-1 and MW-2, ROC has conducted aggressive well development at B-29 to speed the dissipation of the water mound created during drilling, removing 250 gallons from both wells in January and 1,000 gallons from each well in February.

On April 1, ROC purged and sampled MW-1 normally. At MW-2, ROC purged 500 gallons from MW-2 and then sampled it. As only 2,500 gallons of polymer and water were used in the construction of MW-2; the April 1st development event brings the total water removed from that well to 1,750 gallons in the approximately 3 months since the time of drilling. Figure 1 presents chloride concentration data from ground water sampling events at MW-1 and MW-2.



Comparison of the January and April 1st sampling events shows:

1) Samples from both wells demonstrate an increase in chloride concentration over the sampling time interval

2) Chloride concentrations in MW-2 are higher than results for MW-1 at both sampling dates

May 22, 2008

The increasing chloride content with time may be due to:

- Diffusion of the fresh water added to the aquifer during drilling of the borings
- Natural variation of chloride concentration in ground water at the site.

Higher chloride concentrations at MW-2 may be due to:

- Less fresh water was used in the boring of MW-2 than MW-1 resulting in less dilution of ground water at the location of MW-2
- Given the geometry of the release footprint and the position of the monitoring wells, it is possible MW-2 would show higher chloride concentrations than MW-1

Additional quarterly monitoring events should allow us to determine if:

- The fresh water used in drilling is still diffusing at one or both locations. For example, chloride concentration may remain relatively constant at MW-2 and increase at MW-1.
- Differences in chloride variation are due to natural variation (concentrations in one or both wells may decrease in time or concentration in MW-1 may exceed MW-2)

With data showing that ground water samples from both MW-1 and MW-2 are representative of conditions at B-29, we will consider possible Corrective Actions and prepare a Corrective Action Plan for NMOCD review. Quarterly ground water sampling is planned for both wells at B-29. If you have any questions or concerns regarding characterization activities at this site, please do not hesitate to contact us.

Thank you for your time and consideration.

Sincerely,
R.T. Hicks Consultants, Ltd.

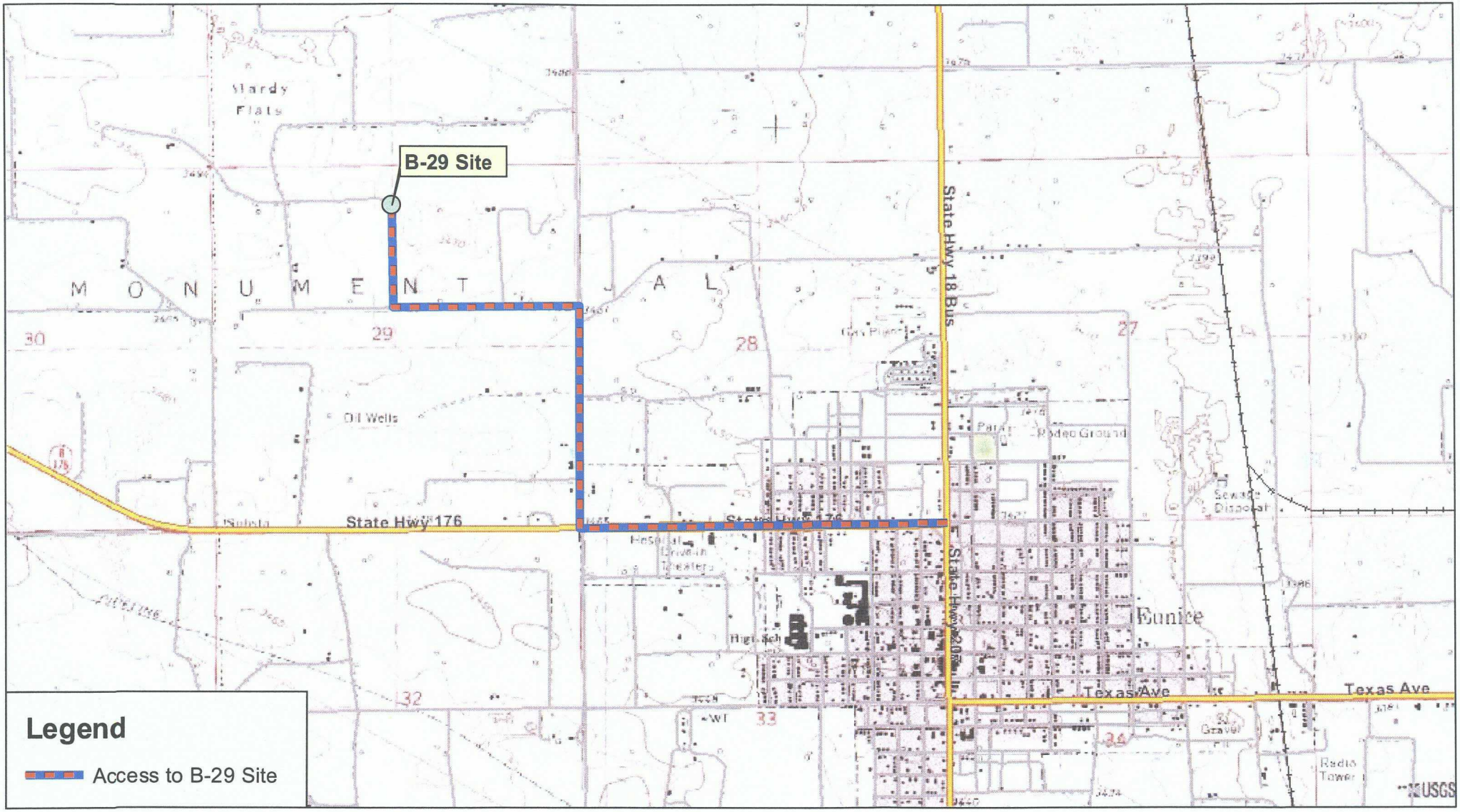
David Hamilton

David Hamilton
Project Scientist

Copy: Rice Operating Company

PLATES

To access the site, from the intersection of State Highway 176 and 207, Eunice, New Mexico, proceed west on State Highway 176 for 1 mile. Turn north on County Rd 33. Proceed north for 0.6 miles. At 0.6 miles, turn west on an unnamed dirt road. Proceed on the dirt road for 0.2 miles. At 0.2 miles, turn north. Proceed north 0.2 miles to the site.



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	7.5 USGS Topo and access to the site	Plate 1
	Rice Operating Company: B-29 Site (BD System)	March 2008

N
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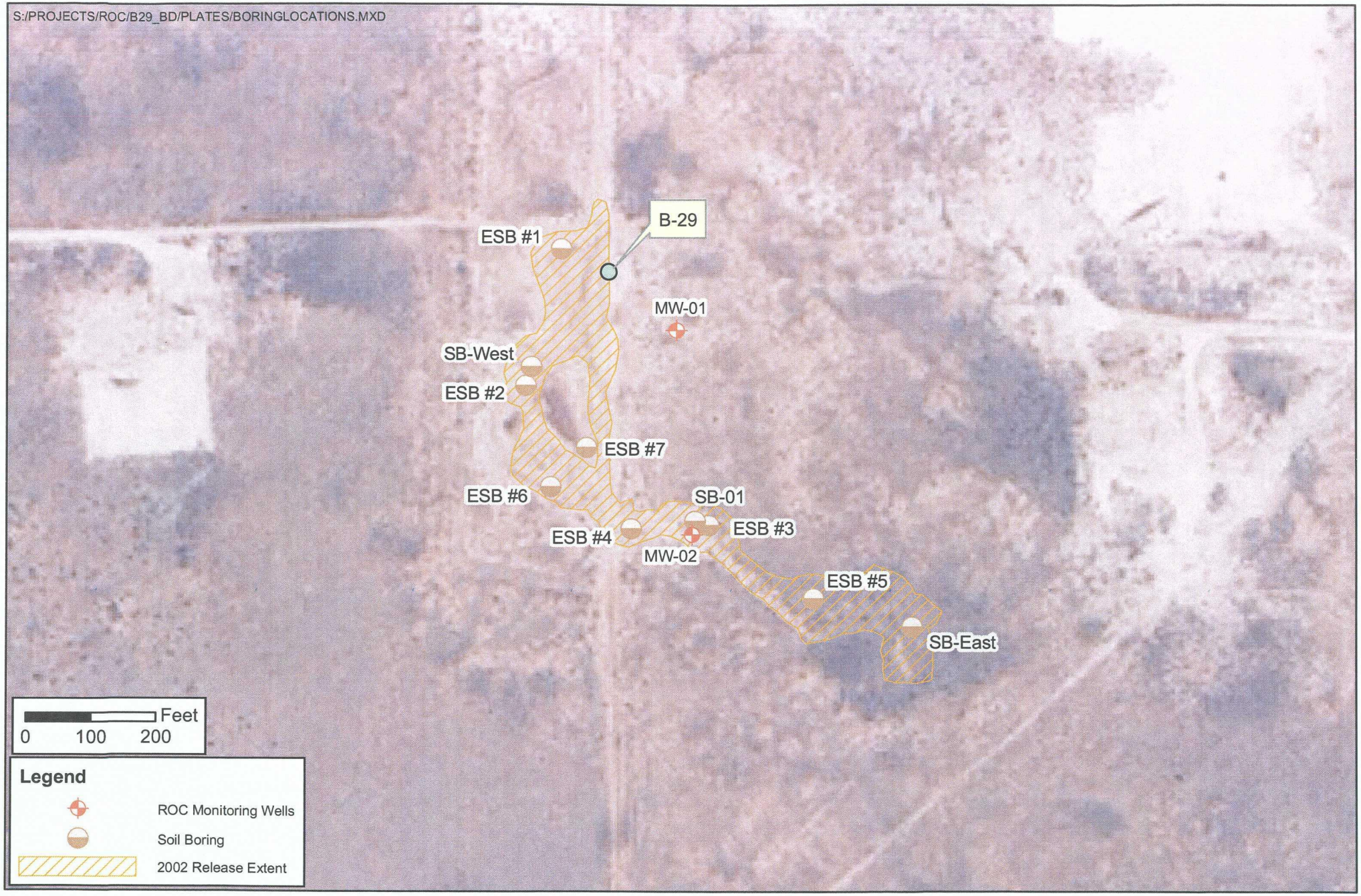
S



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Boring Locations Relative to Extent of Release	Plate 2
	Rice Operating Company: B-29 (BD System)	May 2008

N
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E
S

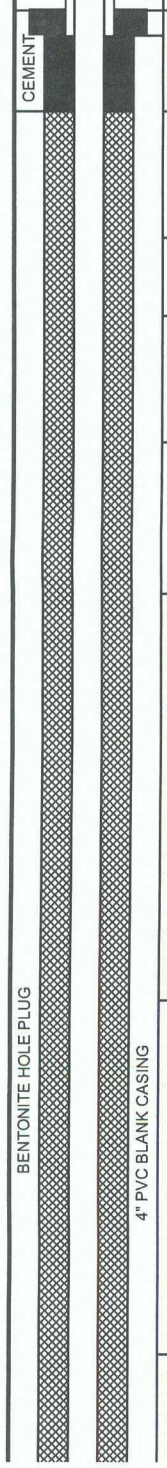
APPENDIX A

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-1	TOTAL DEPTH:	110 Ft
SITE ID:	BD System B-29 Line Leak	CLIENT:	Rice Operating Company
SURFACE ELEVATION:	3475 Feet (MSL)	COUNTY:	Lea County
CONTRACTOR:	Harrison & Cooper, Inc.	STATE:	New Mexico
DRILLING METHOD:	Air-Rotary	LOCATION:	T-21-S, R-37-E, Sec. 29 (B)
INSTALLATION DATE:	12/17 to 12/18/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	68 ft South-southeast of line leak	FILE NAME:	\BD System\B-29\Lithlogs 12-07
COMMENTS:	Lat. 32° 27' 19.2" North, Long. 103° 11' 6.2" West		



Depth	Samples Type	Cl (fld)	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
			SAND AND CLAY Red to reddish brown, medium grain, well sorted, angular sand in red clay matrix.
5	cut	3,273	CALICHE AND SILT Grayish brown, with solid caliche layer from 7 to 9 feet.
10	spoon	1,655	CALICHE AND SILT Grayish brown, Split spoon at 10-12 feet (2,580 mg/kg Cl)
15	cut	3,156	CALICHE Grayish white (hard drilling).
20	cut	2,437	CALICHE AND SILT Gray to light brown with some (5%) very fine grain, sub-angular, poorly sorted sand.
25	cut	2,049	SAND AND SILT Light grayish brown, very fine grain, well sorted, angular.
30	cut	581	
35	cut	350	
40	cut	357	SAND Light brown (with very little silt) very fine grain, well sorted, sub-rounded, with some thin-bedded caliche at 42 feet.
45	cut	377	
50	spoon	274	Split spoon at 50 - 52 feet (6.8 mg/kg Cl).
55			SAND Brown fine grain, well sorted, sub-rounded to rounded.

Continued on next page

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

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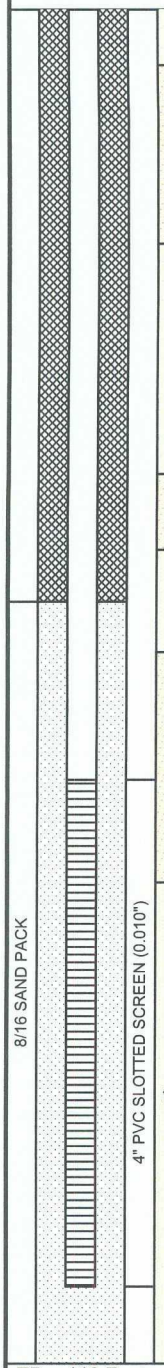
Midland, TX 79708
(432) 528-3878

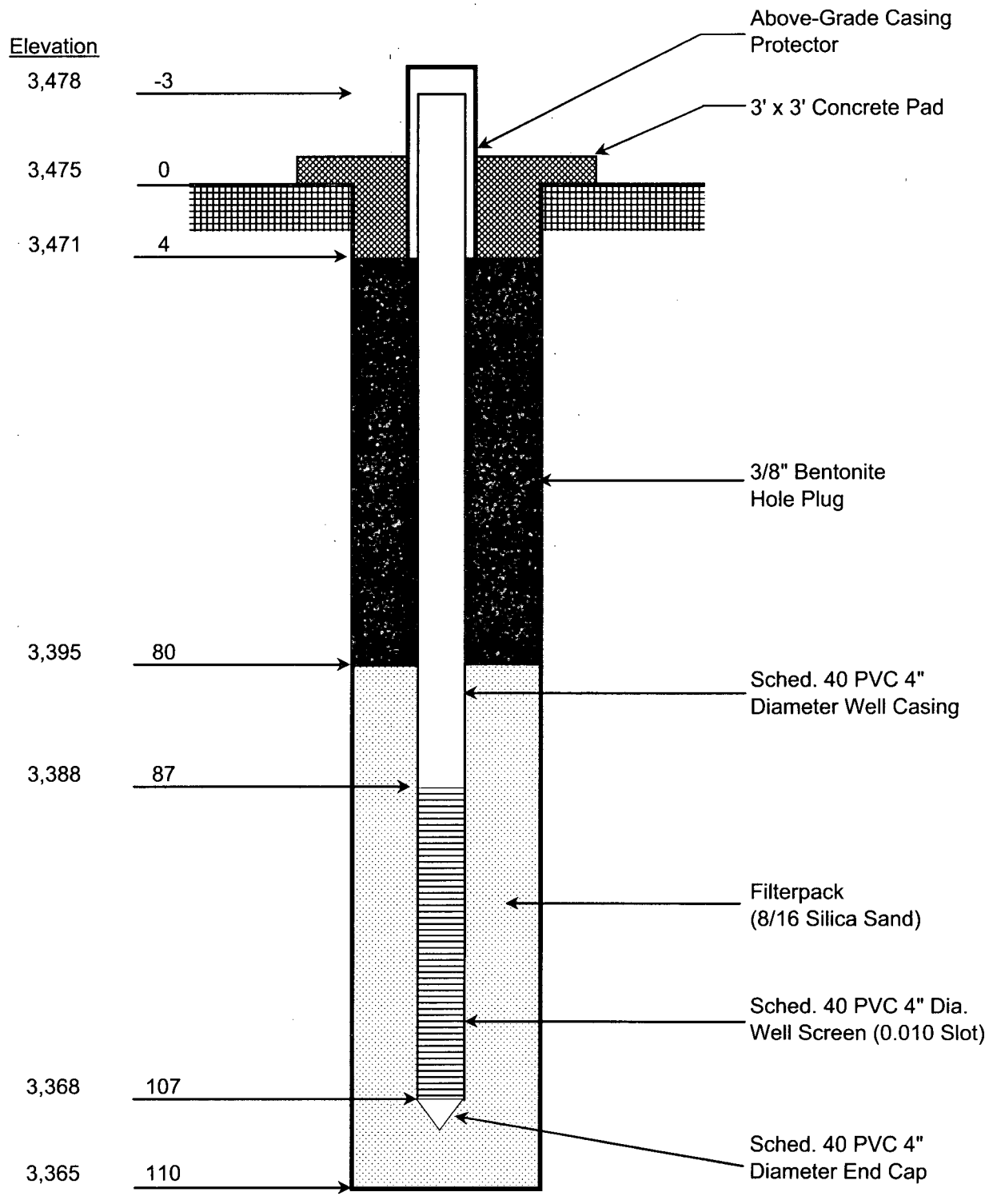
MONITOR WELL NO.:	MW-1	TOTAL DEPTH:	110 Ft
SITE ID:	BD System B-29 Line Leak	CLIENT:	Rice Operating Company
SURFACE ELEVATION:	3475 Feet (MSL)	COUNTY:	Lea County
CONTRACTOR:	Harrison & Cooper, Inc.	STATE:	New Mexico
DRILLING METHOD:	Air-Rotary	LOCATION:	T-21-S, R-37-E, Sec. 29 (B)
INSTALLATION DATE:	12/17 to 12/18/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	68 ft South-southeast of line leak	FILE NAME:	\BD System\B-29\Lithlogs 12-07
COMMENTS:	Lat. 32° 27' 19.2" North, Long. 103° 11' 6.2" West		



				Continued from previous page
	60	cut	240	SANDSTONE Brown, fine grain, well sorted, subangular, well cemented (not crystalline) and hard to drill.
	65			
	70	cut	225	SAND Brown to reddish brown, fine grain, medium sorted, rounded, subject to caving.
	75			
				QUARTZITE, Reddish brown, fine crystalline, very hard drilling (2-ft/hour).
	80	cut	255	SAND Brown, fine to medium grain, medium sorted, sub-rounded, with interbedded thin sandstone and quartzite.
	85			QUARTZITE, Reddish brown, fine crystalline, very hard drilling (2-ft/hour) with some interbedded hard sandstone.
	90			
very few cuttings to surface	95			SAND (aquifer) Reddish brown, fine grain, moderately sorted, rounded quartz.
	100			Great difficulty encountered during the completion of the well due to caving. Required approx. 15,000 gallons of water with polymer to control caving and clean out well sufficiently to install casing.
	105			
	110			

TD = 110 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



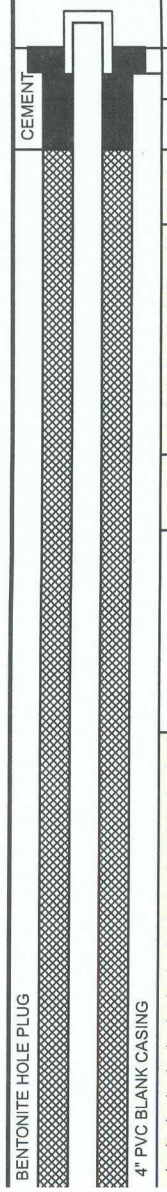
R T Hicks Consultants Ltd	SITE: BD System B-29 Line Leak		**Monitoring Well No. MW-1**
	DATE: ########	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: H & C, Inc	FILE: Lithlogs	

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-2	TOTAL DEPTH:	101 Ft
SITE ID:	BD System B-29 Line Leak	CLIENT:	Rice Operating Company
SURFACE ELEVATION:	3474 Feet (MSL)	COUNTY:	Lea County
CONTRACTOR:	Harrison & Cooper, Inc.	STATE:	New Mexico
DRILLING METHOD:	Air-Rotary	LOCATION:	T-21-S, R-37-E, Sec. 29 (B)
INSTALLATION DATE:	12/18 to 12/19/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	318 feet South of MW-1	FILE NAME:	\BD System\B-29\Lithlogs 12-07
COMMENTS:	Lat. 32° 27' 16.1" North, Long. 103° 11' 6.0" West		



Depth	Samples Type	Cl (fld)	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
			SILTY CLAY Red to reddish brown.
	cut	2,941	CALICHE Gray with some silt.
5	cut	4,886	SILT Brownish gray
	cut	3,981	SILT Pinkish brown, with some (5%) very fine grain sand and caliche (5%)>
10	cut	3,577	
	cut	3,217	
15	spoon	4,453	Split spoon 15 -17 feet (5,190 mg/kg Cl)
	cut	4,042	SAND Light brown, very fine grain, well sorted, angular.
20	cut	3,807	CALICHE Grayish brown with some silt and very fine grain, well sorted sand
	cut	3,348	
25	spoon	3,736	Split spoon 25 -27 feet (4,100 mg/kg Cl)
	cut	3,045	SAND Light brown with 30% silt) very fine grain, well sorted, rounded sand.
30	cut	3,704	
35	cut	2,664	
40	cut	2,205	
45			

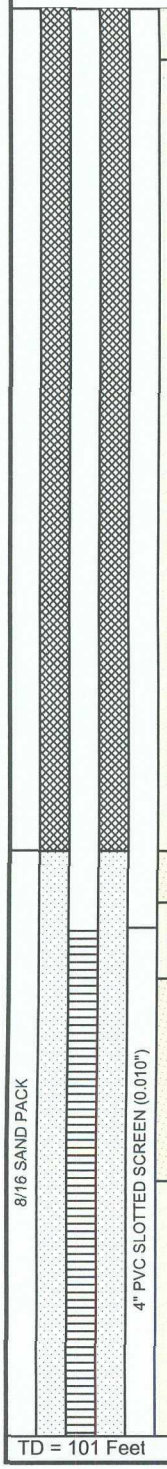
Continued on next page

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

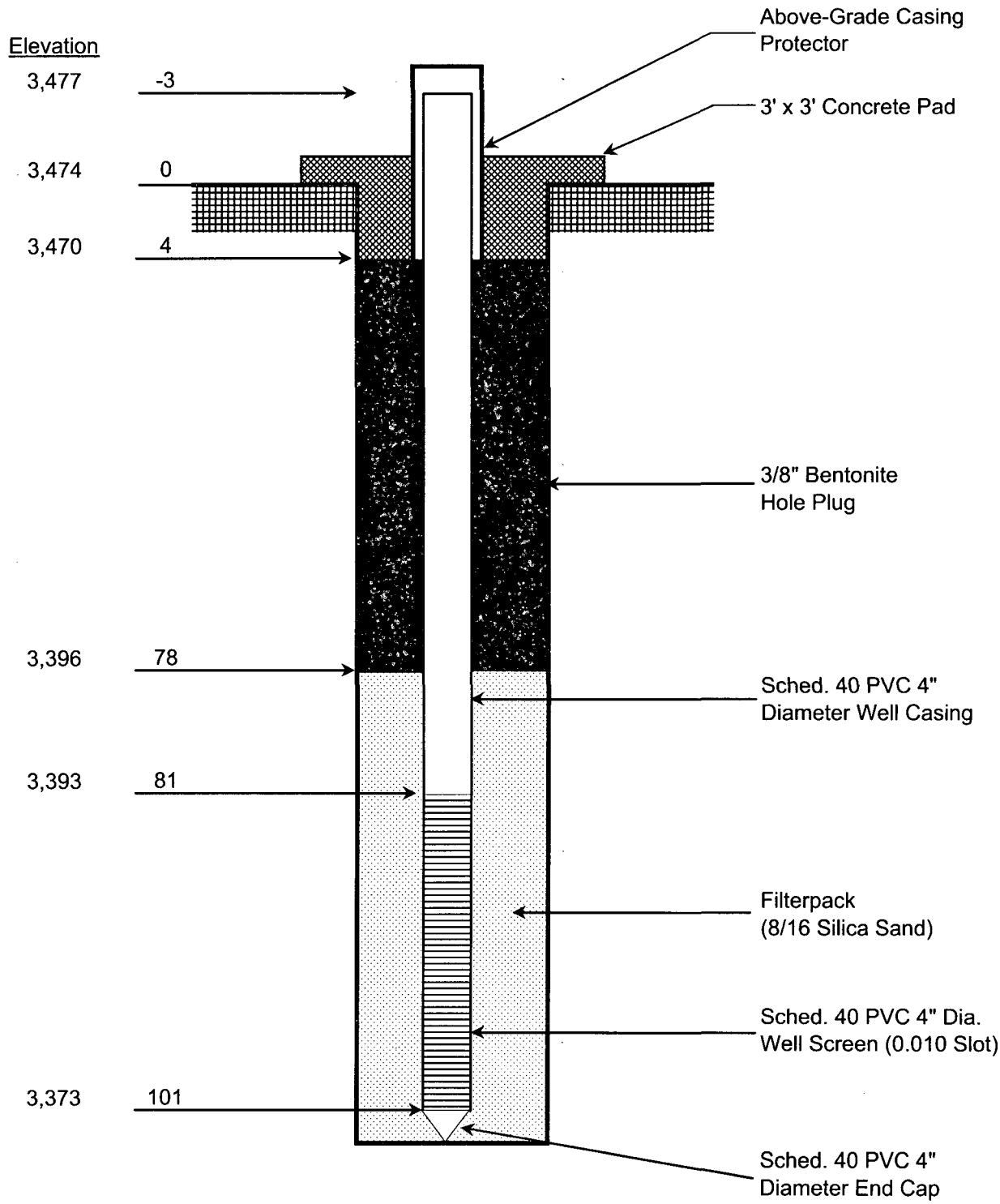
MONITOR WELL NO.:	MW-2	TOTAL DEPTH:	101 Ft
SITE ID:	BD System B-29 Line Leak	CLIENT:	Rice Operating Company
SURFACE ELEVATION:	3474 Feet (MSL)	COUNTY:	Lea County
CONTRACTOR:	Harrison & Cooper, Inc.	STATE:	New Mexico
DRILLING METHOD:	Air-Rotary	LOCATION:	T-21-S, R-37-E, Sec. 29 (B)
INSTALLATION DATE:	12/18 to 12/19/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	318 feet South of MW-1	FILE NAME:	\BD System\B-29\Lithlogs 12-07
COMMENTS:	Lat. 32° 27' 16.1" North, Long. 103° 11' 6.0" West		



		cut	2,044	*Continued from previous page*
No trackable cuttings below 50 Ft Descrip. based on MW-1 and drilling rate	50	spoon	1,478	SAND Brown (no silt) fine to medium grain, moderately sorted, sub-rounded. Split spoon at 50 - 52 feet (1,280 mg/kg Cl). Shut down drilling to add water and polymer (less than 2,500 gallons).
	80			QUARTZITE, Reddish brown, fine crystalline, very hard drilling (2-ft/hour).
				SAND Brown, fine to medium grain, medium sorted, sub-rounded, with interbedded thin sandstone and quartzite.
	85 90			QUARTZITE, Reddish brown, fine crystalline, very hard drilling (2-ft/hour).
	95 100			SAND (aquifer) Reddish brown, fine grain, moderately sorted, rounded quartz.

TD = 101 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: BD System B-29 Line Leak		**Monitoring Well No. MW-2**
	DATE: #########	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: H & C, Inc	FILE: Lithlogs	

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: KRISTIN FARRIS-POPE
122 W. TAYLOR STREET
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 01/14/08
Reporting Date: 01/22/08
Project Number: NOT GIVEN
Project Name: BD B-29 LEAK
Project Location: T21S R37E SEC29 B~LEA COUNTY, NM

Sampling Date: 01/09/08
Sample Type: WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: HM/KS

LAB NUMBER	SAMPLE ID	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Conductivity (uS/cm)	T-Alkalinity ($mgCaCO_3/L$)
ANALYSIS DATE:		01/21/08	01/21/08	01/21/08	01/18/08	01/16/08	01/16/08
H14077-1	MONITOR WELL #1	98	110	28.2	3.29	1,203	176
H14077-2	MONITOR WELL #2	158	144	25.0	3.90	1,631	172
Quality Control		NR	49.2	52.4	2.93	1,433	NR
True Value QC		NR	50.0	50.0	3.00	1,413	NR
% Recovery		NR	98.5	105	97.8	101	NR
Relative Percent Difference		NR	< 0.1	3.0	8.5	1.4	NR
METHODS:			SM3500-Ca-D	3500-Mg E	8049	120.1	310.1

LAB NUMBER	SAMPLE ID	Cl^- (mg/L)	SO_4 (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	pH (s.u.)	TDS (mg/L)
ANALYSIS DATE:		01/16/08	01/17/08	01/16/08	01/16/08	01/16/08	01/14/08
H14077-1	MONITOR WELL #1	212	128	0	215	7.52	749
H14077-2	MONITOR WELL #2	264	257	0	210	7.55	1,085
Quality Control		500	26.8	NR	1000	7.04	NR
True Value QC		500	25.0	NR	1000	7.00	NR
% Recovery		100	107	NR	100	100	NR
Relative Percent Difference		2.0	2.0	NR	< 0.1	0.3	NR
METHODS:		SM4500-Cl-B	375.4	310.1	310.1	150.1	160.1

Chemist

01/22/08
Date

H14077 RICE

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING CO.
ATTN: KRISTIN FARRIS-POPE
122 W. TAYLOR ST.
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 01/14/08
Reporting Date: 01/16/08
Project Number: NOT GIVEN
Project Name: BD B-29 LEAK
Project Location: T21S-R37E-SEC29 B ~ LEA CO., NM

Sampling Date: 01/09/08
Sample Type: WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: AB

LAB NUMBER	SAMPLE ID	BENZENE (mg/L)	TOLUENE (mg/L)	ETHYL BENZENE (mg/L)	TOTAL XYLENES (mg/L)
ANALYSIS DATE		01/15/08	01/15/08	01/15/08	01/15/08
H14077-1	MONITOR WELL #1	<0.001	<0.001	<0.001	<0.003
H14077-2	MONITOR WELL #2	<0.001	<0.001	0.002	<0.003
Quality Control		0.097	0.087	0.093	0.270
True Value QC		0.100	0.100	0.100	0.300
% Recovery		96.5	87.4	92.9	89.9
Relative Percent Difference		6.2	5.8	5.2	5.0

METHOD: EPA SW-846 8021B

Chemist

01/22/08
Date

H14077B.RICE

101 East Marland - Hobbs, New Mexico 88240
Tel (505) 393-2326
Fax (505) 393-2476

Cardinal Laboratories, Inc.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

LAB Order ID # _____

Company Name: RICE Operating Company	BILL TO Company: RICE Operating Company PO#
Project Manager: Kristin Farris-Pope, Project Scientist	Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240
Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240	Phone#: (575) 393-9174 Fax#: (575)397-1471
Phone #: (575) 393-9174	Fax #: (575) 397-1471
Project #:	Project Name: BD B-29 Leak
Project Location: T21S R37E Sec29 B ~ Lea County New Mexico	Sampler Signature: Rozanne Johnson (505)631-9310 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 (2008)	TIME
H14077-1	Monitor Well #1	G	3	X				2				1		1-9	10:15
-2	Monitor Well #2	G	3	X				2				1		1-9	11:30

ANALYSIS REQUEST

(Circle or Specify Method No.)

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)	Total Dissolved Solids	Chlorides	Turn Around Time ~ 24 Hours
	X																X	X	X		
	X																X	X	X		

Relinquished by: Rozanne Johnson	Date: 1-14-2008	Time: 12:35	Received by: Misty LeBert
Relinquished by:	Date:	Time:	Received By: (Laboratory Staff)

Date: 1/14/08 Time: 12:40

Date: Time:

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) MCKB

REMARKS:

Email Results to: kpope@riceswd.com
lweinheimer@riceswd.com
rozanne@valornet.com

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING CO.
ATTN: KRISTIN FARRIS-POPE
122 WEST TAYLOR
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 04/04/08
Reporting Date: 04/07/08
Project Number: NOT GIVEN
Project Name: BD B-29 LEAK
Project Location: T21S R37E SEC29 B~LEA COUNTY, NM

Analysis Date: 04/04/08
Sampling Date: 04/01/08
Sample Type: GROUNDWATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: KS

LAB NO.	SAMPLE ID	Cl⁻ (mg/L)
H14572-1	MONITOR WELL#1 BEFORE PURGE	316
H14572-2	MONITOR WELL#1 AFTER PURGE	280
H14572-3	MONITOR WELL#2 BEFORE PURGE	252
H14572-4	MONITOR WELL#2 AFTER PURGE	396
Quality Control		490
True Value QC		500
% Recovery		98.0
Relative Percent Difference		< 0.1

METHOD: Standard Methods	4500-Cl⁻B

Kristin Superbo
Chemist

04/07/08
Date

H14572 RICE

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: RICE Operating Company	BILL TO Company: RICE Operating Company — PO#
Project Manager: Kristin Farris-Pope, Project Scientist	Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240
Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240	Phone#: (575) 393-9174 — Fax#: (575)397-1471
Phone #: (575) 393-9174	Fax #: (575) 397-1471
Project #:	Project Name: BD B-29 Leak
Project Location: T21S R37E Sec29 B ~ Lea County New Mexico	Sampler Signature: Rozanne Johnson (575)631-9310 rozanne@valornet.com

ANALYSIS REQUEST
(Circle or Specify Method No.)

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 (2008)	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)	Total Dissolved Solids	Chlorides	Turn Around Time ~ 24 Hours
H14572-1	Monitor Well #1 Before Purge	G	1	X								1		4-1	13:30																				X	
-2	Monitor Well #1 After Purge	G	1	X								1		4-1	14:42																				X	
-3	Monitor Well #2 Before Purge	G	1	X								1		4-1	15:19																				X	
-4	Monitor Well #2 After Purge	G	1	X								1		4-1	16:00																				X	

Relinquished by: Rozanne Johnson	Date: 4-4-08	Time: 11:25	Received by: [signature] 4/4/08 11:25
Relinquished by:	Date:	Time:	Received By: (Laboratory Staff) Date: Time:

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

REMARKS:

Email Results to: kpope@riceswd.com
lweinheimer@riceswd.com
rozanne@valornet.com

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

Sample Condition: Cool: Yes ☑ / No ☐ — Intact: Yes ☑ / No ☐

CHECKED BY: (Initials) MC LB

APPENDIX B

Appendix B
Discussion of Chloride Profiles Obtained at the B-29 Site from the SB and EB Boring Series and MW-1, MW-2

Plate B-1 presents the vadose zone chloride concentration profiles from the three series of soil borings at the site:

1) the Soil Boring (SB) series in September, 2002,
2) the Exploratory Boring (EB) Series in December, 2006,
3) the installation of MW-1 and MW-2 in December, 2006

On Plate B-1, they are arranged by distance from the junction box. MW-1 is about 100 feet to the southeast of the junction box while EB-1 is about 100 feet northwest of the junction box and SB East is about 1,000 feet to the southeast of the junction box.

EB-2 and EB-3 borings were located adjacent to the earlier soil borings SB-West and SB-1 in an attempt to measure the rate of chloride migration toward ground water. All other EB borings were located in order to characterize other areas of the site. MW-1 is located southeast of the junction box in an area not affected by the 2002 release while MW-2 is located adjacent to SB-1 and EB-3.

Chloride Loading at the B-29 Site

The calculated chloride loading (in kg/m^2) uses the chloride concentration with depth data obtained from a boring and assumes that all chloride is contained in the soil moisture. Using a moist bulk density of 1,550 kg/ m^3 and a conservative volumetric moisture content of 0.135 (calculated using the weight % moisture measured in EB-1), the chloride concentrations between any two of these data points are averaged and the chloride is summed over that depth interval. Then, all of the intervals are summed to give the total chloride loading of that boring.

Chloride loadings vary from 115 kg/m^2 at the 95-foot boring EB-1 to 4 kg/m^2 for the shallow boring of EB-7. For comparison, the chloride loading for a 100-foot boring that exhibits a constant background chloride concentration of about 100 mg/kg is 6 kg/m^2.

Giving an equal weighting to the chloride loadings calculated from each boring results in an average chloride loading for the site of 72 kg/m^2. If we assume that the produced water had a chloride concentration of 50,000 mg/L, the depth of the release(s) over the area would be about 56 inches (4.6 feet).

Infiltration and Solute Movement in the Vadose Zone

A precipitation event or a release of fluid upon the surface initially infiltrates at a higher rate than at later times. As the fluid is distributed in the depth interval between the surface and the downwards-moving wetting front, the moisture content decreases necessarily, resulting in lowered hydraulic conductivity. With additional removal of moisture from the near surface vadose zone by evaporation

and transpiration (should vegetation exist), hydraulic conductivity is further lowered in this region. As such, movement during and just after infiltration events occurs at much higher rates than during long "dry" periods. In sustained "dry" periods, near-surface movement can be upwards. At depths below this, water and solute fluxes may be close to zero during these time periods.

Should a later, larger infiltration event (greater volume of fluid per unit of area) occur after an earlier infiltration event, the soils containing the later event are moister and therefore have a higher hydraulic conductivity (and water and solute flux). As such, the later event may "catch" an earlier event. A later event "catching" an earlier event results in a merging of the two events.

Chloride primarily enters the vadose zone through discrete release events. It is observed distributed throughout the vadose zone in varying concentrations rather than in isolated depth intervals. The possibility of later events catching earlier events together with hydrodynamic dispersion (the movement of solute within the pore water) accounts for the observed distribution of chloride.

Identifying exact chronologies of release events afterwards may not be possible as a given chloride concentration profile can be produced by numerous combinations of events. These possibilities can be further complicated by horizontal and vertical variation in grain size distributions with attendant differing moisture content. This produces variations in local hydraulic conductivity; and therefore, water and solute fluxes.

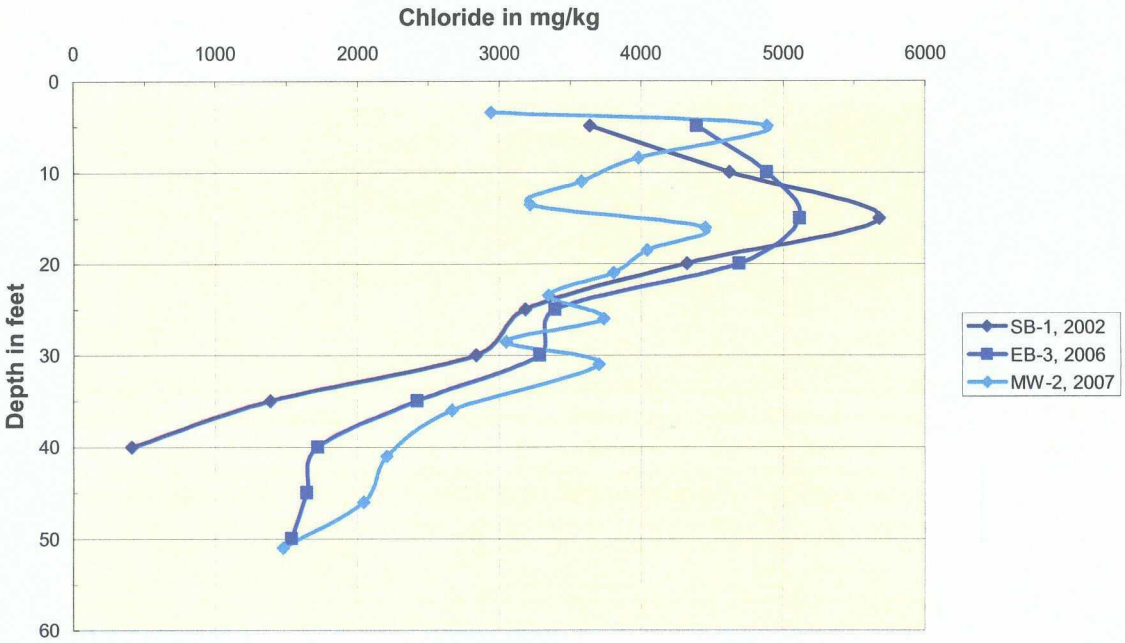
Chloride Migration Rates Suggested by SB-1, EB-3, and MW-2

SB-1 (drilled in Sept. 2002), EB-3 (drilled in Dec 2006) and MW-2 are located less than 50 feet apart and about 500 feet from the junction box. Figure 1 presents the chloride concentration profiles of all three borings. The profiles of SB-1 and EB-3 are very similar with EB-3 showing a lower peak chloride concentration at the depth of 15 feet (5,200 mg/kg) compared with that of SB-1 (5,700 mg/kg). Above and below this depth interval, Chloride concentration in EB-3 is slightly higher than SB-1.

The MW-2 profile is similar in general shape but has finer delineation as sampling occurred about every 2.5 feet of depth from ground level to 30 feet as compared to sampling every 5.0 feet of depth in SB-1 and EB-3. As would therefore be expected, the MW-2 profile shows more local maxima and minima.

Because the locations of the borings vary in distance from the point of release and variation in constituent concentrations in soil samples is common, some variation in the chloride profiles must be expected.

Figure 1: SB-1, EB-3, and MW-2 Chloride Profiles



A chloride maximum and a depth interval of minimal chloride decline can be identified from examination of the profiles of SB-1 and EB-3 (Figure 1):

i. At a depth of 15 feet
ii. And the depth interval of 25 to 30 feet

The similarity in shape of the chloride profiles from SB-1 and EB-3 drilled four years apart supports an estimate of a negligible chloride migration rate for this time interval.

Three depths of local chloride maxima can be identified in MW-2:

i. At a depth of five feet,
ii. A depth of 16 feet,
iii. And the depth interval of 25 to 31 feet.

Comparison of these local chloride concentration maxima at MW-2 with SB-1 and EB-3 suggests that:

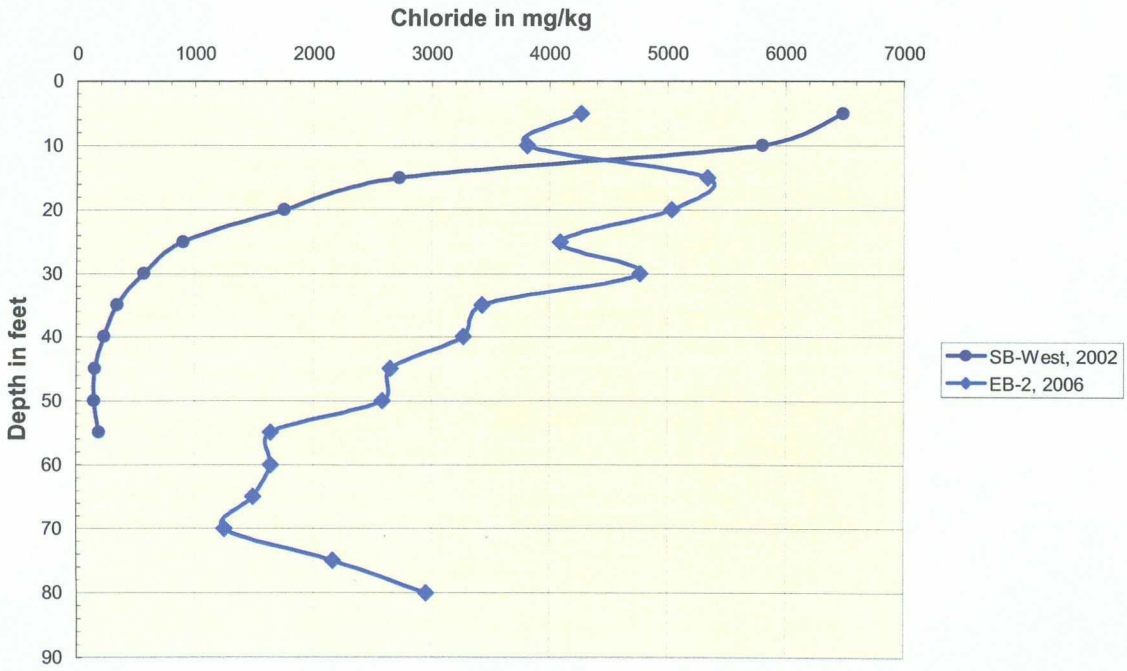
1) The 2002 release chloride maxima can be identified at a depth of about 5 feet in MW-2 in 2007. As evidenced by the increasing chloride concentrations through time in SB-1 and MW-2 the 2002 release was above the 5 foot depth previously.
2) The local maximum identifiable at 15 feet has migrated downwards 1 to 2 feet since 2002. Decreasing chloride concentration may be a result of dispersion through time.
3) The local maximum in the depth interval of 25 to 30 feet has also migrated 1 to 2 feet downwards since 2006.

Over a longer time, the migration rate might be 1-3 feet/year because chloride migration in the vadose zone occurs not as a continuous, slow process but rather approximates a step function. Weather conditions at a certain site over a period of several years may cause chloride to migrate at a rate of more than 5 feet/year – as we have observed at another site. With a change in weather conditions, chloride migration can be much lower for several years – as data at the B-29 site appear to demonstrate.

Chloride Migration Rates Suggested by SB-West and EB-2

EB-2 (2006) was drilled adjacent to SB-West (2002) to provide for another measure of the rate of chloride migration at a different location within the site (see Figure 2). Because the chloride profile signatures of these two borings are obviously different, estimating the rate of migration with the same degree of accuracy as above is difficult. If one had only the data represented in Figure 2, one might conclude that the chloride mass observed in SB-West is the result of the 2002 spill and the center of chloride mass at 5 feet migrated 10-feet downward over the 4-year period to form the center of chloride mass observed in EB-2 (2006) at 15 feet. However, the chloride profiles of Plate B-1 do not support this conclusion as similar relationships between the other SB borings (2002) and the EB borings (2006) do not exist.

Figure 2: SB-West and EB-2 Chloride Profiles



We do not believe that the chloride profile of EB-2 demonstrates a re-distribution of chloride from the 2002 spill event represented by the chloride signature of SB-

West. We believe that the chloride signature of SB-West was caused by surface ponding of released water in 2002. At this location, which we believe had not experienced any past releases, chloride from the 2002 release infiltrated under saturated conditions 5 to 8 feet below land surface. The released water from the 2002 event then drained downward and with re-distribution created the chloride profile that one typically observes from a single release event (SB-West).

At the EB-2 location, the chloride concentration profile suggests there may be up to three historical release events represented from 0 to 40 feet below ground surface: the 2002 release at 5-feet, 15-feet, and 30-feet. The chloride center of mass at 15-feet represents a contribution of chloride from an earlier release plus chloride from the 2002 release. From these two chloride profiles, we conclude that the center of mass of the 2002 release at SB-West and EB-2 are both located about 5-feet below ground surface, suggesting a negligible chloride migration rate for the 2002-2006 time period.

High Concentration Chloride Horizons

Five depth intervals with local chloride concentration maxima are identified and correlated between the borings (Plate B-1). A total of twelve borings have been advanced, ten within the 2002 release footprint and two outside of the 2002 release footprint. The intervals are discussed in order of increasing depth.

At a depth of five feet, six of the twelve borings feature a chloride concentration above 3,500 mg/L. Three of the borings (EB-5, SB East, and EB-7) have a chloride concentration of 1,250mg/kg or less. Of these, EB-5 and SB East are the two furthest borings southeast from the junction box. EB-7 is located on a slight topographic high surrounded by the release footprint. To the northwest of the junction box (EB-1), an intermediate concentration exists (about 2,500 mg/kg in EB-1). MW-1 is located about 100 feet southeast of the junction box within a vegetated area outside of the release footprint.

At a depth of 12 feet to 15 feet, seven of the ten borings within the release area (EB-1, 2,3,4,6, SB-1, and MW-2) have a local chloride concentration maximum (all are above 3,500 mg/kg). Borings without a local maximum at this depth are the two furthest borings (EB-5 and SB East, both less than 1000 mg/kg)) and the boring located on the topographic high (EB-7 at background concentration). MW-1, outside the 2002 release footprint has a concentration of about 3,200 mg/kg. SB West has a chloride concentration of about 2,700 mg/kg at the fifteen-foot depth. SB West, located near the topographic high, has only an uppermost chloride concentration maximum (6,500 mg/kg at five feet) with all concentrations declining below this depth.

A local maximum or non-decrease in chloride concentration can be identified within the depth interval of 25 to 30 feet in 8 of the 10 borings within the release area (EB-1, 2,3,4,5,6, SB-1, and MW-2). Concentrations at this depth interval are all above 3,000 mg/kg for these eight borings. Chloride profiles in SB West and SB East are declining in this depth interval and have concentrations of 30% or

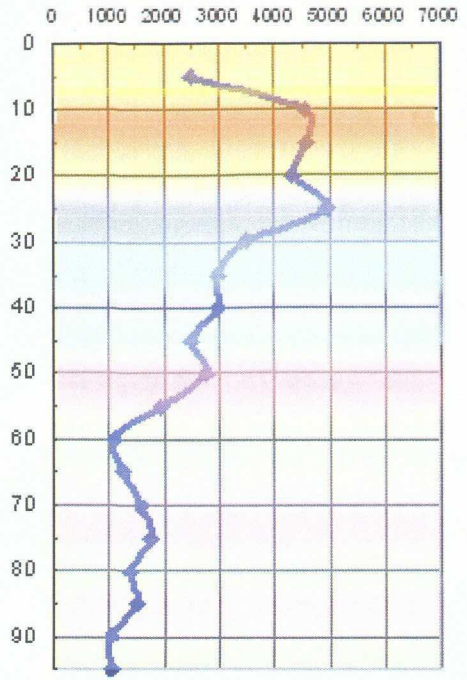
less of the concentrations from the eight borings (less than 1,000 mg/kg in SB West and 275 mg/kg in SB East). MW-1, outside the release footprint, has a comparatively low concentration at this depth (about 2,300 mg/kg). All concentrations in MW-1 below this depth are less than 500 mg/kg. EB-7 did not penetrate this depth.

Additional local maxima can be observed at a depth of 50 feet and at a depth of 75 to 80 feet in EB-1 and EB-2.

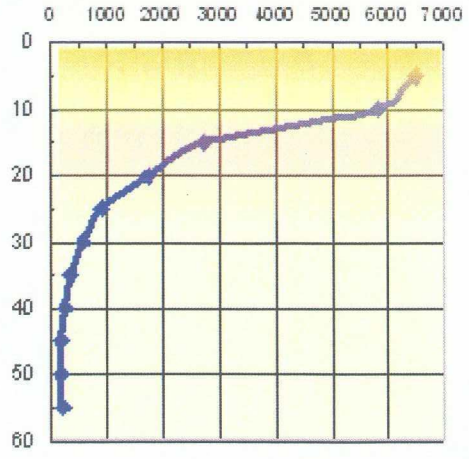
Conclusions:

1) Chloride loading calculations from the boring data suggests multiple releases have occurred at the B-29 site.
2) Chloride concentration profiles at the site feature up to five local chloride concentration maxima.
3) Local chloride concentration maxima at depths of 5 feet, 15 feet, and the interval from 25 to 30 feet exist throughout most of the release area. Additional local maxima may be indicated at depths of 50 feet and at 75 to 80 feet.
4) The sequence of events that created these chloride concentration profiles can not be ascertained from existing data as there are numerous combinations of events that could create them.
5) At intermediate depths (15 to 30 feet), chloride profiles obtained at SB-1 (2002), EB-3 (2006), and MW-2 (2007) suggest a negligible migration rate between Sept. 2002 and Dec. 2006; and a migration rate of 1 to 2 feet/year between Dec 2006 and Dec 2007. These data shows a step-like migration rate at the site. Chloride profiles obtained at SB-West (2002) and EB-2 (2006) are more difficult to interpret, but do not contradict this estimate.
6) The most distant locations and the topographic high areas have been least affected by the 2002 release.

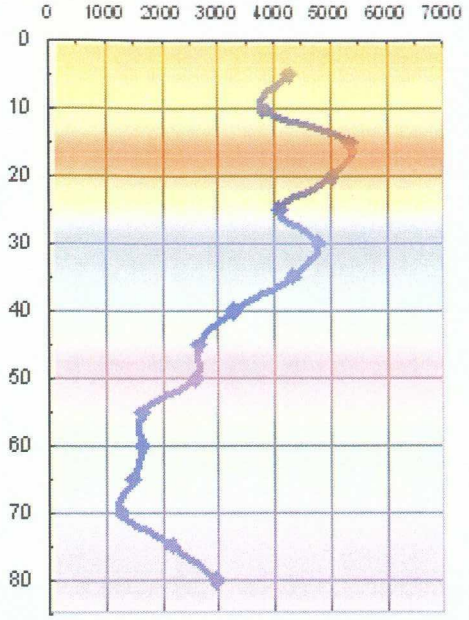
EB-1, 2006



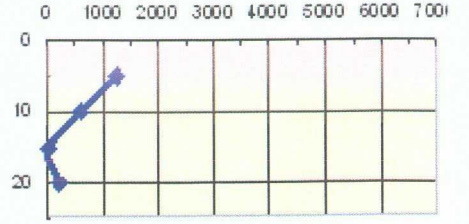
SB West, 2002



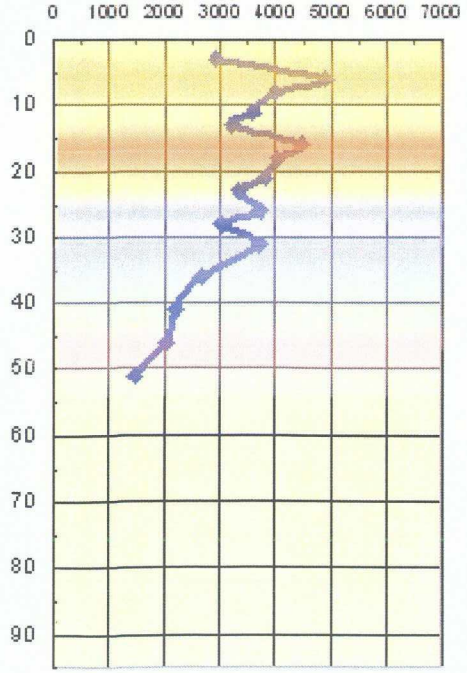
EB-2, 2006



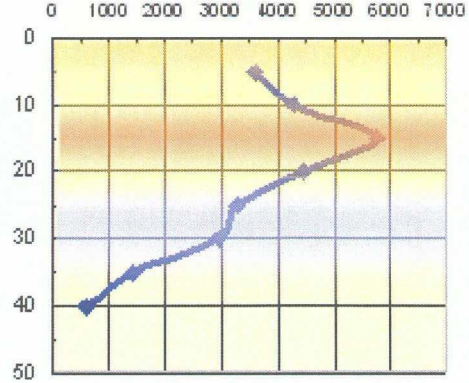
EB-7, 2006



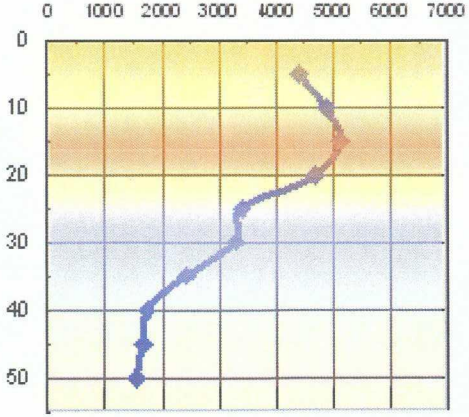
MW-2, 2007



SB-1, 2002



EB-3, Dec 2006



EB-5, 2006