

Remediation of Chloride Impacted Soils North Benson Queen Unit Well #16

Prepared for: Arena Resources, Inc.

2130 W Bender Blvd. Hobbs, NM 88240

Prepared By: Date Prepared:

Etech Environmental & Safety Solutions, Inc.

Date Prepared: Project Number:

June 30, 2009 094-1749-000 District I
1625 N. French Dr., Hobbs, NM 88240
District II
1301 W. Grand Avenue, Artesia, NM 88210
District III
1000 Rto Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico Energy Minerals and Natural Resources

Oil Conservation Division 1220 South St. Francis Dr. Santa Fe, NM 87505 Form C-141 Revised October 10, 2003

Submit 2 Copies to appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action

						OPERA	ror_		Initia	al Report_	\boxtimes	Final Report
Name of Co			ces, Inc.			Contact: Fre						
Address: 21							No.: 575-738-17)		
Facility Nar	ne: North	Benson Que	en Well #	‡ 16	I	Facility Typ	e: Produced Wa	iter Injec	tion			
Surface Ow	ner: BLM			Mineral O	wner: F	BLM			Lease N	No.: 33129		
				LOCA	TION	OF REI	EASE					
Unit Letter	Section	Township	Range	Feet from the		South Line	Feet from the	East/We	est Line	County		
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Type of Relea	ase: Produc	ed Water & O	il			r	Release: 125	7	Volume R	Recovered: 50	0	
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By Whom? T	ony Tucker				-		our 07/29/08-100					
Was a Watero		hed?	Yes 🏻	No			lume Impacting th		course.			
If a Watercou	rse was Imr	pacted Descri	he Fully *									
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Title: Consulta	ınt				A	pproval Date	8-2609	Exp	oiration D	ate: My		
E-mail Addres			420.5		C	onditions of A	ر (روا Approval:	4	İ	Attached		
Date: 07/10/09 Attach Addition			one: 432-5	063-2200			• / •			<u> </u>		
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Remediation of Chloride Impacted Soils North Benson Queen Unit Well #16

Prepared By:

Fred Holmes Project Manager

Etech Environmental & Safety Solutions, Inc.

Reviewed By:

Shane Estep

Senior Environmental Scientist

Etech Environmental & Safety Solutions, Inc.

Date Prepared: Project Number:

June 30, 2009 094-1749-000



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Executive Summary

On July 29, 2008, a release of produced water occurred at the Arena Resources, Inc (Arena) North Benson Queen Unit (NBQU) Well No. 16. On August 4, 2008, Arena contracted Etech Environmental & Safety Solutions, Inc. (Etech) to assess and remediate the spills.

Remediation of the chloride-impacted soils consisted of the construction of a soil-washing unit at the NBQU Tank Battery and the addition of soil amendments to the storm water channels. The unit was constructed to allow the batch treatment of soils on the site. Soils in the stormwater channels were treated with calcium nitrate which was blended into the soils along the bottom of the channels where the water flowed from the release to the pooled areas.

A sampling and analysis procedure was developed to ensure that the washed soils meet the corrective action plan goal of 500 mg/kg of total chlorides. Samples of the wash samples and treated areas were collected and the results of all formal analyses determined that the soils were cleaned to levels that meet the corrective action plan goals of 500 mg/kg or less of total chlorides.

After soil washing was completed the treated soils were transferred back into the excavated areas. The surface was then contoured to meet the existing slopes then seeded with BLM #2 seed mixture. Soil samples were collected from the reclaimed areas and analyzed for chlorides. The results of the analyses indicated that all soils were within the corrective action plan goals.

In conclusion, the impacted soils associated with the produced water spill at the NBQU Well #16 have been remediated. The site will now go to monitoring to ensure that the seeding will germinate. As normal for sites under the Bureau of Land Management's jurisdiction, the site will be monitored for up to 2 years to ensure that the site properly vegetates.







Introduction

On July 29, 2008, a release of produced water occurred at the Arena Resources, Inc (Arena) North Benson Queen Unit (NBQU) Well No. 16. The particulars on this spill are as follows:

 Site:
 NBQU Well 16

 Unit No:
 NMNM70993X

 Latitude:
 N32° 42' 56.300"

 Longitude:
 W103° 58' 26.600"

 Quantity Released:
 125 BBLs.

 Cause:
 Ruptured injection line

On August 4, 2008, Arena contracted Etech Environmental & Safety Solutions, Inc. (Etech) to assess and remediate the spills. A site map is provided in Attachment A.

Assessment

When the spill occurred, the release moved west and north following storm water erosional pathways where the liquids eventually pooled. The first segment flowed west approximately 450 feet before pooling in an area approximately 30 feet in diameter. The other segment flowed northward approximately 150 feet before dividing and flowing around a large sand dune then converging and pooling in an area approximately 30 feet in diameter. The liquids eventually overfilled this area and pooled in a second area adjoining the northeast side of the first. This second area measured approximately 30 feet in diameter. Oil staining associated with the west segment was spotty and confined to the pooled area. The oil staining on the north segment appeared to be largely confined to the pooled areas and to a depth of the first ¼ inch of the surface. There was some spot staining observed in two areas along the spill pathway.

Remediation

Remediation of the chloride-impacted soils consisted of the construction of a soil-washing unit at the NBQU Tank Battery. The unit was constructed to allow the batch treatment of soils on the site. As the soils were cleaned, the solvent (water) was transferred to a holding tank and pumped into the facilities injection well system. Soils from the washing unit were stockpiled in a designated area located directly south of the soil-washing unit. Soils in the stormwater channels were treated with calcium nitrate which was blended into the soils along the bottom of the channels where the water flowed from the release to the pooled areas.

Sampling and Analysis

A sampling and analysis procedure was developed to ensure that the washed soils meet the corrective action plan goal of 500 mg/kg of total chlorides. The plan consisted of daily testing of the soils in the treatment cell using Quantab 30-600 ppm titrators for chlorides. When the results of the testing reached less than 400 ppm of total chlorides, the soils were then transferred to the clean area.

A composite sample was collected approximately every two weeks and taken to Etech's office in Odessa, Texas where the sample was analyzed for chlorides using EPA Standard Method 4500-Cl'B. If the analytical results were less than the levels stated in the corrective action plan, the sample was set aside.





If the results were greater 500 mg/kg, the soil was washed again. Also periodic spot checks were performed on samples collected from the treated pile.

In addition, a split sample composite of the treated soils was sent monthly to Cardinal Laboratories in Hobbs, New Mexico to be analyzed for chlorides via EPA standard Method 4500-Cl'B. All analyses performed at both Etech's and Cardinals facilities determined the chloride levels in the treated soils were less than the 500 mg/kg goal of the corrective action plan. Copies of the field and laboratory analysis are provided in Attachment B.

Reclamation

In May of 2009, treatment operations were suspended and the treated soils were placed into the excavated areas associated with the north and west pool areas. Once placed, the soils were contoured to meet the existing slopes then seeded with BLM #2 seed mixture. Soil samples were collected from the reclaimed areas and analyzed for chlorides. The results of the analyses indicated that all soils were within the corrective action plan goals. Photographs of the sites following reclamation are provided in Attachment C.

Conclusion

In conclusion, the impacted soils associated with the produced water spill at the NBQU Well #16 have been remediated. The site will now go to monitoring to ensure that the seeding will germinate. As normal for sites under the Bureau of Land Management's jurisdiction, the site will be monitored for up to 2 years to ensure that the site properly vegetates.



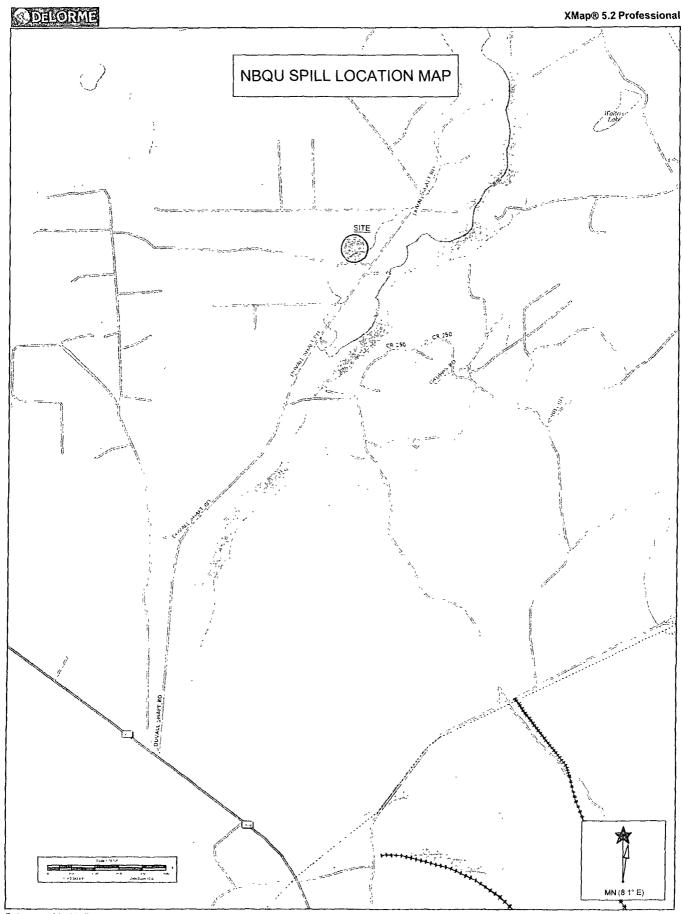




Attachment A Site Location Map

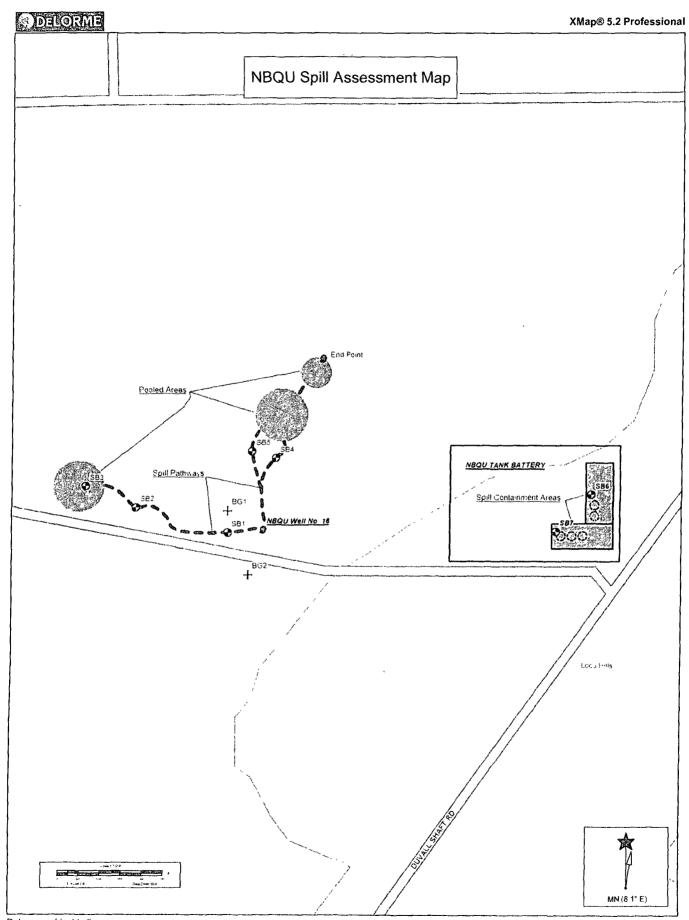






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Attachment B Analytical Results









Project Sample Analysis Sheet

D	ate	:	- (

6/30/2009

Client: Arena Resources, Inc.

Site:

NBQU Soil Washing

Project Number: 094-1748 & 1749

Pro. Mgr.

Fred Holmes

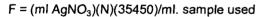
Contaminant: Chlorides

Method:

Standard Method 4500-CIB

QA/QC Standard: 500 mg/kg

Treated Sample Lot (Date)	Milliliters of Sample Used	Dilution	AgNO3 0.028(N)	Result (mg/kg)	Lab Result (mg/kg)	Notations
12/4/2008	10	4	0.700	277.928	272	Sample to Lab for Verification
1/5/2009	10	4	0.600	238.224	N/A	Treated pile spot check. Passed
1/14/2009	10	4	0.450	178.668	160	Treated pile monthly composite, sample to lab for verification
2/3/2009	10	4	0.550	218.372	N/A	Treated pile spot check. Passed
2/16/2009	10	4	1.200	476.448	432	Treated pile monthly composite, sample to lab for verification
3/9/2009	10	4	0.500	198.52	160	Treated pile monthly composite, sample to lab for verification
4/6/2009	10	4	0.600	238.224	N/A	Treated pile spot check. Passed
4/29/2009	10	4	0.650	258.076	224	Treated pile monthly composite, sample to lab for verification
6/1/2009	10	4	0.550	218.372	N/A	Treated pile spot check. Passed
6/15/2009	10	4	0.500	198.52	192	Treated pile monthly composite, sample to lab for verification
Clearance Sampling	Milliliters of Sample Used	Dilution	AgNO3 0.028(N)	Result (mg/kg)	Lab Results (mg/kg)	Notations
N. Pool Area Clearance	10	4	1.150	456.596	480	Clearance sample, split to lab
W. Pool Area Clearance	10	4	0.400	158.816	144	Clearance sample, split to lab
Storm Water Drainage Clearance	10	4	0.450	178.668	176	Clearance sample, split to lab



Soil Sample Volume: 25 Grams Deionized Water Volume = 100 ml





ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC. ATTN: FRED HOLMES

P.O. BOX 8469 MIDLAND, TX 79708 FAX TO: (432) 563-2213

Summary Report

		GI
LAB NO.	SAMPLE ID	(mg/kg)
H16470-1	12/4/2008	272
H17718-1	1/14/2009	160
H17719-1	2/16/2009	432
H17720-1	3/9/2009	160
H17721-1	4/29/2009	224
H17722-1	6/15/2009	192
	administration in the first of the second relations of the second in the second	na and the constitution and administration when the constitution of the constitution o

METHOD: Standard Methods 4500-CIB

Note: Analysis performed on a 1:4 w:v aqueous extract.





ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

ATTN: FRED HOLMES P.O. BOX 8469

MIDLAND, TX 79708 FAX TO: (432) 563-2213

Receiving Date: 06/30/09 Reporting Date: 06/30/09 Project Number: 094-1749

Project Name: NBQU INJECTION-SOIL WASHING

Project Location: EDDY COUNTY, NM

Analysis Date: 06/30/09 Sampling Date: 06/15/09 Sample Type: SOIL

Sample Type: SOIL

Sample Condition: INTACT @ 24°C

Sample Received By: ML

Analyzed By: HM

LAB NO. SAMPLE ID	CI (mg/kg)
H17722-1 06-15-2009	192
	radional designation of the second
Quality Control	500
True Value QC	500
% Recovery	100
Relative Percent Difference	<0.1

METHOD: Standard Methods

Note: Analysis performed on a 1:4 w:v aqueous extract.

Chemist

Date

4500-CIB



H17722 Etech

ARDINAL LABORATORIES 101 East Marland, Hobbs, NM 88240



CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Page _ 1 _ of _ 1

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Phone #: 432	-563-2200	Fax #:	432	2-56	3-22	13		Ac	dre	55:				1				1						l	
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Project Location	n: Eddy County, NM							Pi	none	#:		W. 1					١.	ł	1						
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[†] Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476.



ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

ATTN: FRED HOLMES P.O. BOX 8469 MIDLAND, TX 79708 FAX TO: (432) 563-2213

Receiving Date: 06/30/09 Reporting Date: 06/30/09 Project Number: 094-1749

Project Name: NBQU INJECTION-SOIL WASHING

Project Location: EDDY COUNTY, NM

Analysis Date: 06/30/09 Sampling Date: 04/29/09 Sample Type: SOIL

Sample Condition: INTACT @ 24°C

Sample Received By: ML

Analyzed By: HM

METHOD: Standard Methods

4500-CI'B

07/01/09

Note: Analysis performed on a 1:4 w:v aqueous extract. Analyzed outside EPA recommended hold time, however sample results should not be affected.

Chemist

Date



H17721 Etech





CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Page __1_ of __1_

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ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

ATTN: FRED HOLMES P.O. BOX 8469 MIDLAND, TX 79708 FAX TO: (432) 563-2213

Receiving Date: 06/30/09 Reporting Date: 06/30/09

Project Number: 094-1749

Project Name: NBQU INJECTION-SOIL WASHING

Project Location: EDDY COUNTY, NM

Analysis Date: 06/30/09 Sampling Date: 03/09/09 Sample Type: SOIL

Sample Condition: INTACT @ 24°C

Sample Received By: ML

Analyzed By: HM

CI (mg/kg) LAB NO. SAMPLE ID H17720-1 03-09-2009 **Quality Control** 500 True Value QC 500 % Recovery 100 Relative Percent Difference < 0.1

METHOD: Standard Methods

4500-CIB

Note: Analysis performed on a 1.4 w.v aqueous extract. Analyzed outside EPA recommended hold time, however sample results should not be affected.

H17720 Etech





CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Page 1 of 1

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FOR LAB USE ONLY						MA	TRIX	·	PRI	ESER	<u> </u>	SAMPLII	iG												
Lab I.D.	Sample I.I		Y(G)RAB OR (C)OMP	# CONTAINERS	GROUNDWATER	WASTEWATER SOIL	OIL	OTHER	ACID/BASE:	ICE / COOL	OINER .	DATE	TIME	ТРН (8015)	TPH Ext (TX 1005)	Chlorides									
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† Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476.

#26



ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC. ATTN: FRED HOLMES

P.O. BOX 8469 MIDLAND, TX 79708 FAX TO: (432) 563-2213

Receiving Date: 06/30/09 Reporting Date: 06/30/09 Project Number: 094-1749

Project Name: NBQU INJECTION-SOIL WASHING

Project Location: EDDY COUNTY, NM

Analysis Date: 06/30/09 Sampling Date: 02/16/09 Sample Type: SOIL

Sample Condition: INTACT @ 24°C

Sample Received By: ML

Analyzed By: HM

METHOD: Standard Methods

4500-Cl'B

07/01/09

Note: Analysis performed on a 1:4 w:v aqueous extract. Analyzed outside EPA recommended hold time, however sample results should not be affected.

Chemist

Date

H17719 Etech

ARDINAL LABORATORIES 101 East Marland, Hobbs, NM 88240



CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Page 1 of 1

	(505) 393-2326 F																						
Company Name	: Etech Env. & Safet	y Solutions, In	C.				:		IL	L TO						ANAL	YSIS	RE	QUE	ST			
Project Manage	r: Fred Holmes						P.C).#: S	941	749000								, i					l
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City: Midland	S	tate: TX	Zip	:		79708	Att	n:		an garan aga na mananan a							1				1	1	1
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Project #: 094	-1749	Project Owr	ier:			مالت وراحات ورا	Cit	y:		- marries						1						ł	l
Project Name:	NBQU Injection - Soil V	Vashing			particular for any fine date		Sta	ite:		Zìp:													· [
Project Location	: Eddy County, NM				ma		Ph	one#:	٠	1 ×											l		
Sampler Name:	Jay Latta - Fred Ho	imes					Fa	k #:				•										İ	
FOR LAB USE ONLY					MAT	RIX		PRESE	₹V	SAMPLIN	IG.											- 1	
Lab I.D.	Sample I	.D.	(G)RAB OR (C)OMP	# CONTAINERS	GROUNDWATER WASTEWATER SOIL	OIL	ОТНЕВ	ACID/BASE ICE / COOL	OTHER	DATE	TIME	TPH (8015)	TPH Ext (TX 1005)	Chlorides									
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[†] Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476.



ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

ATTN: FRED HOLMES P.O. BOX 8469

MIDLAND, TX 79708 FAX TO: (432) 563-2213

Receiving Date: 06/30/09 Reporting Date: 06/30/09

Project Number: 094-1749

Project Name: NBQU INJECTION-SOIL WASHING Project Location: EDDY COUNTY, NM

Analysis Date: 06/30/09 Sampling Date: 01/14/09 Sample Type: SOIL

Sample Condition: INTACT @ 24°C

Sample Received By: ML

Analyzed By: HM

LAB NO. SAMPLE ID	Ci¯ (mg/kg)
H17718-1 01-14-2009	160
and the second section of the second section is a second section of the second section of the second section s	
Quality Control	500
True Value QC	500
% Recovery	100
Relative Percent Difference	<0.1

METHOD: Standard Methods

4500-CIB

Note: Analysis performed on a 1:4 w:v aqueous extract. Analyzed outside EPA recommended hold time, however sample results should not be affected.

Chemišt

Date

H17718 Etech

ARDINAL LABORATORIES



CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240 (505) 393-2326 Fax (505) 393-2476

Page	1	of	1	
			·	

	(303) 383-2320 FAX (303) 383-				
Company Name: Etech Env. & Safety Solutions, Inc.				ANALYSIS	REQUEST
Project Manage	r: Fred Holmes	- The water a partie were and the second of the second of	P.O. #: 941749000		
Address: P.O). Box 8469		Company:		
City: Midland	State: TX	Zip: 79708	Attn:		
Phone #: 432	-563-2200 Fax #:	432-563-2213	Address:		
Project#: 094	-1749 Project Own		City:		
Project Name:	NBQU Injection - Soil Washing	manufactured and the four the four the state of the state	State: Zip:		
Project Location	n: Eddy County, NM	THE PERSON NAMED IN THE PERSON NAMED IN THE PARTY OF THE	Phone #:		
Sampler Name:	Jay Latta - Fred Holmes	make to a second street, who have the mission to common the second street, and the second	Fax #:		
FOR LAB USE ONLY		MATRIX	PRESERV. SAMPLIN	G	
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP # CONTAINERS GROUNDWATER WASTEWATER SOIL OIL	OTHER ACIDIBASE ICE / COOL OTHER	TPH (8015) TPH Ext (TX 1005) Chlorides	
H17718-1	01-14-2009	CIIX	1/14/04	1500 X	
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THE OWNER OF SECURITIES & MARKET					
PLEASE NOTE: Limbley as analyses All claims include	nd Damages Caronal's liability and client's exclusive remedy fo ing those for negligence and any other cause whatsoever shall b	r any claim arising whother based in contract to decimed waked unless made in writing an	or tors, shall be invited to the amount paid to directived by Cardinal within 30 days after a	by the chieff for the Terms and Co completion of the applicable 30 days past do	enditions; interest will be charged on all accounts more than too at the rate of 24% per annum from the original date of invoice
service, in no event shall C affiliates or successors are	ardinal be liable for incidental or consequental damages includ and out of or related to the performance of abricas hereunder b				i collections including attorney's fees
Sampler Reling	uishedi Date:	Received By:	1	Phone Result:	e:
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	Time:				
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ANALYTICAL RESULTS FOR ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

ATTN: FRED HOLMES

P.O. BOX 8469 MIDLAND, TX 79708

FAX TO: (432) 563-2213

Receiving Date: 12/04/08 Reporting Date: 12/04/08

Project Owner: NOT GIVEN

Project Name: NORTH BENSON QUEEN INJECTION

FACILITY

Project Location: NOT GIVEN

Analysis Date: 12/04/08 Sampling Date: 12/04/08

Sample Type: SOIL

Sample Condition: COOL & INTACT

Sample Received By: AB

Analyzed By: HM

LAB NO.	SAMPLE ID	Cl¯ (mg/kg)
H16470-1	POST SAMPLE #1	272
H16470-2	PRE SAMPLE	1,500
1		
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~~~		
<b>Quality Cont</b>	trol	500
True Value	QC	500
% Recovery		100
	cent Difference	2.0
	ndard Methods	4500-CFB

Note: Analyses performed on 1:4 w:v aqueous extracts.

Chapting Sillyman

Date

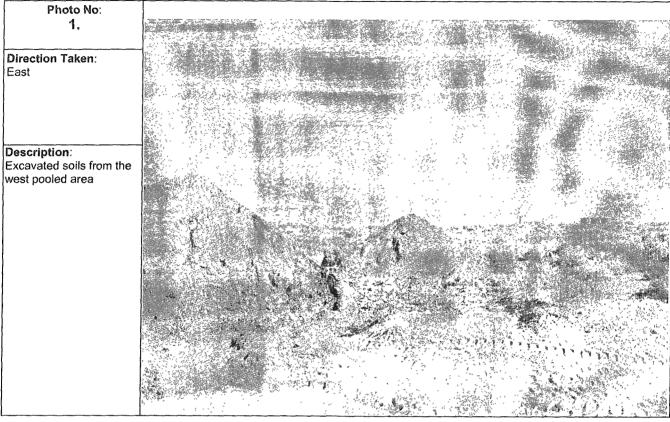
H16470 Etech

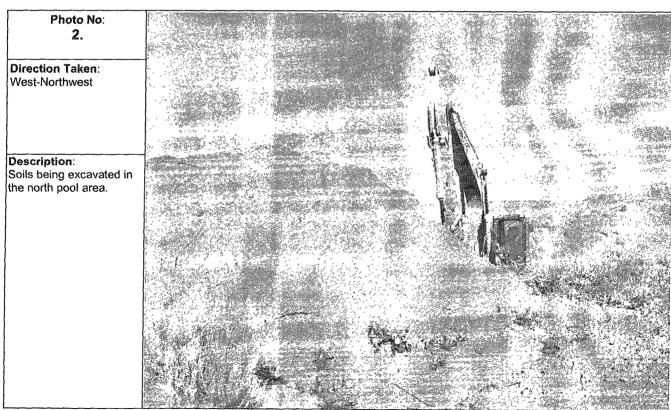


	(575) 393-2326 Fax (575) 393-2	176										F	age	10			
Company Name: ETECH Environ Mental				BILL TO			ANALYSIS REQUEST										
Project Manager:				P O. #:													1
Addréss.				Company:													į
City	State: Zip:				Attn:									ļ			
Phone #	Fax #:				Adaress:										-		1
Projecta:	Project Owner:			City:			Ì						1	}			1
Mojeci Name Mosth Benson Queen Injection tacility				State: Zip:					1				1		1		
Giolest Fosatiou	),			Phone #:								1 1			{		
gambiet Hawe.		_		Fax#:									1		1		
Lab I.D.  H1470-1 -2	Sample I.D.  Post Sample #1  PRE SAMPLE	(GIRAB OR (C)OMP	# CONTAINERS  GROUNDWATER  WASTEWATER  SOL  OIL	OTHER.  OTHER.  ACIDBASE  SES  ICE / COOL	DATE 12/4/68 //	TIME 1:40a ):30a	\(\frac{1}{\sigma}\)										
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Sampler Relling Rellinguisned B	72/04/0 Time: 11:20a Oate: Time:	A Seemad na minaut Cardinal Rec	gostave ni sparti sastru Davišus	g and received by Certa one loss of use or inse	nel within 30 days after cor of profits incurred by client of the above stated reason P	mpieson of	ine applicat me CSult: Lit'		1	odaye pasi ond all costs o	and the rate of concession and the rate of concession and the rate of concession and the rate of the concession and the rate of the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and the concession and	al 24% per ncluding en e #:	annum lior	nigira anu			
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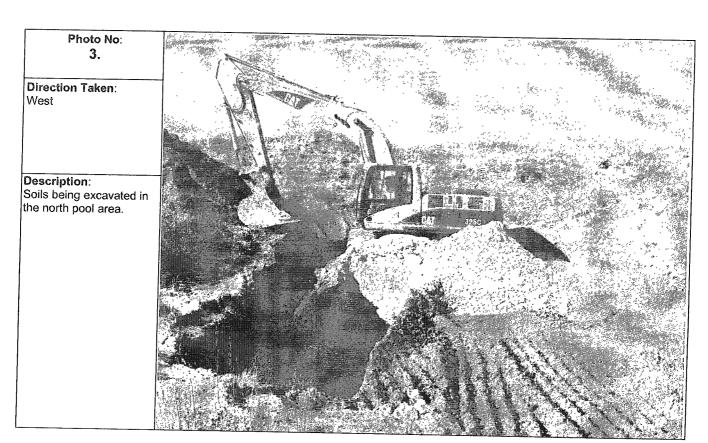
# Attachment C Photographs

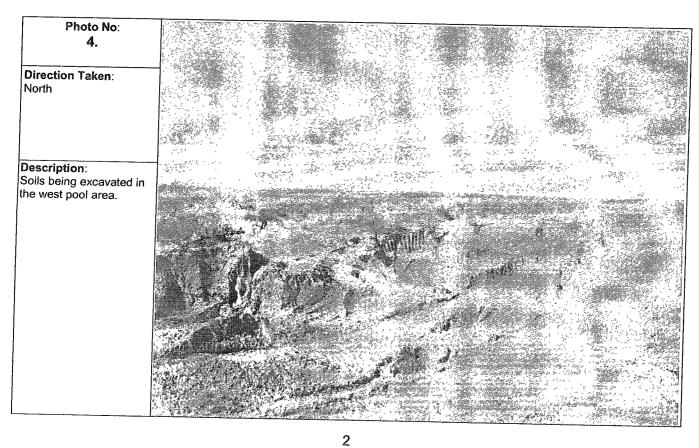






Photograph Log Date Taken: October 2008 – June 2009





Project Name: North Benson Queen Unit - Well #16 Remediation

Project No: 094-1749-000

Photograph Log Date Taken: October 2008 – June 2009

