



June 28, 2019

Kevin Rowsey  
U.S. EPA Region III  
Ground Water & Enforcement Branch (3WP22)  
1650 Arch Street  
Philadelphia, PA 19103

**Subject: Application For Renewal of UIC Class II-D Well Permit (Non-Commercial)**  
**EXCO Resources (PA), LLC Spencer Land Company #2**  
**Permit #PAS2D902BCLE**  
**Clearfield County, Pennsylvania**

Dear Mr. Rowsey:

Enclosed please find three (3) copies of the Underground Injection Control (UIC) Class II-D Brine Disposal Well permit application for the EXCO Resources (PA), LLC (EXCO) Spencer Land Company #2 well. The application was prepared by Tetra Tech, Inc. (Tetra Tech) on behalf of EXCO, and is submitted as part of a request to renew the UIC Class II-D well permit for the subject well. As indicated in "Section 11 - Necessary Resources", EXCO will provide under separate cover the amended Trust Agreement to verify they have the necessary resources to properly plug and abandon the well. An electronic copy of the application has also been submitted to you by email.

Prompt EPA review of the application and renewal of the UIC Class II-D well permit would be greatly appreciated. If you have any questions or comments, please feel free to contact Cary Cannon of EXCO at (972) 201-0658 or at [ccannon@EXCOPAResources.com](mailto:ccannon@EXCOPAResources.com); or me at (412) 921-4006 or at [dale.skoff@tetrtech.com](mailto:dale.skoff@tetrtech.com).

Sincerely,  
**Tetra Tech, Inc.**

A handwritten signature in black ink that reads "Dale E. Skoff".

Dale E. Skoff, P.G.  
Sr. Project Manager

cc: Dave Rectenwald – EPA  
Cary Cannon - EXCO



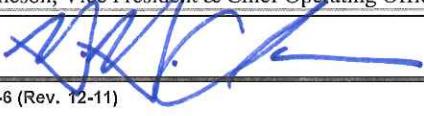
TETRA TECH

**UIC CLASS IID WELL PERMIT APPLICATION  
(NON-COMMERCIAL)  
EXCO RESOURCES (PA), LLC  
SPENCER LAND COMPANY #2**

**FERGUSON TOWNSHIP  
CLEARFIELD COUNTY, PA**

**(RENEWAL OF PERMIT #PAS2D902BCLE)**

**June 2019**

<b>United States Environmental Protection Agency</b> <b>Underground Injection Control</b> <b>Permit Application</b> <i>(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)</i>														
<b>I. EPA ID Number</b>  <table border="1"> <tr> <td>U</td> <td>T/A</td> <td>C</td> </tr> </table>												U	T/A	C
U	T/A	C												
<b>Read Attached Instructions Before Starting</b> <b>For Official Use Only</b>														
Application approved mo day year			Date received mo day year			Permit Number		Well ID		FINDS Number				
<b>II. Owner Name and Address</b>						<b>III. Operator Name and Address</b>								
Owner Name EXCO Resources (PA), LLC						Owner Name EXCO Resources (PA), LLC								
Street Address 13448 State Route 422, Suite 1			Phone Number (724) 720-2500			Street Address 13448 State Route 422, Suite 1			Phone Number (724) 720-2500					
City Kittanning			State PA			City Kittanning			State PA					
ZIP CODE 16201									ZIP CODE 16201					
<b>IV. Commercial Facility</b>			<b>V. Ownership</b>			<b>VI. Legal Contact</b>			<b>VII. SIC Codes</b>					
<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> No			<input checked="" type="checkbox"/> Private <input type="checkbox"/> Federal <input type="checkbox"/> Other			<input type="checkbox"/> Owner <input checked="" type="checkbox"/> Operator			1311 - Crude Petroleum and Natural Gas					
<b>VIII. Well Status (Mark "x")</b>														
<input type="checkbox"/> A  Operating		Date Started mo day year			<input checked="" type="checkbox"/> B. Modification/Conversion			<input type="checkbox"/> C. Proposed						
<b>IX. Type of Permit Requested (Mark "x" and specify if required)</b>														
<input checked="" type="checkbox"/> A. Individual		<input type="checkbox"/> B. Area		Number of Existing Wells 1		Number of Proposed Wells		Name(s) of field(s) or project(s) Spencer Land Company Disposal Well #2						
<b>X. Class and Type of Well (see reverse)</b>														
A. Class(es) (enter code(s))		B. Type(s) (enter code(s))		C. If class is "other" or type is code 'x,' explain				D. Number of wells per type (if area permit)						
II		D												
<b>XI. Location of Well(s) or Approximate Center of Field or Project</b>														
Latitude			Longitude			Township and Range						<b>XII. Indian Lands (Mark 'x')</b>		
Deg 40	Min 54	Sec 38.9	Deg -78	Min 35	Sec 54.7	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line	
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No														
<b>XIII. Attachments</b>														
<i>(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)</i> For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.														
<b>XIV. Certification</b>														
I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32)														
A. Name and Title (Type or Print) Harold H. Jameson, Vice President & Chief Operating Officer						B. Phone No. (Area Code and No.)								
C. Signature 						D. Date Signed								

## Introduction

This UIC Class IID well permit application for the Spencer Land Company #2 well (Spencer #2) was prepared by Tetra Tech Inc. (Tetra Tech) on behalf of EXCO Resources (PA), LLC (EXCO). The Spencer #2 is an existing UIC Class IID well (USEPA Permit No. PAS2D902BCLE) located in Ferguson Township of Clearfield County, PA. The most recent UIC well permit became effective on October 23, 2008. Modifications were made to the permit on April 14, 2009, which provided for an increase in the volume limitation from 5,880 barrels per month to 9,000 barrels per month. EXCO ceased operation of the injection well in 2012. The UIC well permit expired on October 23, 2018. This application is submitted as part of the request by EXCO to renew the UIC Class IID (non-commercial) well permit.

The Spencer #2 was originally drilled and completed as a natural gas well in the Upper Devonian Tiona Sandstone on December 4, 1984. The well operated as a natural gas well until conversion to a UIC Class IID well in 1988. The well injected into the original perforations in the Tiona Sandstone at a depth of 2603-2617 ft. EXCO plans to add additional perforations in the Tiona Sandstone (in the interval 2600 to 2620 ft.) to facilitate injectivity.

This application has been developed according to pertinent USEPA regulations and application guidelines for UIC Class IID wells. As indicated in the application, EXCO is requesting an increase in the injection rate to 15,000 barrels per month as well as an increase to the Maximum Allowable Injection Pressure (MAIP) from 1450 psi to 1581 psi based on information included in this application.

**Table of Contents**  
**Underground Injection Control (UIC) Class II Well Permit Application**  
**EXCO Resources, LLC**  
**Spencer Land Company #2**  
**Ferguson Township, Clearfield County, PA**

**Section 1.0 – Area of Review Determination**

**Section 2.0 – Maps of Well Area and Area of Review**

**Section 3.0 – Corrective Action Plan and Well Data**

**Section 4.0 – Name and Depth of USDWs**

**Section 5.0 – Geologic Data On Injection and Confining Zones**

**Section 6.0 – Operating Data**

**Section 7.0 – Well Construction Details**

**Section 8.0 – Plans for Well Failures**

**Section 9.0 – Monitoring Program**

**Section 10.0 – Plugging and Abandonment Plan**

**Section 11.0 – Necessary Resources**

**Appendix A – Surrounding Landowner Information**

## **SECTION 1.0 – AREA OF REVIEW DETERMINATION**

## 1.0 AREA OF REVIEW DETERMINATION

This section summarizes the analytical modeling performed by Tetra Tech, Inc. (Tetra Tech) for the Area of Review (AOR)/Zone of Endangerment (ZOE) analysis for the Spencer Land Company Disposal Well #2 well for EXCO Resources (PA), Inc. (EXCO). The well is located in Ferguson Township of Clearfield County, Pennsylvania and targets the Tiona Sandstone as the injection zone. This well was permitted as a UIC Class IID well under permit number PAS2D902BCLE (October 23, 2008).

The relevant parameters for the analysis were obtained from existing permit-related documents and information provided by EXCO or estimated/based on literature values in the absence of any well-specific information. The analysis is described in more detail below.

## OVERVIEW AND METHODOLOGY

There are several methods proposed for calculating the ZOE of an injection well. The most simplistic method is the use of a fixed radius, based on the type of injection well being permitted. Other methods involve calculation of the radius based on well and formation properties. Most regulatory agencies require the use of calculations to determine the ZOE. The method used here is the graphical method first used by USEPA Region 6. It involves the calculation of the increase of pressure in the formation due to injection, then converting that pressure into equivalent feet of head. The increase in head in the formation due to injection is then compared to the equivalent head of the lowest most underground source of drinking water (USDW). When plotted graphically, the intersection of those two curves at some radial distance,  $r$ , determines the radius of the ZOE.

The increase in pressure in the formation due to injection depends on the properties of the injection fluid and the formation, the rate of fluid injection, and the length of time of injection. The most common mathematical expression to describe this increase in pressure was developed by Matthews and Russell (1967). Matthews and Russell assume that, for a single well injecting into an infinite, homogeneous and isotropic, non-leaking formation, the increase in pressure ( $\Delta p$ ) can be described as:

$$\Delta p = 162.6 Q \mu / kh * [(\log(kt / \Phi \mu Cr^2) - 3.23)] \text{ where:}$$

$\Delta p$  = pressure change (psi) at radius,  $r$  and time,  $t$

$Q$  = injection rate (barrels (bbls)/day)

$\mu$  = injectate viscosity (centipoise)

$k$  = formation permeability (millidarcies (md))

$h$  = formation thickness (feet)

$t$  = time since injection began (hours)

$C$  = compressibility (total, sum of water and rock compressibility) ( $\text{psi}^{-1}$ )

$r$  = radial distance from wellbore to point of investigation (feet)

$\Phi$  = average formation porosity (decimal)

## PARAMETERS USED IN THE ANALYSIS

The following parameters were used in the ZOE analysis. For injection rate, we used the proposed daily rate of 500 bbls/day per well. For this analysis, permeability values for the Tiona Sandstone were unavailable. Tetra Tech assigned a value of 50 md, which is based on a literature value of permeability in the Bradford Third Sand (which is the formation immediately below the Tiona Sandstone at the well location). In this study (Ondrusek, 1988), the Middle-High Region of the Bradford is reported to have 18% porosity and permeability of 120 md and the Lower Section of the Middle Zone is reported to have 13.8% porosity and permeability of 22.7 md. Taking the geometric mean of the two porosity values results in a value of 15.8%, which closely approximates the porosity value of the Tiona Sandstone at the Spencer #2 well (16%). Taking the geometric mean of the two permeability values results in a permeability value of 52.2 md. Using the porosity as an analogue, a value of 50 md was assumed for the permeability of the Tiona Sandstone in this analysis.

The initial pressure at the top of the injection formation (845 psi) was based upon observed measurements in February 2019. The above input parameters and others required for the modeling are provided below for the Spencer #2 well along with the basis for the assigned input parameter value.

### Spencer #2 Tiona Sandstone Well

$Q$  = 500 barrels/day (Proposed increase to 15,000 bbls/mo from the current 9,000 bbls/mo permitted volume)

$t$  = 10 years = 87,600 hours (Modeled scenario)

$\mu$  = 1 centipoise (Default)

$k$  = 50 md (Based on analogue of Bradford permeability per Ondrusek (1988))

$h$  = 22 feet (Thickness of Tiona Sandstone)

$C$  = 3.0e-06  $\text{psi}^{-1}$  (Default)

$\Phi$  = 0.16 (Average from neutron-density log)

Specific gravity of injectate = 1.15 (Anticipated specific gravity of injected brine)

Surface elevation = 1,560 feet (Well Completion Report)

Depth to injection formation = 2,600 feet (Requested injection interval)

Base of lowest most USDW (MSL) = 1,210 feet (Surface elevation – 350 feet (depth to lowest most USDW based on review of water well data for the injection well area))

Initial pressure at top of injection formation = 845 psi (Reservoir pressure reported by EXCO based on fluid levels measured on 2/19/19)

## RESULTS

The Matthews and Russell equation was solved for the Spencer #2 well based on the parameters listed above. The equation was used to calculate the increase in pressure in the Tiona Sandstone formation due to injection operations at the well. Then, this value was added to the value of existing pressure in the injection formation to obtain the total pressure in the formation when the well is injecting.

This value was then converted to feet of head of formation brine. The values are plotted against radial distance from the wellbore and are shown in Figure 1. The plot shows the calculated pressure surface within the injection formation, measured as feet of head of formation brine above the top of the injection formation. Also shown is the head of the lowest most USDW. Where the two lines intersect, the radius of the ZOE can be estimated. The results indicate that the radial distance of the ZOE is approximately 1000 feet for the Spencer #2 well. This distance is less than the ¼ mile standard fixed radius for AOR/ZOE.

## CONCLUSIONS

Our analysis of the AOR/ZOE for the Spencer #2 well is based on a methodology typically used by US EPA. Using conservative assumptions and based on the results, we believe the Spencer #2 well is an excellent candidate for use as a brine disposal wells from a ZOE perspective. The analysis indicates that the AOR of ¼ mile is sufficiently protective given the ZOE results of 1000 feet for the Spencer #2 well.

## REFERENCES

Matthews, C.S., Russell, D.G., (1967) Pressure Buildup and Flow Test in Wells, SPE Monograph Series, Volume1, New York.

Ondrusek, P.S., (1988) Micellar/Polymer Flooding in the Bradford Field, Journal of Petroleum Technology, Society of Petroleum Engineers, Volume 40, Issue 8, August 1988.

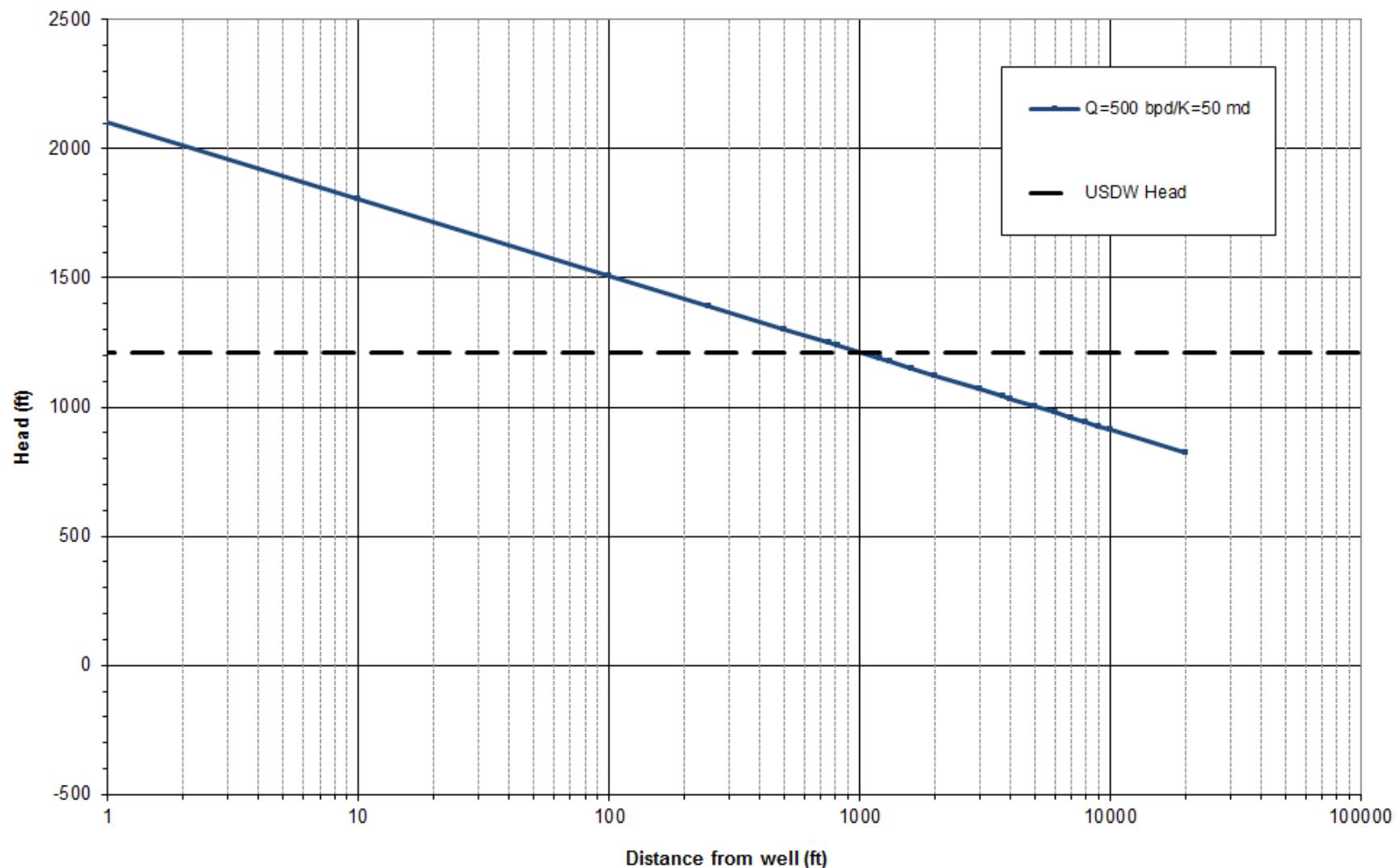


Figure 1. Feet of head of injection formation and USDW vs. distance for Spencer #2 well at 500 bpd and  $K = 50$  md

## **SECTION 2.0 AOR AND RELATED MAPS**

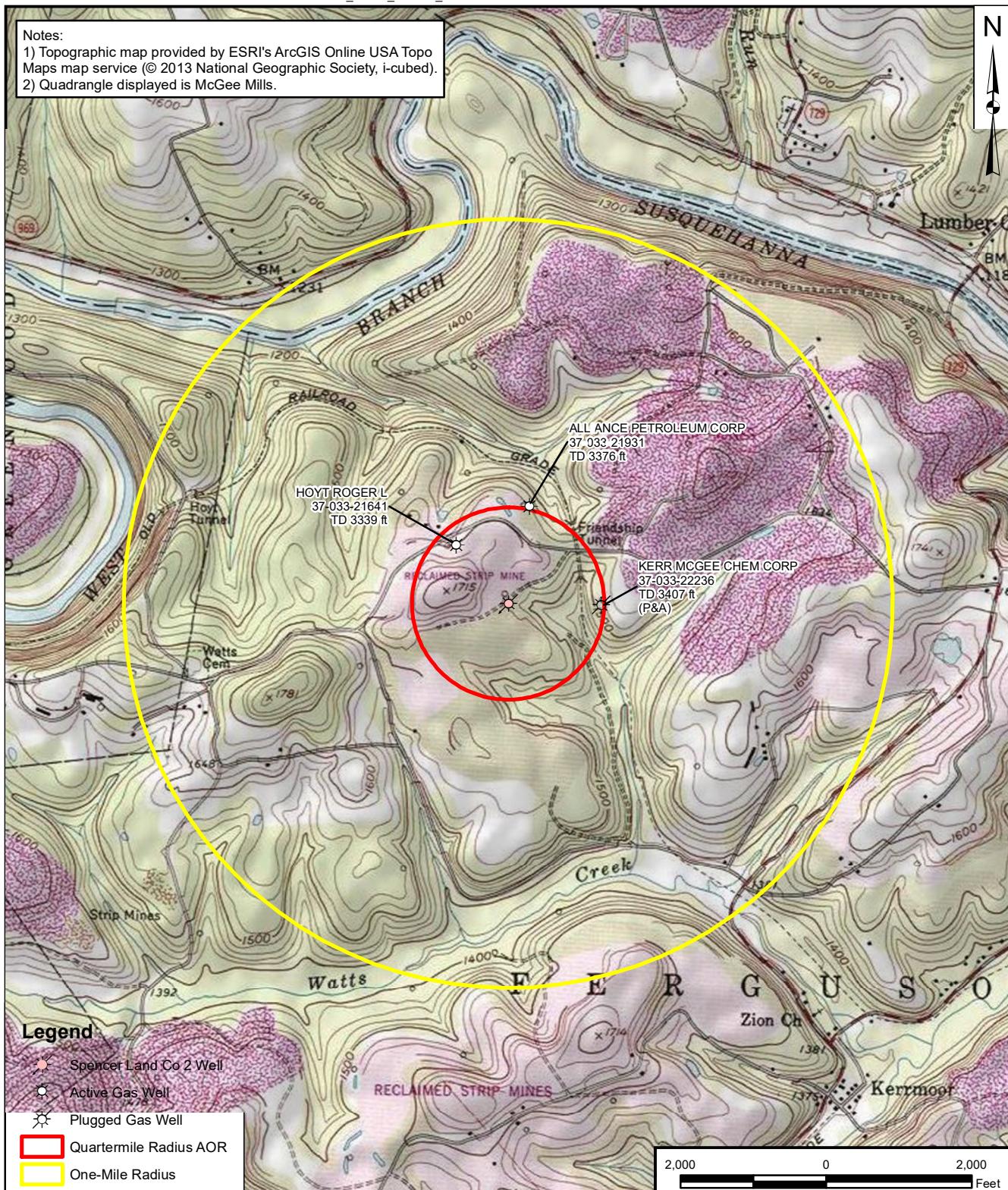
## 2.0 MAPS OF WELL AREA AND AREA OF REVIEW (AOR)

Figure 2 is a topographic map, extending greater than one mile beyond the Spencer #2 well, showing the injection well and indicating the ¼ mile AOR radius around the injection well. There were no intake or discharge structures or hazardous waste treatment, storage or disposal facilities identified within a one-mile radius of the injection well. The following summarizes results of the review of the AOR for the features referenced in permit application requirements to UIC Class IID wells. The summary is based on review of publicly available sources and information otherwise known to EXCO:

- Producing oil or gas wells – There are two producing oil or gas wells (Roger L. Hoyt and Alliance Petroleum wells) on the northern edge of the AOR with key information on these wells summarized on Table 1. The total depth of these wells range from 3337 to 3339 ft. As indicated both wells produce from the Tiona Sandstone with production comingled with other Upper Devonian Sandstone Units.
- Abandoned oil or gas wells – There is one plugged and abandoned oil and gas well (Kerr-McGee Chemical Corp. well) on the eastern edge of the ¼ mile AOR. Key information on this well is also summarized on Table 1. As indicated, the well was not perforated. The well, drilled to a TD of 3407 ft, was plugged in 1987. The well Completion Report and Certificate of Plugging are attached. According to PADEP online records, the bond for the well was released on 9/7/1988, implying PADEP was satisfied with the plugging of the well. There were no other abandoned wells or any orphaned wells indicated as being present in the AOR.
- Injection wells – there are no other injection wells located in the AOR
- Dry holes – There are no dry holes (other than the above-referenced plugged and abandoned Kerr-McGee well).
- Surface water bodies, springs – There are no surface water features in the AOR. The West Branch of the Susquehanna River and Watts Creek are located approximately one mile from the injection well to the north and south, respectively.
- Mines (surface and subsurface), quarries – As indicated on Figure 1, the USGS Topographic Map, there is a reclaimed strip mine located immediately to the north of the Spencer #2 well.
- Residences – The surface owners of properties within ½ mile of the injection well are shown on the figure in Appendix A along with the listing of owners and addresses for the subject parcels.
- Roads – Cemetery Road is located approximately 0.2 miles to the north of the Spencer #2.
- Faults – As discussed in greater detail in Section 5.0 of this application, there are no known or suspected faults present in the AOR.

- Drinking water wells— There are no drinking water wells or springs located within the AOR. As shown on Figure 3, two drinking water wells were identified within one mile of the Spencer Land Company #2. Key information on these wells is summarized in Table 2 and discussed in greater detail in Section 4.0. The wells range from 100 to 200 ft in depth.

**AOR MAPS**  
**OIL AND GAS AND GROUNDWATER**

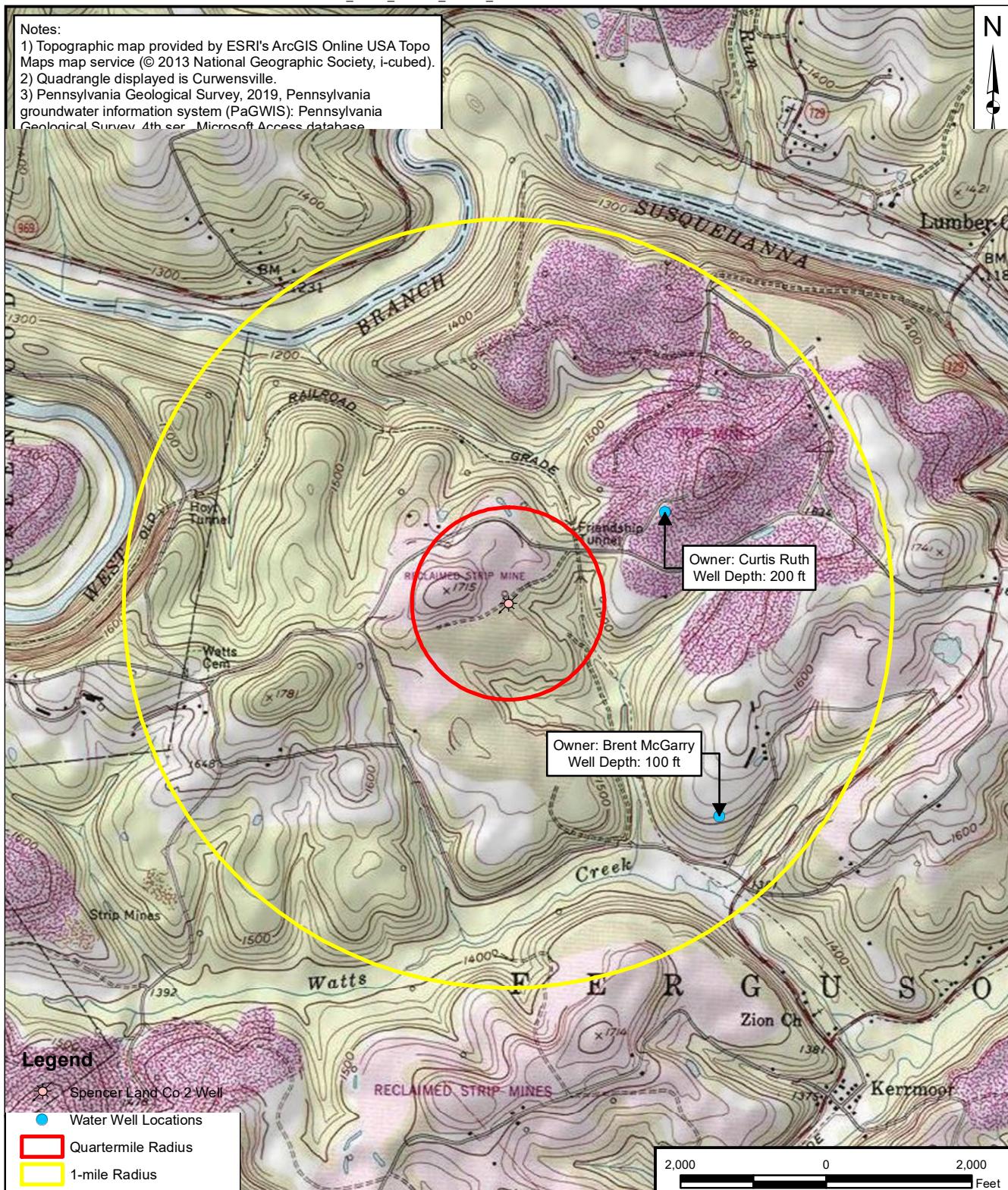


**Table 1****Oil and Gas Wells Located Within the 1/4 Mile Area of Review (AOR)****Spencer Land Company #2 Well****Clearfield County, PA****Spencer Land Co. 2 UIC Class IID Well and Active Oil and Gas Wells in AOR**

Permit No.	Well Name	Operator	Type	Spud Date	Perforations (Ft.)	Interval	Total Depth (Ft.)
033-22059	SPENCER LAND CO. 2	EXCO RESOURCES, LLC	UIC	12/1/1984	2603-2617	Tiona	3439
033-21641	JAMES HOYT 3	HOYT ROGER L	GAS	9/14/1983	2583 -2595 2865-2877	Tiona Sheffield	3339
033-21931	SPENCER LAND CO 1	ALLIANCE PETROLEUM CO LLC	GAS	9/24/1984	1748-1876 1956-2108 2587-2601 2875-3195	Bayard/Fifth Warren/Bayard Tiona 2 <sup>nd</sup> /3 <sup>rd</sup> /Bradford/Sheffield	3337

**Plugged and Abandoned Wells in AOR**

Permit No.	Well Name	Operator	Type	Spud Date/Plug Date	Original Perforations	County	Original Total Depth (Ft.)
033-22236	SPENCER LAND COMPANY 4	KERR MCGEE CHEM CORP	Dry	3/26/1985 10/9/1987	None	Not Produced	3407



**Table 2****Drinking Water Wells Within One Mile of Spencer Land Company #2 Well****Clearfield County, PA**

Well ID NO.	Well Owner	Date Drilled	County	Latitude	Longitude	Well Depth (Ft.)	Well Yield (GPM)	Water Use
630221	McGarry	12/01/2015	Clearfield	40.90287	-78.58794	100	10	DOMESTIC
476006	Ruth	10/12/2011	Clearfield	40.9143	-78.59077	200	1	DOMESTIC

**AOR MAPS**  
**O&G WELL COMPLETION REPORTS**

C-22059  
22059  
Office Use Only

(7)

2000 S 40°55'00"  
4200 W 35'00"

## WELL RECORD

DATE JUN 22 1984

DEIK TGS

SP

PERMIT NO. I

CLE-22059

PROJECT NO. I

WELL NO. I

TYPE OF WELL

GAS

## LUMBER CITY FIELD - DEV

WELL OPERATOR I

Deltaus Corporation, Northeast Production Div.

TELEPHONE NO. I (412) 349-1343

ADDRESS I

R.D. #4 Box #141, Indiana, Pennsylvania

ZIP I 15701

FARM NAME

SPENCER LAND CO.

FARM NO. I

2

SERIAL NO.

ACRES I 65

TOWNSHIP I

FERGUSON

COUNTY

CLEARFIELD

DRILLING COMMENCED

12/01/84

DRILLING I COMPLETED I

12/04/84

ELEVATION I

1560'

QUADRANGLE

CURWENSVILLE

 7 1/2' 15'

## CASING AND TUBING RECORD

PIPE I SIZE	AMOUNT IN I WELL	MATERIAL I BEHIND PIPE I		PACKER I			DATE RUN
		CEMENT I (SKS.) I	GEL I (SKS.) I	TYPE I	SIZE I	DEPTH I	
11-3/4"	0	-	-	-	-	51	12/01/84
8-5/8"	913	230 Skks.	-	FS	1.5	925.5	12/03/84
4-1/2"	3361.75	435 Skks.	5 Skks.	FS	1.5	3374.25	12/04/84
		T.D.	D.D.	D.P.I.	Class	O.I.G.	Lease
		3039		26	1	1	
		F.U.K.					

## PERFORATION RECORD

## STIMULATION RECORD

DATE	INTERVAL PERFORATED I		DATE	INTERVAL TREATED	AMOUNT I FLUID I	AMOUNT I SAND I	INJECTION I RATE
	FROM	TO					
12/12/84	2617	2603	12/12/84	TIONA	75 Q FOAM 32,000	6,000 67,000	24.0 BPM

NATURAL I OPEN I FLOW I

NATURAL I R.I. CK I PRESSURE I

HRS.  
DAYSAFTER I TREATMENT I OPEN I FLOW I  
474,000 GFD

AFTER I TREATMENT I ROCK I PRESSURE I

72 HRS. I

480#

REMARKS:

BRADFORD

JUN 2-8-84

RECEIVED  
(FORMERLY ON REVERSE SIDE)

FEB 19 1985

## FORMATIONS

NAME	TOP	OTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	SOURCE OF ATA
SUBSTRUCTURE	0	12				
FILL	12	25				
SHALE	25	80				
COAL	80	83				
SAND & SHALE	83	130			DAMP @ 80'	
SAND	130	140				
SHALE	140	145				
SAND	145	175				
SHALE	175	195				
SAND	195	288				
SHALE	288	315				
SAND	315	324				
SHALE	324	350				
SAND & SHALE	350	370				
SAND (WHITE)	370	380				
SAND & SHALE	380	410				
SHALE	410	430				
SANDY SHALE	430	610				
SHALE	610	620				
SANDY SHALE	620	670				
SHALE	670	85				
SANDY SHALE	68	705				
SHALE	705	750				
SANDY SHALE	750	800				
SHALE	800	1602				
SAND	1602	1636				
SHALE	1636	1793				
SAND	1793	1804				
SHALE	1804	1900				
SAND	1900	1902				
SHALE	1902	1933				
SAND	1933	1954				
SHALE	1954	1967				
SAND	1967	1987				
SHALE	1987	2214				
SAND	2214	2224				
SHALE	2224	2234				
SAND	2234	2242				
SHALE	2242	2305				
SAND	2305	2311				
SHALE	2311	2600				
SAND	2600	2620				
SHALE	2620	2795				
SAND	2795	2802				
SHALE	2802	2886				
SAND	2886	2902				
SHALE	2902	2940				
SAND	2940	2942				
SHALE	2942	3110				
SAND	3110	3120				
SHALE	3120	3128				
SAND	3128	3134				
SHALE	3134	3284				
SAND	3284	3287				
SHALE	3287	T.D.				
DRILLERS' T.D.	3287	T.D.				
LOGGERS' T.D.	3439					
	3436					

January 9

1985

DATE

D.W. A.C.

APPROVED BY

William A. Fustos  
Production Division Manager

TITLE



## FORMATIONS

NAME	OP	OTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	SOURCE OF DATA
Fill	0	0				
hale	10	77				
Shale & and	77	319				
Red Rock	319	345				
and	345	941				
hale	941	1350				
Red Rock	1350	1440				
hale	1440	1650				
Red Rock	1650	1775				
hale & and	1775	2550				
Red Rock	550	2554				
hale & and	2554	2800				
Sand	2800	2860				
and & Shale	2860	3130				
and	3130	3150				
Shale	3150	3339 TD				

November 4

19 8

DATE

APPROVED BY

James F. Scott

Owner/Operator

TITLE

800' S 40° 55' 00"  
4000' W 78° 35' 00"  
(7)

COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL RESOURCES  
BUREAU OF OIL AND GAS REGULATION  
PITTSBURGH, PENNSYLVANIA 15222

Curwensville

21931

Office Use Only

## ELL RECORD

PERMIT NO.

CLE-21931

PROJECT NO.

TYPE OF ELL

GAS

Lumber City Field - Dev.

WELL OPERATOR 0 DeltaUS CORPORATION, NORTHEAST PRODUCTION DIV. TELEPHONE NO. (412) 0349-13430

ADDRESS 1 R.D. #4 - BOX #141, INDIANA, PENNSYLVANIA ZIP 15701

FARM NAME 1 SPENCER LAND COMPANY 0 FARM NO 1 SERIAL NO. 1 ACR 65

TOWNSHIP 1 FERGUSON 0 COUNTY 1 CLEARFIELD

DRILLING COMMENCED 1 09/24/84 0 DRILLING COMPLETED 1 09/28/84 0

ELEVATION 1 1540' 0 QUADRANGLE CURWENSVILLE  7 1/2'  15'

## CASING AND TUBING RECORD

PIPE I I.D. I	AMOUNT I IN I WELL I	MATERIAL BEHIND PIPE I		PACKER I			DATE RUN
		CEMENT (SKS.) I	GEL (SKS.) I	TYP I	SIZE	DEPTH	
11-3/4" 0	400	-	-	-	-	51.00	09/24/84 0
8-5/8" 0	976.40	245 Sks. 0	-	FS	1.5	88.5	09/27/84 0
4-1/2" 0	24.150	425 Sks. 0	3 Sk. 0	FS 0	1.5	36.65	09/28/84
	D.	D.D.	P.I.	Class	O	G	Lease
	3376		3195	D	2		

E&amp;K

1/2

## PERFORATION RECORD

## STIMULATION RECORD

DATE I	INTERVAL PERFORATION I		DATE I	INTERVAL I TREATED I	AMOUNT I FLUID I	AMOUNT I SAND I	INJECTION RATE
	FROM I	TO					
10/09/84 0	195	2875 0	10/09/84	2nd & 3rd 0 Brad. 05. Shef 0	32,000 0	6,000 67,000 0	8.8 0 BPM
"	2601 0	2587 0	10/09/84 0		40,000	6,000 54,000 0	24.0 0 BPM 0
"	2108 0	1956 0	10/09/84 0	Warren Bayard 0	24,000 0	6,000 49,000 0	19.0 0 BPM 0
"	1876 0	1748 0	10/09/84 0	Bayard 0 50h Sand 0	28,000 0	6,000 8,000 0	34.3 BPM

NATURAL I PEN I FLOW I

NATURAL I ROCK I PRESSURE I

H.P.I.

AFTER IT TREATMENT I OPEN I FLOW I ~~375,000~~ 1

AFTER IT TREATMENT I ROCK I PRESSURE I

1000#/0 72 HIS

REMARKS:

*Venango*  
*Bradford*

11-24-84

40-41-17-00-100 REGI

(FORM 100-100 REV. 10-74, REVERSE SIDE)

SOL-NED

JUL 2 1987

FORMATIONS						
NAME	TOP	BOTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	SOURCE OF DATA
SUB	0	11				DRILLERS' LOG
SHALE	11	59				
SAND	59	63				
COAL	63	69				
SAND	69	77				
COAL	77	83				
SHALE	83	115				
COAL	115	119				
SAND	119	139				
SANDY SHALE	139	157				
SHALE	157	177				
SAND	177	258			DAMP @ 229'	
SHALE	258	274				
SAND & SHALE	274	305				
SHALE	305	310				
SHALE & SAND	310	390				
RED SHALE	390	408				
SAND	408	605				
SANDY SHALE	605	648				
SAND	648	675				
SHALE	675	691				
SAND	691	703				
SHALE	703	719				
RED SHALE	719	735				
SHALE (GRAY)	735	801				
SHALE (RED)	801	835				
SHALE (GRAY)	835	895				
SHALE (RED)	895	915				
SHALE (GRAY)	915	1025				
SANDY SHALE	1025	1136				
SHALE (GRAY)	1136	1591				
SHALE (RED)	1591	1635				
SHALE (GRAY)	1635	1742				
5TH SAND	1742	1794				

## FORMATIONS

PAGE 2.

NAME	TOP	BOTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	SOURCE OF DATA
SHALE (GRAY)	1794	1860				
BAYARD STRAY	1860	1878				
SHALE	1878	1950				
BAYARD	1950	1972				
SHALE	1972	2096				
WARREN	2096	2108				
SAND & SHALE	2108	2585				
TIONA	2585	2604				
SHALE	2604	2872				
1ST BRAD.	2872	2886				
SHALE	2886	3100				
2ND BRAD.	3100	3116				
SHALE	3116	3184				
1ST BRAD.	3184	3197				
SHALE	3197	3265				
KANE	3265	3267				
SHALE	3267	T.D.				
DRILLERS' T.D.	3374					
LOGGERS' T.D.	3376					

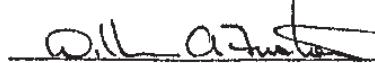
T.D. 3376': ~~Bottom~~ EIK

October 18

84

19

DATE



APPROVED BY

William A. Fustos  
Production Division Manager

TITLE





Spencer Land Company #4

NAME	FORMATIONS					SOURCE OF DATA
	TOP	BOTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	
Fill	0	12				
Shale	12	25				
Sandy Shale	25	65				
Sand	65	116				
Sandy Shale	116	147				
Sand	147	204			1" Wtr @ 140'	
Sand	204	215				
Shale	215	220				
Coal	220	225				
Sandy Shale	225	262				
Sand	262	268				
Sandy Shale	268	280				
Sand	280	290				
Sandy Shale	290	340				
Sand	340	417				
Sand	417	610				
Sandy Shale	610	640			1/2" wtr @ 610'	
Sandy Shale	640	670				
Shale	670	685				
Sand	685	715				
Sandy Shale	715	770				
Sand	770	795				
Shale	795	805				
Sandy Shale	805	825				
Sand & Shale	825	3,407				

TD 3,407'

T.D. EK

DER - TGS  
1987 JUN - 1 AM 10:30  
AND GAS BLOWDOWN

June 23, 1987

DATE

APPROVED BY

William A. Fustos

District Production Superintendent

TITLE

### **SECTION 3.0 – CORRECTIVE ACTION PLAN**

### **3.0 CORRECTIVE ACTION PLAN AND WELL DATA**

As discussed in the previous section, two oil and gas wells were identified as present within the AOR. A table summarizing information on these and Completion Reports for these wells are included in Section 2.0. Both wells are located along the edge of the AOR at a distance of approximately 1/4 mile from the injection well and as indicated in the Completion Reports have cemented surface and production casing.

Also as discussed in the previous section, there is one plugged and abandoned well located along the eastern edge of the AOR. A Certificate of Plugging was filed for this well with PADEP in 1987 and the bond on the well was released by PADEP in 1988.

Based on the above, no corrective action is deemed necessary for wells in the AOR.

## **SECTION 4.0 – USDW**

#### 4.0 NAME AND DEPTH OF USDWS

The site lies within the Pittsburgh Low Plateau section of the Appalachian Plateaus Physiographic province. Within Clearfield County the most productive water bearing formation is the Pottsville Formation. The Allegheny Formation's sandstones are of next importance as well as the Conemaugh formation but only in Du Bois along the Caledonia syncline. The Pottsville Formation consists chiefly of hard sandstone with the Homewood and Connoquenessing members producing the most water-bearing zones. The Allegheny Formation main water producing intervals beds are those of the Clarion, Kittanning, and Butler sandstone members where wells can produce from 50 to 150 gallons per minute. (Pennsylvania Topographic and Geologic Survey, 1938).

The Pennsylvania Geologic Survey "Ground Water Inventory System" (GWIS) database was accessed to determine sources of groundwater in the site area. The database contained a total of two groundwater wells within a one-mile radius and one of those wells being within ½ mile radius of the Spencer Land Company #2 well. These wells range from 100 to 200 feet in depth. The wells yielded 1 to 10 gpm during a 120 minute tests. Depth to bedrock ranges from 10 to 34 feet deep. The wells were all completed within the bedrock unit. The listed information for these wells is provided in Table 2 and the locations are shown on Figure 3 (in Section 2.0). Although there are two total wells listed, it is noted that the well reporting requirement was established in 1968 is not considered to be a complete record of water wells and other wells may be present. (Pennsylvania Topographic and Geologic Survey, February 7, 2019).

The GWIS database indicated that several wells in Ferguson Township produced water from the Allegheny Group and overlying Glenshaw Formation (of the Conemaugh Group). (Producing formation is not identified for most wells in the database). As discussed in Section 5.0, the Glenshaw and Casselman Formations (also Conemaugh Group) are the uppermost bedrock units in the vicinity of Spencer #2 based on geologic mapping. Therefore it is interpreted that depending on location the USDW may occur in the Conemaugh Group or possibly underlying Allegheny Group Rocks.

For the purpose of this application, in calculating the depth to the base of the lowermost USDW the depth of the deepest well in the vicinity of the Spencer Land Company #2 (as discussed in Section 2.0) is 200 ft. To be conservative, 150 ft was added to result in an estimate of the lowestmost USDW of 350 ft.

#### References:

Pennsylvania Topographic and Geologic Survey, 1938. "Groundwater in South Central Pennsylvania." Bulletin W 5.

Pennsylvania Topographic and Geologic Survey, February 7/19, 2019. "Ground Water Inventory System". [www.dcnr.state.pa.us/topogeo/groundwater/PAGWIS](http://www.dcnr.state.pa.us/topogeo/groundwater/PAGWIS)

## **SECTION 5.0 – GEOLOGIC DATA**

## 5.0 GEOLOGICAL DATA ON INJECTION AND CONFINING ZONES

This section provides an overview of regional geologic setting, information on injection and confining zones and evaluates the potential for induced seismicity.

### Regional Geologic Setting

Figure 4 is a geologic map of the Curwensville quadrangle. From a regional perspective, the Spencer #2 well is located on the eastern edge of the Appalachian Plateau Geologic Province. The well lies within the Pittsburgh Low Plateau section of the Appalachian Plateaus Physiographic province. As indicated on Figure 4, the well is situated along the southwest flank of the Clearfield syncline. As such, the regional dip in the vicinity of the well is anticipated to be to the northeast. There are no faults indicated on the geologic map suggesting that there are no significant faults extending to the surface. The Pennsylvania Glenshaw and Casselman Formations (of the Conemaugh Group) are shown on the geologic map as being the uppermost bedrock formations in the vicinity of the well.

### Injection and Confining Zones

As discussed above, injection at the Spencer #2 well occurs into the Upper Devonian Tiona Sandstone. The Tiona Sandstone occurs at a depth of approximately 2598 to 2620 ft and exhibits a compensated neutron-density log porosity averaging approximately 16 percent (compensated neutron density log through the Tiona Sandstone is attached). The injection interval was perforated with 8 perfs between 2603 and 2617 feet and frac'd in December 1984. The initial after treatment open flow was reported as 474 MCF. Prior to performing injection under the renewed permit EXCO plans to add perforations to the Tiona Sandstone interval to cover the 2600 to 2620 ft interval.

Various Upper Devonian sandstone intervals are productive in the area including Bradford and Sheffield (stratigraphically below the Tiona) and Warren, Bayard and Fifth (stratigraphically above the Tiona). As is typical for many Upper Devonian gas wells, production is often commingled among the various producing sandstone units in the area. An exception being the Spencer #2 which as indicated above was only perforated in the Tiona Sandstone. In general the shallowest productive unit which is productive in the area is at a depth of approximately 1700 ft. Figure 5 is a generalized stratigraphic column for the area which shows the presence of a package (approximately 900 ft thick) of gas producing sandstone units and intervening shales overlying the Tiona Sandstone. Above this package of producing sandstones and intervening shale units is predominantly shale with occasional sandstone and coal in the upper portion. It is estimated that this predominantly shale interval is approximately 1000 ft or more in thickness. In summary, there is a substantial thickness of shale confining intervals between the Tiona Sandstone and the lowest most USDW (estimated at a depth of approximately 350 ft.)

### Evaluation of Potential For Induced Seismicity

Faulting is known to occur in the Appalachian Plateau region, particularly associated with anticlinal structures. Many researchers consider the potential for induced seismicity related to injection wells to be greater when injected fluids and pressures interact with faults which extend

to Precambrian basement rocks. As discussed in the “Geology of Pennsylvania” (Pennsylvania Geological Survey and Pittsburgh Geological Survey, 1999) in describing the typical faults occurring in the Appalachian Plateau structures, “These faults die out in the overlying Devonian Shales.” According to the PA DCNR “Precambrian Basement Map of the Appalachian Basin and Piedmont Province in Pennsylvania” ([http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr\\_016250.pdf](http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_016250.pdf)) the depth to Precambrian basement in the site vicinity is estimated at approximately 5000 meters (or approximately 16,400 feet) below sea level. The base of the Tiona Sands at the Spencer Land Company #2 well is approximately 1,057 ft. below sea level, or roughly 3 miles above the estimated top of Precambrian basement.

According to the PADCNR earthquake mapping website <http://www.gis.dcnr.state.pa.us/maps/index.html?geology=true>, the closest listed earthquake to the Spencer Land Company #2 well occurred on 03/25/1937 near Phillipsburg approximately 20 miles away with an unknown magnitude. The closest earthquake with a listed magnitude occurred on 07/15/1938 near Huston Township at a distance of approximately 42 miles which had a magnitude of 3.3.

The PASEIS website, which is operated by Penn State, <http://paseis.geosc.psu.edu/events.html>, was also reviewed for evidence of earthquakes in the site vicinity. The PSU website lists only the 25 most recent seismic events within Pennsylvania. Of the 25 listed the largest earthquake with magnitude of 1.9 was located at a distance of approximately 76 miles near the town of Cammal occurring on 01/18/2019. The closest listed earthquake occurred on 03/05/2019 located at a distance of approximately 6.26 miles near Phillipsburg with a magnitude of 1.4.

The USGS Seismic Hazards Map for Pennsylvania (Figure 6) indicates that the Spencer Land Company #2 well is situated in the lowest seismic risk area.

The USEPA Region 3 “Framework for evaluating seismic potential associated with UIC Class II permits”. This document states that, “ Seismic activity induced by Class II wells is likely to occur only where all of the following conditions are present: (1) there is a fault in a near-failure state of stress; (2) the fluid injected has a path of communication to the fault; and (3) the pressure exerted by the fluid is high enough and lasts long enough to cause movement along the fault line.” As stated above, based on publicly available information no significant faults are located in the vicinity of the injection well.

The following evaluates conditions pertaining to the Spencer #2 well and site area, relative to other key statements in the USEPA Region 3 document. The key statements are in italics followed by an overview of operational or site conditions.

***“Therefore, limiting the rate and volume of the fluids injected limits the potential for seismicity.”***  
The proposed injection rate (15,000 barrels/month) is a relatively very low rate.

***“Because of the likelihood of greater permeability and the reduction in pore pressure, injecting into formations with a significant history of oil and gas production is unlikely to cause seismicity.”***  
The Tiona Sandstone has been a gas producing interval in the area since at least the 1980s, resulting

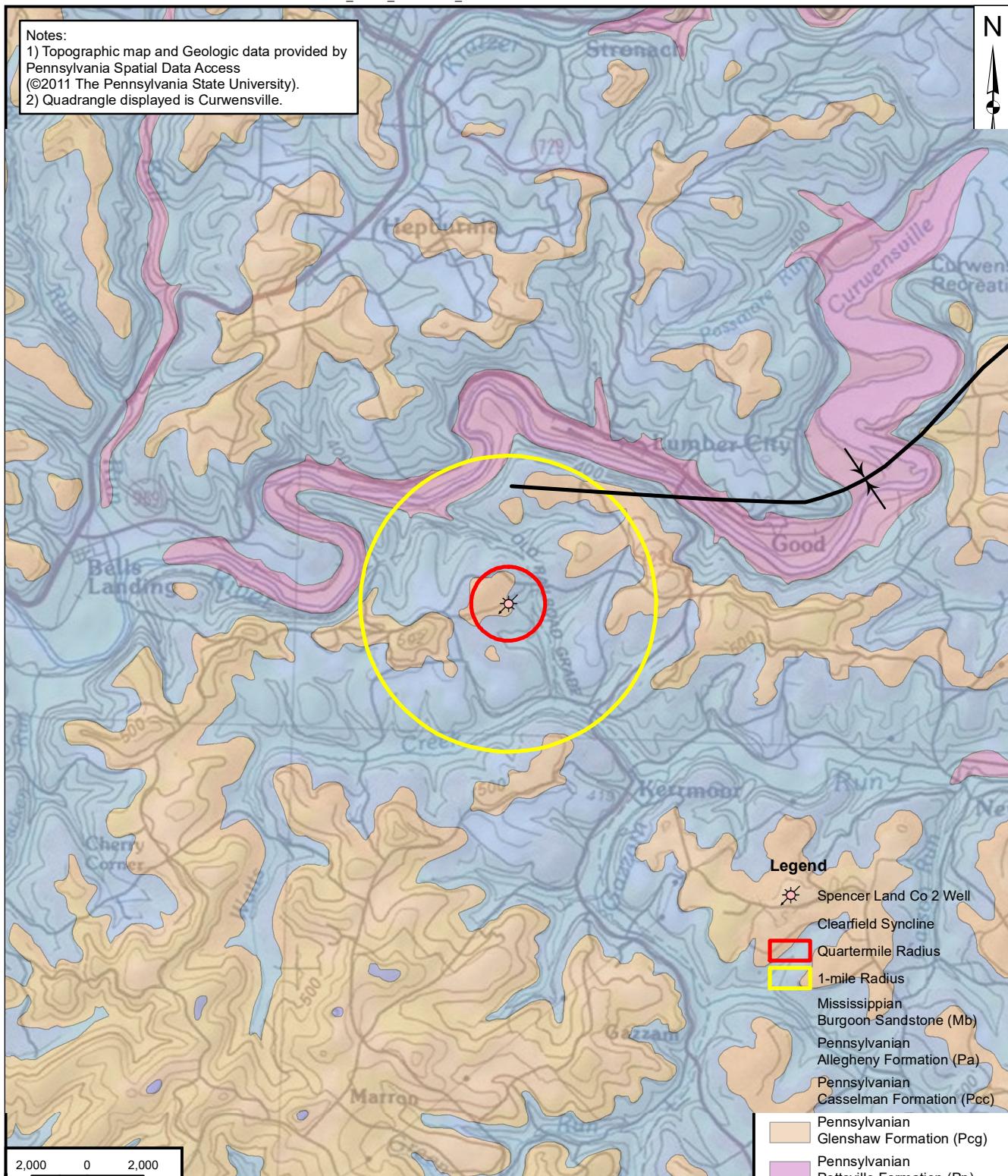
in a likely overall under-pressured condition in the area further decreasing the risk of induced seismicity.

***“Further, history of past, as well as currently active, injection for disposal and enhanced recovery wells (as opposed to production wells) into a formation without induced seismicity is also supporting evidence that seismicity is unlikely, either because no faults are present or because increases in formation pore pressure due to injection have not caused sufficient pressure changes for movement to occur along the fault.”*** The Spencer #2 operated from 1988 to 2012 without any induced seismicity occurring in the well area.

***“Finally, to minimize conduits for fluid to potentially contaminate underground sources of drinking water (USDWs), operating conditions in an injection well permit can expressly limit the injection pressure to prevent fracturing (or cracking of the rock) of the injection zone. Limiting injection pressure provides the secondary benefit of preventing fractures that also could act as conduits through which fluid could flow and act upon an existing fault.”*** The proposed MAIP is below the breakdown pressure of the Tiona Sandstone, therefore, fracturing of the formation will not occur.

In summary, the potential risk of significant induced seismicity resulting from continuing operations at the Spencer #2 is considered extremely low.

**GEOLOGIC DATA FIGURES**  
**GEOLOGIC MAP**  
**GENERALIZED STRATIGRAPHIC COLUMN**  
**SEISMIC HAZARDS MAP**  
**COMPENSATED DENSITY/NEUTRON POROSITY LOG**



 <b>TETRA TECH</b>	<b>GEOLOGIC MAP</b> <b>SPENCER LAND COMPANY #2</b>  <b>EXCO RESOURCES INC.</b> <b>CLEARFIELD COUNTY, PENNSYLVANIA</b>	DRAWN BY: T. TEAFORD 03/22/19 CHECKED BY: J. MARLOW 03/22/19 APPROVED BY: CONTRACT NUMBER: 212C-PB-01103
	FIGURE NUMBER	4 REV 0

**Figure 5**  
**Generalized Stratigraphic Column**  
**Spencer Land Development Company #2**  
**Clearfield County, PA**

	Group	Formation	Predominant Rock Type	Total Depth to Base(Feet)	Thickness Feet	Confining Zone
Missippian / Pennsylvanian			Predominantly Shale with Occassional Sandstone and Coal	700*	700*	
Upper Devonian			Predominantly Shale	1700	1000	
	Bradford	Various Sandstone Reservoirs including 5th, Bayard Stray, Bayard and Warren Sandstones	Alternating Sandstones and Shales	2600	900	
	Bradford	Tiona	Sandstone	2620	20	

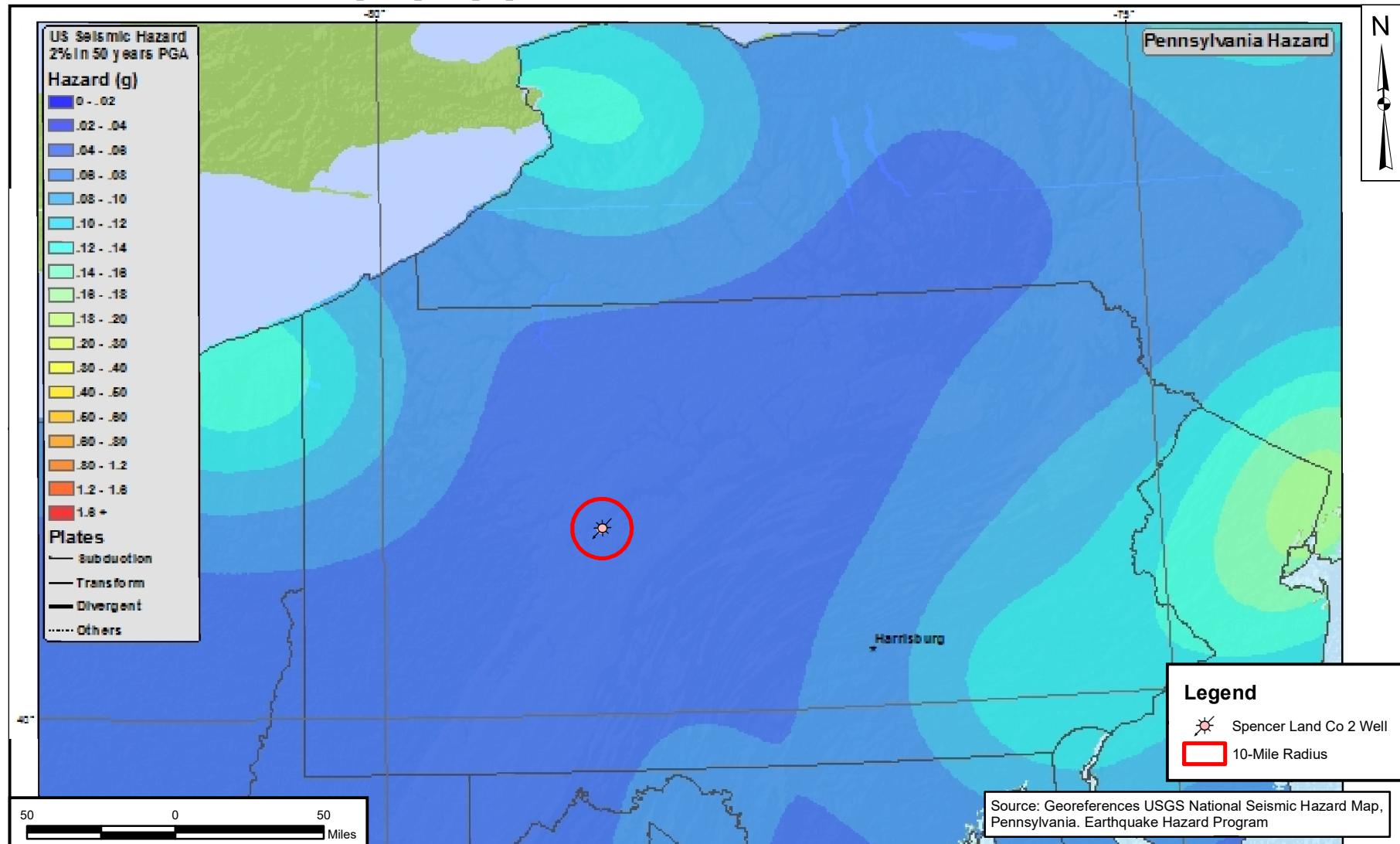
Notes:

\* Geophysical log info not available to pick contact between Missippian/Pennsylvanian and Upper Devonian rocks.

 = Interval is considered to be a confining zone

 = Interval is a confining zone that also contains producing zones within it

 = No shading indicates that this interval is a producing zone and is not considered to be a confining zone



TETRA TECH

USGS SEISMIC HAZARDS MAP FOR PENNSYLVANIA

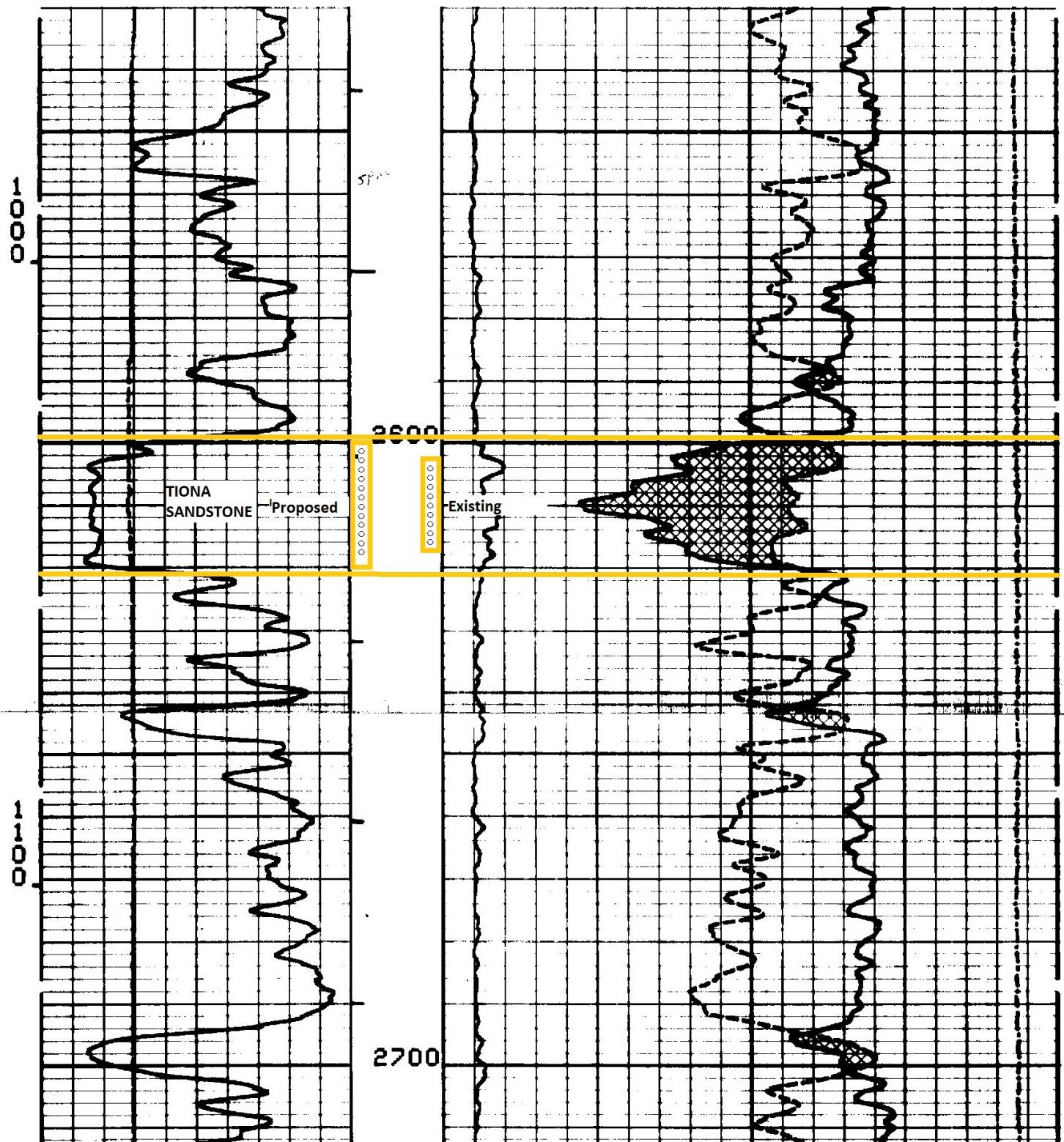
EXCO RESOURCES INC  
CLEARFIELD COUNTY, PENNSYLVANIA

DRAWN BY: T. TEAFORD 02/12/19  
CHECKED BY: J. MARLOW 03/22/19  
APPROVED BY:

CONTRACT NUMBER: 212C-PB-01103

FIGURE NUMBER	REV
6	0

FIGURE 7  
EXCO RESOURCES, LLC  
SPENCER LAND COMPANY #2  
GAMMA RAY /COMPENSATED DENSITY/NEUTRON POROSITY LOG



## **SECTION 6.0 OPERATING DATA**

## 6.0 OPERATING DATA

As mentioned above, EXCO has not operated the Spencer #2 facility since 2012. Upon obtaining the UIC Class IID well permit renewal, EXCO proposes to operate the facility as summarized in this section.

### **Injected Fluid**

EXCO proposes to inject flowback and produced water generated from its own and Dominion Resources oil and gas related operations (as approved in the recently expired permit). Other oil and gas related wastewaters associated with the production of oil and natural gas or natural gas storage operations, which are approved by EPA for injection under a UIC Class II D injection well, may also be injected. According to Title 40 Chapter I Sec. 144.6 (b)(1), such fluids include those “Which are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.”

EXCO anticipates that the Specific Gravity of the injected fluid to be 1.15 based on testing of fluids injected at the EXCO Irvin 1-A UIC Class IID well which is also located in Clearfield County, PA.

Attached are laboratory analytical results for brine which was injected into the EXCO Irvin 1-A UIC well. This sample is considered representative of the types of brine which will be injected into the Spencer #2.

### **Injection Rate**

The permitted injection rate for the Spencer #2 is 9,000 bbls/mo. EXCO is requesting an increase in rate to 15,000 bbls/mo. The proposed increased rate was utilized in the ZOE modeling conducted to determine the AOR (discussed in Attachment A). EXCO plans to add perforations to further enhance the ability of the Tiona Sandstone to take an increased rate while staying below the MAIP. The average and maximum daily injection rate are anticipated to be 400 and 500 bbls/d, respectively.

### **Maximum Allowable Surface Injection Pressure (MASIP) and Average Surface Injection Pressure**

Maximum Allowable Injection Pressure (MAIP)(Surface) calculations based on EPA-approved equations are attached. The calculations were based on information from the 7/12/1989 Haliburton acid job and formation testing, which had an ISIP of 1750 psi and resulted in a Frac Gradient of 1.106. Brine was used for the formation testing. A SG of 1.0 was used for the brine used during the test to be conservative since the actual SG of the brine was not reported. The

calculated MAIP (Surface) is 1581 psi, which is 130 psi higher than the current permit limit of 1450 psi. A copy of the Daily Report for July 12, 1989 referencing the formation test on the Tiona Sandstone and 1750 ISIP is attached.

### **Monitoring of Injection Fluid Samples and Well**

The following identifies the UIC Class II underground injection well regulatory requirements and operational procedures which will be conducted to meet the subject requirements:

1. **Monitoring of the nature of injected fluids at time intervals sufficiently frequent to yield data representative of their characteristics.** An initial sample of fluid will be collected and analyzed from initial loads proposed for disposal from new formations / areas. In addition, samples will be collected for analysis from new types of sources (e.g., from different geologic formations, geographic regions, etc.) which would be expected to differ significantly from brine previously characterized for disposal at the facility. Samples will be analyzed for the following parameters at a minimum: specific gravity, total dissolved solids and pH.
2. **Observation of injection pressure, flow rate, and cumulative volume at least weekly based on the regulatory requirements for produced fluid disposal operations.** Injection pressures, annular pressure, injection rate, and cumulative volume will be continuously monitored and recorded electronically.
3. **A demonstration of mechanical integrity pursuant to 40 CFR Sec. 146.8 during the life of the injection well.** A mechanical integrity test will be performed prior to initiating injection and at least once every five years. Results of the MIT conducted on April 15, 2019 and witnessed by a USEPA representative is attached. As indicated, the well passed the subject test.
4. **Maintenance of the results of all monitoring until the next permit review.** All monitoring records will be maintained throughout the life of the well.

### **Reporting Requirements**

An annual report will be submitted to EPA summarizing the results of the required monitoring, including monthly records of injected fluids, and any major changes in characteristics or sources of injected fluid.

### **Proposed Annulus Fluid**

The proposed annulus fluid for the injection well will consist of fresh water mixed with Multi-Chem's MC MX 6-2960 Corrosion Inhibitor at 2% by volume of the annular capacity. The corrosion inhibitor will be mixed in accordance with the manufacturer's recommendations then loaded into the well annulus prior to conducting injection operations. Product information for the

above-referenced corrosion inhibitor is attached. A similar type product may be used instead of the example product referenced.

## **Facility Layout and Operation**

The attached facility layout schematic shows the following elements of the existing EXCO Spencer #2 brine disposal well facility.

- Storage Tanks in Earthen Diked Containment System
  - One fiberglass gun barrel tank (200 bbls);
  - Two “Dirty Water” (Sediment Settling) poly tanks (250 bbls each);
  - One steel oil storage tank (210 bbls);
  - One Clean Water poly tank (250 bbls);
- Building housing the injection pump, bag filter system and generator
- Associated piping

Produced water will arrive on location via truck and pumped into a gun barrel tank for any oil/water separation, with water then fed to water tanks for additional sediment settling (“dirty water” tanks). From the settling tanks the water is pumped thru bag filters and into a clean water tank. The water is then pumped from the clean water tank to the Spencer UIC well and down hole.

**OPERATING DATA**

**MAIP CALCULATON**

**Maximum Injection Pressure (MIP) Calculations for**  
EXCO Spencer Land Company #2 (Clearfield County, PA)  
Tiona Sand

**1) Frac Gradient (FG)**

$$FG = [ISIP + (0.433 \times SG \times D)] / D$$

Where:

ISIP = 1750 psi - From Daily Report for 7/12/1989 after acid job and formation testing

SG = 1.0 (frac fluid) - Brine used in Formation Test; 1.0 Used to be conservative since SG of brine used is unknown

D = 2599 ft - Top of injection interval as referenced in the USEPA UIC Well Permit and geophysical log

	Hydrostatic Factor (psi/ft)	SG	D (ft)	Fracture Gradient (psi/ft)
ISIP (psi) 1750	0.433	1	2599	1.106

**2) Maximum Injection Pressure (MIP) Calculation**

$$MIP = [FG - (0.433 \times SG)] \times D$$

SG = 1.15 (brine) - Est. for brine for injection

D= 2599 ft

	Hydrostatic Factor (psi/ft)	SG	D (ft)	Fracture Gradient (psi/ft)	MIP (Surface)
-	0.433	1.15	2599	1.106	1581

**OPERATING DATA**

**DAILY REPORT ON HALIBURTON FORMATION TESTING (7/12/1989)**

=====

SPENCER LAND CO. #2 - SWD	8248
LUMBER CITY, CLEARFIELD CO., PA	07/12/89
AFE N/A	TODAY \$2,200
	TOTAL \$2,200

OART: Facility in operation.

1-1/2 hrs MIRU Halliburton. Tst lines to 3000 psi. Pump 500 gals 15% FE-NE-HCl acid & drop 20 perf balls (7/8"). Pump 500 gals 15% MOD 202 acid. Additives 2 gals HAI-65 inhibitor & PEN-88. Pump @ 3 BPM. Avg press 2150. Pump 18 bbls brine. SD, reld balls. Wait 15 min. Pump 23 bbls brine @ 3-1/2 BPM. Avg press 2150. SD. ISIP 1750. 3 min SIP 900. RD&MO Halliburton.

1/2 hr Prep well for injection on vacuum & to monitor inj rate. SD oper till 7am 7-12-89. Inj rate prior to acid job 52-53 bbls/day. Inj rate after acid treatment 75 bbls/day. Will monitor & report inj rate for 24 hr period on 7-13-89.

SUPERVISOR: J. Davis

=====

SPENCER LAND CO. #2 - SWD	8248
LUMBER CITY, CLEARFIELD CO., PA	07/13/89
AFE N/A	TODAY \$0
	TOTAL \$2,200

OART: Injecting brine by vacuum @ rate of 75 bbls/day. Increase in disposal rate by 22 bbls/day. FINAL REPORT.

SUPERVISOR: J. Davis

**OPERATING DATA**

**FACILITY LAYOUT**

AS-BUILT PLAN  
OF  
SPENCER SWD

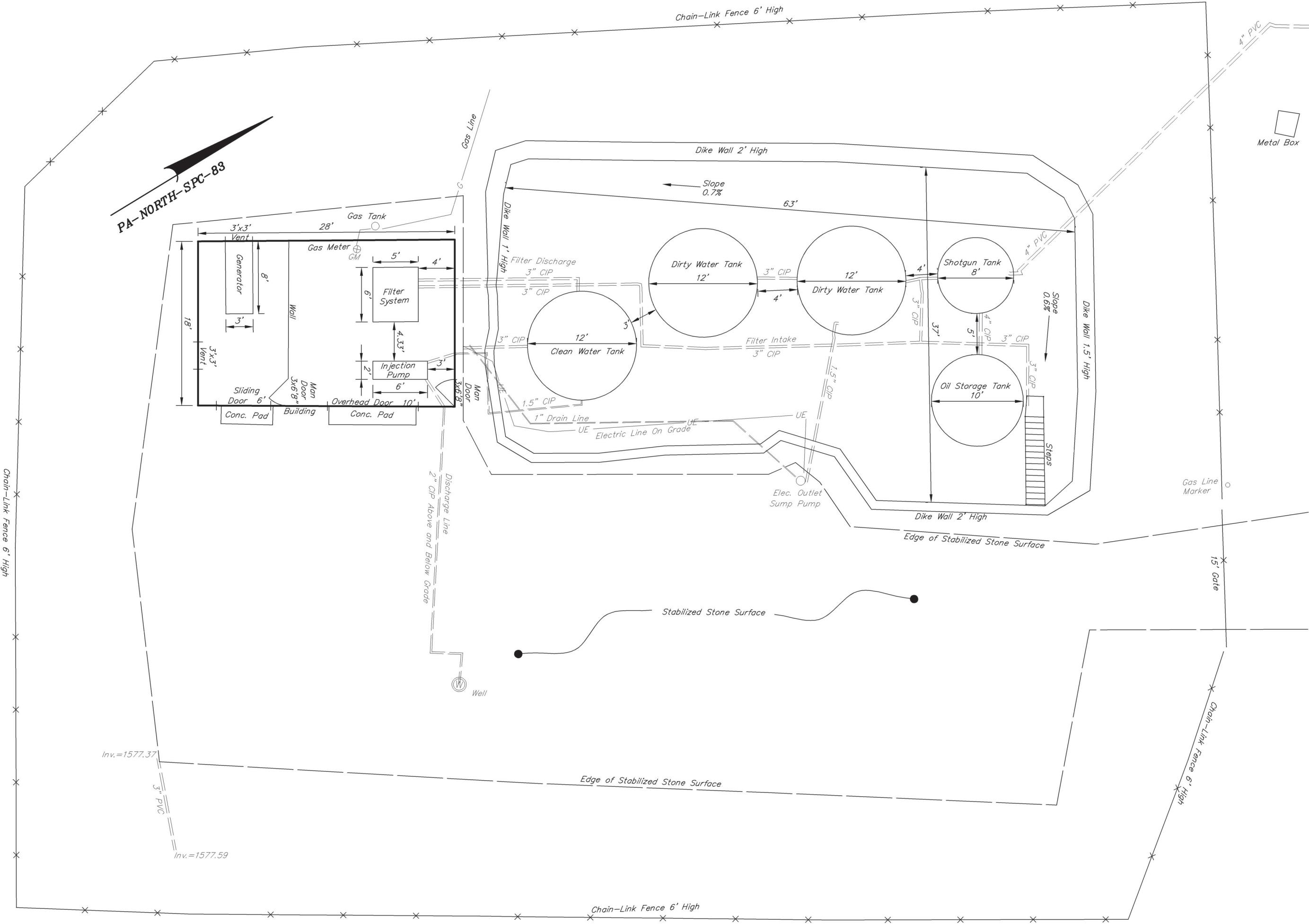
W  
E  
B  
M  
I  
T

**RETTEW Associates, Inc.**  
130 Court Street, Suite 200, Williamsport, PA 17701  
Phone (570) 320-1708 Fax (570) 326-4939  
Engineers • Planners • Surveyors • Landscape Architects

---

Engineers • Planners • Surveyors • Landscape Architects  
Environmental Consultants

DRAWN BY: JES  
DATE: 02-14-12  
SCALE: 1''=10'  
DWG. NO. 088602021



**OPERATING DATA**  
**BRINE ANALYSIS**



551 State Street  
Curwensville, PA 16833

Phone: 1-814-236-3540  
Fax: 1-877-267-4152

[www.mahaffeylaboratory.com](http://www.mahaffeylaboratory.com)

## Certificate of Analysis

Russ Lawrence  
Exco Resources

Project	Irvin	Lab Sample No.	19010422-001
Description		Client Sample ID	Irvin 19
		Matrix	Brine
		Date Received	01/14/19 09:40
		Date Sampled	01/14/2019 08:30
		Date Reported	1/21/2019

Test	Method	Result	RL	MDL	Units	Analyst	Prep Date	Test Date	Qlf.
<u>.Main Analytical</u>									
Alkalinity	SM 2320B	21	NA		mg CaCO <sub>3</sub> /L	BC	Not Required	01/15/19	
Chloride	SM 4110B	154745.0	2500.0	0.716	mg/L	DMM	Not Required	01/15/19	R44,R5n
pH	SM 4500-H+B	5.3	NA		pH Units @ 25C	BC	Not Required	01/15/19	pH1
Specific Conductance	SM 2510B	416000	0		uS/cm	DMM	Not Required	01/14/19	R44
Total Dissolved Solids - WW	USGS I-1750-85	318000	500		mg/L	KM	Not Required	01/15/19	R44,R53
<u>.Wet Chemistry</u>									
Hydrogen Sulfide	SM 4500-S2 C&D	3.03	0.5		mg/L	PG	Not Required	01/18/19	R44
Dissolved Oxygen	SM 4500 OG	3	NA		mg/L	BC	Not Required	01/16/19	H1a
<u>Test</u>									
<u>GC TOC</u>									
TOC - Waste Water	SM 5310 C-11	283	50.0	25.8	mg/l	Sub-FL	01/17/19 15:16	01/18/19 18:26	FL-K
<u>Test</u>									
<u>Metals ICP 200.7</u>									
Total Hardness	SM 2340B-97 / Calculation	2557.3	40.0		gpg	DW	Not Required	01/18/19	R44
Barium	EPA 200.7	6026.00	40.00	0.00251	mg/L	DW	Not Required	01/18/19	R44
Calcium	EPA 200.7	15737.00	40.00	0.0160	mg/L	DW	Not Required	01/18/19	R44



551 State Street  
Curwensville, PA 16833

Phone: 1-814-236-3540  
Fax: 1-877-267-4152

[www.mahaffeylaboratory.com](http://www.mahaffeylaboratory.com)

## Certificate of Analysis

Russ Lawrence  
Exco Resources

Project	Irvin	Lab Sample No.	19010422-001
Description		Client Sample ID	Irvin 19
		Matrix	Brine
		Date Received	01/14/19 09:40
		Date Sampled	01/14/2019 08:30
		Date Reported	1/21/2019

Test	Method	Result	RL	MDL	Units	Analyst	Prep Date	Test Date	Qlf.
<b>Metals ICP 200.7</b>									
Iron	EPA 200.7	84.20	2.00	0.0038	mg/L	DW	Not Required	01/18/19	R44
Magnesium	EPA 200.7	1077.00	4.00	0.0035	mg/L	DW	Not Required	01/18/19	R44
Manganese	EPA 200.7	10.50	0.80	0.00070	mg/L	DW	Not Required	01/18/19	R44
Sodium	EPA 200.7	36692.00	80.00	0.0407	mg/L	DW	Not Required	01/18/19	R44
<b>Test</b>									
<b>Other</b>									
Specific Gravity	CALC	1.10	NA			JL	Not Required	01/14/19	H7

### Qualifiers

FL-K = The RPD result exceeded the quality control limits for the duplicate, Laboratory Control Sample Duplicate (LCSD) or Matrix Spike Duplicate (MSD) sample analyzed with the preparation batch.  
H1a = Sample analyzed past holding time.  
H7 = Laboratory does not maintain accreditation for this method.  
pH1 = Analyzed past hold time of 15 minutes.  
R44 = Sample required dilution.  
R53 = Due to the high concentration, the result is an estimate.  
R5n = Sample spike failed.

Approved By



Carlton R. McCracken, Jr. Chemist

FL - PA DEP Lab Id# 07-00062



# Chain of Custody Receiving Document

Receiver: ZMB  
Date/Time of check: 1/14/19 0940  
Client: Exco  
Date Sampled: 1/14/19  
Lab #: 19010422

Were The Samples Received On ICE?

Yes

No

Receiving Temperature: 32

COC/Labels On Bottles Agree?

Yes

No

If No, Please Explain. \_\_\_\_\_

Is/Are The Samples Properly Preserved?

Yes

No

If No, Please Explain. \_\_\_\_\_

Were Any Of The Samples Out Of Hold?

Yes

No

If Yes, Please Explain. \_\_\_\_\_

Were Any Of The Samples Damaged?

Yes

No

If Yes, Please Explain. \_\_\_\_\_

Method Of Delivery:

UPS

FedEx

US Mail

Lab Courier

Client

Other

Does Client Need To Be Contacted, Why? \_\_\_\_\_

Client Contacted By: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Name Of Client Contacted: \_\_\_\_\_

Discussion/Outcome: \_\_\_\_\_

**OPERATING DATA**  
**MECHANICAL INTEGRITY TESTING (MIT) RESULTS**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

UNDERGROUND INJECTION CONTROL PROGRAM

NOTICE OF INSPECTION

DATE: 4/15/2019

HOUR: 9:00

COMPANY NAME: EXCO RESOURCES (PA), LLC  
ADDRESS: 280 EXECUTIVE DRIVE.  
CRANBERRY TOWNSHIP, PA 00000

INSPECTOR NAME: DAVE RECTENWALD

INSPECTOR TITLE: Environmental Scientist

INSPECTOR SIGNATURE: Dave Rectenwald

NOTICE OF INSPECTION IS HEREBY GIVEN ACCORDING TO SECTION 1445 (b) OF THE  
SAFE DRINKING WATER ACT (42 U.S.C. 300 f et seq.)

REASON FOR INSPECTION:

For the purpose of inspecting records, files, papers, processes, controls and facilities, and/or obtaining samples to determine whether the person subject to an applicable underground injection control program has acted or is acting in compliance with the Safe Drinking Water (SDWA) and the Resource Conservation and Recovery Acts (RCRA) and any applicable permit or rule.

Section 1445 (b)(l) of the SDWA and RCRA \*3007 (a) are quoted on the reverse side of this form.

# Mechanical Integrity Test

## Tubing/Casing Annulus Pressure Test

U.S. Environmental Protection Agency  
Underground Injection Control Program  
1650 Arch Street, Philadelphia, Pa 19103-2029

EPA Witness: DAVID RECHENWALD Date: 4/15/2019

Test conducted by: Joe Smathers

Others present: \_\_\_\_\_

Facility ID: PAS2D902BCLE

Well Name: 37-033-22059 - Spencer Land Co Type: ER SWD Status: AC  TA  UC  
Field: \_\_\_\_\_

Location: 40° 54' 38.9" -78° 35' 54.7"

Operator: G.SHAWN MEENIHAN / REGULATORY ANALYST (724)720-2500

Last MIT: 3/7/2017 - Casing | Tubing Pressure Test Maximum Allowable Pressure: 1,450.00 PSIG

Regularly scheduled test?  Yes  No

Initial test for permit?  Yes  No

Test after well rework?  Yes  No

Well injecting during test? If Yes, rate: No bpd  
Pre-test annulus pressure: 25 psig

MIT DATA TABLE	Test #1	Test #2	Test #3
<b>TUBING</b>		<b>PRESSURE RECORD</b>	
Initial Pressure	○ psig	psig	psig
End of test pressure	○ psig	psig	psig
<b>CASING/TUBING ANNULUS</b>		<b>PRESSURE RECORD</b>	
12:51	0 minutes	526.4 psig	psig
	5 minutes	psig	psig
	10 minutes	psig	psig
	15 minutes	psig	psig
	20 minutes	psig	psig
	25 minutes	psig	psig
1:21	30 minutes	523.8 psig	psig
	_____ minutes	psig	psig
	_____ minutes	psig	psig
<b>RESULT</b>		<input checked="" type="checkbox"/> Pass	[ ] Fail
<b> </b>		[ ] Pass	[ ] Fail
<b> </b>		[ ] Pass	[ ] Fail

Spencer Land Company

Initial Test Pressure 526.4

Initial Test Pressure x .05 - 26.3

Results = 500.1

The Well passes Mechanical Integrity, if the final test pressure exceeds the result calculated above

Test result: Passed  Failed

# MECHANICAL INTEGRITY PRESSURE TEST

Additional comments for mechanical integrity pressure test, such as volume of fluid added to annulus and bled back at end of test, reason for failing test (casing head leak, tubing leak, other), etc.:

Signature of Witness: Dal Rector

**OFFICE USE ONLY - COMPLIANCE FOLLOWUP**

Staff \_\_\_\_\_ Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Do you agree with the reported test results? [ ] YES [ ] NO

If not, why?

Possible violation identified? [ ] YES [ ] NO

If YES, what

If YES - followup initiated? [ ] YES

[. . .] NO - why not?

# Mechanical Integrity Test

## Tubing/Casing Annulus Pressure Test

U.S. Environmental Protection Agency  
Underground Injection Control Program  
1650 Arch Street, Philadelphia, Pa 19103-2029

EPA Witness: DAVIN RECTENWALD Date: 4/15/2019

Test conducted by: JOSEPH SMATHERS

Others present: \_\_\_\_\_

Facility ID: PAS2D205BCLE

Well Name: 37-033-00053 - IRVIN A-19 Type: ER SWD Status: AC TA UC

Field: \_\_\_\_\_

Location: 40° 58' 24.4" -78° 46' 18.3"

Operator: G. SHAWN MEENIHAN / REGULATORY ANALYST (724)720-2500

Last MIT: 3/13/2018 - Casing | Tubing Pressure Test Maximum Allowable Pressure: 3,050.00 PSIG

Regularly scheduled test?  Yes  No

Initial test for permit?  Yes  No

Test after well rework?  Yes  No

Well injecting during test? If Yes, rate: NO bpd

Pre-test annulus pressure: 450 psig

MIT DATA TABLE		Test #1	Test #2	Test #3
<b>TUBING</b>				<b>PRESSURE RECORD</b>
Initial Pressure	2441	psig	psig	psig
End of test pressure	2440	psig	psig	psig
<b>CASING/TUBING ANNULUS</b>				<b>PRESSURE RECORD</b>
10:21 0 minutes	2951.2	psig	psig	psig
5 minutes		psig	psig	psig
10 minutes		psig	psig	psig
15 minutes		psig	psig	psig
20 minutes		psig	psig	psig
25 minutes		psig	psig	psig
10:51 30 minutes	2943.3	psig	psig	psig
minutes		psig	psig	psig
minutes		psig	psig	psig
RESULT	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
				<input type="checkbox"/> Pass
				<input type="checkbox"/> Fail

IRVIN A-19

Initial Test Pressure 2951.2

Initial Test Pressure x .05 - 147.56

Results = 2803.64

The Well passes Mechanical Integrity, if the final test pressure exceeds the result calculated above

Test result: Passed    Failed

# MECHANICAL INTEGRITY PRESSURE TEST

Additional comments for mechanical integrity pressure test, such as volume of fluid added to annulus and bled back at end of test, reason for failing test (casing head leak, tubing leak, other), etc.:

Signature of Witness: D. J. Reeder

**OFFICE USE ONLY - COMPLIANCE FOLLOWUP**

Staff \_\_\_\_\_ Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Do you agree with the reported test results? [ ] YES [ ] NO

If not, why?

Possible violation identified? [ ] YES [ ] NO

If YES, what

If YES - followup initiated? [ ] YES

[ ] NO - why not?

**OPERATING DATA**

**ANNULUS FLUID - CORROSION INHIBITOR**

## MC MX 6-2960 Corrosion Inhibitor

Water Soluble

### Product Description

MC MX 6-2960 is a quaternary amine designed to protect the annular space as a packer fluid inhibitor. This product is also an excellent inhibitor to control corrosion in pipelines and surface equipment. It works well in water and carbon dioxide rich transmission lines and contains an oxygen scavenger to control oxygen corrosion. Formulations are dispersible to completely soluble in all brines including those normally found in the oilfield as well as saturated salt water, sea water and calcium chloride brines.

### Usage and Application

For application of MC MX 6-2960 as a packer fluid inhibitor, general treatment rates range from 0.5% to 2.0% (5,000 to 20,000 ppm). For flooding and hydro testing application, 1000 ppm is generally sufficient. The treatment rate required for specific applications will vary based on the aggressiveness of the fluid and the harshness of the environment. A Multi-Chem technical specialist should be consulted to optimize the total treatment package.

### Features and Benefits

- Provides protection against corrosion caused by various dissolved gasses including carbon dioxide, oxygen and hydrogen sulfide
- Mitigates microbial induced corrosion
- Can be used in various corrosion inhibition applications including inhibition in water based fluids and during flooding and hydro testing procedures

### Typical Physical Properties

Clarity:	Clear - Slightly Hazy
Color:	Light - Dark Amber
Physical State:	Liquid
Density, 60° F:	8.53 - 8.74 lbs./gal
pH (10% in 1:1/IPA:H <sub>2</sub> O):	5.0 - 7.0
Flashpoint, SFCC:	156°F
Lowest Usable Temp:	10°F

### Solubility

Aromatic	Dispersible
Kerosene	Dispersible
Water	Soluble
Brine (15% NaCl)	Dispersible
Acid (15% HCl)	Soluble

### Shipping and Handling

#### Available in the following containers:

55 Gallon Drum  
Bulk

Before handling, storage, or use, consult the Material Safety Data Sheet (MSDS) for details.

### Dial For Emergencies

+1 (866) 519-4752 (USA, Canada, Mexico)  
+1 (760) 476-3962

## SAFETY DATA SHEET

**Product Trade Name:** MC MX 6-2960

**Revision Date:** 18-Jul-2016

**Revision Number:** 4

### 1. Identification

#### 1.1. Product Identifier

**Product Trade Name:** MC MX 6-2960  
**Synonyms** None  
**Chemical Family:** Blend  
**Internal ID Code** MC001977

#### 1.2 Recommended use and restrictions on use

**Application:** Corrosion Inhibitor  
**Uses advised against** Consumer use

#### 1.3 Manufacturer's Name and Contact Details

**Manufacturer/Supplier**  
Multi-Chem Group LLC  
3000 N. Sam Houston Pkwy E., Houston, TX 77032  
Phone: 1 281 871 4000

Halliburton Energy Services, Inc.  
645 - 7th Ave SW Suite 1800  
Calgary, AB  
T2P 4G8  
Canada

**Prepared By** Chemical Stewardship  
Telephone: 1-281-871-6107  
e-mail: fdunexchem@halliburton.com

#### 1.4. Emergency telephone number

**Emergency Telephone Number:** 1-866-519-4752 or 1-760-476-3962  
Global Incident Response Access Code: 334305  
Contract Number: 14012

### 2. Hazards Identification

#### 2.1 Classification in accordance with paragraph (d) of §1910.1200

Skin Corrosion / Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Skin Sensitization	Category 1 - H317
Reproductive Toxicity	Category 1B - H360
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372
Acute Aquatic Toxicity	Category 1 - H400
Chronic Aquatic Toxicity	Category 2 - H411

Flammable liquids.

Category 4 - H227

## 2.2. Label Elements

### Hazard Pictograms

**Signal Word:**

Danger

**Hazard Statements**

H227 - Combustible liquid  
 H314 - Causes severe skin burns and eye damage  
 H317 - May cause an allergic skin reaction  
 H318 - Causes serious eye damage  
 H360 - May damage fertility or the unborn child  
 H372 - Causes damage to organs through prolonged or repeated exposure  
 H400 - Very toxic to aquatic life  
 H411 - Toxic to aquatic life with long lasting effects

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P272 - Contaminated work clothing should not be allowed out of the workplace  
 P273 - Avoid release to the environment  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection

**Response**

P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P302 + P352 - IF ON SKIN: Wash with plenty of soap and water  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower  
 P363 - Wash contaminated clothing before reuse  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P370 + P378 - In case of fire: Use CO<sub>2</sub>, dry chemical, or foam  
 P391 - Collect spillage

**Storage**

P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

## 2.3 Hazards not otherwise classified

None known

## 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - US
Ethylene glycol	107-21-1	5 - 10%	Acute Tox. 4 (H302) STOT RE 1 (H372)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	1 - 5%	Acute Tox. 4 (H302) Acute Tox. 3 (H311) Skin Corr. 1B (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410)
Pyridinium Salt	Proprietary	1 - 5%	Acute Tox. 4 (H302) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Skin Sens. 1 (H317) Aquatic Acute 2 (H401) Flam. Liq. 4 (H227)
Ammonium bisulfite	10192-30-0	1 - 5%	Eye Irrit. 2A (H319) STOT SE 3 (H335) Aquatic Acute 3 (H402)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	1 - 5%	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) Aquatic Acute 1 (H400)
Complex Phosphate Ester Compounds	Proprietary	1 - 5%	Skin Corr. 1 (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) Aquatic Acute 1 (H400) Aquatic Chronic 2 (H411)
Complex Amine Compound	Proprietary	1 - 5%	Acute Tox. 4 (H302) Eye Irrit. 2 (H319)
Isopropanol	67-63-0	1 - 5%	Eye Irrit. 2 (H319) STOT SE 3 (H336) Flam. Liq. 2 (H225)
2-Mercaptoethanol	60-24-2	1 - 5%	Acute Tox. 3 (H301) Acute Tox. 2 (H310) Acute Tox. 2 (H330) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Skin Sens. 1 (H317) STOT SE 3 (H335) STOT RE 2 (H373) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410) Flam. Liq. 4 (H227)
Methanol	67-56-1	0.1 - 1%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Repr. 1B (H360) STOT SE 1 (H370) Flam. Liq. 2 (H225)
Diethylenetriamine	111-40-0	0.1 - 1%	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Acute Tox. 2 (H330) Skin Corr. 1B (H314) Eye Corr. 1 (H318) Skin Sens. 1 (H317) STOT SE 2 (H371) STOT SE 3 (H335) Aquatic Acute 3 (H402)
Triethylenetetraamine	112-24-3	0.1 - 1%	Acute Tox. 3 (H311) Skin Corr. 1B (H314)

			Eye Corr. 1 (H318) Skin Sens. 1 (H317) STOT SE 3 (H335) Aquatic Acute 2 (H401) Aquatic Chronic 2 (H411)
--	--	--	---

The specific chemical identity of the composition has been withheld as proprietary. The exact percentage (concentration) of the composition has been withheld as proprietary.

## 4. First Aid Measures

### 4.1. Description of first aid measures

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Following ingestion, onset of symptoms may be delayed by 12 to 24 hours. Admission to hospital should be the first priority even if symptoms are absent.

### 4.2 Most important symptoms/effects, acute and delayed

Causes severe skin irritation with tissue destruction. Causes severe eye irritation which may damage tissue. May cause allergic skin reaction. Potential reproductive hazard. May cause birth defects. May cause damage to organs through prolonged or repeated exposure.

### 4.3. Indication of any immediate medical attention and special treatment needed

<b>Notes to Physician</b>	Gastric lavage or emesis should be performed as soon as possible to minimize absorption, and is recommended within 4 hours of ingestion. Ethanol may be given intravenously to prevent build-up of toxic effects of methanol metabolites. Visual disturbances and metabolic acidosis may occur and dialysis, preferably hemodialysis may be employed to treat these complications.
---------------------------	--

## 5. Fire-fighting measures

### 5.1. Extinguishing media

#### Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

#### Extinguishing media which must not be used for safety reasons

Do NOT spray pool fires directly with water. A solid stream of water directed into hot burning liquid can cause splattering.

### 5.2 Specific hazards arising from the substance or mixture

#### Special exposure hazards in a fire

Decomposition in fire may produce harmful gases.

### 5.3 Special protective equipment and precautions for fire-fighters

#### Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

## **6.1. Personal precautions, protective equipment and emergency procedures**

Ensure adequate ventilation. Use appropriate protective equipment. Do not breathe dust/fume/gas/mist/vapors/spray. Remove sources of ignition. Take precautionary measures against static discharges All equipment used when handling the product must be grounded Avoid contact with skin, eyes and clothing. See Section 8 for additional information

## **6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

## **6.3. Methods and material for containment and cleaning up**

Dike far ahead of liquid spill for later disposal. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers. Remove ignition sources and work with non-sparking tools.

## **7. Handling and storage**

### **7.1. Precautions for safe handling**

#### **Handling Precautions**

Do not breathe dust/fume/gas/mist/vapors/spray. Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Ground and bond containers when transferring from one container to another. Avoid contact with eyes, skin, or clothing.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### **7.2. Conditions for safe storage, including any incompatibilities**

#### **Storage Information**

Store in a cool well ventilated area. Keep from heat, sparks, and open flames.

## **8. Exposure Controls/Personal Protection**

### **8.1 Occupational Exposure Limits**

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA
Ethylene glycol	107-21-1	Not applicable	Not applicable
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable	Not applicable
Pyridinium Salt	Proprietary	Not applicable	Not applicable
Ammonium bisulfite	10192-30-0	Not applicable	Not applicable
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable	Not applicable
Complex Amine Compound	Proprietary	Not applicable	Not applicable
Isopropanol	67-63-0	TWA: 400 ppm TWA: 980 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 400 ppm
2-Mercaptoethanol	60-24-2	Not applicable	Not applicable
Methanol	67-56-1	TWA: 200 ppm TWA: 260 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 250 ppm
Diethylenetriamine	111-40-0	Not applicable	TWA: 1 ppm
Triethylenetetraamine	112-24-3	Not applicable	Not applicable

### **8.2 Appropriate engineering controls**

**Engineering Controls** Ensure adequate ventilation, especially in confined areas

### **8.3 Individual protection measures, such as personal protective equipment**

**Personal Protective Equipment** If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the

<b>Respiratory Protection</b>	specific application of this product. If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.
<b>Hand Protection</b>	Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
<b>Skin Protection</b>	Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.
<b>Eye Protection</b>	Safety glasses with side-shields. If splashes are likely to occur, wear: Goggles, Face-shield.
<b>Other Precautions</b>	Eyewash fountains and safety showers must be easily accessible.

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b> Liquid	<b>Color</b>	Clear to Slightly Hazy , Light Amber to Dark Amber
<b>Odor:</b> Pungent	<b>Odor Threshold:</b>	No information available
<b>Property</b>		<b>Values</b>
<b>Remarks/ - Method</b>		
<b>pH:</b>	5.0-7.0 (10% in 1:1 IPA:H <sub>2</sub> O)	
<b>Freezing Point / Range</b>	-12.2 °C / 10 °F	
<b>Melting Point / Range</b>	No data available	
<b>Boiling Point / Range</b>	No data available	
<b>Flash Point</b>	69.4 °C / 156.9 °F (SFCC)	
<b>Flammability (solid, gas)</b>	No data available	
Upper flammability limit	No data available	
Lower flammability limit	No data available	
<b>Evaporation rate</b>	No data available	
<b>Vapor Pressure</b>	No data available	
<b>Vapor Density</b>	No data available	
<b>Specific Gravity</b>	1.0236-1.0486 (20 °C/68 °F)	
<b>Water Solubility</b>	No data available	
<b>Solubility in other solvents</b>	No data available	
<b>Partition coefficient: n-octanol/water</b>	No data available	
<b>Autoignition Temperature</b>	No data available	
<b>Decomposition Temperature</b>	No data available	
<b>Viscosity</b>	No data available	
<b>Explosive Properties</b>	No information available	
<b>Oxidizing Properties</b>	No information available	

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
<b>Liquid Density</b>	8.53 - 8.74 lbs/gal

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Carbon oxides. Oxides of nitrogen.

**11. Toxicological Information****11.1 Information on likely routes of exposure****Principle Route of Exposure** Inhalation. Ingestion. Eye contact. Skin contact.**11.2 Symptoms related to the physical, chemical and toxicological characteristics****Acute Toxicity****Inhalation**

May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

**Eye Contact**

Causes serious eye damage.

**Skin Contact**

Causes severe burns. May cause an allergic skin reaction.

**Ingestion**

Ingestion of this product may cause blindness due to the presence of methanol. Causes burns of the mouth, throat and stomach.

**Chronic Effects/Carcinogenicity** May cause birth defects. Contains known or suspected reproductive toxins. Causes damage to organs through prolonged or repeated exposure.**11.3 Toxicity data****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylene glycol	107-21-1	4000 mg/kg (Rat) 7712 mg/kg (Rat) > 10000 mg/kg (Rat) 1670 mg/kg (Cat) 1400 – 1600 mg/kg (Human)	9530 µL/kg (Rabbit) > 3500 mg/kg (Mouse)	> 2.5 mg/L (Rat) 6h (saturated concentration)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	304.5 mg/kg (Rat)	930 mg/kg (rat)	No data available
Pyridinium Salt	Proprietary	1377 mg/kg bw (rat) (similar substance)	1000 mg/kg-bw (rabbit) (similar substance)	2.67 mg/L (rat, 4h, vapor) (similar substance)
Ammonium bisulfite	10192-30-0	11200 mg/kg 2610 mg/kg (Rat) (similar substance)	> 2000 mg/kg (Rat) (similar substance)	> 5.5 mg/L (Rat) 4h (similar substance)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No data available	No data available	No data available
Complex Phosphate Ester Compounds	Proprietary	> 2000 mg/kg < 5000 mg/kg (Rat) (similar substance)	No data available	No data available
Complex Amine Compound	Proprietary	1990 mg/kg (Rat) (similar substance)	> 5000 mg/kg (Rabbit) (similar substance)	> Saturated Vapors (Rat) 8h (similar substace)
Isopropanol	67-63-0	5840 mg/kg-bw (rat)	12870 mg/kg-bw (rabbit)	72.6 mg/L (Rat, 4h, vapor)

2-Mercaptoethanol	60-24-2	98 - 336 mg/kg (Rat)	112-251 mg/kg (Rabbit)	2 mg/L (Rat) 4h
Methanol	67-56-1	300 mg/kg-bw (human) < 790 to 13,000 mg/kg (rat)	1000 mg/kg-bw (human) 17,100 mg/kg (rabbit)	10 mg/L (human, 4h, vapor)
Diethylenetriamine	111-40-0	1553 mg/kg (Rat)	678 mg/kg (Rabbit)	0.07 mg/L (Rat, 4h, aerosol)
Triethylenetetraamine	112-24-3	2500 mg/kg (Rat)	550 mg/kg (Rabbit)	> Saturated concentration (Rat, 4h, vapour)

Substances	CAS Number	Skin corrosion/irritation
Ethylene glycol	107-21-1	Non-irritating to the skin (Rabbit)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Causes burns (Rabbit)
Pyridinium Salt		Skin, rabbit: Causes moderate skin irritation. (similar substances) Irritating to skin.
Ammonium bisulfite	10192-30-0	Not irritating to skin in rabbits.
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	May cause moderate skin irritation.
Complex Phosphate Ester Compounds		Causes severe skin irritation with tissue destruction.
Complex Amine Compound		Not irritating to skin in rabbits.
Isopropanol	67-63-0	Non-irritating to the skin (Rabbit)
2-Mercaptoethanol	60-24-2	Skin, rabbit: Causes moderate skin irritation.
Methanol	67-56-1	Non-irritating to the skin (Rabbit)
Diethylenetriamine	111-40-0	Corrosive to skin (Rabbit)
Triethylenetetraamine	112-24-3	Causes severe skin irritation with tissue destruction. (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Ethylene glycol	107-21-1	Non-irritating to the eye (Rabbit)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Causes eye burns (Rabbit)
Pyridinium Salt		Causes severe eye irritation (similar substances) Causes moderate eye irritation Eye, rabbit:
Ammonium bisulfite	10192-30-0	Eye, rabbit: Causes mild eye irritation. (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	May cause moderate eye irritation.
Complex Phosphate Ester Compounds		Causes severe eye irritation (Rabbit) (similar substances)
Complex Amine Compound		Eye, rabbit: Causes moderate eye irritation
Isopropanol	67-63-0	Causes moderate eye irritation (Rabbit)
2-Mercaptoethanol	60-24-2	Eye, rabbit: Causes severe eye irritation. Will damage tissue.
Methanol	67-56-1	Non-irritating to the eye (Rabbit)
Diethylenetriamine	111-40-0	Corrosive to eyes (Rabbit)
Triethylenetetraamine	112-24-3	Causes severe eye irritation which may damage tissue. (Rabbit)

Substances	CAS Number	Skin Sensitization
Ethylene glycol	107-21-1	Did not cause sensitization on laboratory animals (guinea pig) Patch test on human volunteers did not demonstrate sensitization properties
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Did not cause sensitization on laboratory animals (guinea pig)
Pyridinium Salt		May cause sensitization by skin contact (mouse) (similar substances)
Ammonium bisulfite	10192-30-0	Did not cause sensitization on laboratory animals (mouse) (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Complex Amine Compound		Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Isopropanol	67-63-0	Did not cause sensitization on laboratory animals (guinea pig)
2-Mercaptoethanol	60-24-2	Skin sensitizer in guinea pig.
Methanol	67-56-1	Did not cause sensitization on laboratory animals (guinea pig)
Diethylenetriamine	111-40-0	Skin sensitizer in guinea pig.
Triethylenetetraamine	112-24-3	Skin sensitizer in guinea pig.

Substances	CAS Number	Respiratory Sensitization

Ethylene glycol	107-21-1	No information available
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	No information available
Pyridinium Salt		No information available
Ammonium bisulfite	10192-30-0	No information available
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		No information available
Complex Amine Compound		No information available
Isopropanol	67-63-0	No information available
2-Mercaptoethanol	60-24-2	No information available
Methanol	67-56-1	No information available
Diethylenetriamine	111-40-0	No data of sufficient quality are available.
Triethylenetetraamine	112-24-3	No information available

Substances	CAS Number	Mutagenic Effects
Ethylene glycol	107-21-1	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Did not show mutagenic effects in animal experiments
Pyridinium Salt		While some in vitro tests were positive and/or equivocal, in vivo results were negative. (similar substances)
Ammonium bisulfite	10192-30-0	Did not show mutagenic effects in animal experiments (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		In vitro tests did not show mutagenic effects (similar substances)
Complex Amine Compound		In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects. (similar substances)
Isopropanol	67-63-0	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
2-Mercaptoethanol	60-24-2	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.
Methanol	67-56-1	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.
Diethylenetriamine	111-40-0	In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects.
Triethylenetetraamine	112-24-3	While some in vitro tests were positive and/or equivocal, in vivo results were negative.

Substances	CAS Number	Carcinogenic Effects
Ethylene glycol	107-21-1	Did not show carcinogenic effects in animal experiments
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Did not show carcinogenic effects in animal experiments
Pyridinium Salt		No information available
Ammonium bisulfite	10192-30-0	Did not show carcinogenic or teratogenic effects in animal experiments (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		Did not show carcinogenic effects in animal experiments (similar substances)
Complex Amine Compound		No information available
Isopropanol	67-63-0	Did not show carcinogenic effects in animal experiments
2-Mercaptoethanol	60-24-2	No information available
Methanol	67-56-1	No data of sufficient quality are available.
Diethylenetriamine	111-40-0	Did not show carcinogenic effects in animal experiments
Triethylenetetraamine	112-24-3	Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Ethylene glycol	107-21-1	Fetotoxic and teratogenic effects observed in experimental animals at concentrations that did not produce maternal toxicity.
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not a confirmed teratogen or embryotoxin.
Pyridinium Salt		Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal

		experiments. (similar substances)
Ammonium bisulfite	10192-30-0	Animal testing did not show any effects on fertility. (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		Not a confirmed teratogen or embryotoxin. (similar substances)
Complex Amine Compound		Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
Isopropanol	67-63-0	Animal testing did not show any effects on fertility.
2-Mercaptoethanol	60-24-2	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Methanol	67-56-1	Experiments have shown reproductive toxicity effects on laboratory animals
Diethylenetriamine	111-40-0	Did not show teratogenic effects in animal experiments.
Triethylenetetraamine	112-24-3	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.

<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Ethylene glycol	107-21-1	No significant toxicity observed in animal studies at concentration requiring classification.
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Causes moderate respiratory irritation.
Pyridinium Salt		No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Ammonium bisulfite	10192-30-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	May cause respiratory irritation.
Complex Phosphate Ester Compounds		May cause respiratory irritation. (similar substances)
Complex Amine Compound		No information available
Isopropanol	67-63-0	May cause headache, dizziness, and other central nervous system effects.
2-Mercaptoethanol	60-24-2	May cause respiratory irritation.
Methanol	67-56-1	May cause disorder and damage to the Central Nervous System (CNS)
Diethylenetriamine	111-40-0	May cause respiratory irritation. May cause disorder and damage to the (Liver) Kidney Respiratory system.
Triethylenetetraamine	112-24-3	May cause respiratory irritation.

<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Ethylene glycol	107-21-1	Causes damage to organs through prolonged or repeated exposure: Kidney
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	None under normal use conditions
Pyridinium Salt		No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Ammonium bisulfite	10192-30-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds		No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Complex Amine Compound		No significant toxicity observed in animal studies at concentration requiring classification.
Isopropanol	67-63-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
2-Mercaptoethanol	60-24-2	Causes damage to organs through prolonged or repeated exposure: (Liver) Heart
Methanol	67-56-1	No data of sufficient quality are available.
Diethylenetriamine	111-40-0	No significant toxicity observed in animal studies at concentration requiring classification.
Triethylenetetraamine	112-24-3	No significant toxicity observed in animal studies at concentration requiring classification.

<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Ethylene glycol	107-21-1	Not applicable
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	No information available
Pyridinium Salt		Not applicable
Ammonium bisulfite	10192-30-0	Not applicable

Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable
Complex Phosphate Ester Compounds		Not applicable
Complex Amine Compound		Not applicable
Isopropanol	67-63-0	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable
Methanol	67-56-1	Not applicable
Diethylenetriamine	111-40-0	No information available
Triethylenetetraamine	112-24-3	Not applicable

## 12. Ecological Information

### 12.1. Toxicity

#### Ecotoxicity effects

Very toxic to aquatic life. Toxic to aquatic life with long lasting effects.

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Ethylene glycol	107-21-1	EC50 6500 - 13000 mg/L (Pseudokirchneriella subcapitata) TGK (8d) > 10000 mg/L (Scenedesmus quadricauda) EC50 (72h) 6500 mg/L (Selenastrum capricornutum)	LC50 41000 mg/L (Oncorhynchus mykiss) LC50 (96h) 72860 mg/L (Pimephales promelas) LC50 (96h) 8050 mg/L (Selenastrum capricornutum) NOEC (7d) 15380 mg/L (mortality) (Pimephales promelas)	TTC (16h) > 10000 mg/L (Pseudomonas putida) EC20 (30 m) > 1995 mg/L (activated sludge, domestic) (similar substance)	EC50 46300 mg/L (Daphnia magna) EC50 (48 h) 7170 mg/L (Daphnia magna) NOEC (7d) 8590 mg/L (reproduction) (Ceriodaphnia dubia)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	EC50 (72h) < 0.1 mg/L (Skeletonema costatum)	LC50 (96h) 0.44 mg/L (Scophthalmus maximus)	No information available	LC50 (48h) 0.72 mg/L (Acartia tonsa)
Pyridinium Salt	Proprietary	LC50 (72 h) =61.2 mg/L (Scenedesmus capricornutum)	LC50 (96 h) =2.96 mg/L (Oncorhynchus mykiss)	No information available	EC50 (48 h) =39.6 mg/L (Daphnia magna) NOEC (21 d) =22.2 mg/L (Daphnia magna)
Ammonium bisulfite	10192-30-0	ErC50 (72h) 43.8 mg/L (Desmodesmus subspicatus) (similar substance)	LC50 5000 mg/L (Lepomis macrochirus) LC50 (96h) 681.2 mg/L (Danio rerio) (similar substance) LC50 (96h) 316 mg/L (Leuciscus idus) (similar substance) NOEC (34d) => 316 mg/L (Danio rerio) (similar substance)	EC50 (17h) 410 mg/L (Pseudomonas putida) (similar substance) EC50 (17h) 65 mg/L (Pseudomonas putida) (similar substance)	EC50 (48h) >1000 mg/L (Daphnia magna) EC50 (48 hr) 89 mg/L (Daphnia magna) (similar substance) NOEC (21d) > 10 mg/L (Daphnia magna) (reproduction) (similar substance)
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available	No information available	No information available	No information available
Complex Phosphate Ester Compounds	Proprietary	EC50 (72h) 3 mg/L (Pseudokirchneriella subcapitata)	LC50 (96h) 0.323 mg/L (Pimephales promelas)	EC50 (3h) 104 mg/L (Sludge) (similar substance)	LC50 (48h) 0.148 mg/L (Daphnia magna) NOEC (21d) 0.1 mg/L (Daphnia magna)
Complex Amine Compound	Proprietary	EC50 (72h) 141 mg/L (Skeletonema costatum) NOEC (72h) 6.25 mg/L (Desmodesmus subspicatus) (similar substances)	LC50 (96h) 1466 mg/L (Leuciscus idus) LC50 (96h) > 1000 mg/L (Cyprinodon variegatus) LC50 (96h) 1170 mg/L (Pimephales promelas) (similar substances)	EC50 (17h) 413.8 mg/L (Pseudomonas putida) (similar substance)	EC50 (48h) 230 mg/L (Daphnia magna) (similar substance)
Isopropanol	67-63-0	EC50 (72h) > 1000 mg/L (Desmodesmus subspicatus)	LC50 (96h) 9640 mg/L (Pimephales promelas) LC50 (7d) 7060 mg/L	TT (16h) 1050 mg/L (Pseudomonas putida)	EC50 (48h) 13,299 mg/L (Daphnia magna) EC50 (24h) > 10,000

		EC50 (7d) 1800 mg/L ( <i>Scenedesmus quadricauda</i> )	( <i>Poecilia reticulata</i> )		mg/L ( <i>Daphnia magna</i> )
2-Mercaptoethanol	60-24-2	EC50 (72h) 12 mg/L ( <i>Desmodesmus subspicatus</i> ) EC50 (72h) 19 mg/L ( <i>Desmodesmus subspicatus</i> )	LC50 (96h) 37 mg/L ( <i>Leuciscus idus</i> ) LC50 (96h) 46 mg/L ( <i>Leuciscus idus</i> ) LC50 (96h) 46-100 mg/L ( <i>Leuciscus idus</i> ) LC50 (96h) 46-100 mg/L ( <i>Carassius carassis auratis</i> )	No information available	EC50 (48h) 0.4 mg/L ( <i>Daphnia magna</i> ) NOEC (21d) 0.0632 mg/L ( <i>Daphnia magna</i> )
Methanol	67-56-1	EC50 (96 h) =22000 mg/L ( <i>Pseudokirchnerella subcapitata</i> ) NOEC (8 d) =8000 mg/L ( <i>Scenedesmus quadricauda</i> )	LC50 (96 h) =15400 mg/L ( <i>Lepomis macrochirus</i> ) EC50 (200 h) =14536 mg/L ( <i>Oryzias latipes</i> )	IC50 (3h) > 1000 mg/L (activated sludge)	EC50 (96 h) =18260 mg/L ( <i>Daphnia magna</i> ) NOEC (21 d) =208 mg/L ( <i>Daphnia magna</i> )
Diethylenetriamine	111-40-0	EC50 (72h) 187 mg/L ( <i>Pseudokirchnerella subcapitata</i> ) (biomass)	LC50 (96h) 430 mg/L ( <i>Poecilia reticulata</i> ) NOEC (28d) > 10 mg/L ( <i>Gasterosteus aculeatus</i> )	ErC50 (3h) 32.7 mg/L (Nitrifying bacteria)	EC50 (48h) 16 mg/L ( <i>Daphnia magna</i> ) NOEC (21d) 5.6 mg/L ( <i>Daphnia magna</i> )
Triethylenetetraamine	112-24-3	EC50 (72h) 2.5 mg/L ( <i>Desmodesmus subspicatus</i> ) ErC50 (96h) 3.7 mg/L ( <i>Selenastrum capricornutum</i> )	LC50 (96h): 570 mg/L ( <i>Poecilia reticulata</i> ) LC50(96h): 495 mg/L ( <i>Pimephales promelas</i> )	EC6 (25h) 500 mg/L ( <i>Pseudomonas fluorescens</i> )	EC50 (48h) 31.1 mg/L ( <i>Daphnia magna</i> ) NOEC (21d) 1 mg/L ( <i>Daphnia magna</i> )

## 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Ethylene glycol	107-21-1	Readily biodegradable (100% @ 10d)
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Biodegradable.
Pyridinium Salt	Proprietary	Not readily biodegradable. (56.6% @ 28d)
Ammonium bisulfite	10192-30-0	The methods for determining biodegradability are not applicable to inorganic substances.
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Readily biodegradable
Complex Phosphate Ester Compounds	Proprietary	Not readily biodegradable (58.7% @ 28d) (similar substances)
Complex Amine Compound	Proprietary	Readily biodegradable (96% @ 18d)
Isopropanol	67-63-0	Readily biodegradable (53% @ 5d)
2-Mercaptoethanol	60-24-2	Product is not biodegradable (15-21% @ 28d)
Methanol	67-56-1	Readily biodegradable (95-97% @ 20d)
Diethylenetriamine	111-40-0	Readily biodegradable (> 96% @ 10d)
Triethylenetetraamine	112-24-3	(0% @ 28d)

## 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Ethylene glycol	107-21-1	-1.36
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	No information available
Pyridinium Salt	Proprietary	2.1 - 2.52 (similar substance)
Ammonium bisulfite	10192-30-0	No information available
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds	Proprietary	4.48
Complex Amine Compound	Proprietary	-1.16 (similar substance)
Isopropanol	67-63-0	0.05
2-Mercaptoethanol	60-24-2	-0.056
Methanol	67-56-1	-0.77 BCF = 1.0 – 4.5 (Cyprinus carpio)

		BCF < 10 (Leuciscus idus melanotus)
Diethylenetriamine	111-40-0	-1.58
Triethylenetetraamine	112-24-3	-1.4

#### **12.4. Mobility in soil**

Substances	CAS Number	Mobility
Ethylene glycol	107-21-1	No information available
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	No information available
Pyridinium Salt	Proprietary	No information available
Ammonium bisulfite	10192-30-0	No information available
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	No information available
Complex Phosphate Ester Compounds	Proprietary	No information available
Complex Amine Compound	Proprietary	KOC = 0.17
Isopropanol	67-63-0	No information available
2-Mercaptoethanol	60-24-2	KOC = 1.325
Methanol	67-56-1	No information available
Diethylenetriamine	111-40-0	KOC = 2582 - 36,658
Triethylenetetraamine	112-24-3	No information available

#### **12.5 Other adverse effects**

No information available

### **13. Disposal Considerations**

#### **13.1. Waste treatment methods**

**Disposal methods** Disposal should be made in accordance with federal, state, and local regulations.  
**Contaminated Packaging** Dispose of container according to national or local regulations.

### **14. Transport Information**

#### **US DOT**

**UN Number** UN1760  
**UN proper shipping name:** Corrosive Liquid, N.O.S. (Contains Quaternary ammonium compound, Complex Phosphate Ester Compounds)  
**Transport Hazard Class(es):** 8  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant  
**NAERG:** NAERG 154

#### **Canadian TDG**

**UN Number** UN1760  
**UN proper shipping name:** Corrosive Liquid, N.O.S. (Contains Quaternary ammonium compound, Complex Phosphate Ester Compounds)  
**Transport Hazard Class(es):** 8  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant

#### **IMDG/IMO**

**UN Number** UN1760  
**UN proper shipping name:** Corrosive Liquid, N.O.S. (Contains Quaternary ammonium compound, Complex Phosphate Ester Compounds )  
**Transport Hazard Class(es):** 8  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant  
**EMS:** EmS F-A, S-B

**IATA/ICAO**

**UN Number** UN1760  
**UN proper shipping name:** Corrosive Liquid, N.O.S. (Contains Quaternary ammonium compound, Complex Phosphate Ester Compounds )  
**Transport Hazard Class(es):** 8  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant

**Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code** Not applicable  
**Special Precautions for User** None

## 15. Regulatory Information

### US Regulations

**US TSCA Inventory** All components listed on inventory or are exempt.

#### TSCA Significant New Use Rules - S5A2

Substances	CAS Number	TSCA Significant New Use Rules - S5A2
Ethylene glycol	107-21-1	Not applicable
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable
Pyridinium Salt	Proprietary	Not applicable
Ammonium bisulfite	10192-30-0	Not applicable
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable
Complex Amine Compound	Proprietary	Not applicable
Isopropanol	67-63-0	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable
Methanol	67-56-1	Not applicable
Diethylenetriamine	111-40-0	Not applicable
Triethylenetetraamine	112-24-3	Not applicable

#### EPA SARA Title III Extremely Hazardous Substances

Substances	CAS Number	EPA SARA Title III Extremely Hazardous Substances
Ethylene glycol	107-21-1	Not applicable
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable
Pyridinium Salt	Proprietary	Not applicable
Ammonium bisulfite	10192-30-0	Not applicable
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable
Complex Amine Compound	Proprietary	Not applicable
Isopropanol	67-63-0	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable
Methanol	67-56-1	Not applicable
Diethylenetriamine	111-40-0	Not applicable
Triethylenetetraamine	112-24-3	Not applicable

#### EPA SARA (311,312) Hazard Class

Acute Health Hazard  
Chronic Health Hazard  
Fire Hazard

#### EPA SARA (313) Chemicals

Substances	CAS Number	Toxic Release Inventory (TRI) - Group I	Toxic Release Inventory (TRI) - Group II
Ethylene glycol	107-21-1	1.0%	Not applicable
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable	Not applicable

Pyridinium Salt	Proprietary	Not applicable	Not applicable
Ammonium bisulfite	10192-30-0	1.0%	Not applicable
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable	Not applicable
Complex Amine Compound	Proprietary	Not applicable	Not applicable
Isopropanol	67-63-0	1.0%	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable	Not applicable
Methanol	67-56-1	1.0%	Not applicable
Diethylenetriamine	111-40-0	Not applicable	Not applicable
Triethylenetetraamine	112-24-3	Not applicable	Not applicable

**EPA CERCLA/Superfund Reportable Spill Quantity**

Substances	CAS Number	CERCLA RQ
Ethylene glycol	107-21-1	5000 lb 2270 kg
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable
Pyridinium Salt	Proprietary	Not applicable
Ammonium bisulfite	10192-30-0	5000 lb 2270 kg
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable
Complex Amine Compound	Proprietary	Not applicable
Isopropanol	67-63-0	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable
Methanol	67-56-1	5000 lb 2270 kg
Diethylenetriamine	111-40-0	Not applicable
Triethylenetetraamine	112-24-3	Not applicable

**EPA RCRA Hazardous Waste Classification**

Corrosivity D002

**California Proposition 65**

Substances	CAS Number	California Proposition 65
Ethylene glycol	107-21-1	developmental toxicity
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable
Pyridinium Salt	Proprietary	Not applicable
Ammonium bisulfite	10192-30-0	Not applicable
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable
Complex Amine Compound	Proprietary	Not applicable
Isopropanol	67-63-0	Not applicable
2-Mercaptoethanol	60-24-2	Not applicable
Methanol	67-56-1	developmental toxicity
Diethylenetriamine	111-40-0	Not applicable
Triethylenetetraamine	112-24-3	Not applicable

**U.S. State Right-to-Know Regulations**

Substances	CAS Number	MA Right-to-Know Law	NJ Right-to-Know Law	PA Right-to-Know Law
Ethylene glycol	107-21-1	Present	0878	Environmental hazard
n-Benzyl dimethyl cocoamine, C12-C18 quaternary salt	61789-71-7	Not applicable	Not applicable	Not applicable
Pyridinium Salt	Proprietary	Not applicable	Not applicable	Not applicable
Ammonium bisulfite	10192-30-0	Present	0090	Environmental hazard
Fatty acids, tall-oil, reaction products with diethylenetriamine, acetates	68153-60-6	Not applicable	Not applicable	Not applicable
Complex Phosphate Ester Compounds	Proprietary	Not applicable	Not applicable	Not applicable
Complex Amine Compound	Proprietary	Not applicable	Not applicable	Not applicable
Isopropanol	67-63-0	Present	1076	Environmental hazard

2-Mercaptoethanol	60-24-2	Present	2821	Present
Methanol	67-56-1	Present	1222	Environmental hazard
Diethylenetriamine	111-40-0	Present	0700	Present
Triethylenetetraamine	112-24-3	Present	1908	Present

**NFPA Ratings:** Health 3, Flammability 2, Reactivity 0

**HMIS Ratings:** Health 3\*, Flammability 2, Physical Hazard 0 , PPE: X

## Canadian Regulations

**Canadian Domestic Substances** All components listed on inventory or are exempt.  
**List (DSL)**

## 16. Other information

### Preparation Information

**Prepared By**

Chemical Stewardship  
Telephone: 1-281-871-6107  
e-mail: fdunexchem@halliburton.com

**Revision Date:** 18-Jul-2016

**Reason for Revision** Initial Release

### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

### **Key or legend to abbreviations and acronyms used in the safety data sheet**

bw – body weight

CAS – Chemical Abstracts Service

d - day

EC50 – Effective Concentration 50%

ErC50 – Effective Concentration growth rate 50%

h - hour

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

NIOSH – National Institute for Occupational Safety and Health

NTP – National Toxicology Program

OEL – Occupational Exposure Limit

PEL – Permissible Exposure Limit

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

UN – United Nations

w/w - weight/weight

### **Key literature references and sources for data**

www.ChemADVISOR.com/

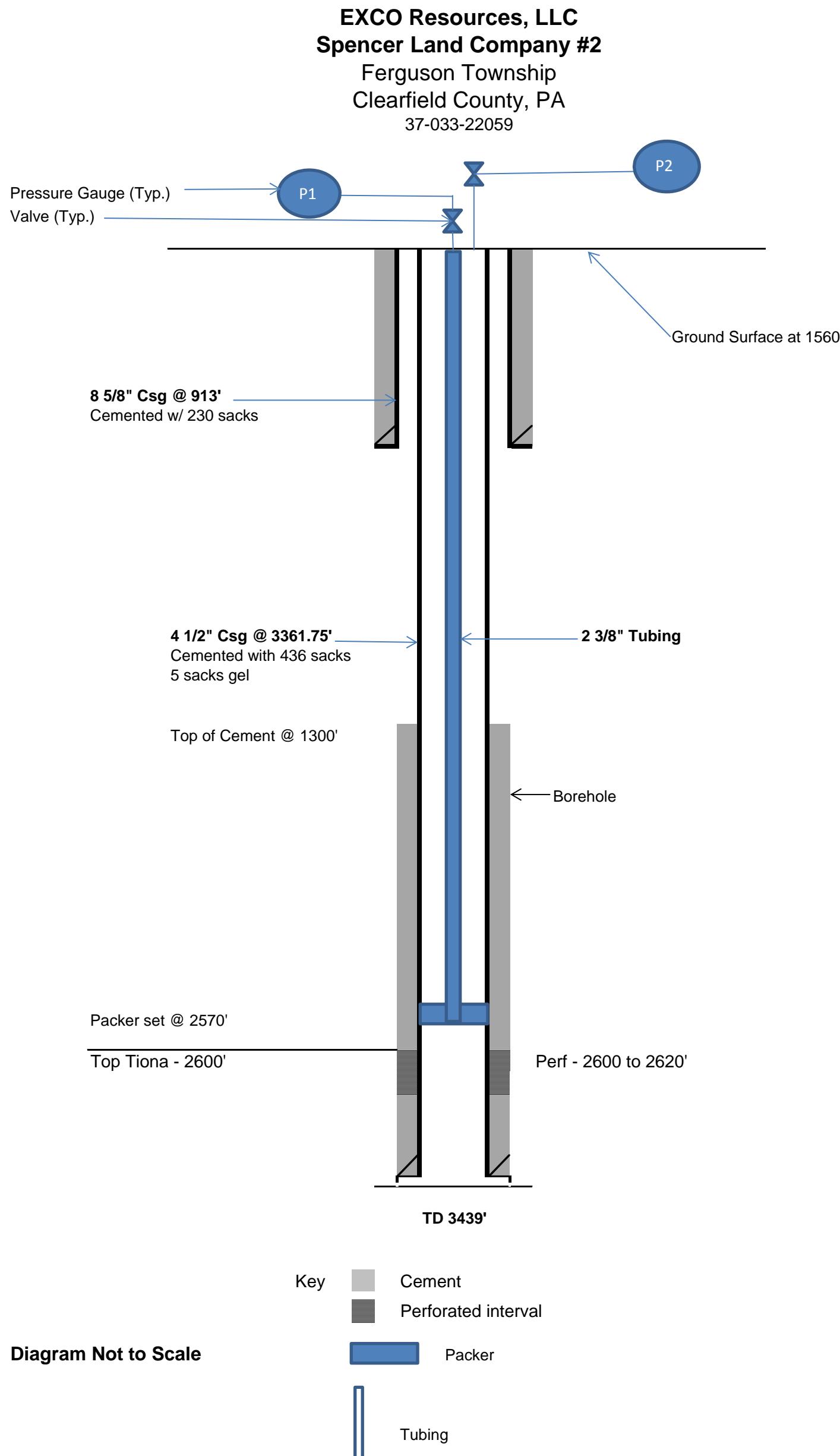
**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## **SECTION 7.0 – UIC WELL CONSTRUCTION**

**Figure 8**  
**Well Construction Diagram**



## **SECTION 8.0 – PLAN FOR WELL FAILURE**

## 8.0 PLANS FOR WELL FAILURES

### General System Design and Monitoring

The system being utilized for monitoring and control will function with the use of pressure switch gauges with adjustable limit switches in the PLC. The gauges provide a sensing device for changes in pressure conditions, and if the limit switches are reached, they will send responses to activate the PLC controller for injection flow and pressure relief. All monitoring described in detail below will be stored and transmitted via our SCADA system and will be continuously monitored remotely (24/7/365). In addition to the automated portion of the system, the manual operation of all pumping equipment as well as the continual inspections of the pumping and monitoring equipment provide additional safeguards for appropriate actions necessary in case of well failures.

### Injection Pressure Limit Monitoring

The primary safeguard to prevent over pressuring is the automated shutdown on the pumping equipment at which the Maximum Allowable Injection Pressure (MAIP) (Surface) will be set as a limit at which all pumping will cease. Additional switch gauges and the PLC will be utilized by reading the gauges at the wellhead to monitor pressure changes that would be caused by tubing or casing failures and the appropriate valve will be activated to cease injection.

### Tubing and Packer Monitoring

With the monitoring switch gauge connected to the tubing, there will be a secondary system to prevent over pressuring of the tubing. When the MAIP is sensed, a response is sent to a PLC which will stop additional injection into the tubing.

### Tubing to Casing Annulus Monitoring

This annular space will be monitored for both increase and decreases in pressure. The switch gauge will have both a low and high shutdown tab limit. When either of the limits is reached, the sensor will send a response to the PLC for shutting down flow. The lower limit will be used to monitor damage to the casing which allows fluid to leave the casing, and the high limit will sense a pressure increase in the annular space that may be caused by communication with the tubing or flow into the annular space. Both of these limits when reached will send responses shutting down the injection cycle.

Under the monitoring provided above, well failures will either be identified by the automated equipment and switch gauges or by visual inspection during injection operations or at other times. Should any failure occur, all injections will cease and EPA will be verbally notified within 24 hours and notified in writing within 7 days. Analysis of the failure will take place and the necessary repairs to be implemented along with any equipment replacement will be coordinated with the EPA.

## **SECTION 9.0 – MONITORING PROGRAM**

## **9.0 MONITORING PROGRAM**

Since EXCO does not own any wells in the AOR, no fluid level monitoring of wells is proposed. As discussed in Section 6.0 Operating Data and Section 8.0 Plan for Well Failures, there will be routine monitoring of the injection well itself for annular and injection pressures and rates.

## **SECTION 10.0 P&A PLAN**

## **10.0 PLUGGING AND ABANDONMENT PLAN**

At the point when the Spencer #2 well is no longer used, the well will be abandoned in accordance with EPA and PADEP regulations. With regard to PADEP regulations, this currently includes providing a “Notice of Intent to Plug a Well” no less than 3 days and no more than 30 days prior to abandoning the well, to allow a PADEP inspector to be present during the plugging procedure. The PADEP may waive the notification period. The notification will include well location plat, well logs, production logs, injection logs, construction details, and proposed abandonment method. After receiving approval from PADEP to proceed, the well will be abandoned and the abandonment procedures will be documented on a “Certificate of Plugging”.

The USEPA will be notified of the plugging activity at least 45 days prior to commencing activities. This notification will include USEPA Form No. 7514-20. Attached are the following:

- A summary of the proposed plugging procedure based on PADEP and USEPA regulations
- Breakdown of estimated P&A costs
- Well schematic showing the placement of proposed cement plugs
- Completed EPA Form 7514-20

It is noted that this form may be modified prior to plugging in order to meet the requirements at the time of the plugging activity. The total contractor estimate to plug and abandon the well according to the above procedures is \$60,280.

### Plugging Procedure

- 1 MIRU WOR, dig pit & set liner
- 2 Unseat packer and TOOH w/ tubing and packer.
- 3 MIRU wireline unit, PU and RIH and set CIBP at 2560'
- 4 PU tubing and TIH to spot 50' of cement over CIBP F/2560', T/2510'.  
Pull up tubing, WOC, tag and top off if needed. TOOH
- 5 PU and spot second plug from 1750' to 1650'.
- 6 RU wireline w/ casing cutter and RIH to cut casing at +/-1150'. POOH.
- 7 RU 4-1/2" tools and pull 4-1/2" casing, LD.
- 8 RU cementers and TIH w/ tubing to spot plug across cut F/1200', T/875'.  
Pull up tubing, WOC, tag and top off if needed. TOOH w/ tubing.
- 9 RU wireline and CBL tool and RIH to log from 875' to surface.
- 10 Cut and pull any uncemented 8-5/8" casing and cement to surface, or  
if good bond on surface pipe, fill hole with gravel and install vent.
- 11 RD, install marker and reclaim location.

### Estimated Cement Requirements

1st & 2nd Plugs (inside 4.5" csg):

<u>Plug Base</u>	<u>Plug Top</u>	<u>Hole Vol, ft3/ft</u>	<u>Yield, ft3/sk</u>	<u># sacks</u>
2575	2525	0.0872	1.15	3.8
1750	1650	0.0872	1.15	7.6
1200	1150	0.0872	1.15	3.8

3rd Plug (across casing stub):

<u>Plug Base</u>	<u>Plug Top</u>	<u>Hole Vol, ft3/ft</u>	<u>Yield, ft3/sk</u>	<u># sacks</u>
1150	926	0.2246	1.15	43.7

4th Plug (open hole & across surface shoe):

<u>Plug Base</u>	<u>Plug Top</u>	<u>Hole Vol, ft3/ft</u>	<u>Yield, ft3/sk</u>	<u># sacks</u>
926	875	0.3575	1.15	15.9

**Cement Detail:** **Calc.Total (no excess):** **63.4**

<u>Description</u>	<u>Price, \$</u>	<u>Quantity</u>	<u>Unit</u>	<u>Cost</u>
Mob/Demob				
Mix & Pump Chg				
Cement				
			<b>Total:</b>	<b>0</b>

Formation	MD	Current Plugged Status			Sections/Comments	Plugged			Procedure
		C	B	A		A	B	C	
Tiona SS 2603'-2617'	51				Conductor Csg				
					Hole, in				Fill hole above top plug with either gel or gravel.
	926				Csg, in	11.75			Run CBL from 825 to surf?
					Cmt, sks				
					Surface Csg				
					Hole, in	10.75?			Cement F/875',T/1200'
					Csg, in	8.625			
					Cmt, sks	230			
	PBTD TD				TOC (CBL), ft	1148			Cut & pull casing from TOC at 1150'
					Production Tbg	2566			
					2-3/8", 4.6 #, J-55				Cement F/1750',T/1650' Top of possible hydrocarbon zones at 1787' (top of Fifth Sand)
					Production Packer	2566			
					Production Csg				
					Hole, in	7.875			
					Csg, in	4.5			
					Cmt, sks	435			
		3374							Spot 50' of cement over CIBP Set CIBP @ 2560'
		3439							

**P&A PLAN**

**P&A PLAN FORM (EPA 7520-14)**



United States Environmental Protection Agency  
Washington, DC 20460

## PLUGGING AND ABANDONMENT PLAN

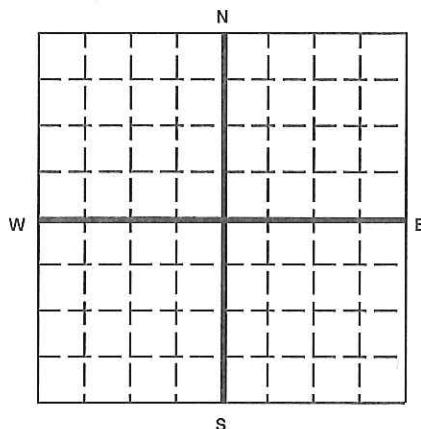
**Name and Address of Facility**

Spencer Land Company Disposal Well #2  
Ferguson Township, Clearfield County, PA

**Name and Address of Owner/Operator**

EXCO Resources, Inc.  
12377 Merit Drive Suite, 1700, Dallas, TX 75251

Locate Well and Outline Unit on  
Section Plat - 640 Acres



State  
PA

County  
Clearfield

Permit Number

**Surface Location Description**

1/4 of  1/4 of  1/4 of  1/4 of Section  Township  Range

Locate well in two directions from nearest lines of quarter section and drilling unit

**Surface**

Location  ft. frm (N/S)  Line of quarter section  
and  ft. from (E/W)  Line of quarter section.

**TYPE OF AUTHORIZATION**

Individual Permit  
 Area Permit  
 Rule

Number of Wells

**WELL ACTIVITY**

CLASS I  
 CLASS II  
 Brine Disposal  
 Enhanced Recovery  
 Hydrocarbon Storage  
 CLASS III

Lease Name  Spencer Land Company

Well Number  2

**CASING AND TUBING RECORD AFTER PLUGGING**

SIZE	WT (LB/FT)	TO BE PUT IN WELL (FT)	TO BE LEFT IN WELL (FT)	HOLE SIZE
4-1/2"	10.5		2224'	7-7/8"
8-5/8"	23		926'	10 5/8"
11 3/4	42		51'	15"

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

The Balance Method  
 The Dump Bailer Method  
 The Two-Plug Method  
 Other

**CEMENTING TO PLUG AND ABANDON DATA:**

Size of Hole or Pipe in which Plug Will Be Placed (inches)	PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
4-1/2"	4-1/2"	4-1/2"	4-1/2"	4-1/2"	7-7/8"	8-5/8"	
8-5/8"							
11 3/4							

Slurry Volume To Be Pumped (cu. ft.)	PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
2560'	2510'	1650'	1150'	926'	875'		

Type Cement or Other Material (Class III)	CIBP	Class A					

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

From	To	From	To
Bottom perf: 2617'	Top perf: 2603'		
Base of open hole: 1150'	Top of open hole: 926'		

**Estimated Cost to Plug Wells**

Estimated plugging cost is \$60,280

### Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32)

Name and Official Title (Please type or print)

Cary Cannon, Environmental Affairs and Regulatory Dir

Signature

Date Signed

6/28/19

### **Paperwork Reduction Act Notice**

The public reporting and record keeping burden for this collection of information is estimated to average 4.5 hours for operators of Class I hazardous wells, 1.5 hours for operators of Class I non-hazardous wells, 3 hours for operators of Class II wells, and 1.5 hours for operators of Class III wells.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15.

Please send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Office of Environmental Information, Collection Strategies Division, U.S. Environmental Protection Agency (2822), Ariel Rios Building, 1200 Pennsylvania Ave., NW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th Street, NW., Washington, DC 20503, Attention: Desk Officer for EPA. Please include the EPA ICR number and OMB control number in any correspondence.

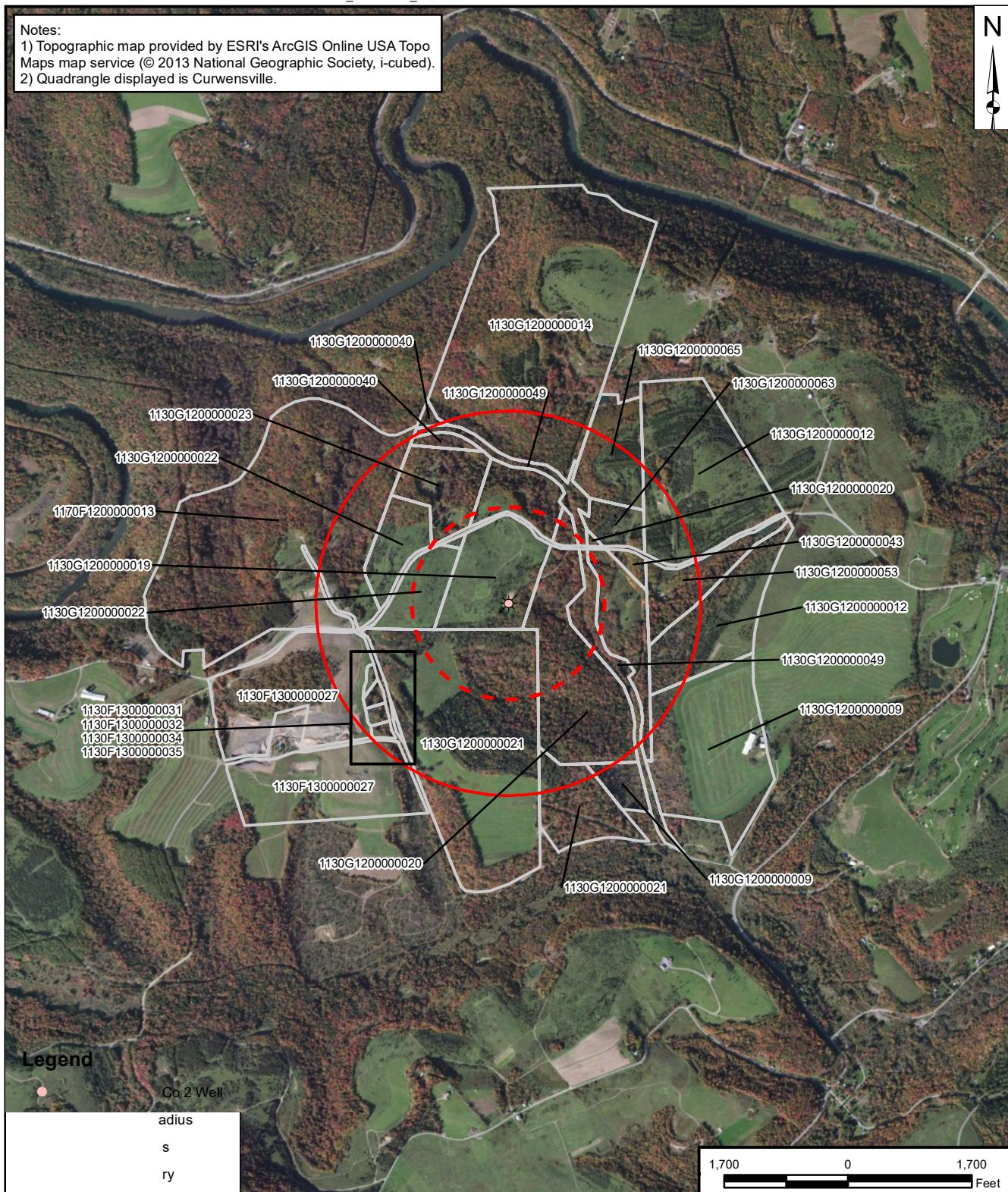
## **SECTION 11.0 – NECESSARY RESOURCES**

## **11.0 NECESSARY RESOURCES**

EXCO currently has a Trust Agreement in place with USEPA covering both the Irvin 1-A and Spencer Land Company #2 UIC Class IID wells in Clearfield County. EXCO anticipates amending the existing Trust Agreement to meet necessary resources requirements for properly plugging and abandoning the Spencer Land Company #2 well. This documentation will be provided under a separate cover at a later date.

**APPENDIX A**  
**LIST OF LANDOWNERS WITHIN ONE-HALF MILE OF INJECTION WELL**

Notes:  
 1) Topographic map provided by ESRI's ArcGIS Online USA Topo Maps map service (© 2013 National Geographic Society, i-cubed).  
 2) Quadrangle displayed is Curwensville.



TETRA TECH

PARCELS WITHIN ONE-HALF MILE  
 SPENCER LAND COMPANY #2

EXCO RESOURCES INC.  
 CLEARFIELD COUNTY, PENNSYLVANIA

DRAWN BY: T. TEAFORD 03/22/19  
 CHECKED BY: J. MARLOW 03/22/19  
 APPROVED BY:

CONTRACT NUMBER: 212C-PB-01103

FIGURE NUMBER

REV  
0

Landowners within 1/2 mile of the Spencer Land #2 well

PARCEL #	OWNER	MAILING ADDRESS
1130-G12-000-00019	HUMPHREYS RICHARD L & MARY LOU	63 BRIDLE PATH RD., KIRKWOOD, PA 17536
1130-G12-000-00023	HOYT ROGER L & KATHY CHRISTINE	889 CEMETERY RD., CURWENSVILLE, PA 16833
1130-G12-000-00022	ROGERS WILLIAM W TRUST	24 LONGCOURSE LANE, PAOLI, PA 19301
1130-G12-000-00021	ROGERS WILLIAM W TRUST	25 LONGCOURSE LANE, PAOLI, PA 19301
1130-G12-000-00020	HUMPHREYS RICHARD L & MARY LOU	63 BRIDLE PATH RD., KIRKWOOD, PA 17536
1130-G12-000-00049	SPENCER LAND COMPANY	P O BOX I, GRAMPIAN, PA 16838
1130-G12-000-00014	SPENCER LAND CO	P O BOX I, GRAMPIAN, PA 16838
1130-G12-000-00040	SPENCER LAND CO	P O BOX I, GRAMPIAN, PA 16838
1170-F12-000-00013	SPENCER LAND CO.	P O BOX I, GRAMPIAN, PA 16838
1130-F13-000-00027	PRISK KENNETH B & PATRICIA AND KENNETH B PRISK, JR	2205 WATTS RD., CURWENSVILLE, PA 16833
1130-F13-000-00035	GEISLER WILLIAM J & DIANE D	9908 CHERRY CORNER RD., CURWENSVILLE, PA 16833
1130-F13-000-00031	GEISLER WILLIAM J & DIANE D	9908 CHERRY CORNER RD., CURWENSVILLE, PA 16833
1130-F13-000-00032	GEISLER WILLIAM J & DIANE D	9908 CHERRY CORNER RD., CURWENSVILLE, PA 16833
1130-F13-000-00034	GEISLER WILLIAM J & DIANE D	9908 CHERRY CORNER RD., CURWENSVILLE, PA 16833
1130-G12-000-00009	BYLER ALBERT M & AMANDA F	396 VERN'S RD., CURWENSVILLE, PA 16833
1130-G12-000-00012	RUTH CURTIS S	1457 CEMETERY RD., CURWENSVILLE, PA 16833
1130-G12-000-00053	BLOOM STEVEN	1364 CEMETERY RD., CURWENSVILLE, PA 16833
1130-G12-000-00043	THORP CHRISTOPHER L & PAULA J	526 MCFADDEN RD., GRAMPIAN, PA 16838
1130-G12-000-00063	SPENCER ANDY A	220 ELIZABETH ST., CLEARFIELD, PA 16830
1130-G12-000-00065	SPENCER ALAN R & ROBERTA SPENCER	103 ALLEN DR., GRAMPIAN, PA 16838