

JUL 21 2009

OCD Case #AP-100



TETRA TECH

**STAGE I ABATEMENT PLAN  
OF  
UNIT PETROLEUM COMPANY  
GOURLEY FEDERAL #3 WELL  
UNIT H, SECTION 28, T-22-S, R-28-E**

**LOCATED IN  
EDDY COUNTY, NEW MEXICO**

*Prepared for:*

**UNIT PETROLEUM COMPANY**  
7130 S. Lewis Ave.  
Suite 1000  
Tulsa, OK 74136

*Prepared by:*

**Tetra Tech**  
1910 N. Big Spring St.  
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**Tetra Tech Project No. 115-6403654  
July 17, 2009**

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**STAGE I ABATEMENT PLAN**

**OCD Case #AP-100**

**STAGE I ABATEMENT PLAN**

**Unit Petroleum Company**

**Gourley Federal #3 Well**

**Unit H, Section 28, T-22-S, R-28-E**

**Eddy County, New Mexico**

**1.0 EXECUTIVE SUMMARY**

Soil samples collected from the Gourley Federal #3 open reserve pit (Pit) in June and July, 2007 and again in January, 2009 establish that chloride concentrations in the soil within the Pit were generally below 10,000 mg/kg, with the exception of 3 samples, two collected from the center of the Pit at the Pit bottom and at 15 feet below the bottom (bpb) and one from the Pit bottom in the northeast corner. Samples collected from the center of the Pit at depths below 15 feet bpb were below 10,000 mg/kg. Unit proposes to delineate the depth and areal extent of Pit soils having chloride concentrations in excess of 10,000 mg/kg and to then excavate those soils. Upon completion of the excavation, the balance of the Pit would be leveled, lined with sand, and covered with a 40 mil synthetic impermeable liner. The Pit would then be backfilled with clean fill material and brought up to grade.

Groundwater sampling in the vicinity of the Pit suggests that local groundwater flow may be to the west/northwest. The reported regional hydraulic gradient is directed southwest, towards the Pecos River. Groundwater samples collected from monitor wells located east and west of the Pit and on the south edge of the Pit, contained chloride concentrations of 1110 mg/L, 1270 mg/L and 907 mg/L respectively. A groundwater sample collected from a monitor well located 180 feet north of the northwest corner of the Pit and essentially cross gradient of local groundwater flow contained chloride concentrations of 3,220 mg/L. To further evaluate the elevated chlorides in MW-1, and to confirm the gradient of the groundwater around the site, additional delineation may be required.

**2.0 CHRONOLOGY OF EVENTS**

April 23, 2007	NMOCD District II Office received Operator's C-144 pit closure plan from Sweatt Construction Co. (Sweatt)
April 24, 2008	NMOCD District II Supervisor Tim Gum approved operator's C-144 pit closure plan submitted by Sweatt.

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OCD Case #AP-100**

May 31, 2007- July 25, 2007	Sweatt excavates the reserve pit contents and samples the Pit for closure.
October 5, 2008	Don Peterson from the Bureau of Land Management's Carlsbad Field Office called Mr. Bratcher and told him that the pit was still open and what appeared to be drill cuttings were stockpiled in the middle of the Pit.
November 17, 2008	NMOCD issued a Notice of Violation (NOV No. 02-08-23) to Unit for an open pit.
December 3, 2008	An administrative conference was held on the NOV. Unit's district engineer and E-Tech Environmental & Safety Solutions were onsite for conference. Conclusion was that Sweat had failed to complete the Pit closure at the site.
January 7, 2009	Unit contacted Tetra Tech to perform confirmation sampling of the open Pit.
February 19, 2009	Tetra Tech was onsite to install one monitor well northwest of the Pit.
February 25, 2009	Tetra Tech personnel were onsite to sample the one monitor well and the water well located one mile southwest of the site.
May 29, 2009	Tetra Tech emailed the NMOCD requesting an extension of the Pit closure.
June 1, 2009	NMOCD grants extension of closure of the Pit until October 1, 2009.
June 1, 2009	Unit files a C-141 with the NMOCD.
June 2, 2009	Unit submits revised C-141 to the NMOCD.
June 5, 2009	NMOCD issued letter requiring a Stage I Abatement Plan for the site.
June 25, 2009	Two additional monitor wells (MW-2 and MW-3) are installed on the pad adjacent to the open Pit.

### **3.0 BACKGROUND & PREVIOUS WORK**

In June 2007, Sweatt excavated the Pit to a maximum depth of 6' below ground surface (bgs), with sample trenches to 20 feet (bgs) for chloride sampling. Sampling conducted on July 25, 2007 found that chloride concentrations within the Pit were generally below 10,000 mg/kg with the exception of 3 samples. Two samples were collected from



the center of the Pit at the Pit bottom and at 15 feet below the Pit bottom (bpb). The third sample was from the Pit bottom in the northeast corner. Samples collected from the center of the Pit at depths below 15 feet bpb were below 10,000 mg/kg. At the request of the NMOCD, a temporary monitor well was installed on the south edge of the Pit in June 2007 to establish the depth to groundwater. The well was drilled to a depth of 50' bgs. Samples from that well showed chloride concentrations of 907 mg/L and TDS concentrations of 3990 mg/L. See Tetra Tech January 19, 2009, report to Mr. Mike Bratcher, NMOCD. A Notice of Violation was subsequently issued by the NMOCD on November 17, 2008.

In January 2009, Tetra Tech was contracted to perform sampling of the Pit at the site. As requested by the NMOCD, samples were collected from the center and southwest corner of the Pit. Samples from a depth of 25 feet bgs were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), total petroleum hydrocarbons (TPH), and chlorides. Confirmation samples were also collected for chlorides from a depth of 39 feet bgs in the center and 35 feet bgs in the southwest corner. During the confirmation sampling, the soils were field screened for chlorides. A one to two foot thick clay layer was encountered in both sample trenches at 37 feet bgs in the center and 34 feet bgs in the southwest corner. Sampling in the southwest corner of the pit showed elevated chlorides ranging from 5,800 mg/kg at the bottom of the Pit, declining to 700 mg/kg at 30 feet bgs, and increasing to 6,450 mg/kg at the clay layer. The concentration below the clay layer at 35 feet bgs was 761 mg/kg. The field screening at the center of the Pit showed chloride concentrations ranging from 13,520 mg/kg at the bottom of the pit, to 19,600 at 15 feet bgs, declining to 1,050 mg/kg at 35 feet bgs. At the clay layer at 37 feet bgs, the chloride concentration increased to 9,450 mg/kg. Below the clay layer at 39 feet bgs, the field chloride concentration was 1,600 mg/kg. The laboratory results for the 39 foot sample showed a concentration of 2,170 mg/kg chlorides.

At the request of Unit, Tetra Tech was onsite February 19, 2009, to oversee the installation of one 2" monitor well approximately 180' north of the northwest corner of the Pit. The monitor well was drilled to a depth of 60 feet bgs and installed with 30 feet of 0.02" slotted PVC at the bottom of the well boring. Following installation, the well was developed by utilizing a pump to remove the fine grain sediments, disturbed during drilling, and to ensure collection of representative groundwater samples.

On February 25, 2009, Tetra Tech personnel were onsite to purge and sample the newly installed monitor well, (MW-1). Samples were collected and submitted to Trace Analysis Inc. (Trace) for analysis of major anions, cations and total dissolved solids (TDS). Analytical results showed a chloride concentration of 3,220 milligrams per liter (mg/L) and TDS concentration of 7,800 mg/L.

On June 25, 2009, Tetra Tech installed two additional monitor wells. One well (MW-2) was installed east of the Pit. The other well (MW-3) was installed west of the Pit.



#### **4.0 GEOLOGY & HYDROGEOLOGY**

##### **4.1 Regional and Local Geology**

According to the Geology and Groundwater Resources of Eddy County, New Mexico (Report 3), the Rustler, Castile and Salado formation (Ochoa Series) is present west and east of the Pecos River. The Salado formation, which consists of halite and small amounts of anhydrite, polyhalite and other potassium salts and red sandy shale, overlies the Castile formation in the area east of the Pecos River. West of the river, most of the formation has been removed by solution. Underlying the Salado formation is the Castile formation which consists of 1,300 to 2,000 feet of anhydrite, gypsum, and small amounts of halite, dolomite, and sandstone. As originally deposited, most of the gypsum probably was anhydrite, but it has since been altered by groundwater. The Rustler formation overlies the Salado formation east of the Pecos River, and the Castile formation west of the Pecos River. The Rustler formation ranges in thickness from about 200 feet in northern Eddy County to about 500 feet southeast of Carlsbad. It consists of anhydrite, gypsum, interbedded red and green sandy clay, and some beds of dolomite.

##### **4.2 Regional and Local Hydrogeology**

The groundwater in the area generally comes from the Rustler formation. Historically, chlorides and sulfate concentrations are elevated in the Rustler formation. Generally, the groundwater in this area primarily moves to the southwest towards the Pecos River. However, based on the gauging event of June 27, 2009, the groundwater gradient is towards the west-northwest. See groundwater gradient map Figure 3. The depth to water in this area is approximately 45 to 50 feet below ground surface.

##### **4.3 Water Well Inventory**

A water well inventory was performed to encompass a ½ mile radius around the facility. The inventory included a review of water well records on the New Mexico Office of the State Engineer W.A.T.E.R.S. database, the United States Geologic Survey (USGS) website and any water wells denoted on the USGS 7.5 minute topographic quadrangle map within the search radius. No wells were shown in either database or on the USGS 7.5 minute topographic quadrangle map within the search radius. One 18" diameter out of service water well was observed approximately 1 mile southwest of the site.



## **5.0 SUBSURFACE SOILS**

The soils in the vicinity of this site are of the Bippus Series. The Bippus series consist of deep, moderately dark colored, well-drained, calcareous soils that developed in alluvium. These soils occur mainly on flood plains of intermittent streams in the southeastern part of the survey area, but smaller areas are scattered throughout the eastern part.

Soils of the Bippus series typically have a surface layer that is about 21 inches thick. The uppermost few inches consists of grayish-brown sandy loam. This material overlies dark grayish-brown silty clay loam. Beneath the surface layer is a transitional layer of dark-brown to brown silty clay loam about 16 inches thick. The substratum, about 11 inches thick, is brown clay loam enriched by calcium carbonate. It rests on weak cemented caliche at a depth of about 4 feet.

Bippus soils are uneroded to slightly eroded. They are subject to periodic flooding, and there is some deposition of sandy material at the edges of the flood plain. Runoff is medium. Permeability is moderately slow, and the water-holding capacity is high.

## **6.0 GROUNDWATER GRADIENT and QUALITY**

A monitor well (MW-1) was installed north of the Pit on February 19, 2009. The monitor well was drilled to a maximum depth of 60 feet bgs and installed with 30 feet of 0.02" slotted PVC piping.

In order to determine a groundwater gradient at the site, two additional monitor wells (MW-2 and MW-3) were installed adjacent to the Pit on June 25, 2009. The two monitor wells were drilled to a maximum depth of 60 feet bgs and installed with 20 feet of 0.02" slotted PVC piping. Upon completion of the monitor wells, all three wells were gauged, purged and sampled on June 27, 2009. The samples were submitted to Trace Analysis, Inc. for analysis of major anions/cations and TDS. Analytical results indicate chloride concentrations of 4,140 mg/L in monitor well MW-1, 1,110 mg/L in MW-2, and 1,270 mg/L in MW-3. The gauging and analytical data are presented in Tables 1 and 2. Laboratory analytical is presented in Appendix A. Based upon the data collected from MW-1, MW-2 and MW-3, the groundwater gradient in the vicinity of this site appears to be towards the west/northwest. MW-1 appears to be located essentially cross-gradient from the Pit.

Stiff diagrams were created for the three wells based upon the analytical data. The stiff diagrams for MW-2 and MW-3 are nearly identical and may be indicative of background quality of the Rustler Formation in this area. The stiff diagrams for the three monitor wells and the abandoned 18" water well are included in Appendix B.

## **7.0 STAGE I ABATEMENT PLAN**

### **7.1 Pit Closure**

In order to close the Pit at the site, Unit proposes to drill a total of five (5) soil borings in the center horseshoe section of the Pit in order to delineate



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STAGE I ABATEMENT PLAN  
OCD Case #AP-100

chloride concentrations to below 10,000 mg/kg. The soil borings will be advanced with an air-rotary drilling rig to an estimated depth of 20 feet bgs. Once the data has been collected and analyzed, the center of the Pit will be excavated to the depth at which the chloride concentrations have declined below 10,000 mg/kg. Upon completion of the excavation, the site will be leveled, lined with sand, and a 40 mil synthetic impermeable liner placed into the excavation to isolate the residual chloride impacted soils. The remainder of the excavation will be backfilled with clean fill material and brought up to grade.

7.2 Additional Monitor Wells

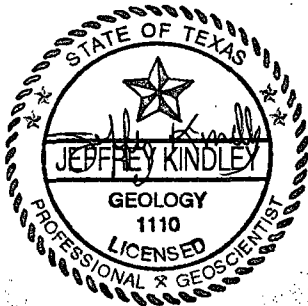
Monitor well MW-2 and MW-3 had nearly identical qualities and may be consistent with background quality for the Rustler Formation in this area. Groundwater samples collected from MW-1, which is located 180 feet north of the northwest corner of the pit and essentially cross gradient of local groundwater flow, contained higher chloride concentrations than the samples collected from MW-2 and MW-3. To further evaluate the elevated chlorides in MW-1, and to confirm the gradient of the groundwater around the site, additional delineation may be required.

8.0 **QUALITY ASSURANCE/ QUALITY CONTROL**

Any additional monitor wells, to be installed at the site, will be constructed to EPA and industry standards. All downhole equipment (i.e., drill pipe, drill bits, etc.) will be thoroughly decontaminated between each use with a steam cleaner. The wells will be properly purged and sampled with clean, dedicated, polyethylene bailers and disposable line. The groundwater samples will be submitted to a laboratory for analysis of major anions/cations and TDS by EPA methods 310.1, 9253, 375.4, 6010B, 160.1 and 300.0E.

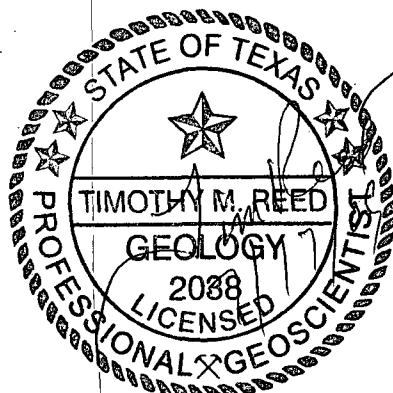
9.0 **PROPOSED SCHEDULE OF ACTIVITIES**

Upon approval, the work outlined above will be implemented in a timely manner, dependent upon availability of local drilling contractors and trackhoe operators.



Respectfully submitted,  
Tetra Tech Inc.

  
Jeffrey Kindley, P.G.  
Senior Environmental Geologist

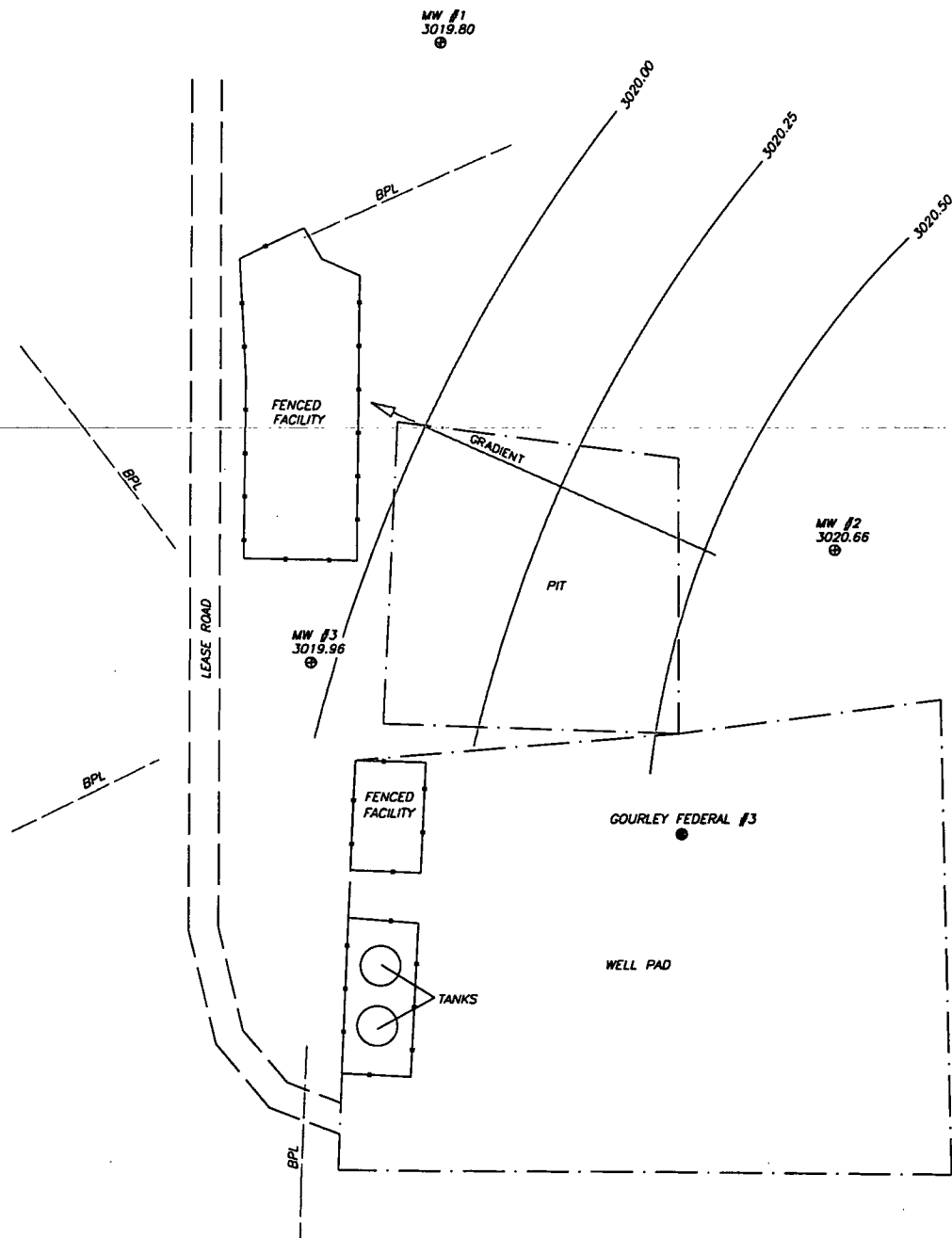


  
Tim Reed, P.G.  
Senior Project Manager

## FIGURES







**FIGURE NO. 4**

EDDY COUNTY, NEW MEXICO

UNIT PETROLEUM COMPANY

**GOURLEY FEDERAL #3  
GROUNDWATER GRADIENT MAP  
GAUGED ON 6/27/09**

**TETRA TECH, INC.**  
**MIDLAND, TEXAS**

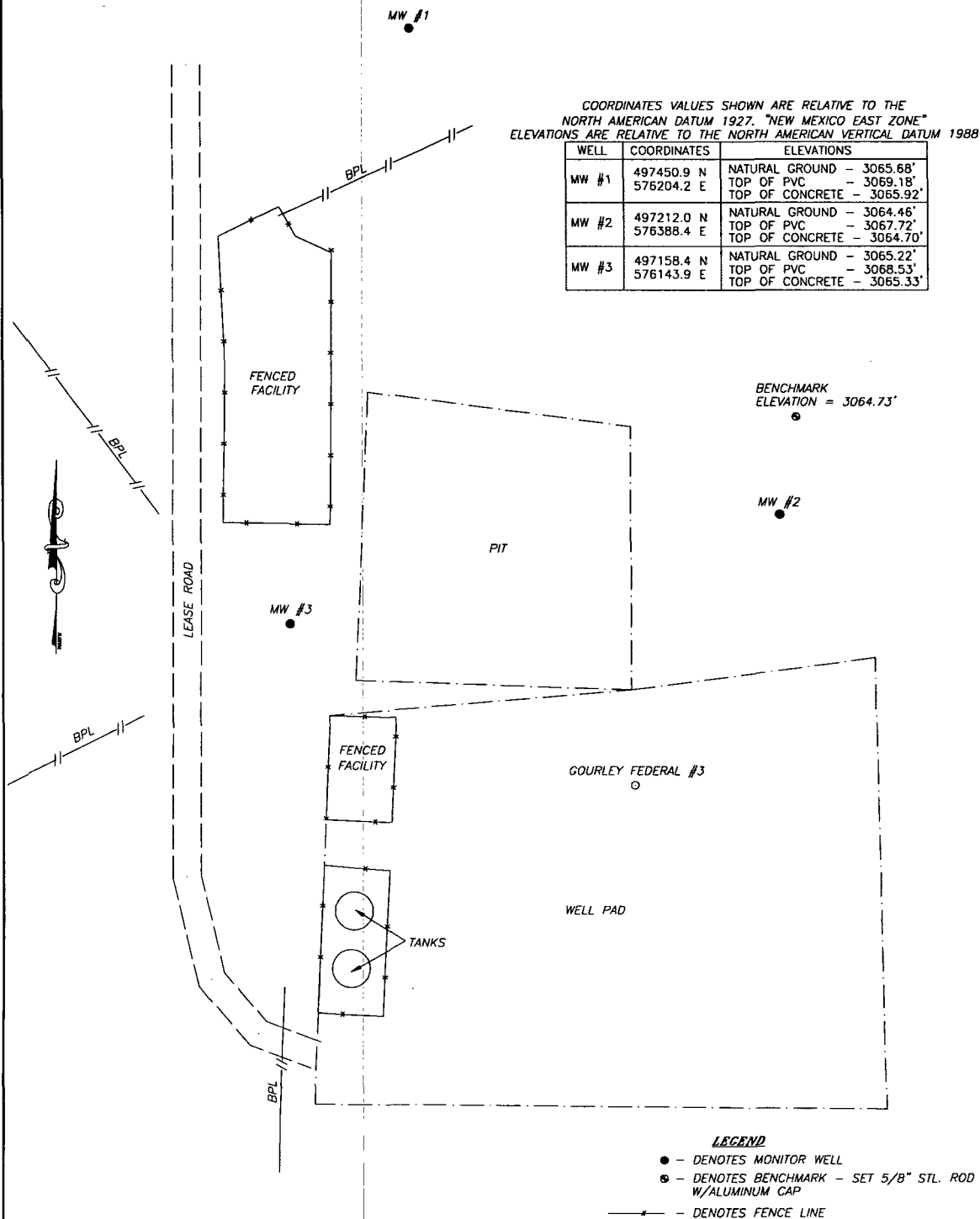
DATE:  
7/9/09

DWN. BY:  
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FILE:  
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GOURLEY FED #3 PMH

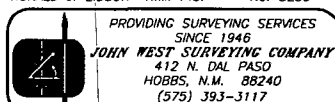
**NOT TO SCALE**

SECTION 28, TOWNSHIP 22 SOUTH, RANGE 28 EAST, N.M.P.M.,  
EDDY COUNTY, NEW MEXICO



I HEREBY CERTIFY THAT I DIRECTED AND AM  
RESPONSIBLE FOR THIS SURVEY, THAT THIS SURVEY IS  
TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE  
AND BELIEF, AND THAT THIS SURVEY AND PLAT MEET  
THE MINIMUM STANDARDS FOR SURVEYING IN NEW MEXICO

RONALD J. EIDSON N.M. P.S. No. 3239



**TETRA TECH**

SURVEY TO LOCATE MONITOR WELLS  
AND FACILITIES AROUND THE GOURLEY FEDERAL #3 IN  
SECTION 28, TOWNSHIP 22 SOUTH, RANGE 28 EAST,  
N.M.P.M., EDDY COUNTY, NEW MEXICO

Survey Date: 6/29/09	Sheet 1 of 1 Sheets
W.D. Number: 09.11.0580	Drawn By: L.A.
Date: 7/7/09	09110580

## TABLES

Table 1  
Unit Petroleum Company  
Groundwater Gauging Data  
Gourley Federal #3  
Eddy County, New Mexico

Monitor Well	Date Gauged	Date of Well Installation	Top of Casing Elevation (ft)	Total Depth of Well (bgs in ft)	Water Level Below TOC (ft)	Groundwater Elevation (ft)
MW-1	06/27/09	02/19/09	3,069.18	61.24	49.38	3,019.80
MW-2	06/27/09	06/25/09	3,067.72	63.73	47.06	3,020.66
MW-3	06/27/09	06/25/09	3,068.53	63.47	48.57	3,019.96

Table 2  
Unit Petroleum Company  
Groundwater Analytical Results  
Gourley Federal #3  
Eddy County, New Mexico

Monitor Well	Date Sampled	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Potassium (mg/L)	Hydroxide Alkalinity (mg/L)	Carbonate Alkalinity (mg/L)	Bicarbonate Alkalinity (mg/L)	Total Alkalinity (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	TDS (mg/L)	Hardness (mg/L)	pH
MW-1	02/25/09	1,340	473	1,190	16.0	<1.00	<1.00	94	94	1,800	3,220	7,800	5,290	7.26
	06/27/09	1,470	507	1,450	18.8	<1.00	<1.00	145	145	1,840	4,140	10,000	5,770	6.98
MW-2	06/27/09	582	165	474	11.4	<1.00	<1.00	115	115	1,520	1,110	3,960	2,130	7.14
MW-3	06/27/09	603	170	540	10.4	<1.00	<1.00	120	120	1,540	1,270	4,030	2,210	7.18
18" Abandoned Well	02/25/09	482	160	275	10.2	<1.00	<1.00	140	140	1,390	284	2,630	1,860	7.62

**APPENDIX A**  
**SUMMARY REPORT**  
**July 1, 2009**

## Summary Report

Gary Miller  
Tetra Tech  
1910 N. Big Spring Street  
Midland, TX 79705

Report Date: July 1, 2009

Work Order: 9062907



Project Location: Eddy Co., NM  
Project Name: Gourley Fed. #3  
Project Number: 115-6403654

Sample	Description	Matrix	Date Taken	Time Taken	Date Received
200653	MW-1	water	2009-06-27	11:30	2009-06-29
200654	MW-2	water	2009-06-27	10:00	2009-06-29
200655	MW-3	water	2009-06-27	10:45	2009-06-29

### Sample: 200653 - MW-1

Param	Flag	Result	Units	RL
Hydroxide Alkalinity		<1.00	mg/L as CaCo3	1.00
Carbonate Alkalinity		<1.00	mg/L as CaCo3	1.00
Bicarbonate Alkalinity		145	mg/L as CaCo3	4.00
Total Alkalinity		145	mg/L as CaCo3	4.00
Dissolved Calcium		1470	mg/L	1.00
Chloride		4140	mg/L	0.500
Hardness (by ICP)		5770	mg eq CaCO3/L	0.00
Dissolved Potassium		18.8	mg/L	1.00
Dissolved Magnesium		507	mg/L	1.00
Dissolved Sodium		1450	mg/L	1.00
pH		6.98	s.u.	0.00
Sulfate		1840	mg/L	0.500
Total Dissolved Solids		10000	mg/L	10.0

### Sample: 200654 - MW-2

Param	Flag	Result	Units	RL
Hydroxide Alkalinity		<1.00	mg/L as CaCo3	1.00

continued ...



*sample 200654 continued ...*

Param	Flag	Result	Units	RL
Carbonate Alkalinity		<1.00	mg/L as CaCo3	1.00
Bicarbonate Alkalinity		115	mg/L as CaCo3	4.00
Total Alkalinity		115	mg/L as CaCo3	4.00
Dissolved Calcium		582	mg/L	1.00
Chloride		1110	mg/L	0.500
Hardness (by ICP)		2130	mg eq CaCO3/L	0.00
Dissolved Potassium		11.4	mg/L	1.00
Dissolved Magnesium		165	mg/L	1.00
Dissolved Sodium		474	mg/L	1.00
pH		7.14	s.u.	0.00
Sulfate		1520	mg/L	0.500
Total Dissolved Solids		3960	mg/L	10.0

**Sample: 200655 - MW-3**

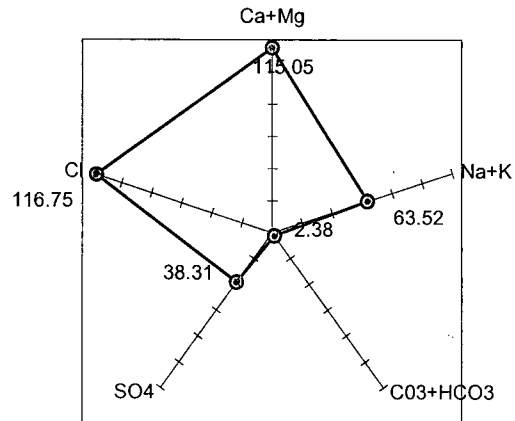
Param	Flag	Result	Units	RL
Hydroxide Alkalinity		<1.00	mg/L as CaCo3	1.00
Carbonate Alkalinity		<1.00	mg/L as CaCo3	1.00
Bicarbonate Alkalinity		120	mg/L as CaCo3	4.00
Total Alkalinity		120	mg/L as CaCo3	4.00
Dissolved Calcium		603	mg/L	1.00
Chloride		1270	mg/L	0.500
Hardness (by ICP)		2210	mg eq CaCO3/L	0.00
Dissolved Potassium		10.4	mg/L	1.00
Dissolved Magnesium		170	mg/L	1.00
Dissolved Sodium		540	mg/L	1.00
pH		7.18	s.u.	0.00
Sulfate		1540	mg/L	0.500
Total Dissolved Solids		4030	mg/L	10.0

**APPENDIX B**  
**STIFF DIAGRAMS**

# Stiff Diagrams (1)

MW-1		
Ca	73.35	
Mg	41.69	Ca+Mg 115.05
Na	63.04	Na+K 63.52
K	0.48	CO3+HCO3 2.38
CO3	0.00	SO4 38.31
HCO3	2.38	Cl 116.75
SO4	38.31	
Cl	116.75	
NO3	0.00	
F	0.00	

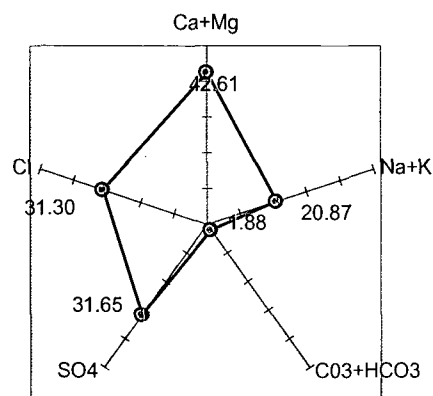
Stiff Diagram for MW-1  
Unit Petroleum Company - Gourley #3  
Eddy County, New Mexico  
June 27, 2009



# Stiff Diagrams (2)

	MW-2	
Ca	29.04	
Mg	13.57	Ca+Mg 42.61
Na	20.61	Na+K 20.87
K	0.27	CO <sub>3</sub> +HCO <sub>3</sub> 1.88
CO <sub>3</sub>	0.00	SO <sub>4</sub> 31.65
HCO <sub>3</sub>	1.88	Cl 31.30
SO <sub>4</sub>	31.65	
Cl	31.30	
NO <sub>3</sub>	0.00	
F	0.00	

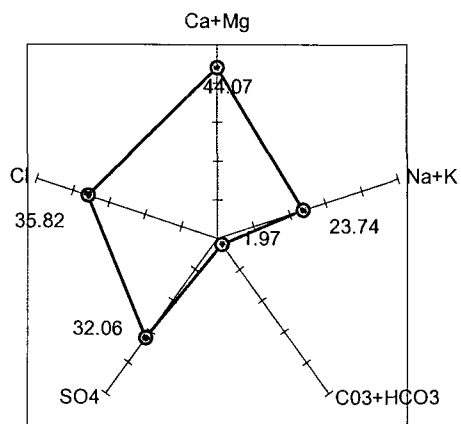
Stiff Diagram Monitor Well #2  
Unit Petroleum Company - Gourley #3  
Eddy County, New Mexico  
June 27, 2009



# Stiff Diagrams (5)

	<b>MW-3</b>	
Ca	30.09	
Mg	13.98	Ca+Mg 44.07
Na	23.48	Na+K 23.74
K	0.27	CO3+HCO3 1.97
CO3	0.00	SO4 32.06
HCO3	1.97	Cl 35.82
SO4	32.06	
Cl	35.82	
NO3	0.00	
F	0.00	

**Stiff Diagram for MW-3**  
**Unit Petroleum Company - Gourley #3**  
**Eddy County, New Mexico**  
**June 27, 2009**



# Stiff Diagrams (2)

Abandoned 18 inch well			
Ca	24.05		
Mg	13.16	Ca+Mg	37.21
Na	11.96	Na+K	12.22
K	0.26	CO <sub>3</sub> +HCO <sub>3</sub>	2.29
CO <sub>3</sub>	0.00	SO <sub>4</sub>	2.91
HCO <sub>3</sub>	2.29	Cl	8.01
SO <sub>4</sub>	2.91		
Cl	8.01		
NO <sub>3</sub>	0.00		
F	0.00		

Stiff Diagram Abandoned 18 inch well  
Unit Petroleum Company - Gourley #3  
Eddy County, New Mexico  
February 25, 2009

