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REPORTS

DATE:

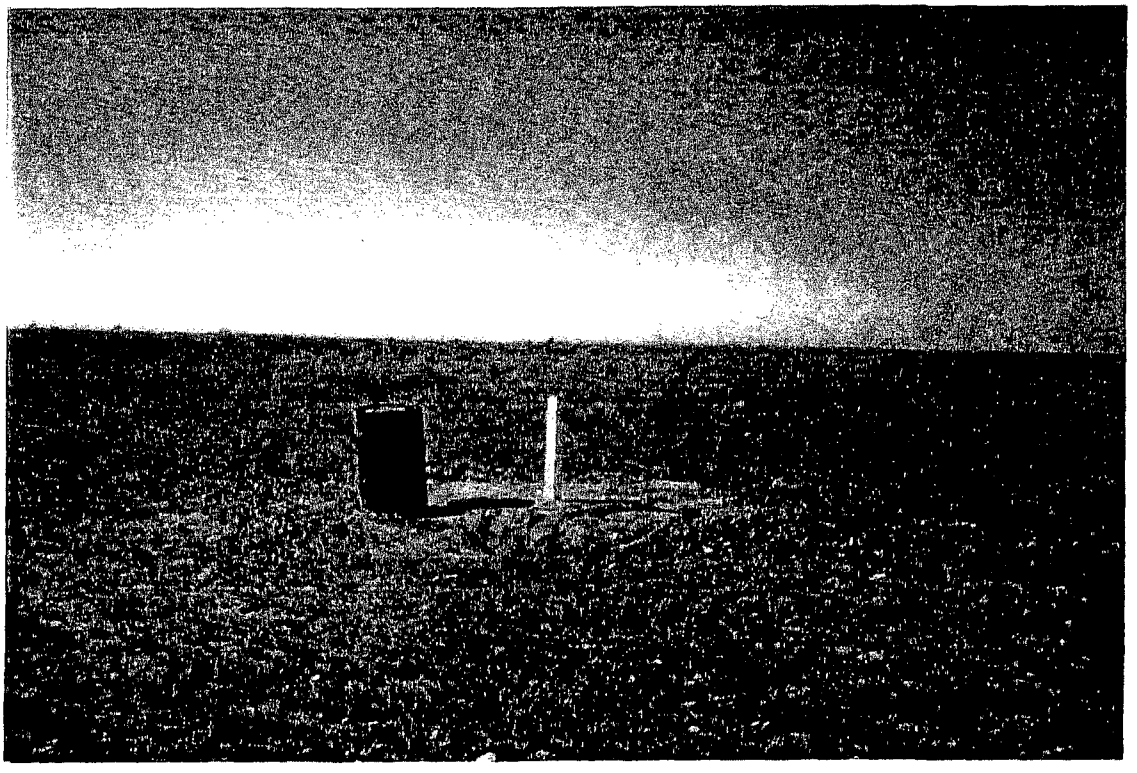
2000

UNOCAL CORPORATION
REPORT OF ADDITIONAL GROUNDWATER INVESTIGATION
FORMER UNOCAL SOUTH VACUUM UNIT
LEA COUNTY, NEW MEXICO

JULY 18, 2000

Prepared For:

Unocal Corporation
Asset Management Group
P. O. Box 1283
Nederland, Texas 77627



TRW

TRW Systems & Information Technology Group
415 West Wall Street, Suite 1818
Midland, TX 79701

July 18, 2000

Mr. William C. Olson
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
2040 S. Pacheco
Santa Fe, New Mexico 87505

RE: REPORT OF ADDITIONAL GROUNDWATER INVESTIGATION
FORMER UNOCAL SOUTH VACUUM UNIT
LEA COUNTY, NEW MEXICO

Dear Mr. Olson:

TRW Inc. – Energy & Environmental Systems (TRW) has completed the installation of two additional monitoring wells (MW-5 and MW-6) and groundwater sampling of all wells (MW-1 through MW-6) at the former Unocal South Vacuum Unit in Lea County, New Mexico. The investigation was conducted in accordance with the February 9, 2000 Groundwater Investigation Work Plan submitted by the Asset Management Group of Unocal Corporation (Unocal) and the requirements specified in your letter dated May 24, 2000. This Groundwater Investigation Report documents the results of the monitoring well installation on June 12, 2000, and sampling activities conducted by TRW on June 14, 2000.

Procedures

Monitoring Well Construction Methods

Drilling operations for the two additional monitoring wells (MW-5 and MW-6) were conducted by Diversified Water Well Drilling using an air-rotary drilling rig. The monitoring wells were constructed of 2-inch diameter schedule 40 PVC well casing and 20 feet of 0.010-inch slotted well screen. At least 5 feet of well screen was installed above the water table leaving approximately 15 feet of well screen below the water table. The screened portion of each monitoring well was surrounded with a filterpack consisting of 10/20 Colorado sand that was capped with approximately 45 feet of bentonite. The remaining 10 feet of annular space in each monitoring well was sealed with a portland cement grout emplaced from the top of the bentonite plug to ground surface. A 4-foot by 4-foot concrete pad was constructed at the surface and the top of casing protected with an above ground, locked steel well cover. The monitoring well construction diagrams are provided in Attachment A. The monitoring well and soil borings locations and elevations were surveyed by Basin Surveys of Hobbs, New Mexico. A copy of the survey plat is included in Attachment B.

Groundwater Sampling Methods

Monitoring wells MW-5 and MW-6 were developed by hand with a clean bailer two days prior to purging and sampling. Each of the six monitoring wells, MW-1 through MW-6, was gauged for depth to groundwater using a Solinst Model 101 electronic water indicator immediately prior to purging operations. A total of approximately 170 gallons was purged from the site monitoring wells using a decontaminated 2-inch diameter Grundfos Redi Flo2 submersible pump. Field parameters, including pH, conductivity, temperature, and

dissolved oxygen were measured and groundwater samples collected after these parameters stabilized. Water samples measured during purging, collected from monitoring wells MW-1 through MW-6 for laboratory analysis were transferred into 1,000 milliliter (ml) plastic containers for analysis of total dissolved solids (TDS) (EPA Method 160.1) and chloride (EPA Method 325.3). An additional set of samples was collected in 40 ml glass containers with teflon-lined lids and zero headspace for analysis of benzene, toluene, ethlylbenzene, and xylenes (BTEX) using EPA Method 8021B. For each set of samples, chain of custody forms documenting sample identification numbers, collection times, and delivery times to the laboratory were completed. All water samples were placed in an ice-filled cooler immediately after collection and transported to SPL, Inc. in Houston, Texas for analysis.

Local Geology

The lithology of the subsurface soils in monitoring wells MW-1 through MW-6 is similar. Generally, the unsaturated zone is composed of a hard, weathered and fractured, light gray caliche layer to a depth of approximately 10 to 20 feet. Below the caliche layer, a tan to light gray siliceous sandstone layers interbedded with a very fine-grained sand was encountered to a depth of approximately 27 feet; however the very fine-grained sand layer gradationally became more dominant with depth and the sandstone layers occurred as intermittent stringers to the bottom of the borings. Groundwater was encountered at depths ranging from 47 to 68 feet below ground surface. A detailed description of the subsurface soils for monitoring wells MW-5 and MW-6 is provided on the lithologic logs in Attachment A.

Groundwater Gradient

Depth to groundwater varies from approximately 47 to 67 feet below ground surface at the site. Groundwater elevations are summarized in Table 1. A groundwater gradient map indicating the direction of groundwater flow is illustrated in Figure 1. A historical groundwater elevation graph is shown in Figure 2. The groundwater gradient direction is to the southeast with a hydraulic gradient of approximately 0.004 ft/ft. According to published reports (*Ground-Water Conditions in Northern Lea County, New Mexico*, Ash, 1963 and *Geology and Ground-Water Conditions in Southern Lea County, New Mexico*, Nicholson and Clebsch, 1961) the groundwater encountered at the site is that of the Tertiary Ogallala Formation. The Ogallala Formation unconformably overlies the impermeable red-beds of the Triassic Chinle Formation at an elevation of approximately 3700 feet above mean sea level (AMSL). Based on the current groundwater elevations measured on site and published data referenced, the saturated thickness of the Ogallala Formation at the site ranges from approximately 85 to 95 feet.

Groundwater Analytical Results

Groundwater sample analytical results are presented in Table 2. The New Mexico Water Quality Control Commission (WQCC) standards are presented for comparison. Those constituents that recorded concentrations above the WQCC standards are highlighted in boldface type. The WQCC standard of 250 mg/L for chloride was exceeded in MW-1 (927 mg/L), MW-2 (317 mg/L), and MW-4 (1500 mg/L). The WQCC standard of 1,000 mg/L for TDS was exceeded in MW-1 (2,040 mg/L) and MW-4 (2,910 mg/L). The groundwater samples obtained from upgradient monitoring well MW-3 and downgradient wells MW-5 and MW-6 had chloride and TDS concentrations below WQCC standards.

BTEX was not detected. BTEX concentrations for all monitoring wells were below the laboratory detection limit of 0.001 mg/L and were below the WQCC standards as referenced in Table 2.

The chloride and TDS concentrations are depicted graphically in Figure 3 and 4, respectively. The concentration isopleths were drawn utilizing the Surfer® (version 6.0) contour modeling program (Kriging method). Since this contouring program does not take into account the known groundwater gradient, some of the isopleths were manually converged into a more southeasterly orientation. Graphs depicting historical TDS and chloride concentrations in monitoring wells MW-1and MW-4 are shown in Figures 5 and 6.

Table 1
Summary of Groundwater Elevation Measurements
Former Unocal South Vacuum Unit

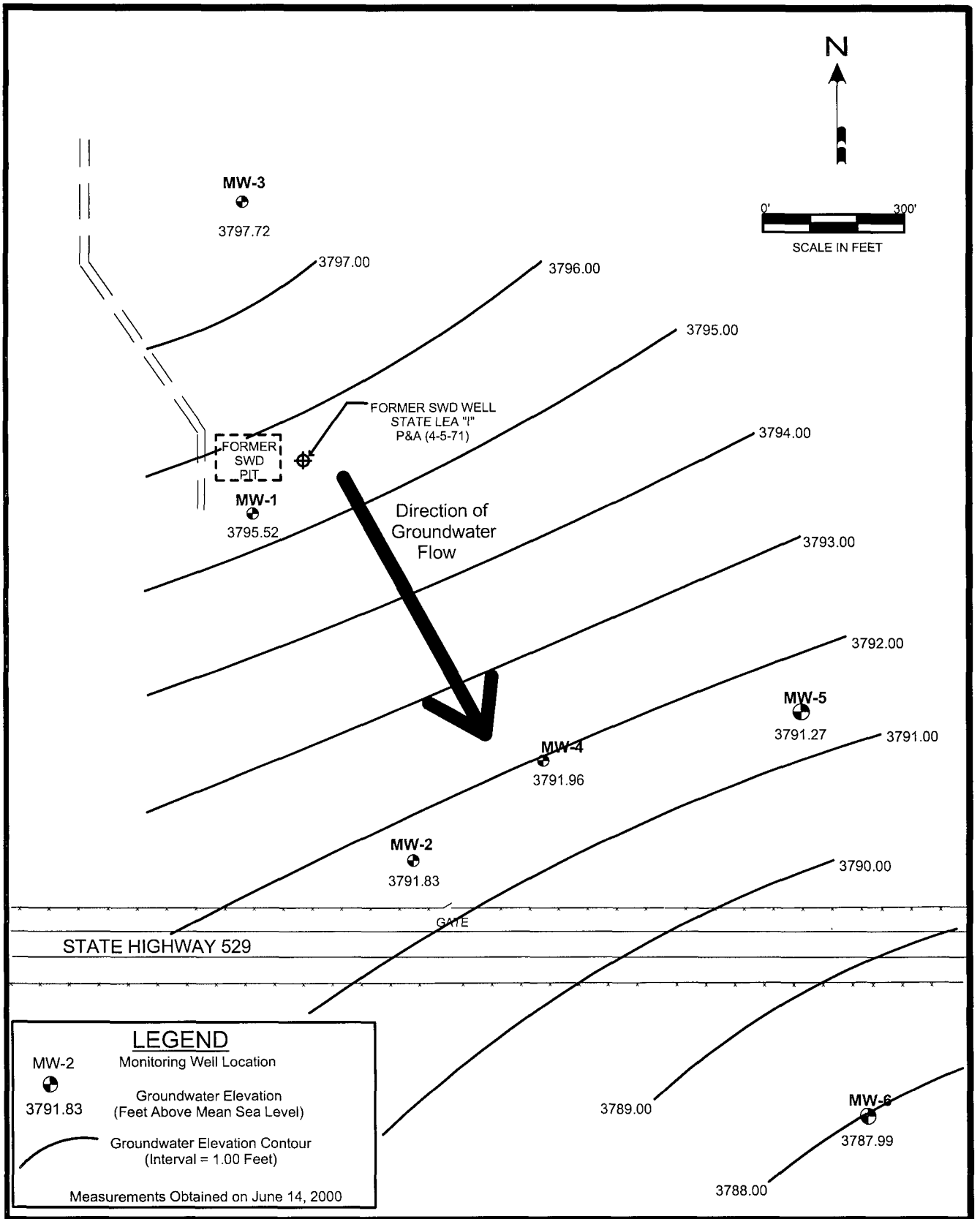
Monitoring Well	Measurement Date	Ground Surface Elevation (feet AMSL)	Top of Casing Elevation (feet AMSL)	Depth to Groundwater (feet BTOC)	Groundwater Elevation (feet AMSL)
MW-1	01/27/95	3856.76	3858.37	59.57	3798.80
	05/18/95	3856.76	3858.37	61.30	3797.07
	08/28/96	3856.76	3858.37	61.57	3796.80
	08/13/97	3856.76	3858.37	61.75	3796.62
	09/30/99	3856.76	3858.37	62.51	3795.86
	06/14/00	3856.76	3858.37	62.85	3795.52
MW-2	09/30/99	3839.11	3841.64	49.51	3792.13
	06/14/00	3839.11	3841.64	49.81	3791.83
MW-3	09/30/99	3862.20	3864.73	66.74	3797.99
	06/14/00	3862.20	3864.73	67.01	3797.72
MW-4	09/30/99	3849.87	3852.51	60.18	3792.33
	06/14/00	3849.87	3852.51	60.55	3791.96
MW-5	06/14/00	3856.59	3859.84	68.57	3791.27
MW-6	06/14/00	3855.32	3858.78	70.79	3787.99

AMSL - Above Mean Sea Level; BTOC - Below Top of Casing
Groundwater flow direction is to the southeast with a gradient of approx. 0.004 ft/ft.
Elevations and state plane coordinates surveyed by Basin Surveys, Hobbs, NM.

Table 2
Summary of Groundwater Analytical Results
Former Unocal South Vacuum Unit

Monitoring Well	Sample Date	Chloride (mg/L)	TDS (mg/L)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylene (mg/L)
MW-1	01/27/95	**1174**	**2250**	< 0.001	< 0.001	< 0.001	< 0.001
	05/18/95	**983**	**2251**	< 0.001	< 0.001	< 0.001	< 0.001
	08/28/96	**1420**	**2730**	< 0.001	< 0.001	< 0.001	< 0.001
	08/13/97	**1400**	**2800**	< 0.001	< 0.001	< 0.001	< 0.001
	12/14/98	**1400**	**2400**	< 0.001	< 0.001	< 0.001	< 0.001
	09/29/99	**1094**	**2318**	< 0.001	< 0.001	< 0.001	< 0.001
	06/14/00	**927**	**2040**	< 0.001	< 0.001	< 0.001	< 0.001
MW-2	09/30/99	**298**	922	< 0.001	< 0.001	< 0.001	< 0.001
	06/14/00	**317**	852	< 0.001	< 0.001	< 0.001	< 0.001
MW-3	09/30/99	73.6	427	< 0.001	< 0.001	< 0.001	< 0.001
	06/14/00	75.5	433	< 0.001	< 0.001	< 0.001	< 0.001
MW-4	09/30/99	**1576**	**2981**	< 0.001	< 0.001	< 0.001	< 0.001
	06/14/00	**1500**	**2910**	< 0.001	< 0.001	< 0.001	< 0.001
MW-5	06/14/00	13.7	274	< 0.001	< 0.001	< 0.001	< 0.001
MW-6	06/14/00	48	382	< 0.001	< 0.001	< 0.001	< 0.001
WQCC Standards		250	1000	0.01	0.75	0.75	0.62

Total Dissolved Soilds (TDS), chloride, and BTEX concentrations listed in milligrams per liter (mg/L)
Analyses performed by Trace Analysis Inc., Lubbock, TX (1995-1998) and SPL, Inc., Houston, TX (1999-2000).
Values in boldface type indicate concentrations exceed New Mexico Water Quality Commission (WQCC) standards.

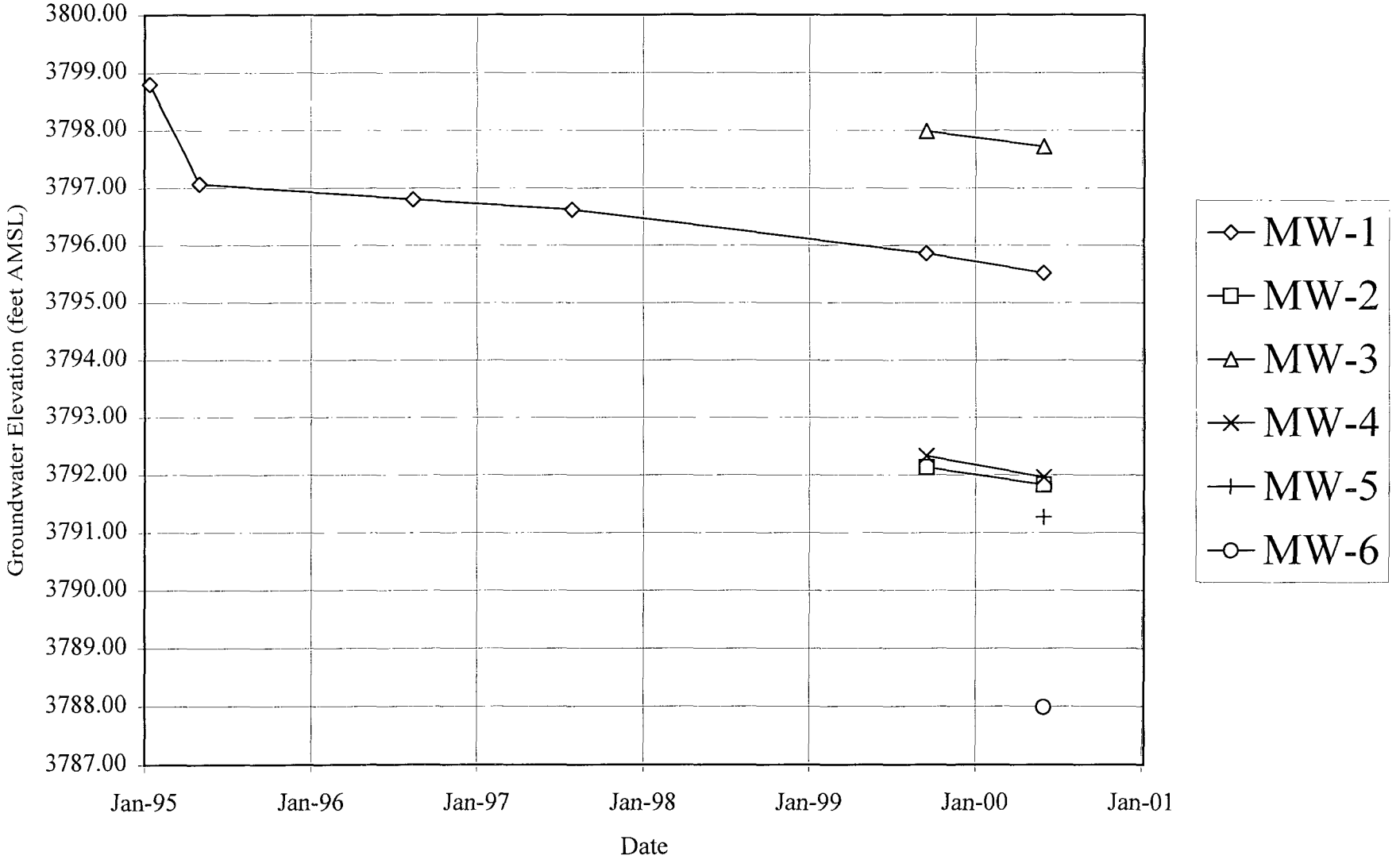


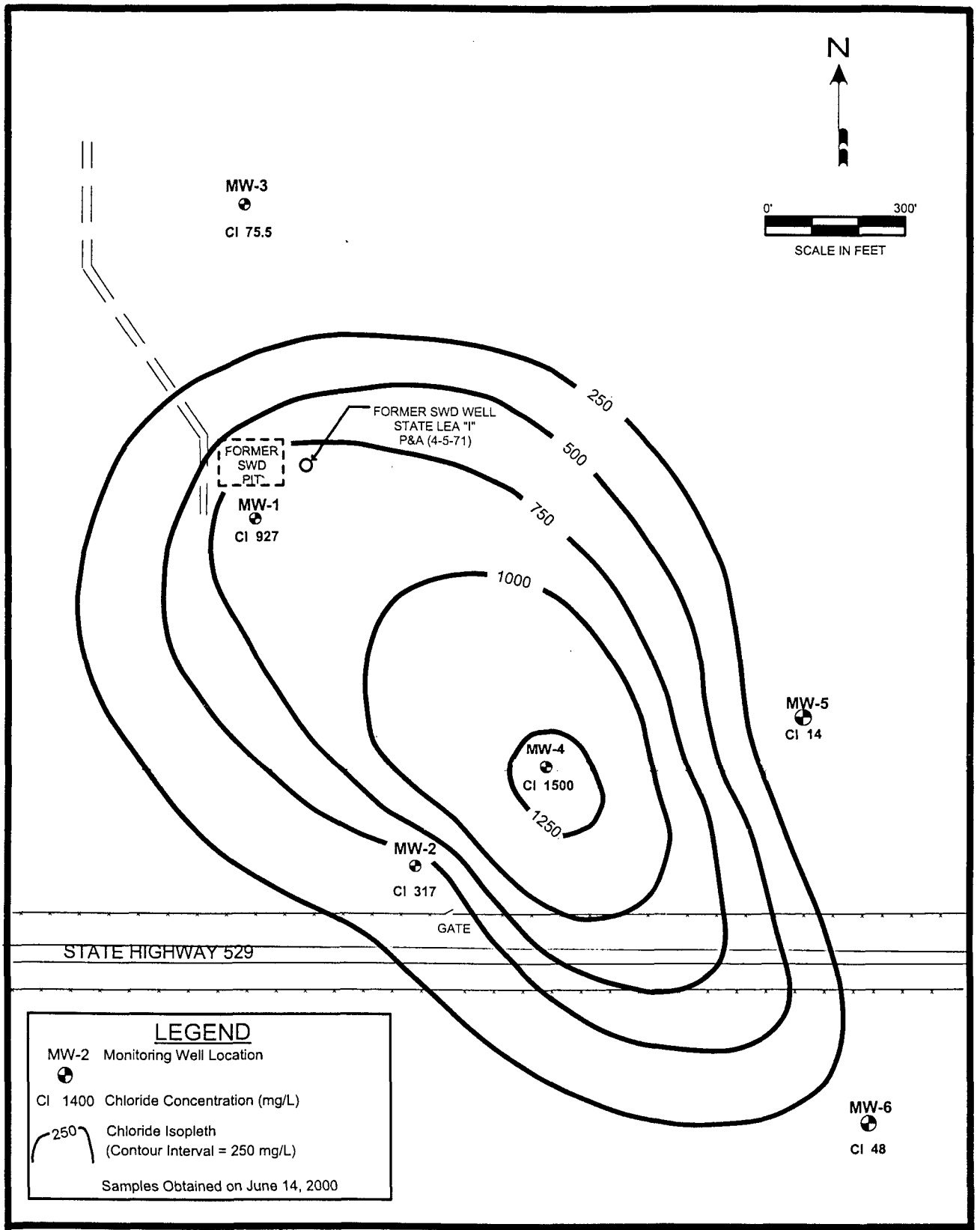
SITE: UNOCAL SOUTH VACUUM UNIT	
DATE: 06/14/00	REV. NO.: 062600
AUTHOR: GJV	DRN BY: GJV
CK'D BY: DTL	FILE: VACUUM.TCW

FIGURE 1

GROUNDWATER ELEVATION MAP

Figure 2
Historical Groundwater Elevations

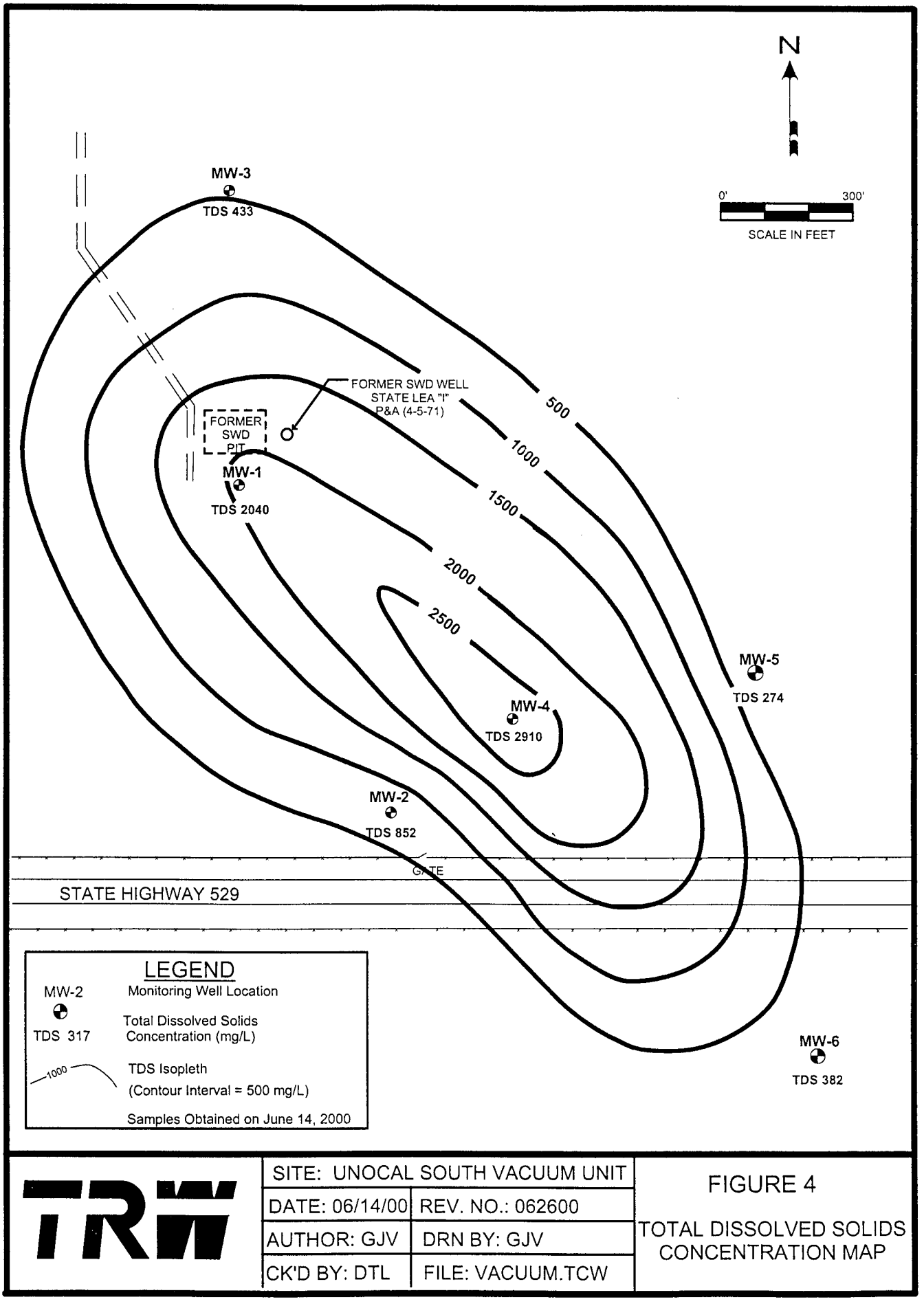




SITE: UNOCAL SOUTH VACUUM UNIT	
DATE: 06/14/00	REV. NO.: 062600
AUTHOR: GJV	DRN BY: GJV
CK'D BY: DTL	FILE: VACUUM.TCW

FIGURE 3

CHLORIDE CONCENTRATION MAP



TRW

SITE: UNOCAL SOUTH VACUUM UNIT	
DATE: 06/14/00	REV. NO.: 062600
AUTHOR: GJV	DRN BY: GJV
CK'D BY: DTL	FILE: VACUUM.TCW

FIGURE 4

TOTAL DISSOLVED SOLIDS CONCENTRATION MAP

Figure 5
TDS and Chloride Concentrations (MW-1)

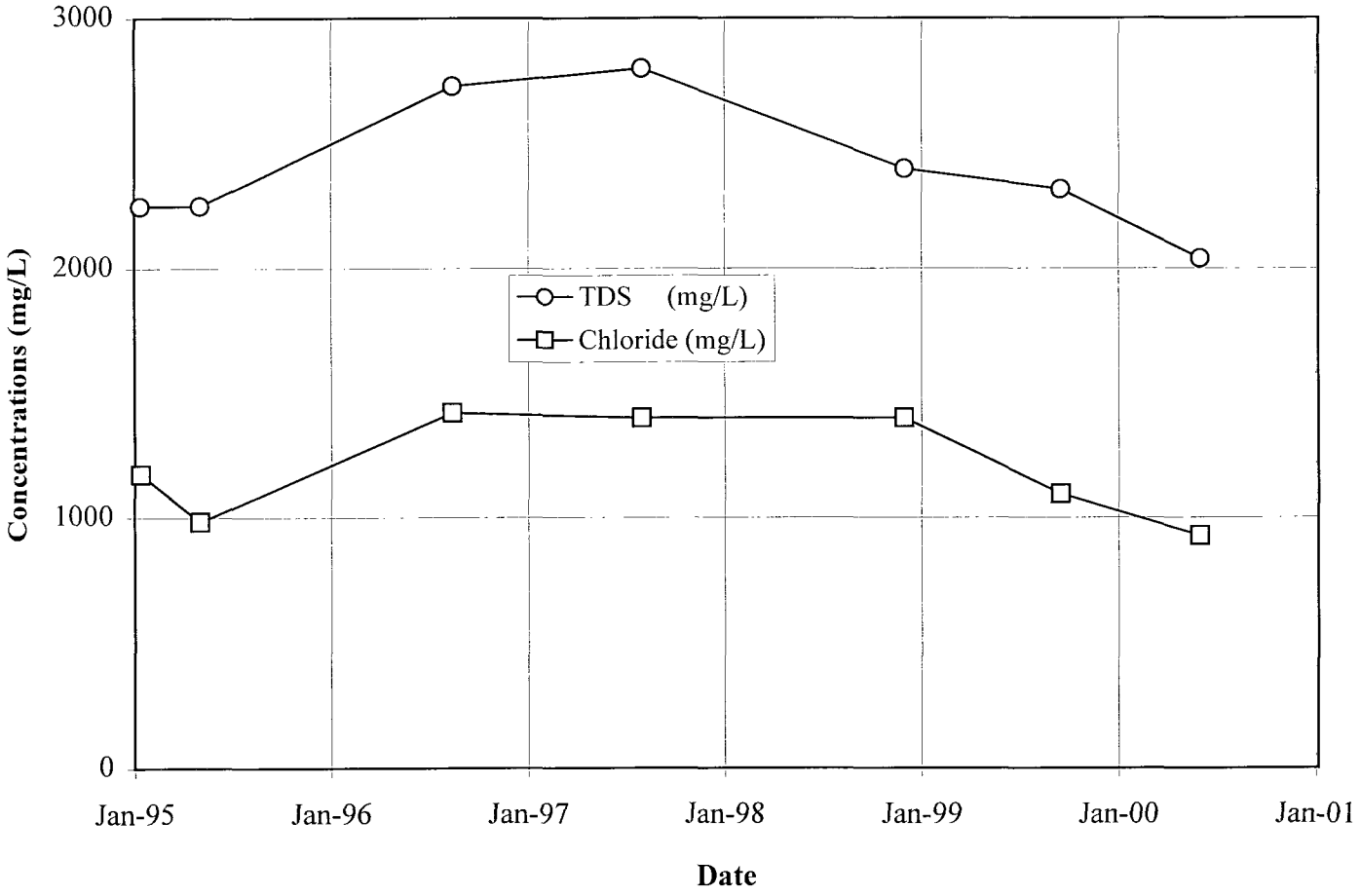
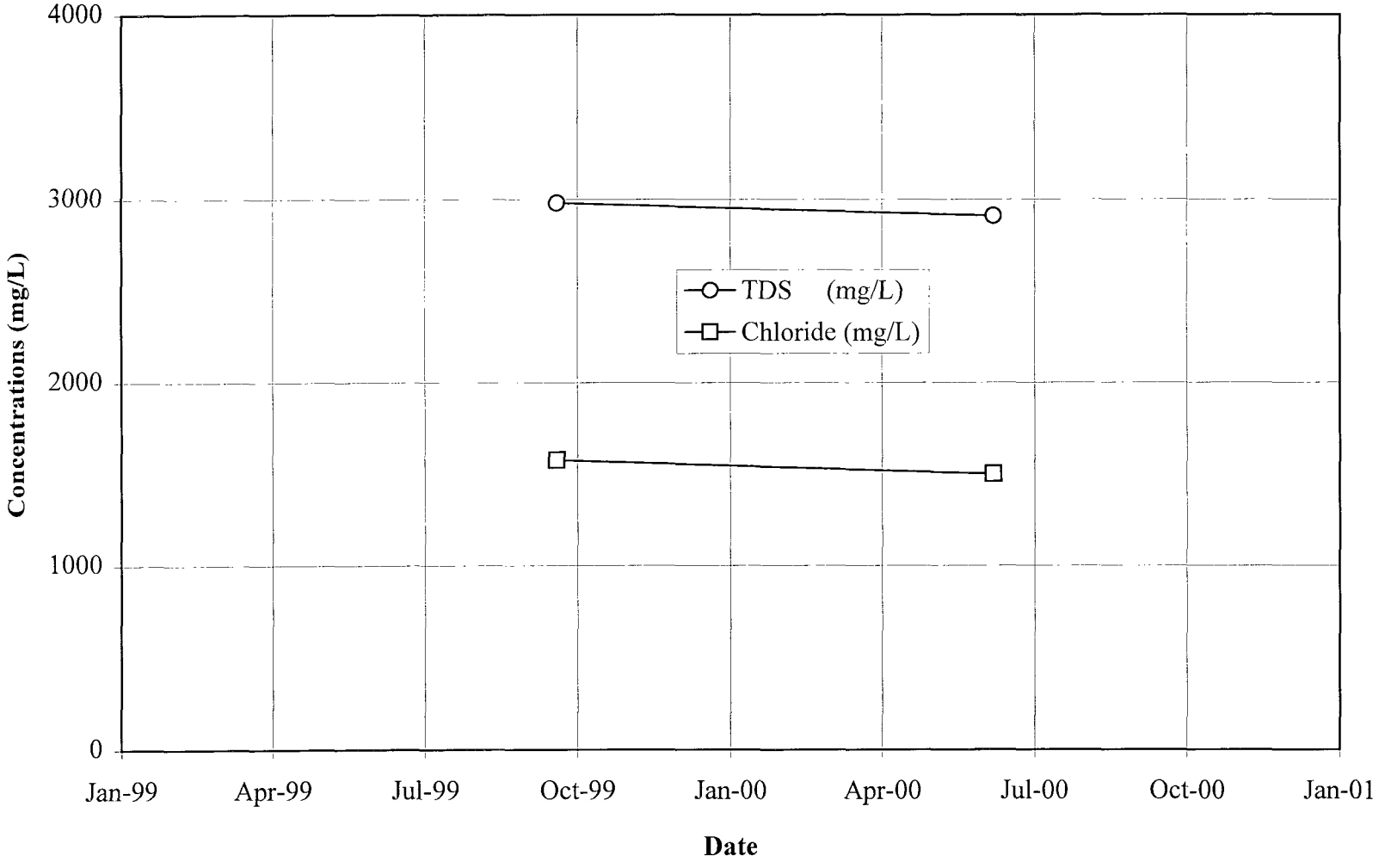


Figure 6
TDS and Chloride Concentrations (MW-4)



Conclusions

The results of this groundwater investigation at the South Vacuum Unit are summarized as follows:

- The WQCC standard of 1,000 mg/L for TDS in groundwater was exceeded in MW-1 and MW-4.
- The WQCC standard of 250 mg/L for chloride in groundwater was exceeded in MW1, MW-2 and MW-4.
- The higher TDS and chloride concentrations in downgradient monitoring well MW-4 indicate the plume has migrated in the downgrdient direction (southeast) and that there is not a continual source (former SWD pit near MW-1).
- Based on the analytical results for monitoring wells MW-5 and MW-6, the downgradient extent of the TDS/chloride plume has been delineated. The downgradient extent of the TDS and chloride plumes are approximately 800 and 900 feet downgradient of MW-4, respectively, as estimated by linear extrapolation of TDS and chloride concentrations between MW-4 and MW-6.
- TDS and chloride concentrations in monitoring well MW-1 have been decreasing since the August 13, 1997 sampling event. TDS and chloride concentrations in MW-4 have also declined since the previous sampling event in September 1999.
- Groundwater elevations have been steadily decreasing since the initial sampling event in January 1995.

Recommendations

Based on the consistency of the analytical results and successful delineation of the downgradient extent of the TDS and chloride plume, groundwater sampling should be reduced to an annual frequency. Since there is no evidence of BTEX in any of the monitoring wells there is no need for continued sampling and analysis of BTEX constituents.

Sincerely,

Gilbert J. Van Deventer, REM

Attachments

xc: Ben Terry, Unocal – Houston, TX
Kevin Behrens, IT Group – Houston, TX
Donna Williams, OCD - Hobbs, NM

ATTACHMENTS

ATTACHMENT A

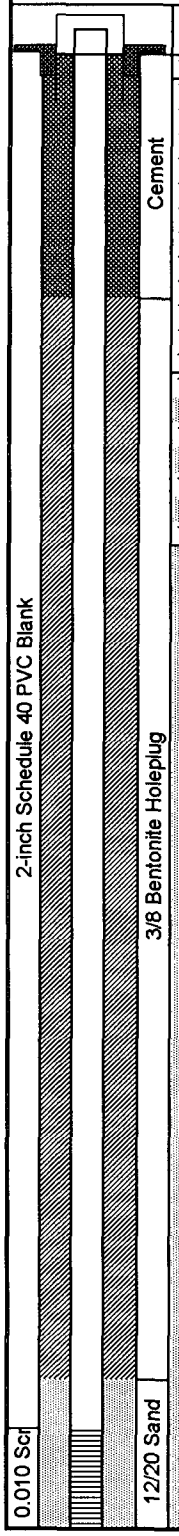
LITHOLOGIC LOGS AND

MONITORING WELL CONSTRUCTION DIAGRAMS

LITHOLOGIC LOG (MONITORING WELL)

TRW
415 WEST WALL
SUITE 1818
MIDLAND, TEXAS 79701

MONITOR WELL NO.:	MW-5	TOTAL DEPTH:	78 Feet
SITE ID:	South Vacuum Unit	CLIENT:	Unocal
SURFACE ELEVATION:	3856.59	COUNTY:	Lea
CONTRACTOR:	Diversified Water Well	STATE:	New Mexico
DRILLING METHOD:	Air Rotary	LOCATION:	Sec 35, T-18-S, R-35-E
START DATE:	06/12/00	FIELD REP.:	J. Fergerson
COMPLETION DATE:	06/12/00	FILE NAME:	
COMMENTS:	413 feet east of MW-4 and 420 feet north of south fenceline.		

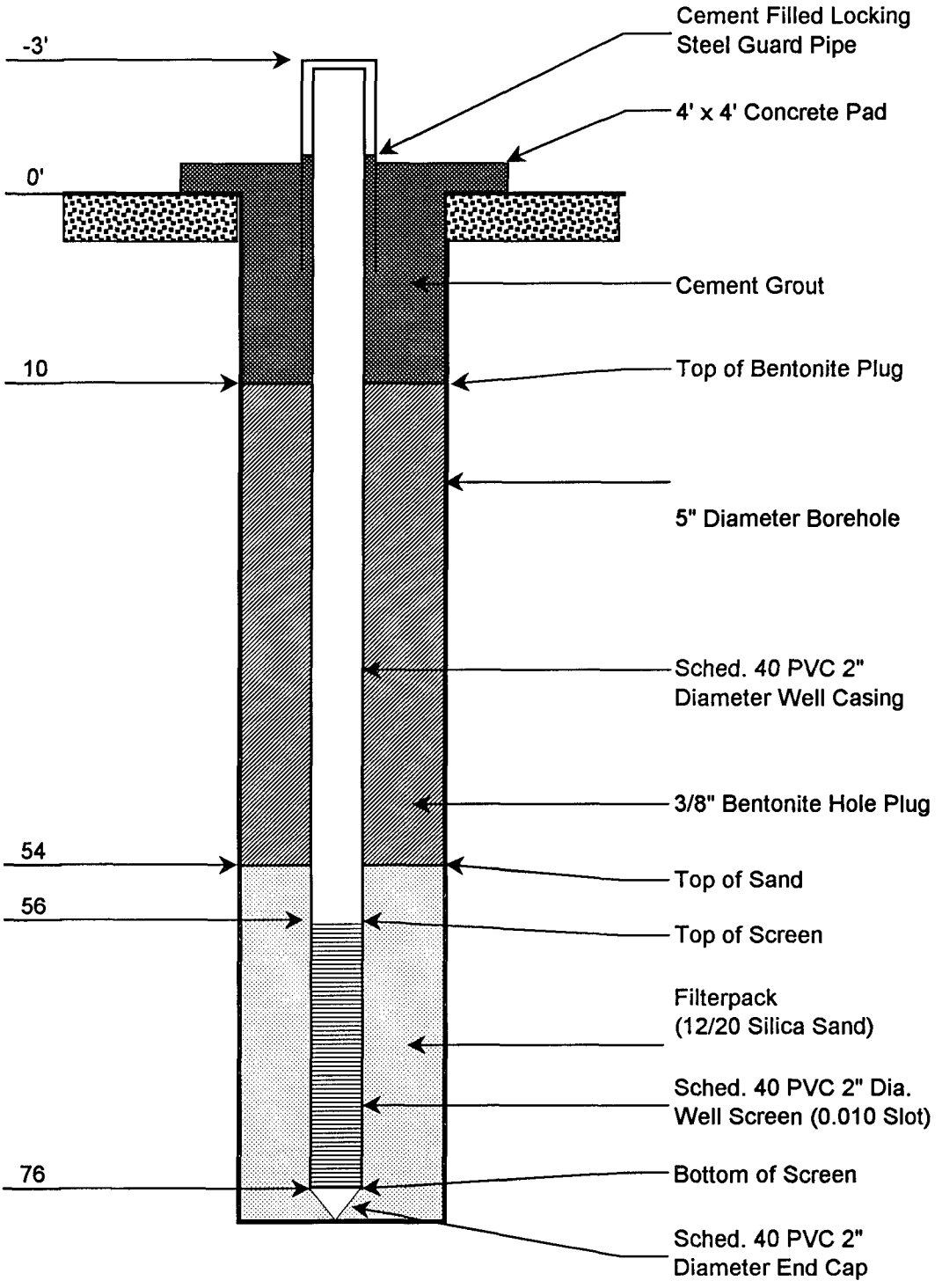


LITH.	USCS	Sample Depth	Sample Time	Sample Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
	CAL	0	0905				Caliche, tan-white, no odor, w/clayey silt in matrix.
							Caliche, tan-white, no odor, weathered, interbedded with dense caliche layers.
		5		Cuttings	1.1	5	
	CAL						
		10	0920	Cuttings	4.3	10	
							Caliche, tan-white, no odor, weathered, interbedded with dense caliche layers and mod-well cemented sandstone.
		15		Cuttings	6.9	15	
	CAL/SS						
		20	0932	Cuttings	5.2	20	
							Sand, vf grain, tan-lt brown, no odor, w mod-well cemented sandstone interbedded.
		25		Cuttings	5.7	25	
							Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
		30	0948	Cuttings	7.6	30	
		35		Cuttings	8.1	35	
	SW	40	0951	Cuttings	7.3	40	
							Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
		45		Cuttings	5.4	45	
		50	0958	Cuttings	3.2	50	
							Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
		55		Cuttings	3.6	55	
		60	1002	Cuttings	3.9	60	

MONITORING WELL NO: MW-5 TOTAL DEPTH: 78 Feet

	LITH.	USCS	Sample Depth	Sample Time	Sample Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
NS 0.010 Slot PVC Screen / 12/20 Silica Sand Pack NS							▼	Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
								Encountered groundwater @ 61 feet
			65		Cuttings	3.3	65	
		SW	70	1007			70	Sand, vf grain, tan-brown, wet, no odor, with well cemented sandstone interbedded.
			75				75	
				1011				TD @ 78 Feet

MONITORING WELL CONSTRUCTION DIAGRAM (MW-5)

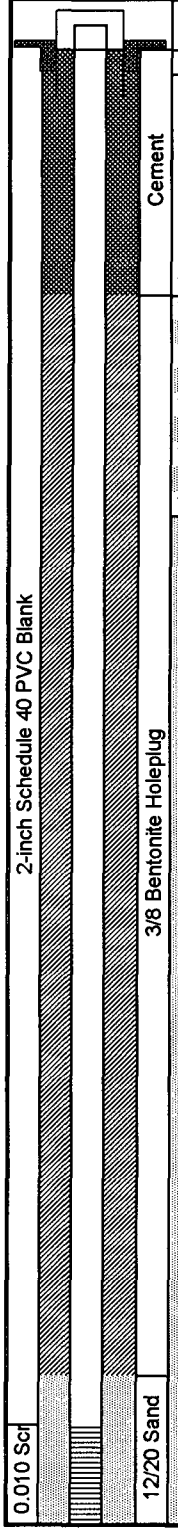


TRW Energy & Environmental Systems	SITE: Former Unocal South Vacuum Unit		**MW-5 Monitoring Well Construction Diagram**
	DATE: 06/12/00	REV. NO.: 1	
	AUTHOR: GJV	DRAWN BY: GJV	
	CK'D BY: DTL	FILE: Well Bore Diagram	

LITHOLOGIC LOG (MONITORING WELL)

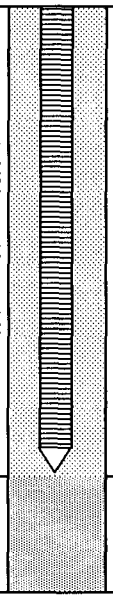
TRW
415 WEST WALL
SUITE 1818
MIDLAND, TEXAS 79701

MONITOR WELL NO.:	MW-6	TOTAL DEPTH:	80 Feet
SITE ID:	South Vacuum Unit	CLIENT:	Unocal
SURFACE ELEVATION:	3859.00	COUNTY:	Lea
CONTRACTOR:	Diversified Water Well	STATE:	New Mexico
DRILLING METHOD:	Air Rotary	LOCATION:	Sec 35, T-18-S, R-35-E
START DATE:	06/12/00	FIELD REP.:	J. Fergerson
COMPLETION DATE:	06/12/00	FILE NAME:	
COMMENTS:	120 feet east of MW-5 and 250 feet south of north fenceline		



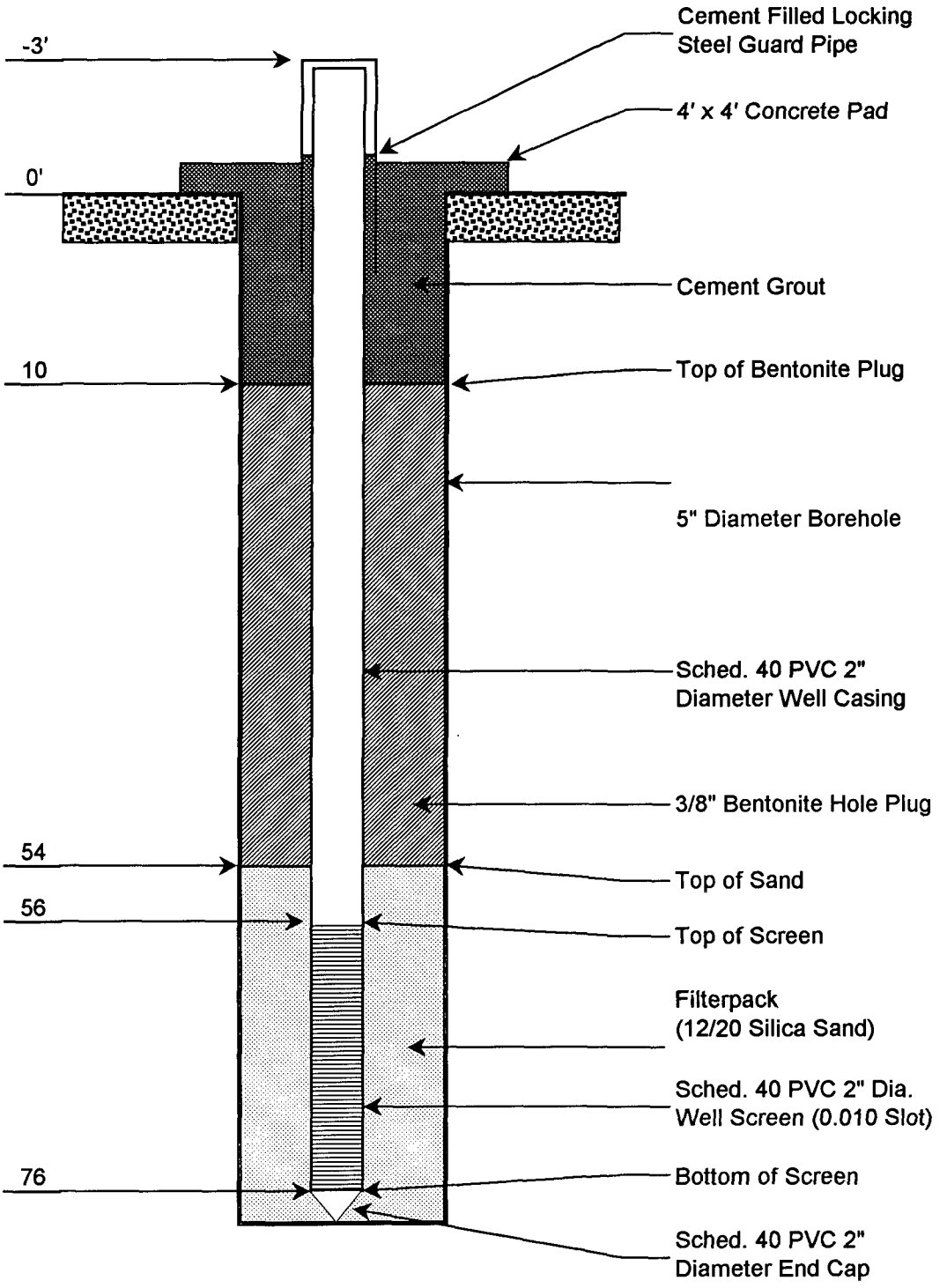
LITH.	USCS	Sample Depth	Sample Time	Sample Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
	CAL	0	1159				Caliche, tan-white, no odor, w/clayey silt in matrix.
	CAL	5		Cuttings	9.2	5	Caliche, tan-white, no odor, weathered, interbedded with dense caliche layers.
		10	1208	Cuttings	6.2	10	
	CAL/SS	15		Cuttings	6.8	15	Caliche, tan-white, no odor, weathered, interbedded with dense caliche layers and mod-well cemented sandstone.
		20	1216	Cuttings	6.8	20	Sand, vf grain, tan-lt brown, no odor, w mod-well cemented sandstone interbedded.
		25		Cuttings	3.8	25	
		30	1227	Cuttings	4.6	30	Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
		35		Cuttings	3.6	35	
	SW	40	1231	Cuttings	2.4	40	
		45		Cuttings	2.8	45	Sand, vf grain, tan-brown, no odor, with well cemented sandstone interbedded.
		50	1237	Cuttings	2.8	50	Sand, vf grain, tan-brown, sl moist, no odor, with well cemented sandstone interbedded.
		55		Cuttings	1.3	55	
		60	1243	Cuttings	1.5	60	

MONITORING WELL NO: MW-6 TOTAL DEPTH: 80 Feet



LITH.	USCS	Sample Depth	Sample Time	Sample Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
							Sand, vf grain, tan-brown, sl moist, no odor, with well cemented sandstone interbedded.
						▼	Encountered groundwater @ 63 feet
		65		Cuttings	1.7	65	
							Sand, vf grain, tan-brown, wet, no odor, with well cemented sandstone interbedded.
	SW	70	1249			70	
		75				75	
		80	1255			80	TD @ 80 Feet

MONITORING WELL CONSTRUCTION DIAGRAM (MW-6)



TRW Energy & Environmental Systems	SITE: Former Unocal South Vacuum Unit		**MW-6 Monitoring Well Construction Diagram**
	DATE: 06/12/00	REV. NO.: 1	
	AUTHOR: GJV	DRAWN BY: GJV	
	CK'D BY: DTL	FILE: Well Bore Diagram	

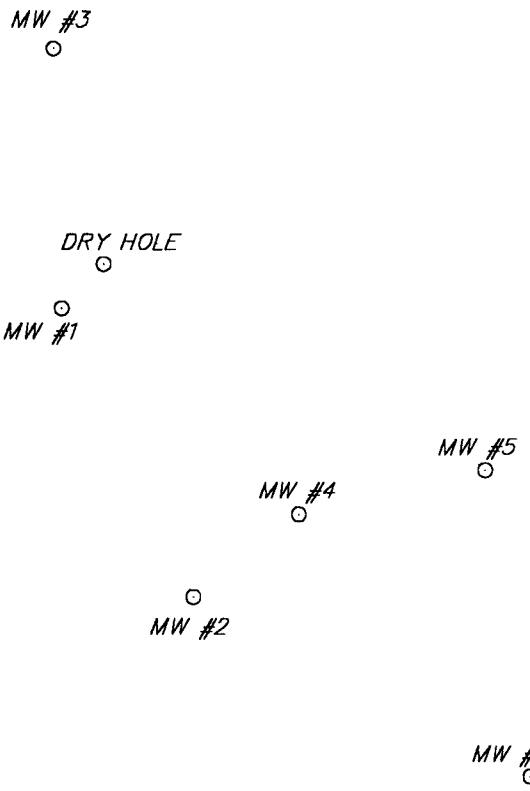
ATTACHMENT B

SURVEY PLAT OF

FORMER UNOCAL SOUTH VACUUM UNIT

SECTION 35, TOWNSHIP 18 SOUTH, RANGE 35 EAST, N.M.P.M.,

LEA COUNTY, **NEW MEXICO.**



NOTE:

- COORDINATES ARE NMSPCE NAD83(92)
- ELEVATIONS ARE NAVD 88 (92)
- DRY HOLE MKR ELEVATION – ORIGINAL NAVD 29 GRD. ELEV.=3856.6' SURVEYED BY JOHN WEST ON 1-6-1960
- CASING ELEVATIONS – MARKS ON NORTH SIDE OF 2" PVC CASING
- GROUND ELEVATION – BOLT SET IN CONCRETE ±0.5' NORTH OF CASING EXCEPT MW #1-SPOT ON CONCRETE ±0.5 NORTH

WELL	NORTHING	EASTING	CASING ELEV.	GRND ELEV.
MW #1	619281.058	822716.421	3858.37'	3856.76'
MW #2	618530.968	823060.987	3841.64'	3839.11'
MW #3	619954.109	822693.599	3864.73'	3862.20'
MW #4	618746.632	823341.129	3852.51'	3849.87'
MW #5	618860.923	823828.533	3859.84'	3856.59'
MW #6	618057.613	823948.359	3858.78'	3855.32'
DRY HOLE MKR	619396.127	822825.405	TOP OF MARKER 3864.91'	3859.00'

500 0 500 1000 FEET

I HEREBY CERTIFY THAT THIS PLAT WAS PREPARED FROM FIELD NOTES OF AN ACTUAL SURVEY AND MEETS OR EXCEEDS ALL REQUIREMENTS FOR LAND SURVEYS AS SPECIFIED BY THIS STATE.

GARY L. JONES NEW MEXICO 7977 REGISTERED PROFESSIONAL LAND SURVEYOR

GARY L. JONES N.M. P.S. No. 7977
TEXAS P.L.S. No. 5074

BASIN SURVEYS P.O. BOX 1786 – HOBBS, NEW MEXICO

TRW SYSTEMS AND INFORMATION

REF: MONITOR WELLS

MONITOR WELLS LOCATED IN

SECTION 35, TOWNSHIP 18 SOUTH, RANGE 35 EAST,

N.M.P.M., LEA COUNTY, NEW MEXICO.

W.O. Number: 0328	Drawn By: K. GOAD		
Date: 06-16-2000	Disk: KJG #122 – TRW0328A.DWG	Survey Date: 06-14-2000	Sheet 1 of 1 Sheets

ATTACHMENT C

LABORATORY ANALYTICAL REPORTS AND CHAIN-OF-CUSTODY DOCUMENTATION

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Case Narrative for:

Unocal-Mid Continent-CERT

Certificate of Analysis Number:

00060427

Report To:		Project Name:	South Vacuum Unit/8864-9924770-4675-
TRW Energy and Environmental Integration Systems		Site:	9924770
Gil Van Deventer		Site Address:	
415 West Wall Suite 1818.			
Midland		PO Number:	
Texas		State:	Texas
79701-		State Cert. No.:	
ph: (915) 682-0008	fax:	Date Reported:	6/22/00

Any data flags or quality control exceptions associated with this report will be footnoted in the analytical result page(s) or the quality control summary page(s).

Please do not hesitate to contact us if you have any questions or comments pertaining to this data report. Please reference the above Certificate of Analysis Number.

SPL, Inc. is pleased to be of service to you. We anticipate working with you in fulfilling all your current and future analytical needs.

6/22/00

Sommers, Elessa
Senior Project Manager

Date

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Unocal-Mid Continent-CERT

Certificate of Analysis Number:

00060427

Report To:	TRW Energy and Environmental Integration Systems Gil Van Deventer 415 West Wall Suite 1818. Midland Texas 79701- ph: (915) 682-0008 fax:	**Project Name:**	South Vacuum Unit/8864-9924770-4675-
		Site:	9924770
		Site Address:	
		PO Number:	
		State:	Texas
		State Cert. No.:	
Fax To:	*fax:*	**Date Reported:**	6/22/00

Client Sample ID	Lab Sample ID	Matrix	Date Collected	Date Received	COC ID	HOLD
0006140930(MW-6)	00060427-01	Water	6/14/00 8:30:00 AM	6/16/00 10:00:00 AM	8588	☐
0006141110(MW-5)	00060427-02	Water	6/14/00 11:10:00 AM	6/16/00 10:00:00 AM	8588	☐
0006141225(MW-3)	00060427-03	Water	6/14/00 12:25:00 PM	6/16/00 10:00:00 AM	8588	☐
0006141315(MW-2)	00060427-04	Water	6/14/00 1:15:00 PM	6/16/00 10:00:00 AM	8588	☐
0006141415(MW-1)	00060427-05	Water	6/14/00 2:15:00 PM	6/16/00 10:00:00 AM	8588	☐
0006141510(MW-4)	00060427-06	Water	6/14/00 3:10:00 PM	6/16/00 10:00:00 AM	8588	☐

6/22/00

Sommers, Elessa
Senior Project Manager

Date

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

6/22/00 9:27:25 AM

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006141110(MW-5) **Collected:** 6/14/00 11:10:00 **SPL Sample ID:** 00060427-02

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	13.7		1		1		06/20/00 14:30	CV	313714
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 18:06	WR	313675
Ethylbenzene	ND		1		1		06/20/00 18:06	WR	313675
Toluene	ND		1		1		06/20/00 18:06	WR	313675
Xylenes,Total	ND		1		1		06/20/00 18:06	WR	313675
Surr: 1,4-Difluorobenzene	101	%	72-137		1		06/20/00 18:06	WR	313675
Surr: 4-Bromofluorobenzene	106	%	48-156		1		06/20/00 18:06	WR	313675
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	274		20		2		06/19/00 16:15	C_V	314557

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006140930(MW-6) **Collected:** 6/14/00 8:30:00 **SPL Sample ID:** 00060427-01

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	48		1		1		06/20/00 14:30	CV	313713
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 17:41	WR	313674
Ethylbenzene	ND		1		1		06/20/00 17:41	WR	313674
Toluene	ND		1		1		06/20/00 17:41	WR	313674
Xylenes,Total	ND		1		1		06/20/00 17:41	WR	313674
Surr: 1,4-Difluorobenzene	99.1	%	72-137		1		06/20/00 17:41	WR	313674
Surr: 4-Bromofluorobenzene	102	%	48-156		1		06/20/00 17:41	WR	313674
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	382		20		2		06/19/00 16:15	C_V	314555

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006141225(MW-3) **Collected:** 6/14/00 12:25:00 **SPL Sample ID:** 00060427-03

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	75.5		1		1		06/20/00 14:30	CV	313715
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 18:30	WR	313676
Ethylbenzene	ND		1		1		06/20/00 18:30	WR	313676
Toluene	ND		1		1		06/20/00 18:30	WR	313676
Xylenes,Total	ND		1		1		06/20/00 18:30	WR	313676
Surr: 1,4-Difluorobenzene	99.7	%	72-137		1		06/20/00 18:30	WR	313676
Surr: 4-Bromofluorobenzene	103	%	48-156		1		06/20/00 18:30	WR	313676
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	433		10		1		06/19/00 16:15	C_V	314558

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006141315(MW-2) **Collected:** 6/14/00 1:15:00 **SPL Sample ID:** 00060427-04

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	317		5		5		06/20/00 14:30	CV	313716
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 18:55	WR	313678
Ethylbenzene	ND		1		1		06/20/00 18:55	WR	313678
Toluene	ND		1		1		06/20/00 18:55	WR	313678
Xylenes,Total	ND		1		1		06/20/00 18:55	WR	313678
Surr: 1,4-Difluorobenzene	98.5	%	72-137		1		06/20/00 18:55	WR	313678
Surr: 4-Bromofluorobenzene	105	%	48-156		1		06/20/00 18:55	WR	313678
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	852		10		1		06/19/00 16:15	C_V	314559

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006141415(MW-1) **Collected:** 6/14/00 2:15:00 **SPL Sample ID:** 00060427-05

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	927		10		10		06/20/00 14:30	CV	313717
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 19:19	WR	313681
Ethylbenzene	ND		1		1		06/20/00 19:19	WR	313681
Toluene	ND		1		1		06/20/00 19:19	WR	313681
Xylenes,Total	ND		1		1		06/20/00 19:19	WR	313681
Surr: 1,4-Difluorobenzene	102	%	72-137		1		06/20/00 19:19	WR	313681
Surr: 4-Bromofluorobenzene	106	%	48-156		1		06/20/00 19:19	WR	313681
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	2040		10		1		06/19/00 16:15	C_V	314560

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID: 0006141510(MW-4) **Collected:** 6/14/00 3:10:00 **SPL Sample ID:** 00060427-06

Site: 9924770

Analyses/Method	Result		Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
CHLORIDE, TOTAL				MCL	E325.3		Units: mg/L		
Chloride	1500		25		25		06/20/00 14:30	CV	313718
PURGEABLE AROMATICS				MCL	SW8021B		Units: ug/L		
Benzene	ND		1		1		06/20/00 19:43	WR	313684
Ethylbenzene	ND		1		1		06/20/00 19:43	WR	313684
Toluene	ND		1		1		06/20/00 19:43	WR	313684
Xylenes,Total	ND		1		1		06/20/00 19:43	WR	313684
Surr: 1,4-Difluorobenzene	100	%	72-137		1		06/20/00 19:43	WR	313684
Surr: 4-Bromofluorobenzene	104	%	48-156		1		06/20/00 19:43	WR	313684
TOTAL DISSOLVED SOLIDS				MCL	E160.1		Units: mg/L		
Total Dissolved Solids (Residue,Filterable)	2910		10		1		06/19/00 16:15	C_V	314561

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

Quality Control Documentation

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Quality Control Report

Unocal-Mid Continent-CERT

South Vacuum Unit/8864-9924770-4675-64430

Analysis: Purgeable Aromatics
Method: SW8021B
WorkOrder: 00060427
Lab Batch ID: R15977

Method Blank

RunID: HP_U_000620A-313659 Units: ug/L
Analysis Date: 06/20/2000 14:26 Analyst: WR

Analyte	Result	Rep Limit
Benzene	ND	1.0
Ethylbenzene	ND	1.0
Toluene	ND	1.0
Xylenes,Total	ND	1.0
Surr: 1,4-Difluorobenzene	98.9	72-137
Surr: 4-Bromofluorobenzene	100.8	48-156

Samples in Analytical Batch:

Lab Sample ID	Client Sample ID
00060427-01A	0006140930(MW-6)
00060427-02A	0006141110(MW-5)
00060427-03A	0006141225(MW-3)
00060427-04A	0006141315(MW-2)
00060427-05A	0006141415(MW-1)
00060427-06A	0006141510(MW-4)

Laboratory Control Sample (LCS)

RunID: HP_U_000620A-313656 Units: ug/L
Analysis Date: 06/20/2000 14:02 Analyst: WR

Analyte	Spike Added	Result	Percent Recovery	Lower Limit	Upper Limit
Benzene	50	53	105	70	130
Ethylbenzene	50	52	104	70	130
Toluene	50	52	104	70	130
Xylenes,Total	150	151	101	72	117

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

Sample Spiked: 00060340-09
RunID: HP_U_000620A-313662 Units: ug/L
Analysis Date: 06/20/2000 14:51 Analyst: WR

Analyte	Sample Result	MS Spike Added	MS Result	MS % Recovery	MSD Spike Added	MSD Result	MSD % Recovery	RPD	RPD Limit	Low Limit	High Limit
Benzene	ND	20	21	102	20	21	102	.0127	21	32	164
Ethylbenzene	ND	20	20	101	20	20	101	.0307	19	52	142
Toluene	26	20	41	77.1	20	42	78.5	1.76	20	38	159
Xylenes,Total	ND	60	61	102	60	61	102	0	18	53	144

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
J - Estimated value between MDL and PQL
* - Recovery Outside Advisable QC Limits
D - Recovery Unreportable due to Dilution
MI - Matrix Interference

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HOUSTON, TEXAS 77054
(713) 660-0901

Quality Control Report

Unocal-Mid Continent-CERT

South Vacuum Unit/8864-9924770-4675-64430

Analysis: Chloride, Total
Method: E325.3
WorkOrder: 00060427
Lab Batch ID: R15978

Method Blank

RunID: WET_000620I-313707 Units: mg/L
Analysis Date: 06/20/2000 14:30 Analyst: CV

Analyte	Result	Rep Limit
Chloride	ND	1.0

Samples in Analytical Batch:

Lab Sample ID	Client Sample ID
00060427-01B	0006140930(MW-6)
00060427-02B	0006141110(MW-5)
00060427-03B	0006141225(MW-3)
00060427-04B	0006141315(MW-2)
00060427-05B	0006141415(MW-1)
00060427-06B	0006141510(MW-4)

Laboratory Control Sample (LCS)

RunID: WET_000620I-313709 Units: mg/L
Analysis Date: 06/20/2000 14:30 Analyst: CV

Analyte	Spike Added	Result	Percent Recovery	Lower Limit	Upper Limit
Chloride	120.3	117	97	90	110

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

Sample Spiked: 00060350-01
RunID: WET_000620I-313711 Units: mg/L
Analysis Date: 06/20/2000 14:30 Analyst: CV

Analyte	Sample Result	MS Spike Added	MS Result	MS % Recovery	MSD Spike Added	MSD Result	MSD % Recovery	RPD	RPD Limit	Low Limit	High Limit
Chloride	31	50	80.6	99.5	50	80.6	99.5	0	20	85	115

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
J - Estimated value between MDL and PQL
* - Recovery Outside Advisable QC Limits
D - Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Quality Control Report

Unocal-Mid Continent-CERT

South Vacuum Unit/8864-9924770-4675-64430

Analysis: **Total Dissolved Solids** **WorkOrder:** **00060427**
Method: **E160.1** **Lab Batch ID:** **R16031**

Method Blank

RunID: WET_000619U-314552 Units: mg/L
Analysis Date: 06/19/2000 16:15 Analyst: C_V

Analyte	Result	Rep Limit
Total Dissolved Solids (Residue,Filterable)	ND	10

Samples in Analytical Batch:

Lab Sample ID	Client Sample ID
00060427-01B	0006140930(MW-6)
00060427-02B	0006141110(MW-5)
00060427-03B	0006141225(MW-3)
00060427-04B	0006141315(MW-2)
00060427-05B	0006141415(MW-1)
00060427-06B	0006141510(MW-4)

Laboratory Control Sample (LCS)

RunID: WET_000619U-314554 Units: mg/L
Analysis Date: 06/19/2000 16:15 Analyst: C_V

Analyte	Spike Added	Result	Percent Recovery	Lower Limit	Upper Limit
Total Dissolved Solids (Residue,Filterabl	420	442	105	90	110

Sample Duplicate

Original Sample: 00060427-01
RunID: WET_000619U-314555 Units: mg/L
Analysis Date: 06/19/2000 16:15 Analyst: C_V

Analyte	Sample Result	DUP Result	RPD	RPD Limit
Total Dissolved Solids (Residue,Filterabl	382	372	3	20

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
J - Estimated value between MDL and PQL
* - Recovery Outside Advisable QC Limits
D - Recovery Unreportable due to Dilution
MI - Matrix Interference

Chain of Custody

And

Sample Receipt Checklist

0000600427

SPL Laboratories, Inc.

☐ 1511 East Orangethorpe Ave.
Fullerton, CA 92631
(714) 447-6868
Fax:(714) 447-6800

☐ 8880 Interchange Drive
Houston, Texas 77054
(713) 660-0901
Fax: (713) 660-8975

☐ 500 Ambassador Caffery Pkwy.
Scott, Louisiana 70583
(318) 237-4775
Fax: (318) 237-7080

UNOCAL 76
Chain of Custody Record 8588

Company Name: TRW Energy + Environmental Integration Systems	Project Name: South Vacuum Unit
Address: 415 W. Wall Suite 1818	UNOCAL Project Manager: Ben Terry
City: Midland State: TX Zip Code: 79701	AFE#: 8864-9924770-4675-64430
Telephone: 915-682-0008 FAX: 915-682-0028	Site #: 9924770
Report To: Gil Van Deventer Sampler: John Fergerson	QC Data: ☐ Level D (Standard) ☐ Level C ☐ Level B ☐ Level A

Turnaround Time: (Calendar Days) ☐ 10 Days (Standard) ☒ 5 Days ☐ 3 Days ☐ 2 Days ☐ 1 Day

CODE: ☐ Misc. ☒ Detecl. ☐ Eval. ☐ Remed. ☐ Demol. ☐ Closure

☐ Drinking Water ☐ Waste Water ☒ Other

Analyses Requested

Client Sample I.D.	Date/Time Sampled	Matrix Desc.	# of Cont.	Cont. Type	Laboratory Sample #	BTEX 8021	chloride 325.3	TDS 160.1						Comments
000614 0930 (MW-6)	6/14/00 0930	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
000614 1110 (MW-5)	6/14/00 1110	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
000614 1225 (MW-3)	6/14/00 1225	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
000614 1315 (MW-2)	6/14/00 1315	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
000614 1415 (MW-1)	6/14/00 1415	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
000614 1510 (MW-4)	6/14/00 1510	Water	4	40ml Vial 32oz Plast		✓	✓	✓						
														3c

4.1 D

Relinquished By: John Fergerson	Date: 6/15/00	Time: 1730	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By: Nancy Barrera	Date: 6/16/00	Time: 1010

Were Samples Received in Good Condition? ☐ Yes ☐ No Samples on Ice? ☐ Yes ☐ No Method of Shipment ______ Page ___ of ___

PINK - Client
YELLOW - Laboratory
WHITE - Laboratory

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Sample Receipt Checklist

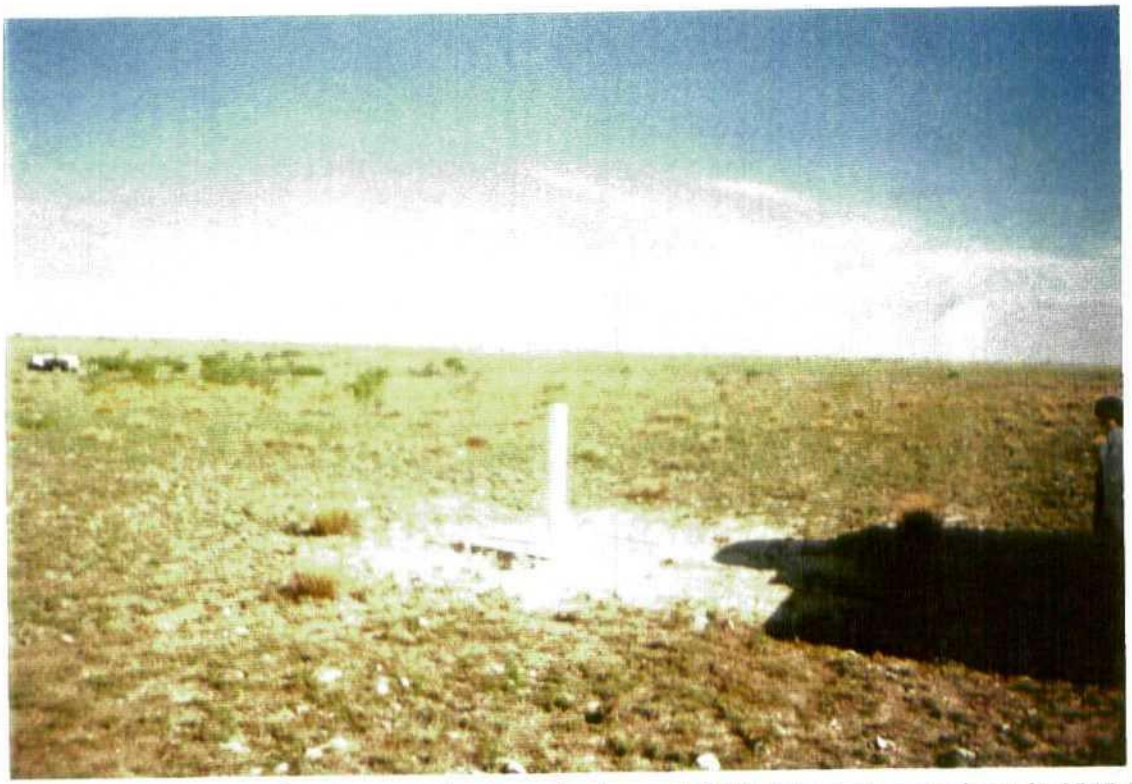
Workorder:	00060427	Received by:	Barrera, Nancy
Date and Time Received:	6/16/00 10:00:00 AM	Carrier name:	FedEx
Temperature:	3		

Shipping container/cooler in good condition?	Yes	☑	No ☐	Not Present	☐
Custody seals intact on shippping container/cooler?	Yes	☑	No ☐	Not Present	☐
Custody seals intact on sample bottles?	Yes	☐	No ☐	Not Present	☑
Chain of custody present?	Yes	☑	No ☐		
Chain of custody signed when relinquished and received?	Yes	☑	No ☐		
Chain of custody agrees with sample labels?	Yes	☑	No ☐		
Samples in proper container/bottle?	Yes	☑	No ☐		
Sample containers intact?	Yes	☑	No ☐		
Sufficient sample volume for indicated test?	Yes	☑	No ☐		
All samples received within holding time?	Yes	☑	No ☐		
Container/Temp Blank temperature in compliance?	Yes	☑	No ☐		
Water - VOA vials have zero headspace?	Yes	☑	No ☐	Not Present	☐
Water - pH acceptable upon receipt?	Yes	☑	No ☐		

ATTACHMENT D

PHOTODOCUMENTATION

View facing southwest showing placement of bentonite well seal in monitoring well MW-5.



View facing northwest showing completed monitoring well MW-6 located approximately 1800 ft. downgradient (southeast) of the former salt water disposal well (horizon, center of photograph).