BP OIL

BP Oil Company
Aetna Bldg , Suite 360
2868 Prospect Park Drive
Rancho Cordova, California 95670-6020
(916) 631-0733

October 9, 1991

LOP 3878

Mr. Rafat Shahid
Alameda County Department of Health Services
80 Swan Way, #200
Oakland, CA 94621

CC 4/5/90

RE: BP OIL FACILITY #11132
3201 35TH AVENUE 94619
OAKLAND, CALIFORNIA

Dear Mr. Shahad,

Attached please find results of the quarterly sampling and analysis performed at the above referenced facility.

Please call me at 916/631-6919 with any questions regarding this submission.

Respectfully,

Peter J. DeSantis
Environmental Resource Management

PJD:lk

cc: Tom Callaghan - RWQCB, San Francisco Bay Region
Dave Baker - Mobil Oil Corporation
J.R. Rocco - BP Oil, Cleveland
Site file

QUARTERLY GROUND WATER MONITORING AND SAMPLING REPORT

for

BP Oil Company

BP Oil Service Station No. 11132
3201 35th Avenue
Oakland, California 94619

Project No. 30-0081-01

Prepared by:

Alton Geoscience
1000 Burnett Avenue, Suite 140
Concord, California

October 8, 1991

QUARTERLY GROUND WATER MONITORING AND SAMPLING REPORT for BP Oil Service Station No. 11132 3201 35th Avenue Oakland, California

INTRODUCTION

This report presents the results and findings of the quarterly ground water monitoring and sampling activities performed by Alton Geoscience at BP Oil Service Station No. 11132, 3201 35th Avenue, Oakland, California. A site vicinity map is presented in Figure 1.

PROJECT BACKGROUND

On July 30, 1986, Kaprealian Engineering, Inc. (KEI) was retained by Mobil Oil Corporation to install three 2-inch-diameter monitoring wells (MW-1, MW-2, and MW-3) at this former Mobil Oil service station. Monitoring and sampling of the wells, performed by KEI, indicated detectable levels of total petroleum hydrocarbons (TPH) in MW-1 and MW-2 at concentrations of up to 210 parts per million (ppm).

In May 1990, BP Oil Company retained Alton Geoscience to conduct a supplemental site investigation. Between May and June 1990, Alton Geoscience supervised the installation of ground water Monitoring Wells MW-4, MW-5, MW-6, and MW-7 and Recovery Well RW-1. Free-floating product was observed in MW-1 and MW-2, while dissolved-phase petroleum hydrocarbon constituents were detected in ground water samples collected from MW-3 and MW-5.

The supplemental site investigation was completed in August 1990, however, the extent of the free-floating product and dissolved-phase hydrocarbon plume in the ground water beneath the site was not adequately assessed at that time. It was therefore proposed that an additional investigation be conducted to assess the extent of hydrocarbon-impacted ground water and develop appropriate remedial measures.

On February 25 and 26, 1991, Alton Geoscience supervised the installation of ground water Monitoring Wells MW-8, MW-9, and MW-10. Free-floating product was detected in MW-1, MW-2, and RW-1. Dissolved-phase petroleum hydrocarbon constituents were detected in ground water samples collected from MW-3, MW-10, MW-8, and MW-9.

FIELD PROCEDURES

On June 27, 1991, Alton Geoscience monitored MW-1 through MW-10, and RW-1, and sampled MW-3, MW-4, MW-5, MW-7, MW-8, MW-9, and MW-10 in accordance with Alton Geoscience's procedures and the guidelines of the RWQCB and ACDHS.

Free-floating product was encountered in MW-1 (0.18 feet), MW-2 (0.19 feet), and RW-1 (0.04 feet). Monitoring Wells MW-1, MW-2, and Recovery Well RW-1 were not sampled due to the presence of free-floating product.

Ground water samples were analyzed for total petroleum hydrocarbons as gasoline (TPH-G), and benzene, toluene, ethylbenzene, and total xylenes (BTEX) constituents. Ground water sampling field procedures, ground water sampling field survey forms, and official laboratory reports and chain of custody records are presented in Appendices A, B, and C, respectively.

DISCUSSION OF RESULTS

The results of the June 27, 1991 ground water monitoring and sampling performed by Alton Geoscience are summarized in Tables 1 and 2. A ground water elevation contour map based on the depth to ground water measurements collected on June 27, 1991, is presented in Figure 2. The equivalent ground water surface elevation for MW-1, MW-2, and RW-1 was calculated assuming a specific gravity of 0.75 for free product. Concentrations of TPH-G and benzene in the ground water are presented in Figures 3 and 4, respectively.

- Free-floating product was encountered in MW-1 (0.18 foot), MW-2 (0.19 foot), and RW-1 (0.04 foot).
- Depth to ground water has dropped an average of 5.35 feet since March 1991.
- Ground water gradient and direction was estimated to be approximately 0.01 foot/foot and to the south-southwest.
- Water samples collected from MW-4 had no detectable concentrations of TPH-G above reported detection limits.
- The highest concentrations of TPH-G and benzene were detected in the water samples collected from two offsite, downgradient monitoring wells, MW-8 and MW-10. The water samples collected from Monitoring Wells MW-8 and MW-10 revealed concentrations of TPH-G at 12,000 ppb for each sample, and of benzene at 3,400 ppb and 7,300 ppb, respectively.

This report was based on currently available data and was developed in accordance with current hydrogeologic and engineering practices.

ALTON GEOSCIENCE

Matthew A. Taylor
Civil Engineer

FIGURES

Source: U.S.G.S. Map, East Oakland, California Quadrangle
7.5 minute series. 1959. Photorvised 1980.

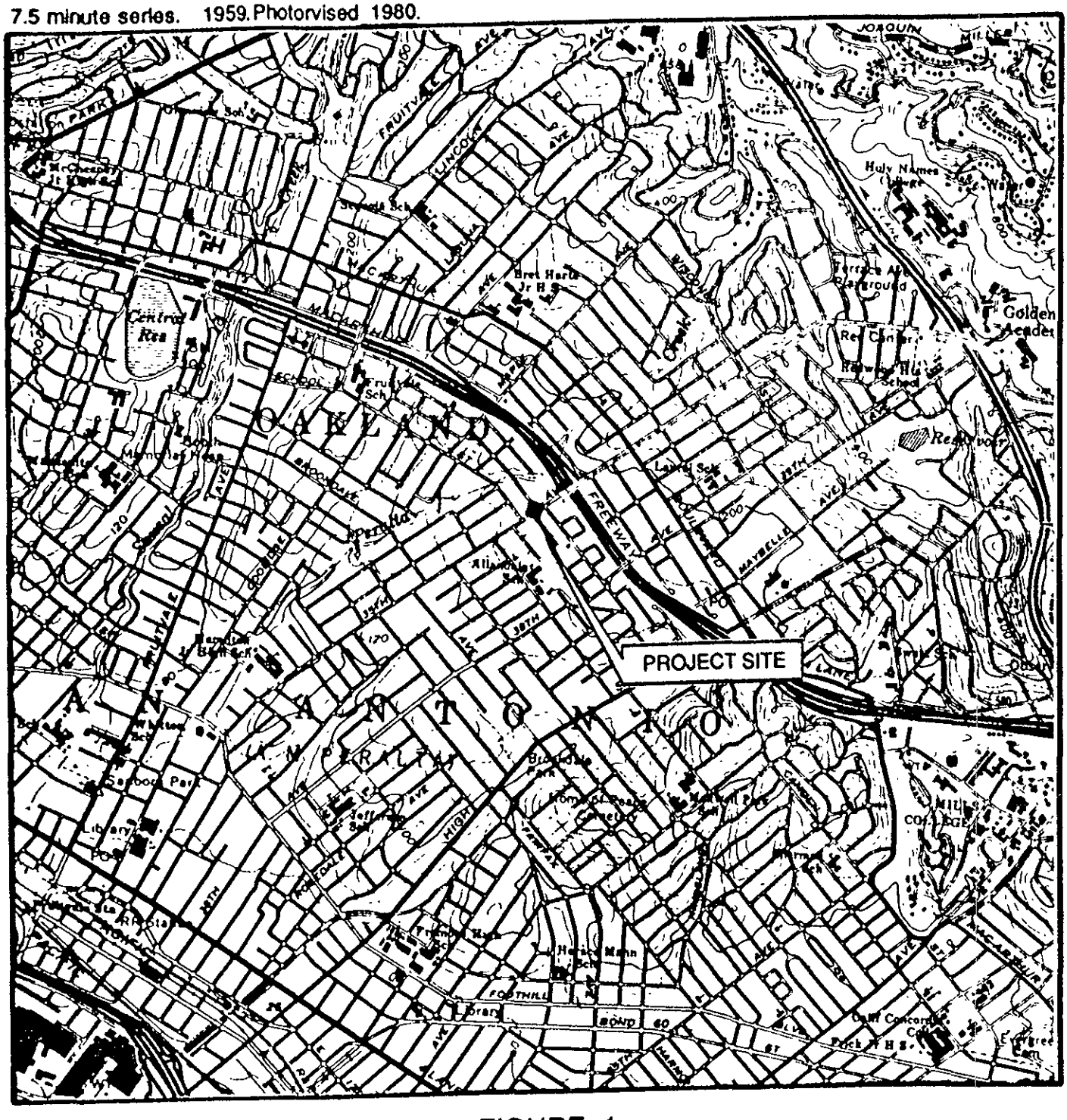


FIGURE 1

SITE VICINITY MAP

0 1000 2000
SCALE IN FEET

B P SERVICE STATION NO. 11132
3201 35TH AVENUE
OAKLAND, CALIFORNIA

PROJECT NO. 30-081-01

ALTON GEOSCIENCE
1000 Burnett Ave., Ste 140
Concord, CA 94520

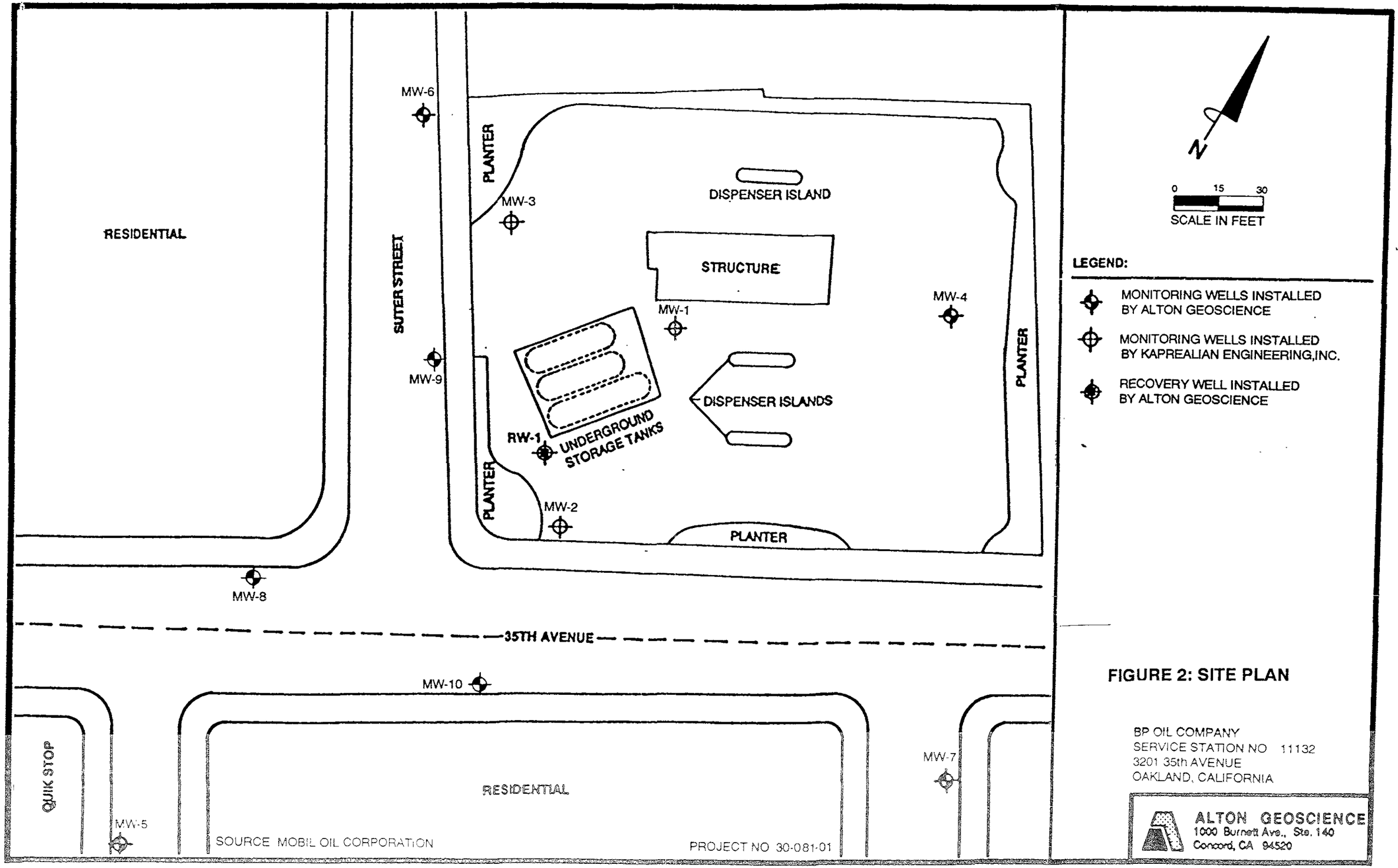
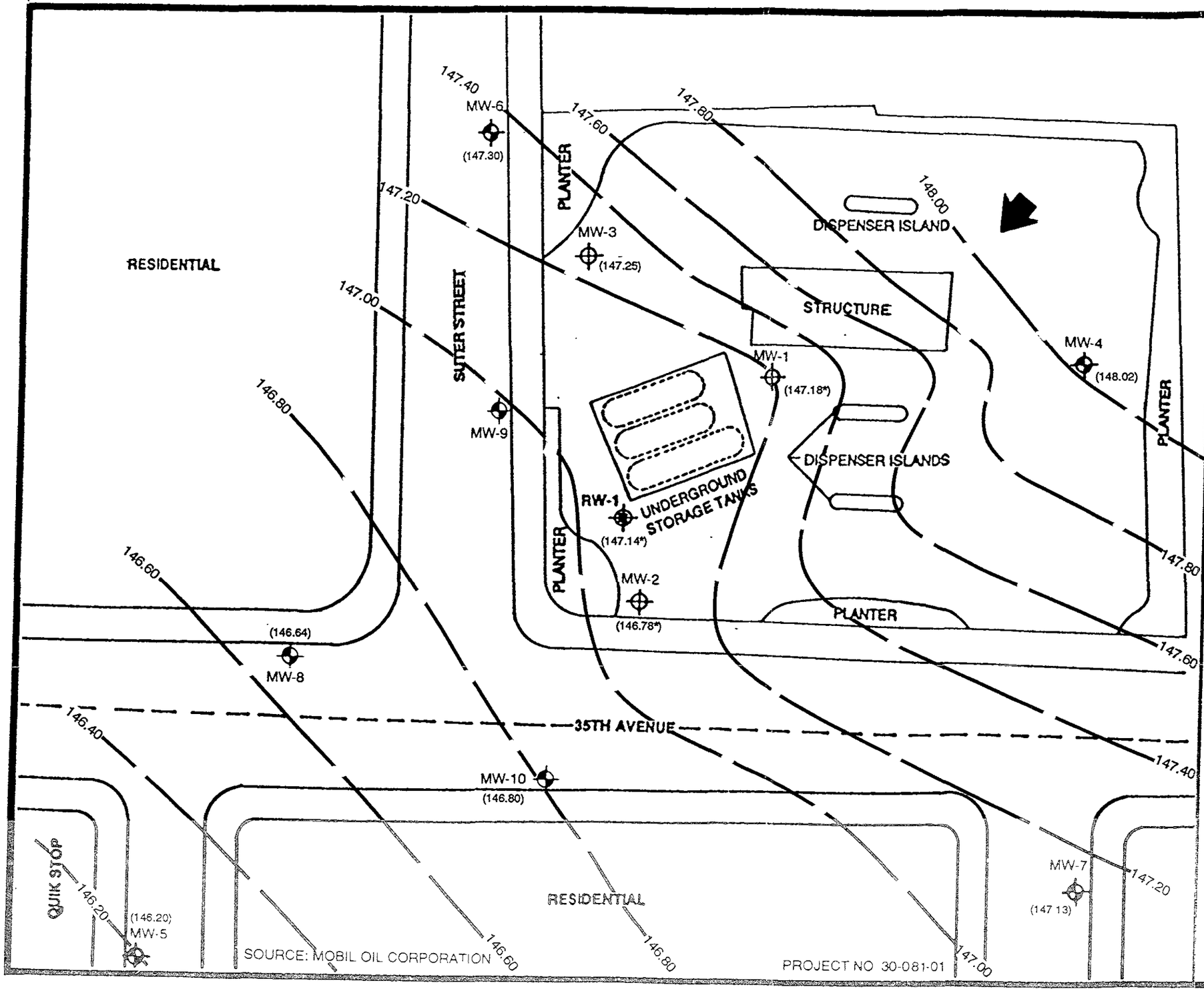


FIGURE 2: SITE PLAN

BP OIL COMPANY
SERVICE STATION NO 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave., Ste. 140
Concord, CA 94520


147.40
MW-6
(147.30)
147.60
147.80
148.00
147.20
PLANTER
MW-3
(147.25)
DISPENSER ISLAND
RESIDENTIAL
147.00
SUTER STREET
STRUCTURE
MW-1
(147.18*)
MW-4
(148.02)
146.80
MW-9
DISPENSER ISLANDS
PLANTER
UNDERGROUND STORAGE TANKS
RW-1
(147.14*)
146.60
MW-2
(146.78*)
PLANTER
147.80
(146.64)
MW-8
147.60
146.40
35TH AVENUE
147.40
MW-10
(146.80)
QUIK STOP
146.20
(146.20)
MW-5
RESIDENTIAL
MW-7
(147.13)
147.20
SOURCE: MOBIL OIL CORPORATION
146.60
146.80
147.00
PROJECT NO 30-081-01
N
0
15
30
SCALE IN FEET
LEGEND:
MONITORING WELLS INSTALLED BY ALTON GEOSCIENCE
MONITORING WELLS INSTALLED BY KAPREALIAN ENGINEERING,INC.
RECOVERY WELL INSTALLED BY ALTON GEOSCIENCE
(147.30) GROUND WATER ELEVATION
146.60 GROUND WATER ELEVATION CONTOUR
GROUND WATER GRADIENT=0.01 FT/FT
GENERAL DIRECTION OF GROUND WATER GRADIENT
* NOTE: EQUIVALENT GROUND WATER SURFACE ELEVATION CALCULATED ASSUMING 0.75 SPECIFIC GRAVITY FOR FREE PRODUCT.
6/91
FIGURE 3: GROUND ELEVATION CONTOUR MAP
BP OIL COMPANY
SERVICE STATION NO 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA
ALTON GEOSCIENCE
1000 Burnett Ave., Ste. 140
Concord, CA 94520

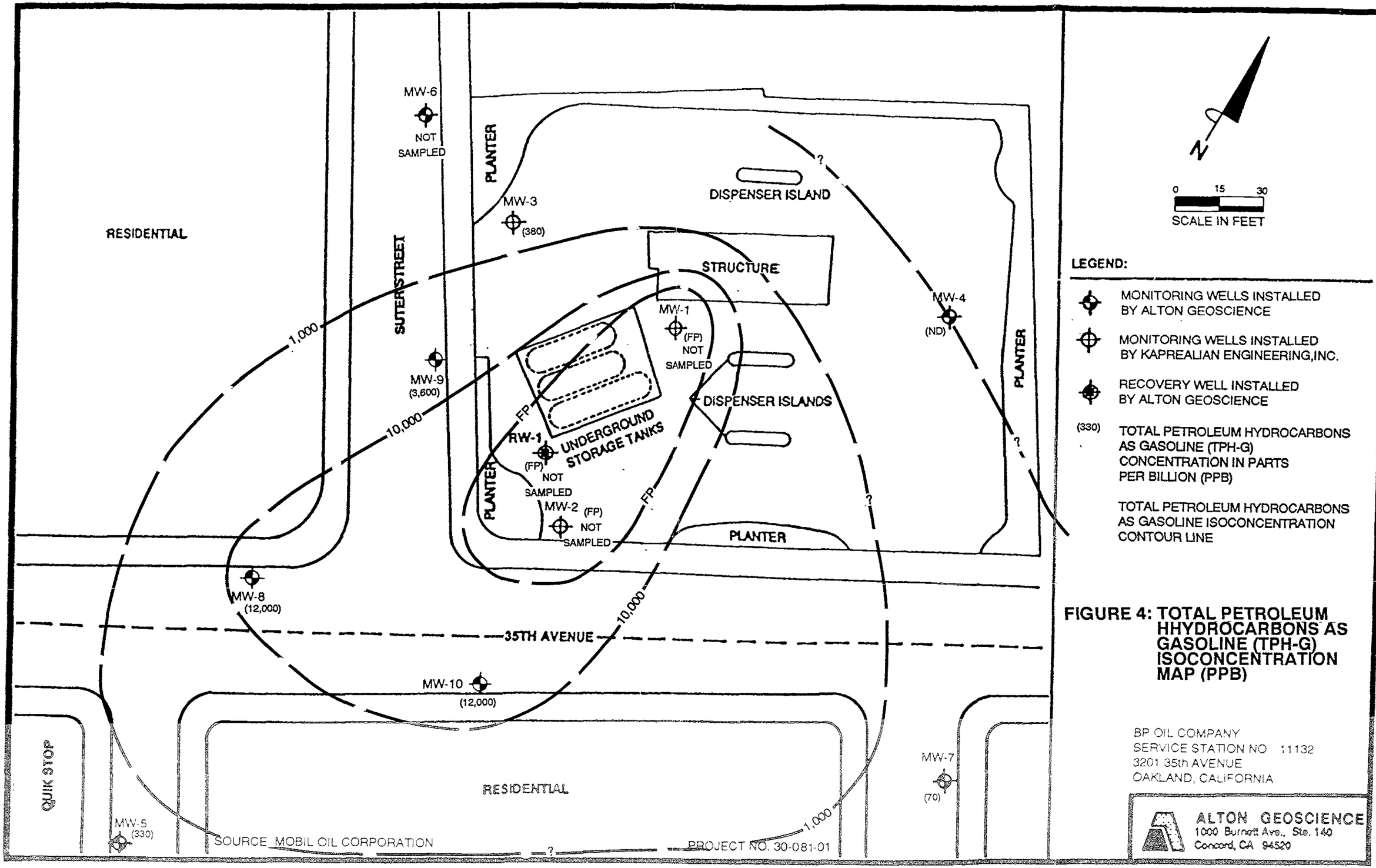


FIGURE 4: TOTAL PETROLEUM HHYDROCARBONS AS GASOLINE (TPH-G) ISOCONCENTRATION MAP (PPB)

BP OIL COMPANY
SERVICE STATION NO 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave., Ste. 140
Concord, CA 94520

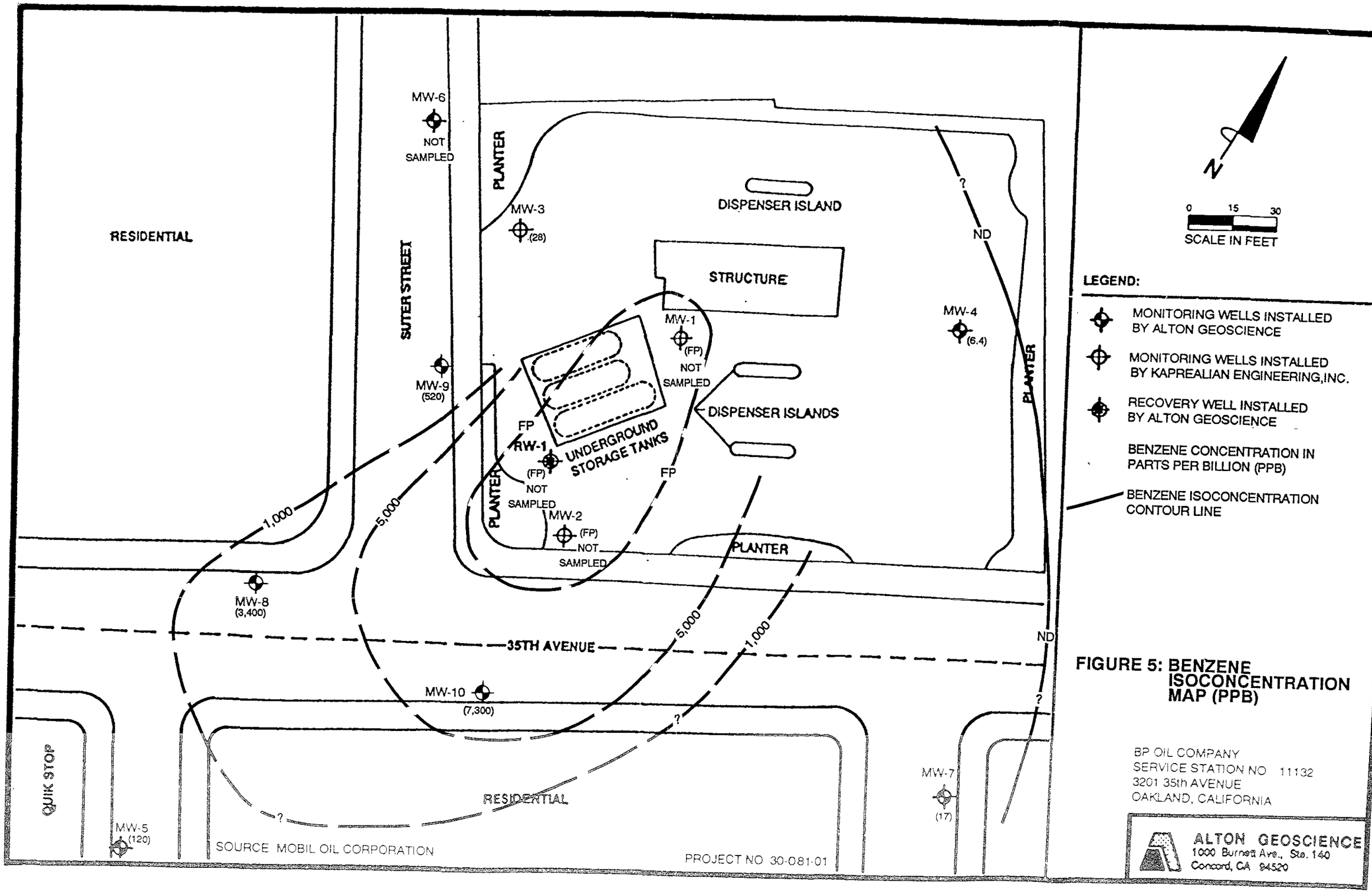


FIGURE 5: BENZENE ISOCONCENTRATION MAP (PPB)

BP OIL COMPANY
SERVICE STATION NO 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave., Ste. 140
Concord, CA 94520

TABLES

TABLE 1

SURVEY AND WATER LEVEL MONITORING DATA
June 1991

Well ID	Well Elevation (Feet)*	Date	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-1		01-90			
MW-1		07-90	21.46	0.22	
MW-1		03-91	17.18	----	
MW-1	169.75	06-91	22.70	0.18	147.18**
MW-2		01-90		----	
MW-2		07-90	20.24	0.10	
MW-2		03-91	15.64	----	
MW-2	168.14	06-91	21.50	0.19	146.78**
MW-3		01-90		----	
MW-3		07-90	18.96	----	
MW-3		03-91	14.06	----	
MW-3	167.17	06-91	19.92	----	147.25
MW-4		01-90		----	
MW-4		07-90	21.30	----	
MW-4		03-91	18.28	----	
MW-4	170.36	06-91	22.34	----	148.02

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, MW-2, and RW-1 were calculated assuming a specific gravity of 0.75 for free product.

*** Depth to water not recorded.

N.A. Monitoring well was not accessible.

TABLE 1
(cont'd)

SURVEY AND WATER LEVEL MONITORING DATA
June 1991

Well ID	Well Elevation (Feet)*	Date	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-5		01-90			
MW-5		07-90	17.97	----	
MW-5		03-91	12.62	----	
MW-5	146.20	06-91	18.94	----	146.20
MW-6		01-90			
MW-6		07-90	17.20	----	
MW-6		03-91	N.A.	----	
MW-6	165.40	06-91	18.10	----	147.30
MW-7		01-90			
MW-7		07-90	19.70	----	
MW-7		03-91	17.82	----	
MW-7	167.61	06-91	20.48	----	147.13
MW-8		03-91	12.98	----	
MW-8	165.74	06-91	19.10	----	146.64
MW-9		03-91	13.42	----	
MW-9	166.20	06-91	19.22	----	146.98

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, MW-2, and RW-1 were calculated assuming a specific gravity of 0.75 for free product.

*** Depth to water not recorded.

N.A. Monitoring well was not accessible.

TABLE 1
(cont'd)

SURVEY AND WATER LEVEL MONITORING DATA
June 1991

Well ID	Well Elevation (Feet)*	Date	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-10		03-91	14.32	----	
MW-10	167.01	06-91	20.21	----	146.80
RW-1		07-90	27.93	1.21	
RW-1		03-91	***	***	
RW-1	168.01	06-91	20.90	0.04	147.14**

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, MW-2, and RW-1 were calculated assuming a specific gravity of 0.75 for free product.

*** Depth to water not recorded.

N.A. Monitoring well was not accessible.

TABLE 2

RESULTS OF
LABORATORY ANALYSIS OF GROUND WATER SAMPLES
June 1991

Well ID	Date	TPH-G	B	T	E	X
		(Concentrations in Parts per Billion)				
MW-1	1-29-90	---	---	---	---	---
MW-1	7-09-90	---	---	---	---	---
MW-1	3-07-91	---	---	---	---	---
MW-1	6-27-91	---	---	---	---	---
MW-2	1-29-90	14	580	1,300	460	2,300
MW-2	7-09-90	---	---	---	---	---
MW-2	3-07-91	---	---	---	---	---
MW-2	6-27-91	---	---	---	---	---
MW-3	1-29-90	0.5	20	30	24	35
MW-3	7-09-90	140	5.3	4.6	2.0	3.8
MW-3	3-07-91	400	69	22	6.1	57
MW-3	6-27-91	380	28	26	13	46
MW-4	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-4	3-07-91	ND<50	2.2	3.8	1.5	2.8
MW-4	6-27-91	ND<50	6.3	1.8	0.4	1.0
MW-5	7-09-90	280	200	210	46	290
MW-5	3-07-91	ND<50	17	0.9	0.7	1.6
MW-5	6-27-91	330	120	10	12	8
MW-6	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-6	3-07-91	N.A.	N.A.	N.A.	N.A.	N.A.
MW-6	6-27-91	N.A.	N.A.	N.A.	N.A.	N.A.

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
ND = Not Detected at Method Detection Limit
--- = No sample collected from MW-1 and RW-1 due to the presence of free product
N.A. = Monitoring well was not accessible.

TABLE 2
(cont'd)

RESULTS OF
LABORATORY ANALYSIS OF GROUND WATER SAMPLES
June 1991

Well ID	Date	TPH-G	B	T	E	X
		(Concentrations in Parts per Billion)				
MW-7	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-7	3-07-91	ND<50	ND<0.3	0.4	0.3	2.4
MW-7	6-27-91	70	17	4	0.8	2.2
MW-8	3-07-91	2,700	780	450	64	310
MW-8	6-27-91	12,000	3,400	1,100	240	750
MW-9	3-07-91	7,100	220	4	2.4	2,400
MW-9	6-27-91	3,600	520	400	85	310
MW-10	3-07-91	1,600	120	190	32	230
MW-10	6-27-91	12,000	7,300	500	150	300
RW-1	3-07-91	---	---	---	---	---
RW-1	6-27-91	---	---	---	---	---

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
ND = Not Detected at Method Detection Limit
--- = No sample collected from MW-1 and RW-1 due to the presence of free product
N.A. = Monitoring well was not accessible.

APPENDIX A

GROUND WATER SAMPLING FIELD PROCEDURES

APPENDIX A

GROUND WATER SAMPLING FIELD PROCEDURES

Prior to purging and sampling, total well depth and depth to ground water were measured from a reference mark at the top of each well casing to the nearest 0.01 foot using an electronic sounder. Ground water was examined, using a hand bailer, for the presence of free-floating product or sheen.

Prior to sample collection, each well was purged of the required well casing volumes and until stabilization of pH, temperature, and conductivity was achieved. Each sample was collected using a clean bailer and transferred to the appropriate clean sample containers for delivery to a California certified laboratory following proper preservation and chain of custody procedures. Purged ground water was stored onsite in DOT-approved, 55-gallon drums pending analytical results and proper offsite disposal.

APPENDIX B

GROUND WATER SAMPLING FIELD SURVEY FORMS

ALTON GEOSCIENCE, INC
1170 Burnett Ave., Ste. S
Concord, CA 94520

JOB NUMBER 30-081-01 TECHNICIAN Chris R / Donnie R

JOB LOCATION BP 35th Ave Oakland DATE 6-27-91

PUMPOUT ☒ YES ☐ NO	DATE OF LAST PUMPOUT:			WEATHER: cloudy TIME:		COMMENTS (Notes, conditions, etc.)
	HOLD	CUT	LEVEL			
WELL #	DEPTH TO WATER	DEPTH TO PRODUCT	PROD. THICKNESS (FT)	TOTAL DEPTH	DEPTH TO PUMP	
MW-1	22.70		~2.1"	44.18		FP black ~2.1" thick
MW-2	21.50		~2.25"	34.37		FP 2.25" thick (check fails
MW-3	19.92		—	34.36		
MW-4	22 34		—	38.72		
ND MW-5	18.94		—	30.95		
ND MW-6	18.10		—	34.38		car on well
MW-7	20.48		—	34.47		
ND MW-8	19.10		—	38.80		
MW-9	19 22		—	29.55		
MW-10	20.21		—	34.04		
RW-1	20.90		~0.5"	38 36		FP ~0.5" thick
			23 drums on site			(1 ~ full)

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Oakland Date: 6-27-91

Well: MW-1 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. rinse

Well Development/ Well Sampling Data

Total Well Depth: 29.19 feet Time: _____ Water level Before Pumping: 22.70

Water Column		Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
/	feet x	0.16	0.65	/	/	/

Depth Purging From: ____ feet. Time Purging Begins: 5.30

Notes on Initial Discharge: Free Product 2.1"

Time	Volume	pH	Conductivity	T	Notes

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: _____

Time Sample Collection Begins: — [0.5 gallon FP purged]

Time Sample Collection Ends: —

Total Gallons Purged: 8

Comments: FP black & globular,

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project #30-081-01 Site: BP 35th Oakland Date: 6-27-91

Well: MJ-2 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: FP bailer

Describe Equipment Before Sampling This Well: Trip rinse

Well Development/ Well Sampling Data

Total Well Depth: 34.37 feet Time: ______ Water level Before Pumping: 21.50

Water Column		Casing Diameter 2-inch	Casing Diameter 4-inch	Volume	Factor	Volume to Purge
______	feet x	0.16	0.65	______	______	______

Depth Purging From: ____ feet. Time Purging Begins: 5:08

Notes on Initial Discharge: Free product ~2.25" thick

Time	Volume	pH	Conductivity	T	Notes

Time Field Parameter Measurement Begins: ______

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: ______ ~10 gallon FP purged

Time Sample Collection Begins: —

Time Sample Collection Ends: —

Total Gallons Purged: 10

Comments: FP black & globular

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: 32 35th, Oak. Date: 6-27-91

Well: MW-3 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. rinse

Well Development/ Well Sampling Data

Total Well Depth: 34.36 feet Time: _____ Water level Before Pumping: 19.92

Water Column		Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
14.44	feet x	(0.16)	0.65	2.31	3	6.93

Depth Purging From: 22 feet. Time Purging Begins: 4:09

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity (x1000)	T	Notes
4:12	5.0	8.26	0.90	67.9	clear
4:12	5.5	7.98	0.87	67.9	"
4:13	6.0	7.90	0.85	67.7	"
4:14	6.5	7.89	0.86	67.8	"
4:14	7	7.86	0.87	67.7	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 6.93

Time Sample Collection Begins: 4:15

Time Sample Collection Ends: 4:19

Total Gallons Purged: 7

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th, Oak. Date: 6-27-91

Well: MW-4 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. rinse

Well Development/ Well Sampling Data

Total Well Depth: 38.72 feet Time: _____ Water level Before Pumping: 22.34

Water Column	Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
16.38 feet x	0.16	0.65	2.62	3	7.86

Depth Purging From: 26 feet. Time Purging Begins: 3:35

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity (x1000)	T	Notes
3:37	5.5	8.29	0.70	68.2	cloudy
3:37	6.0	8.24	0.70	68.3	"
3:38	6.5	8.21	0.70	68.2	"
3:38	7.0	8.14	0.69	68.2	"
3:39	7.5	8.10	0.67	67.9	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 7.86

Time Sample Collection Begins: 3:40

Time Sample Collection Ends: 3:42

Total Gallons Purged: 8

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30.081-01 Site: BP 35th Oak Date: 6-27-91

Well: MW-5 Sampling Team: Chris K / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. rinse

Well Development/ Well Sampling Data

Total Well Depth: 30.95 feet Time: _____ Water level Before Pumping: 18.94

Water Column		Casing Diameter 2-inch	4-inch	Volume		Factor	Volume to Purge
12.01	feet x	0.16	0.65	1.92	·	3	5.76

Depth Purging From: 22 feet. Time Purging Begins: 2:15

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity (X1000)	T	Notes
2:21	3.0	8.56	0.90	70.1	cloudy H brown
2:22	3.5	8.36	0.85	68.9	"
2:23	4.0	8.28	0.84	68.9	"
2:24	4.5	8.22	0.85	68.6	"
2:25	5.0	8.18	0.86	68.5	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 5.76

Time Sample Collection Begins: 2:27

Time Sample Collection Ends: 2:31

Total Gallons Purged: 5

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Oak. Date: 6-27-91

Well: MW-6 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. rinsed

Well Development/ Well Sampling Data

Total Well Depth: 18.10 feet Time: _____ Water level Before Pumping: 34.38

Water Column		Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
_____	feet x	0.16	0.65	_____	_____	_____

Depth Purging From: ____ feet. Time Purging Begins: _____

Notes on Initial Discharge: _____

Time	Volume	pH	Conductivity	T	Notes
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH	_____	_____	_____	_____
Conductivity	_____	_____	_____	_____
Temperature (F)	_____	_____	_____	_____

Presample Collection Gallons Purged: _____

Time Sample Collection Begins: _____

Time Sample Collection Ends: _____

Total Gallons Purged: _____

Comments: Well not accessible

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Ctk Date: 6-27-91

Well: MW-7 Sampling Team: Chris R / DS

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Tr.p. rinse

Well Development/ Well Sampling Data

Total Well Depth: 34.47 feet Time: _____ Water level Before Pumping: 20.48

Water Column		Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
13.99	feet x	(0.16)	0.65	2.23	3	6.71

Depth Purging From: 26 feet. Time Purging Begins: 3:15

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity x1000	T	Notes
3:17	5.0	8.22	1.04	69.1	cloudy
3:17	5.5	8.09	1.03	68.6	
3:18	6.0	8.02	1.04	68.3	
3:19	6.5	8.00	1.05	68.0	
3:19	7.0	7.98	1.01	67.9	

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 6.71

Time Sample Collection Begins: 3:21

Time Sample Collection Ends: 3:23

Total Gallons Purged: 7

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Ave. Date: 6-27-91

Well: MW-8 Sampling Team: Chris K / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip. mind

Well Development/ Well Sampling Data

Total Well Depth: 38.80 feet Time: _____ Water level Before Pumping: 19.10

Water Column	Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
19.70 feet x	(0.16)	0.65	3.15	3	9.45

Depth Purging From: 22 feet. Time Purging Begins: 1:28

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity (x 1000)	T	Notes
1:52	7.0	8.28	2.01	69.1	slightly cloudy
1:52	7.5	8.26	1.68	69.6	"
1:53	8.0	8.08	1.43	69.3	"
1:54	8.5	7.98	1.38	68.9	"
1:55	9	7.89	1.38	68.8	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 9.45

Time Sample Collection Begins: _____

Time Sample Collection Ends: 2:00

Total Gallons Purged: 10.0

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Oak Date: 6-27-91

Well: MW-9 Sampling Team: Chris R / DB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip rinse

Well Development/ Well Sampling Data

Total Well Depth: 29.55 feet Time: _____ Water level Before Pumping: 19.22

Water Column	Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
10.33 feet x	(0.16)	0.65	1.65	3	4.95

Depth Purging From: 22 feet. Time Purging Begins: 4:34

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity	T	Notes
4:38	3.5	9.00	0.92	67.7	cloudy
4:38	4.0	8.12	0.93	67.9	"
4:39	4.5	8.14	0.95	67.7	"
4:39	5.0	8.08	0.91	67.5	"
4:40	5.5	8.06	0.90	67.6	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 4.95

Time Sample Collection Begins: 4:42

Time Sample Collection Ends: 4:45

Total Gallons Purged: 6

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Oak. Date: 6-27-91

Well: MW-10 Sampling Team: Chris R / DTB

Well Development Method: —

Sampling Method: bailer

Describe Equipment Before Sampling This Well: Trip rinsed

Well Development/ Well Sampling Data

Total Well Depth: 34.04 feet Time: _____ Water level Before Pumping: 20.21

Water Column		Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
13.83	feet x	(0.16)	0.65	2.12	3	6.63

Depth Purging From: 26 feet. Time Purging Begins: 2:46

Notes on Initial Discharge: clear

Time	Volume	pH	Conductivity	T	Notes
2:48	4.5	8.27	.22	67.5	clear
2:49	5.0	8.09	1.22	67.7	cloudy
2:50	5.5	7.89	1.24	67.6	"
2:51	6.0	7.88	1.23	67.6	"
2:52	6.5	7.80	1.24	67.7	"

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: 6.63

Time Sample Collection Begins: 2:58

Time Sample Collection Ends: 3:05

Total Gallons Purged: 6.5

Comments: _____

ALTON GEOSCIENCE, INC.
Well Development and
Water Sampling Field Survey

Project # 30-081-01 Site: BP 35th Oak. Date: 6-27-91

Well: PW Sampling Team: Chris R / D3

Well Development Method: —

Sampling Method: FP bailer

Describe Equipment Before Sampling This Well: _____

Well Development/ Well Sampling Data

Total Well Depth: 20.90 feet Time: _____ Water level Before Pumping: 38.36

Water Column	Casing Diameter 2-inch	4-inch	Volume	Factor	Volume to Purge
_____ feet x	0.16	0.65 (6")	_____	_____	_____

Depth Purging From: ____ feet. Time Purging Begins: 5:04

Notes on Initial Discharge: clear + sheen

Time	Volume	pH	Conductivity	T	Notes

Time Field Parameter Measurement Begins: _____

	Rep #1	Rep #2	Rep #3	Rep #4
pH				
Conductivity				
Temperature (F)				

Presample Collection Gallons Purged: _____

Time Sample Collection Begins: _____

Time Sample Collection Ends: _____

Total Gallons Purged: 10 [bailed ~ 1 gal FP]

Comments: Keck d'd not give consistent reading: FP ~ 0.5" thick

APPENDIX C

OFFICIAL LABORATORY REPORTS
AND
CHAIN OF CUSTODY RECORD

JUL 1 1 1991

SUPERIOR ANALYTICAL LABORATORY, INC.
1555 BURKE UNIT I · SAN FRANCISCO CA 94124 · PHONE (415) 647-2081 DOHS #1332

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 53831
CLIENT: Alton Geoscience
CLIENT JOB NO.: 30-081-01

DATE RECEIVED: 07/01/91
DATE REPORTED: 07/09/91

ANALYSIS FOR TOTAL PETROLEUM HYDROCARBONS
by Modified EPA SW-846 Method 5030 and 8015

LAB #	Sample Identification	Concentration (ug/L) Gasoline Range
1	MW-3	380
2	MW-4	ND<50
3	MW-5	330
4	MW-7	70
5	MW-8	12000
6	MW-9	3600
7	MW-10	12000

ug/L - parts per billion (ppb)
Minimum Detection Limit for Gasoline in Water: 50ug/L

QAQC Summary:
Daily Standard run at 2mg/L: RPD Gasoline = <15%
MS/MSD Average Recovery = 105%: Duplicate RPD = 3.1%

Richard Srna, Ph.D.

Laboratory Director

SUPERIOR ANALYTICAL LABORATORY, INC.
1555 BURKE UNIT I · SAN FRANCISCO CA 94124 · PHONE (415) 647-2081 DOHS #1332

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 53831
CLIENT: Alton Geoscience
CLIENT JOB NO.: 30-081-01

DATE RECEIVED: 07/01/91
DATE REPORTED: 07/09/91

ANALYSIS FOR BENZENE, TOLUENE, ETHYL BENZENE & XYLENES
by EPA SW-846 Methods 5030 and 8020

LAB #	Sample Identification	Concentration(ug/L) Benzene	Toluene	Ethyl Benzene	Xylenes
1	MW-3	28	26	13	46
2	MW-4	6.3	1.8	0.4	1.0
3	MW-5	120	10	12	8
4	MW-7	17	4	0.8	2.2
5	MW-8	3400	1100	240	750
6	MW-9	520	400	85	310
7	MW-10	7300	500	150	300

ug/L - parts per billion (ppb)

Minimum Detection Limit in Water:0.3ug/L

QAQC Summary:
Daily Standard run at 20ug/L: RPD = <15%
MS/MSD Average Recovery = 104% : Duplicate RPD = 0.9%

Richard Srna, Ph.D.

Laboratory Director

ALTON GEOSCIENCE
1000 BURNETT ST., #140
CONCORD, CA 94520 (415) 682-1582

CHAIN of CUSTODY RECORD

PAGE 1 of 1

DATE: 6-27-91

RESULTS DUE BY:

PROJECT NUMBER: 30-081-01 PROJECT NAME AND ADDRESS: BP Oil 3200 35th Oakland CA

PROJECT MANAGER: Matt Hopwood SAMPLER'S SIGNATURE: [signature] LABORATORY: SF# 5383

REMARKS OR SPECIAL INSTRUCTIONS:
Standard T/A time

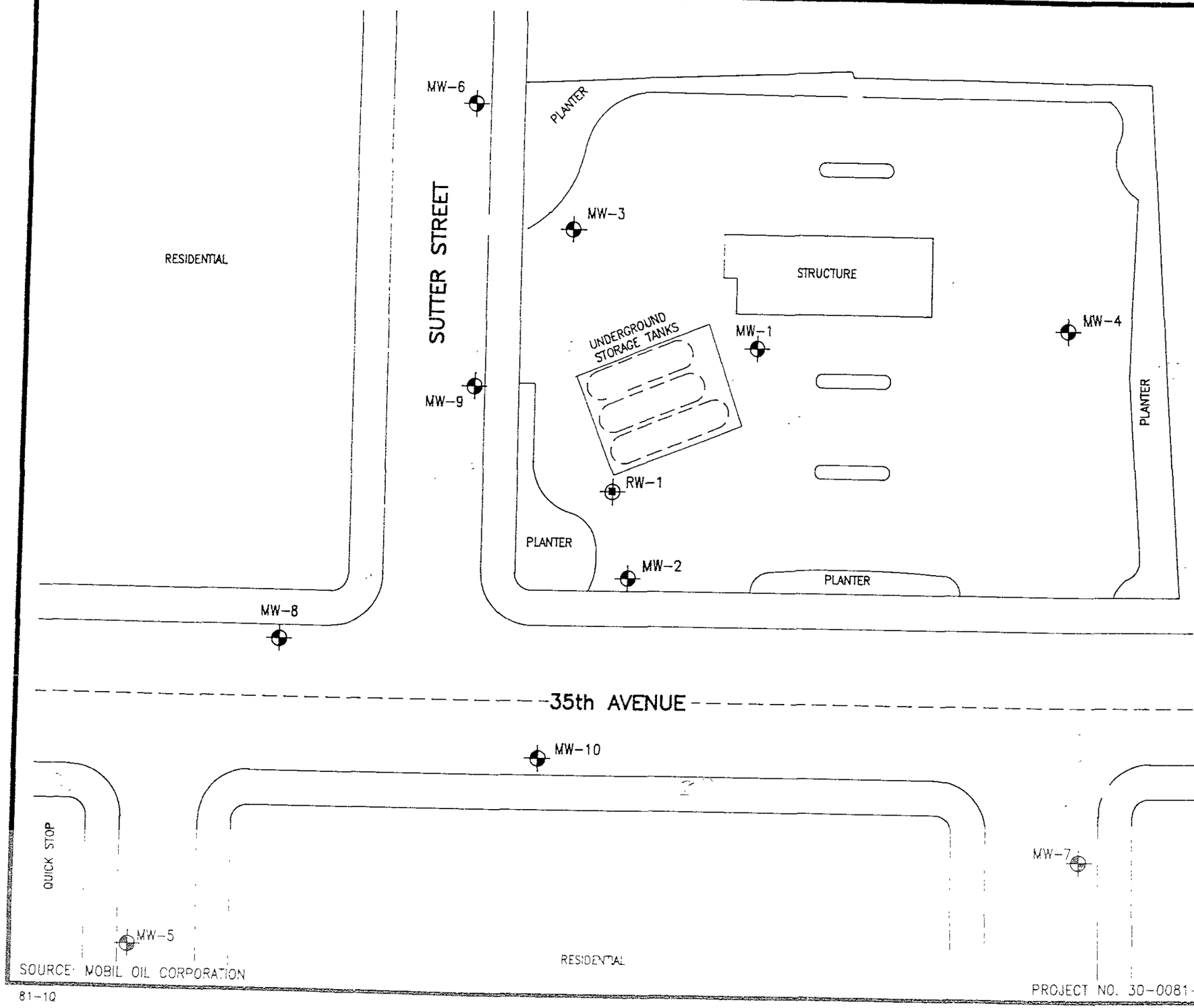
NOTE: PLEASE INDICATE VERBAL REQUESTS FOR ADDITIONAL ANALYSES IN THIS BOX.

SAMPLE NUMBER	SAMPLE DATE/TIME	LOCATION/ DESCRIPTION	SAMPLE MATERIAL	SAMPLE TYPE: GRAB	SAMPLE TYPE: COMP.	NUMBER OF CONTAINERS
MW-3	6-27-91 4:19		WATER	X		3
MW-4	6-27-91 3:42					3
MW-5	6-27-91 2:31					3
MW-7	6-27-91 3:23					3
MW-8	6-27-91 2:06					3
MW-9	6-27-91 4:45					3
MW-10	6-27-91 3:05					3
				TOTAL NO. OF CONTAINERS:		21

SAMPLE PREP.				SOIL ANALYSIS					WATER ANALYSIS					
3510: SOLV. EXTR.	3810: HEAD SPACE	5030: PURGE & TRAP		418.1: TPHC (IR)	8010: HALOCARBONS	8020: BTXE	DHS METHOD: TPHC (GC)	7420: TOTAL Pb	418.1: TPHC (IR)	601: HALOCARBONS	602: BTXE	DHS METHOD: TPHC (GC)	7421: TOTAL Pb	TPH-G/BTEX

Please initial:
Samples stored in ice.
Appropriate containers.
Samples preserved.
VOA's without headspace.
Comments:

RELINQUISHED BY: [signature]	RECEIVED BY: Dave Charlett	DATE/TIME: 7-1 10:30A	METHOD OF SHIPMENT: EXPRESS-IT
RELINQUISHED BY: [signature]	RECEIVED BY: [signature]	DATE/TIME: 7-1-91	SHIPPED BY: EXPRESS-IT
RELINQUISHED BY:	RECEIVED BY: [signature] SAL	DATE/TIME: 7-1-91 1130 AM	COURIER:



APPROXIMATE SCALE IN FEET

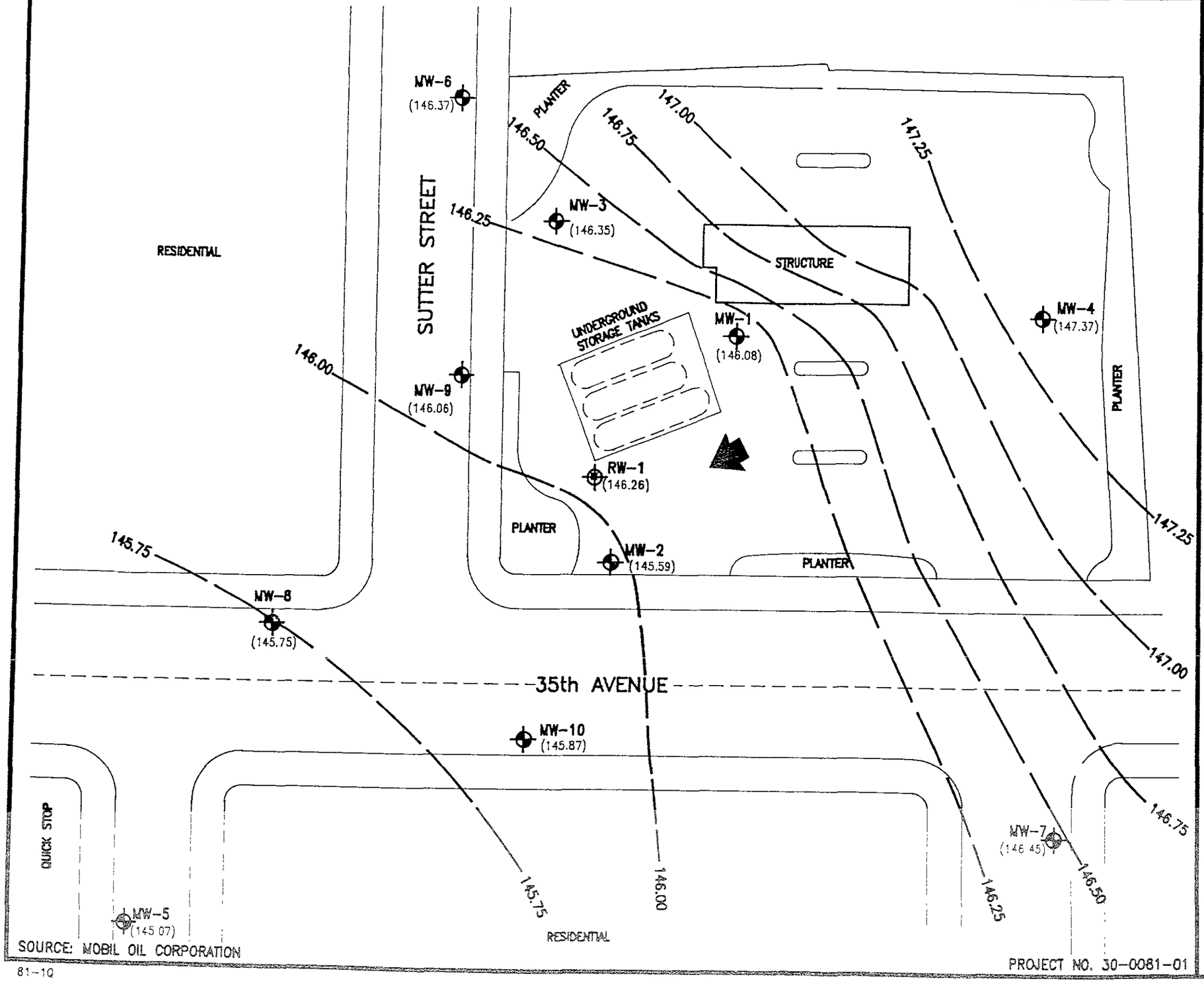
LEGEND:

- MONITORING WELL
- RECOVERY WELL

FIGURE 2: SITE PLAN

BP OIL COMPANY
SERVICE STATION NO 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave Ste. 140
Concord, California



N

0 15 30

APPROXIMATE SCALE IN FEET

LEGEND:

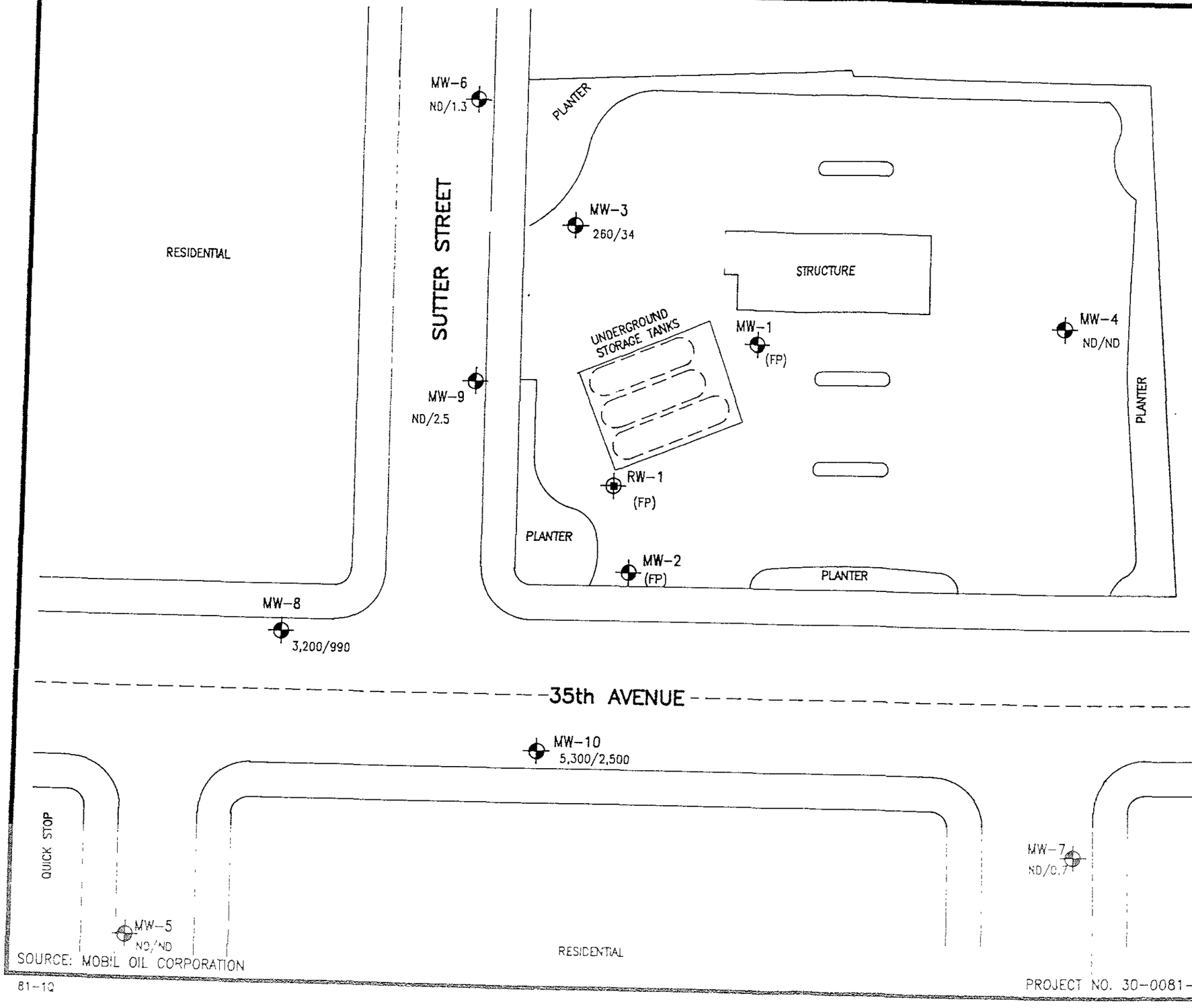
- MONITORING WELL
- RECOVERY WELL
- (145.59) GROUND WATER ELEVATION
- —147.00— GROUND WATER ELEVATION CONTOUR LINE
- GENERAL DIRECTION OF GROUND WATER GRADIENT

NOTE:
1. CONTOUR LINES ARE INTERPRETIVE BASED ON WATER LEVELS IN MONITORING WELLS MEASURED ON DECEMBER 18, 1991.
2. EQUIVALENT GROUND WATER SURFACE ELEVATION CALCULATED ASSUMING 0.75 SPECIFIC GRAVITY FOR FREE PRODUCT IN MW-1, MW-2, & RW-1.
3. CONTOUR INTERVAL = 0.25 FOOT.
4. GROUND WATER GRADIENT = 0.01 FOOT/FOOT

FIGURE 3: GROUND WATER ELEVATION CONTOUR MAP

BP OIL COMPANY
SERVICE STATION NO. 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave. Ste. 140
Concord, California



0 15 30

APPROXIMATE SCALE IN FEET

LEGEND:

⊕	MONITORING WELL
⊕	RECOVERY WELL
ND	NOT DETECTED AT OR ABOVE METHOD DETECTION LIMITS
FP	FREE PRODUCT
TPH-G	TOTAL PETROLEUM HYDROCARBONS AS GASOLINE
ND/0.7	TPH-G/BENZENE CONCENTRATIONS IN PARTS PER BILLION (ppb)

FIGURE 4: ANALYTICAL RESULTS OF GROUND WATER SAMPLES

BP OIL COMPANY
SERVICE STATION NO. 11132
3201 35th AVENUE
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave. Ste. 140
Concord, California

2/92

TABLES

TABLE 1

SURVEY AND WATER LEVEL MONITORING DATA
December 1991

Well ID	Well Elevation (Feet)*	Date	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-1	169.75	01-90	N.M.	N.M.	N.C.
MW-1	169.75	07-90	21.46	0.22	148.29**
MW-1	169.75	03-91	17.18	N.M.	152.57
MW-1	169.75	06-91	22.70	0.18	147.18**
MW-1	169.75	09-91	23.69	0.27	146.26**
MW-1	169.75	12-91	23.88	0.28	146.08**
MW-2	168.14	01-90	N.M.	N.M.	N.C.
MW-2	168.14	07-90	20.24	0.10	147.90**
MW-2	168.14	03-91	15.64	N.M.	152.50
MW-2	168.14	06-91	21.50	0.19	146.78**
MW-2	168.14	09-91	22.52	0.15	145.73**
MW-2	168.14	12-91	22.82	0.36	145.59**
MW-3	167.17	01-90	N.M.	N.M.	N.C.
MW-3	167.17	07-90	18.96	----	148.21
MW-3	167.17	03-91	14.06	----	153.11
MW-3	167.17	06-91	19.92	----	147.25
MW-3	167.17	09-91	20.95	----	146.22
MW-3	167.17	12-91	20.82	----	146.35
MW-4	170.36	01-90	N.M.	N.M.	N.C.
MW-4	170.36	07-90	21.30	----	149.06
MW-4	170.36	03-91	18.28	----	152.08
MW-4	170.36	06-91	22.34	----	148.02
MW-4	170.36	09-91	23.19	----	147.17
MW-4	170.36	12-91	22.99	----	147.37

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, and MW-2 were calculated assuming a specific gravity of 0.75 for free product.

N.M. Not Measured

N.C. Not Calculated

---- No Free Product Encountered

TABLE 1
(cont'd)

SURVEY AND WATER LEVEL MONITORING DATA
December 1991

Well ID	Well Elevation (Feet)*	Date	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-5	165.14	01-90	N.M.	N.M.	N.C.
MW-5	165.14	07-90	17.97	----	147.17
MW-5	165.14	03-91	12.62	----	152.52
MW-5	165.14	06-91	18.94	----	146.20
MW-5	165.14	09-91	20.07	----	145.07
MW-5	165.14	12-91	19.91	----	145.23
MW-6	165.40	01-90	N.M.	N.M.	N.C.
MW-6	165.40	07-90	17.20	----	148.20
MW-6	165.40	03-91	N.A.	N.M.	N.C.
MW-6	165.40	06-91	18.10	----	147.30
MW-6	165.40	10-91	19.15	----	146.25
MW-6	165.40	12-91	19.03	----	146.37
MW-7	167.61	01-90	N.M.	N.M.	N.C.
MW-7	167.61	07-90	19.70	----	147.91
MW-7	167.61	03-91	17.82	----	149.79
MW-7	167.61	06-91	20.48	----	147.13
MW-7	167.61	09-91	21.40	----	146.21
MW-7	167.61	12-91	21.16	----	146.45
MW-8	165.74	03-91	12.98	----	152.76
MW-8	165.74	06-91	19.10	----	146.64
MW-8	165.74	09-91	20.17	----	145.57
MW-8	165.74	12-91	19.99	----	145.75

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, MW-2, and RW-1 were calculated assuming a specific gravity of 0.75 for free product.

N.M. Monitoring Well was not accessible

N.M. Not Measured

N.C. Not Calculated

---- No Free Prouduct Encountered

TABLE 1
(cont'd)

SURVEY AND WATER LEVEL MONITORING DATA
December 1991

Well ID	Depth to Free Product Well Elevation (Feet)*	Date	Depth to Water (Feet)	Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-9	166.20	03-91	13.42	----	152.78
MW-9	166.20	06-91	19.22	----	146.98
MW-9	166.20	09-91	20.25	----	145.95
MW-9	166.20	12-91	20.14	----	146.06
MW-10	167.01	03-91	14.32	----	152.69
MW-10	167.01	06-91	20.21	----	146.80
MW-10	167.01	09-91	21.22	----	145.79
MW-10	167.01	12-91	21.14	----	145.87
RW-1	168.01	07-90	27.93	1.21	140.08**
RW-1	168.01	03-91	N.M.	N.M.	N.C.
RW-1	168.01	06-91	20.90	0.04	147.14**
RW-1	168.01	09-91	21.92	0.01	146.10**
RW-1	168.01	12-91	21.77	0.02	146.26**

Note:

* Elevation in feet relative to a common datum (MW-2) with an elevation of 168.14 feet above mean sea level, as measured on July 5, 1990 by Alton Geoscience.

** Equivalent ground water surface elevation for MW-1, MW-2, and RW-1 were calculated assuming a specific gravity of 0.75 for free product.

N.M. Not Measured

N.C. Not Calculated

---- No Free Product Encountered

TABLE 2

RESULTS OF
LABORATORY ANALYSIS OF GROUND WATER SAMPLES
December 1991

Well ID	Date	TPH-G	B	T	E	X
		(Concentrations in Parts per Billion)				
MW-1	1-29-90	---	---	---	---	---
MW-1	7-09-90	---	---	---	---	---
MW-1	3-07-91	---	---	---	---	---
MW-1	6-27-91	---	---	---	---	---
MW-1	9-27-91	---	---	---	---	---
MW-1	12-18-91	---	---	---	---	---
MW-2	1-29-90	14	580	1,300	460	2,300
MW-2	7-09-90	---	---	---	---	---
MW-2	3-07-91	---	---	---	---	---
MW-2	6-27-91	---	---	---	---	---
MW-2	9-27-91	---	---	---	---	---
MW-2	12-18-91	---	---	---	---	---
MW-3	1-29-90	0.5	20	30	24	35
MW-3	7-09-90	140	5.3	4.6	2.0	3.8
MW-3	3-07-91	400	69	22	6.1	57
MW-3	6-27-91	380	28	26	13	46
MW-3	9-27-91	70	7.9	ND<0.3	0.4	1.1
MW-3	12-18-91	260	34	24	0.8	28
MW-4	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-4	3-07-91	ND<50	2.2	3.8	1.5	2.8
MW-4	6-27-91	ND<50	6.3	1.8	0.4	1.0
MW-4	9-27-91	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-4	12-18-91	ND<50	ND<0.3	ND<0.3	ND<0.3	0.5

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
ND = Not Detected at Method Detection Limit
--- = No sample collected from MW-1 and MW-2 due to the presence of free product

TABLE 2
(cont'd)

RESULTS OF
LABORATORY ANALYSIS OF GROUND WATER SAMPLES
December 1991

Well ID	Date	TPH-G	B	T	E	X
		(Concentrations in Parts per Billion)				
MW-5	7-09-90	280	200	210	46	290
MW-5	3-07-91	ND<50	17	0.9	0.7	1.6
MW-5	6-27-91	330	120	10	12	8
MW-5	9-27-91	730	230	16	20	22
MW-5	12-18-91	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-6	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-6	3-07-91	N.A.	N.A.	N.A.	N.A.	N.A.
MW-6	6-27-91	N.A.	N.A.	N.A.	N.A.	N.A.
MW-6	9-27-91	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-6	12-18-91	ND<50	1.3	2.2	ND<0.3	2.7
MW-7	7-09-90	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3
MW-7	3-07-91	ND<50	ND<0.3	0.4	0.3	2.4
MW-7	6-27-91	70	17	4	0.8	2.2
MW-7	9-27-91	ND<50	0.4	ND<0.3	ND<0.3	0.4
MW-7	12-18-91	ND<50	0.7	2.9	0.8	3.3
MW-8	3-07-91	2,700	780	450	64	310
MW-8	6-27-91	12,000	3,400	1,100	240	750
MW-8	9-27-91	41,000	5,700	5,200	1,100	4,300
MW-8	12-18-91	3,200	990	150	120	250

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
ND = Not Detected at Method Detection Limit
N.A. = Monitoring well was not accessible.

TABLE 2
(cont'd)

RESULTS OF
LABORATORY ANALYSIS OF GROUND WATER SAMPLES
December 1991

Well ID	Date	TPH-G	B	T	E	X
		(Concentrations in Parts per Billion)				
MW-9	3-07-91	7,100	220	4	2.4	2,400
MW-9	6-27-91	3,600	520	400	85	310
MW-9	9-27-91	3,200	720	150	50	180
MW-9	12-18-91	ND<50	2.5	1.1	0.3	5.8
MW-10	3-07-91	1,600	120	190	32	230
MW-10	6-27-91	12,000	7,300	500	150	300
MW-10	9-27-91	57,000	12,000	7,200	1,400	4,600
MW-10	12-18-91	5,300	2,500	120	36	79
RW-1	3-07-91	---	---	---	---	---
RW-1	6-27-91	---	---	---	---	---
RW-1	9-27-91	---	---	---	---	---
RW-1	12-18-91	---	---	---	---	---

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
ND = Not Detected at Method Detection Limit
--- = No sample collected from RW-1 due to the presence of free product