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Environmental Health

PHASE III - SUPPLEMENTAL SITE INVESTIGATION STUDY

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

Project No. 30-081-01



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Project No. 30-081-01

Prepared for:

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Prepared by:

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August 21, 1991

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1.0 INTRODUCTION AND BACKGROUND

BP Oil Company retained Alton Geoscience, Inc. to conduct a Phase III - Supplemental Site Investigation Study related to subsurface contamination at BP Oil Company Service Station No. 11132, 3201 35th Avenue, Oakland, California. The site location is shown in Figure 1, while a site plan is shown in Figure 2.

1.1 Purpose and Scope

This Phase III - Supplemental Site Investigation Study was performed to: (1) address the concerns of the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) and the Alameda County Department of Environmental Health (ACDEH) regarding petroleum hydrocarbon contamination at the site; and (2) determine the extent of hydrocarbon concentrations in the subsurface soil and ground water.

Alton Geoscience supervised and/or performed the following tasks during this investigation:

- Drilled three soil borings for conversion into offsite ground water monitoring wells.
- 2. Collected and analyzed soil and ground water samples.
- Analyzed field data and laboratory results.
- 4. Prepared this technical report presenting the results, findings, and recommendations of the investigation.

The results of these tasks provide the basis for evaluating the remedial planning and feasibility study.

1.2 Site Description

The site is currently an operating BP Oil service station located on the northeast corner of the intersection of 35th Avenue and Suter Street, Oakland, California. The adjacent properties are residential and commercial developments. The site is located at an elevation of approximately 160 feet above mean sea level. The location and layout of the underground storage tanks are shown in Figure 2, Site Plan.

A sensitive receptors survey was conducted to identify nearby environmental elements and land uses that may be affected by

or affect the subsurface environment at the site. The findings of the survey are as follows:

- o The properties adjacent to the site are a mixture of residential and commercial developments. The site is surrounded by residential property except to the south across 35th avenue where a Quik Stop store is located. The Quik Stop has underground gasoline storage tanks but there are no records of any unauthorized release reported.
- o A review of RWQCB files indicate that there are three confirmed fuel releases within a 1/2-mile radius of the site. Two of the confirmed releases are upgradient of the site. These release are separated from the site by Highway 580, a topographic low.
- o There are no known municipal or private water supply wells within a 1/2-mile radius of the site.
- o Peralta Creek is the nearest surface body of water located approximately 500 feet north of the site.
- o Allandale School is the nearest school, located approximately 1,000 feet south of the site.

A copy of the sensitive receptors survey is presented in Appendix A.

1.3 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 the former Mobil Oil service station. Monitoring and sampling of the wells, performed by KEI, detected concentrations of total petroleum hydrocarbons (TPH) in both MW-1 and MW-2 at concentrations up to 210 parts per million (ppm), (Alton Geoscience 1990).

On January 26 and February 1, 1990, as part of a qualitative shallow ground water survey, Alton Geoscience supervised the drilling of 10 soil borings to various depths, ranging from 25 to 33 feet below grade. The borings were advanced 3 to 4 feet beyond the depth at which ground water was encountered. Following drilling, the borings were converted into temporary wells (TW-1 through TW-10) by inserting clean, 2-inch-diameter, schedule 40 polyvinyl chloride (PVC) casing with 0.020-inch slots. Ground water samples were collected from each temporary well, then the temporary casing was removed from each boring, backfilled with grout slurry and capped with asphalt. Additionally, ground water samples were collected from the three existing monitoring wells.

The sample from Monitoring Well MW-1 contained 0.1 foot of free product and Monitoring Well MW-2 contained 0.05 foot. Samples from the other monitoring and temporary wells contained concentrations of dissolved-phase total petroleum hydrocarbons as gasoline (TPH-G) and benzene, toluene, ethylbenzene and xylenes (BTEX) ranging from nondetectable (ND) to 240,000 parts per billion (ppb), (Alton Geoscience, 1990).

On May 16, 1990, Alton Geoscience supervised the drilling of two soil borings which were converted into one 4-inch-diameter ground water monitoring well (MW-4) and one 6-inch-diameter recovery well (RW-1). On June 25, 1990, Alton Geoscience supervised the drilling of three offsite soil borings which were converted into 2-inch-diameter ground water monitoring wells (MW-5, MW-6, and MW-7).

Laboratory analysis of water samples indicated TPH-G concentrations ranging from nondetectable in Monitoring Wells MW-4, MW-6, and MW-7, to 140 and 280 ppb detected in MW-3 and MW-5, respectively. The laboratory analysis for BTEX in Monitoring Wells MW-4, MW-6, and MW-7 indicated nondetectable concentrations. However, the laboratory analysis indicated 5.3 and 200 ppb of benzene in MW-3 and MW-5, respectively (Alton Geoscience, 1990).

1.4 Regional Geology and Hydrogeology

The site is located approximately 160 feet above mean sea level in Oakland, California (USGS Topographic Map, Oakland East Quadrangle - 7.5 Minute Series) as shown in Figure 1.

The topography of the surrounding area is characterized by rolling hills, gentle slopes, and broad valleys. Undivided Quaternary deposits (QU) form the underling unit in this region. The composition and physical properties of QU vary. The QU unit consists predominantly of Temescal Formation, probably including covered or unrecognized San Antonio Formation and gravel, sand, and clay (Qg), as well as recent alluvium and colluvium, and artificial fill. The site is located in a 580-square-mile basin drained by the Guadalupe River, and Alameda, Coyote, Redwood and San Francisquito Creeks.

The water-bearing material is comprised of younger and older alluvium. Regional surface and ground water flow in the region is to the southwest, towards San Francisco Bay. The nearest surface water drainage is Peralta Creek, about 500 feet north of the site. The water supply of the City of Oakland is obtained from Pardee Dam, which receives water from the Sierra snow melt.

2.0 FIELD METHODS

This investigation included the drilling of three soil borings, as outlined in the drilling and sampling protocol shown in Appendix B. The borings were used to install Monitoring Wells MW-8, MW-9, and MW-10, following the design and installation procedures shown in Appendix B.

2.1 Soil Borings and Sampling

On January 31, 1991, prior to commencement of offsite drilling activities, Ground Water Protection Ordinance Permit No. 91057 was obtained from the Alameda County Flood Control and Water Conservation District. Additionally, on February 15, 1991, Street Excavation Permit Nos. 9100232 and 9100234 were obtained from the City of Oakland Department of Public Works. Copies of the ground water protection ordinance permit and street excavation permits are presented in Appendix D.

On February 25 and 26, 1991, Alton Geoscience supervised the drilling of three offsite soil borings (SB-8, SB-9, and SB-10), which were converted into ground water monitoring wells (MW-8, MW-9, and MW-10). The borings were drilled using an 8-inch-diameter, hollow-stem augers to total depths of approximately 35 to 40 feet below grade, respectively.

During drilling, soil samples were collected from the soil borings at 5-foot intervals below grade and at significant lithologic changes until the first ground water was encountered at a depth of approximately 25 feet below grade in each well.

Drilling activities were performed by Soils Exploration Services, Inc. of Vacaville, California, using a high-torque CME-55 drilling rig. The soil samples were collected using a split-spoon sampler lined with brass tubes. The samples recovered for laboratory analysis were covered with aluminum foil, capped with polyurethane caps, wrapped with clear tape, labeled, and placed immediately in an iced cooler. A description of drilling procedures and soil sampling protocol, and copies of boring logs, are presented in Appendix B.

2.2 Ground Water Monitoring Well Construction

The soil borings were completed as Ground Water Monitoring Wells MW-8, MW-9, and MW-10. The monitoring wells were constructed of clean, 2-inch-diameter, flush-threaded, Schedule 40 PVC blank casing and 0.020-inch, slotted casing to a total depth of approximately 35 to 40 feet below grade. Well installation procedures and construction details are presented in Appendix B.

2.3 Monitoring Well Development and Sampling

Well development and sampling procedures were conducted in accordance with the RWQCB and ACDEH guidelines. A description of Alton Geoscience general field procedures for well development and sampling is presented in Appendix C.

Monitoring wells were developed by removing approximately 47.7 gallons from MW-8, 23.2 gallons from MW-9, and 33 gallons from MW-10. Development of the monitoring wells was conducted on March 6, 1991. Prior to well development, a clear PVC bailer was used in each well to check for the presence of floating product.

Prior to sampling of the wells on March 7, 1991, a minimum of 3 casing volumes of water was purged from each well. Water samples were collected after stabilization of temperature, pH, and conductivity readings in the purged water was observed. Each well was observed for the presence of free product and sheen. The water samples were decanted from a bailer into clean containers. Samples were immediately placed in an iced cooler prior to and during transportation to a California-certified laboratory for analysis following proper chain of custody procedures. Water sampling field survey forms documenting field observations during well development, purging, and sampling are presented in Appendix C. Analytical methods, official laboratory reports and chain of custody records are presented in Appendix E.

2.4 Ground Water Level Monitoring and Surveying

Permanent reference marks at the top of each well casing of Monitoring Wells MW-8, MW-9, and MW-10 were surveyed on April 5, 1991, to the nearest 0.01 foot in reference to Monitoring Well MW-2 which has a top of casing elevation of 168.14 feet above mean sea level. The purpose of the survey was to determine the relative top of casing elevations of the monitoring wells for use in calculating the ground water elevation at each well. The water table elevation data is used to estimate the general direction of ground water flow and average hydraulic gradient beneath the site. The survey data field notes are presented in Appendix D.

Ground water level monitoring and survey data collected on April 5, 1991 is presented in Table 1. A ground water elevation contour map based on interpretation of the monitoring data is shown in Figure 3.

2.5 Aguifer Analysis by Pumping Test

A pumping test was performed at the site on April 25, 1991. The purpose of the test was to estimate aquifer parameters which are used for remedial engineering design.

Prior to initiating the pumping test, transducers were placed in the pumping well (RW-1) and two observation wells (MW-1 and MW-2). An Instrumentation Northwest TERRA 8 data logger was programed to record readings from the transducers every 15 seconds for the first 30 minutes after pumping began, every minute for the next 2 hours, and then every 2 minutes for the duration of the test. Depth to water Measurements were taken every hour from MW-3, MW-4, MW-5, and MW-6 using an electronic probe.

A 2-inch diameter, variable flow rate pump was submersed in the well. The water was pumped into 55 gallon drums prior to proper offsite disposal.

The test began at 10:13 a.m. on April 25, 1991. Flow rates were measured using a stopwatch and a 5-gallon bucket marked with 1/4-gallon increments. The flow rate was maintained at 0.9 gallons per minute (GPM) to 1 GPM. Drawdown was observed in MW-1 and MW-2 after 20 minutes of pumping, and in all the monitored wells within an hour of the onset of the test.

After approximately 8 hours of continuous pumping 5.5 feet of drawdown had occurred in the pumping well, and between 0.27 and 1.38 feet of drawdown was recorded in the observation wells. The pump was then turned off and removed from the well. Ground water elevation readings continued after pump removal until ground water levels had recovered to approximately the initial static water level.

3.0 ANALYTICAL METHODS

All laboratory analyses of soil and ground water samples were performed by Superior Analytical Laboratories, Inc., a California-certified analytical laboratory, using standard test methods of the U.S. Environmental Protection Agency (EPA) and the California Department of Health Services (DHS). The laboratory reports and listing of the analytical methods used are presented in Appendix E.

3.1 Soil Analysis

Soil samples from the three borings were analyzed for the following constituents:

- o TPH-G using EPA Methods 5030/8015
- o BTEX constituents using EPA Methods 5030/8020

The results of the laboratory analyses of the soil samples are presented in Table 2; the official laboratory reports and chain of custody records are included in Appendix E.

3.2 Water Analysis

Ground water samples collected from all monitoring wells except MW-1 and MW-2, which exhibited sheen, were analyzed for the following constituents:

- o TPH-G using EPA Methods 5030/8015
- o BTEX constituents using EPA Methods 5030/8020

The results of the laboratory analyses of the ground water samples are presented in Table 3; the official laboratory reports and chain of custody records are included in Appendix E.

4.0 SITE GEOLOGY AND HYDROGEOLOGY

A brief description of the pertinent information on the site geology and hydrogeology is presented below.

4.1 Site Geology

A review of the boring logs generated during this phase, and previous phases, of the investigation indicated that the stratigraphy beneath the site is relatively consistent. Silty clay was the predominant soil type encountered throughout each new boring to a depth of approximately 35 to 40 feet below grade and is generally consistent with the results of previous investigations at the site.

4.2 Site Hydrogeology

As presented in Table 1, the depth to ground water in MW-1 through MW-5 and MW-7 through MW-10, as measured from the top of casing on April 5, 1991, ranged from 12 to 18 feet below grade. The depth to water in MW-6 could not be obtained due to the presence of an abandoned vehicle over the well box. The depth to water was not measured in RW-1 due to the presence of an oily substance on the water surface.

The ground water elevations as measured on April 5, 1991, were used to develop the ground water elevation contour map shown in Figure 3. The data indicates a southeasterly ground water flow direction at the site, with an average hydraulic gradient of approximately 0.003 foot per foot across the site.

5.0 DISCUSSION OF RESULTS

The results of the field activities and laboratory analysis of soil and ground water samples collected during this investigation are presented in Tables 2 and 3, and are discussed below.

5.1 <u>Soil</u>

A total of 21 soil samples was collected, 9 of which were analyzed as part of this site investigation study to assess the extent of subsurface soil contamination. The results are discussed below.

- o Laboratory analysis indicates low to nondetectable levels of TPH-G and BTEX constituents detected in soil samples collected from Soil Borings SB-8, SB-9, and SB-10 at the 10.5 to 11.0 foot interval below grade.
- o The highest levels of TPH-G in the soil samples were detected at 20.5 to 21.0 feet below grade, with levels ranging from 73 to 390 ppm.

5.2 Ground Water

Results of the field survey and laboratory analysis of the ground water samples collected from the new and existing monitoring wells were used to assess the extent of ground water contamination. The results of the laboratory analysis are discussed below and summarized in Table 3.

- o Ground water samples collected from MW-1 and MW-2 exhibited sheen and were not analyzed. Recovery Well RW-1 was not sampled due to the presence of an oily substance on the water surface. Monitoring Well MW-6 was not sampled due to the presence of an abandoned vehicle parked over the monitoring well.
- O Laboratory analysis of ground water samples indicated TPH-G concentrations ranging from nondetectable in Monitoring Wells MW-4, MW-5, and MW-7, with concentrations of 400, 1,600, 2,700, and 7,100 ppb detected in ground water samples collected from MW-3, MW-10, MW-8, and MW-9, respectively.
- o The laboratory analysis of ground water samples for benzene revealed concentrations ranging from nondetectable in Monitoring Well MW-7 to 780 ppb detected in MW-8.
- o The laboratory analysis of ground water samples for toluene revealed concentrations ranging from 0.9 ppb detected in MW-5 to 450 ppb detected in MW-8.

- o The laboratory analysis of ground water samples analyzed for ethylbenzene revealed concentrations ranging from 0.7 ppb detected in MW-5 to 64 ppb detected in MW-8.
- o The laboratory analysis of ground water samples for total xylenes revealed concentrations ranging from 1.6 ppb detected in MW-5 to 2,400 ppb detected in MW-9.

5.3 Analysis of Aguifer Parameters by Pumping Test

As described in section 2.5, an aquifer pumping test was performed on well RW-1 with six observation wells located between 30 and 200 feet from the pumping well. After pumping for about 8 hours, measurable drawdown was observed in all the wells.

Storativity (S) and transmissivity (T) were calculated using the computer program AQTESOLV, (Geraghty & Miller Modelling Group), based on the Theis (1935) solutions. Storativity (S) and transmissivity (T) values are indicated below:

Well ID	S	T (ft ² /min)
MW-1	0.0027	0.239
MW-2	0.0030	0.276
MW-3	0.0032	0.221
MW-4	0.0013	0.302
MW-5	0.0011	0.966
MW-6	0.0026	0.348

These values will be used to calculate the parameters for the design of the remediation system. A graphical representation of the drawdown curve is presented in Appendix F.

6.0 FINDINGS AND CONCLUSIONS

The findings and conclusions of this site investigation study are summarized below:

- o The concentrations of TPH-G and BTEX constituents detected in the soil samples from the offsite soil borings ranged from nondetectable to 390 ppm. The adsorbed phase petroleum hydrocarbon constituents in the soil extends offsite to the south.
- o Samples from two of the monitoring wells (MW-1 and MW-2) exhibited free product and therefore were not sampled. Recovery Well RW-1 was not sampled due to the presence of an oily substance.
- o The shallow ground water beneath the site has been impacted by free-floating and dissolved-phase

hydrocarbon constituents, the extent of which can be defined generally to the north, east, and west of the site.

- 4. The dissolved-phase hydrocarbon plume has migrated offsite south of the property. This is consistent with the general flow direction of the shallow ground water.
- 5. The average equilibrated depth to ground water in the monitoring wells at the site is 15 feet below grade.
- 6. The ground water elevation contour map, developed from the water level and survey data, indicates an overall southeasterly ground water flow direction beneath the site, with an average hydraulic gradient of approximately 0.003 foot per foot.
- 7. Based on the pumping test data, the average transmissivity of the aquifer beneath the site was calculated to be 0.392 ft²/min. The calculated average hydraulic conductivity beneath the site was determined to be 0.016 ft/min. The average linear velocity of the aquifer beneath the site was determined to be approximately 4.80 X 10⁻⁵ ft/min.
- 8. Soil types encountered at the site during drilling generally consisted of silty clay.
- 9. There are no existing domestic water supply wells in the immediate vicinity or within a 1/2-mile radius of the site.

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

ALTON GEOSCIENCE

Matthew A. Taylor Staff Engineer

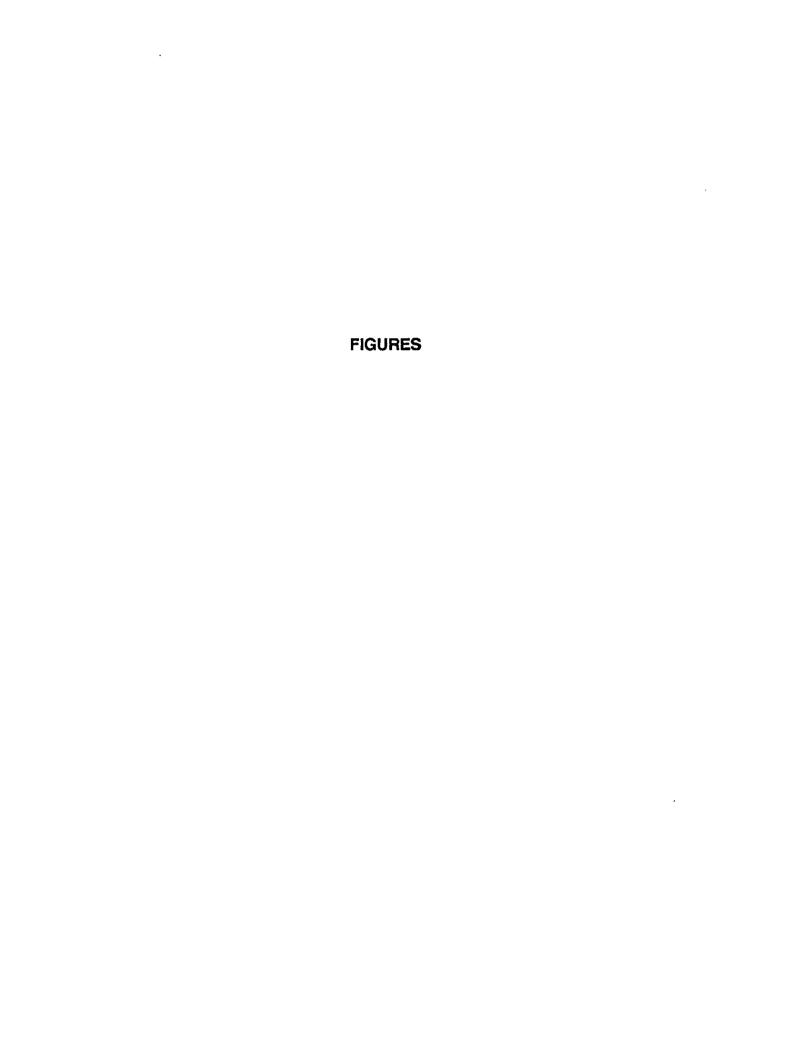
Matthew Hopwood Project Manager

Jefferey W. Wiegand, C.E.G. 331

Vice President

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- Alton Geoscience, A., 1990. Phase II Supplemental Site Investigation Report
- Geraghty & Miller Modeling Group, AQTESOLV: Aquifer Test Solver, by G. M. Duffield and J. O. Rumbaugh, 1989.
- Theis, C. V., 1935. "The Relation Between the Lowering of the Piezometric Surface and Duration of Discharge of a Well using Ground Water Storage", American Geophysical Union Transactions, Vol. 16, pp. 519-524.



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

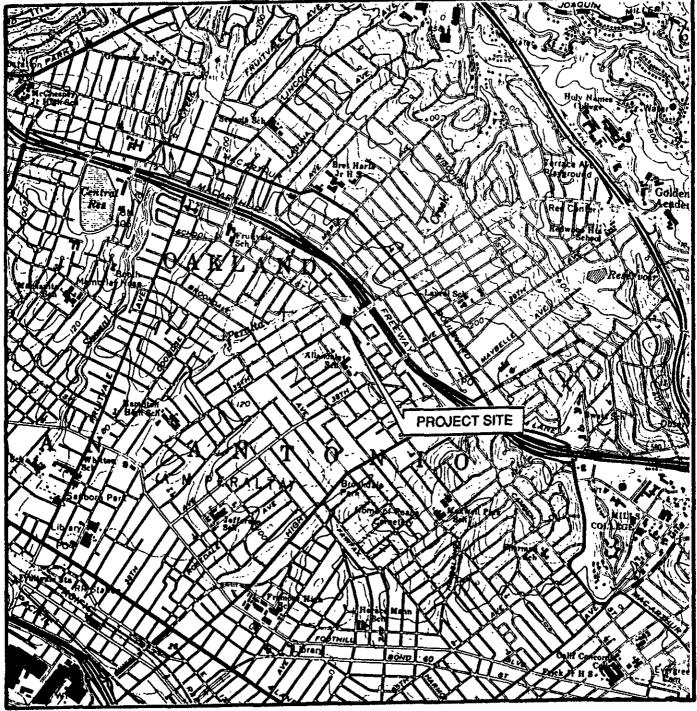


FIGURE 1 SITE VICINITY MAP

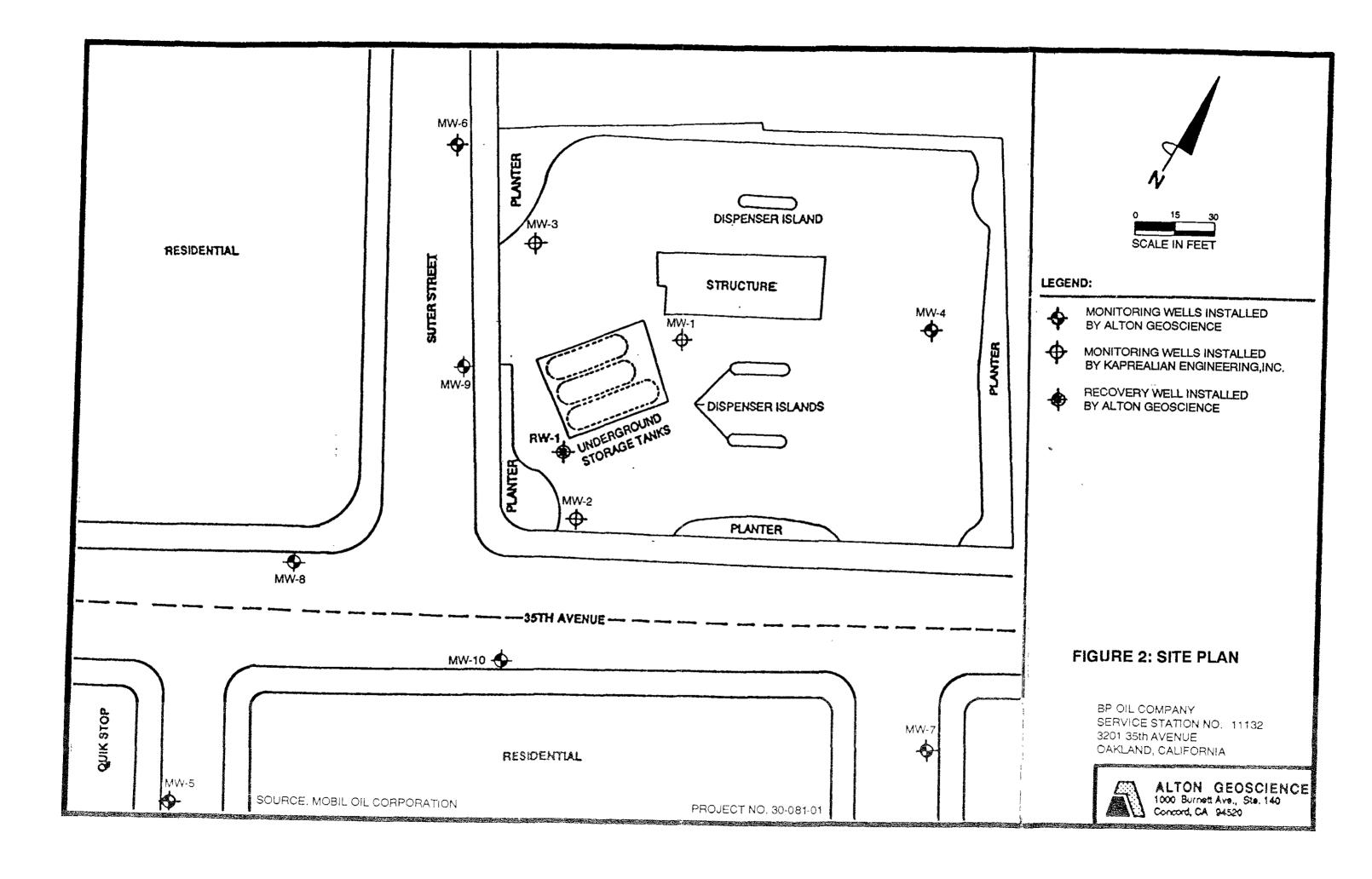
0 1000 2000 SCALE IN FEET B P SERVICE STATION NO. 11132 3201 35TH AVENUE OAKLAND, CALIFORNIA

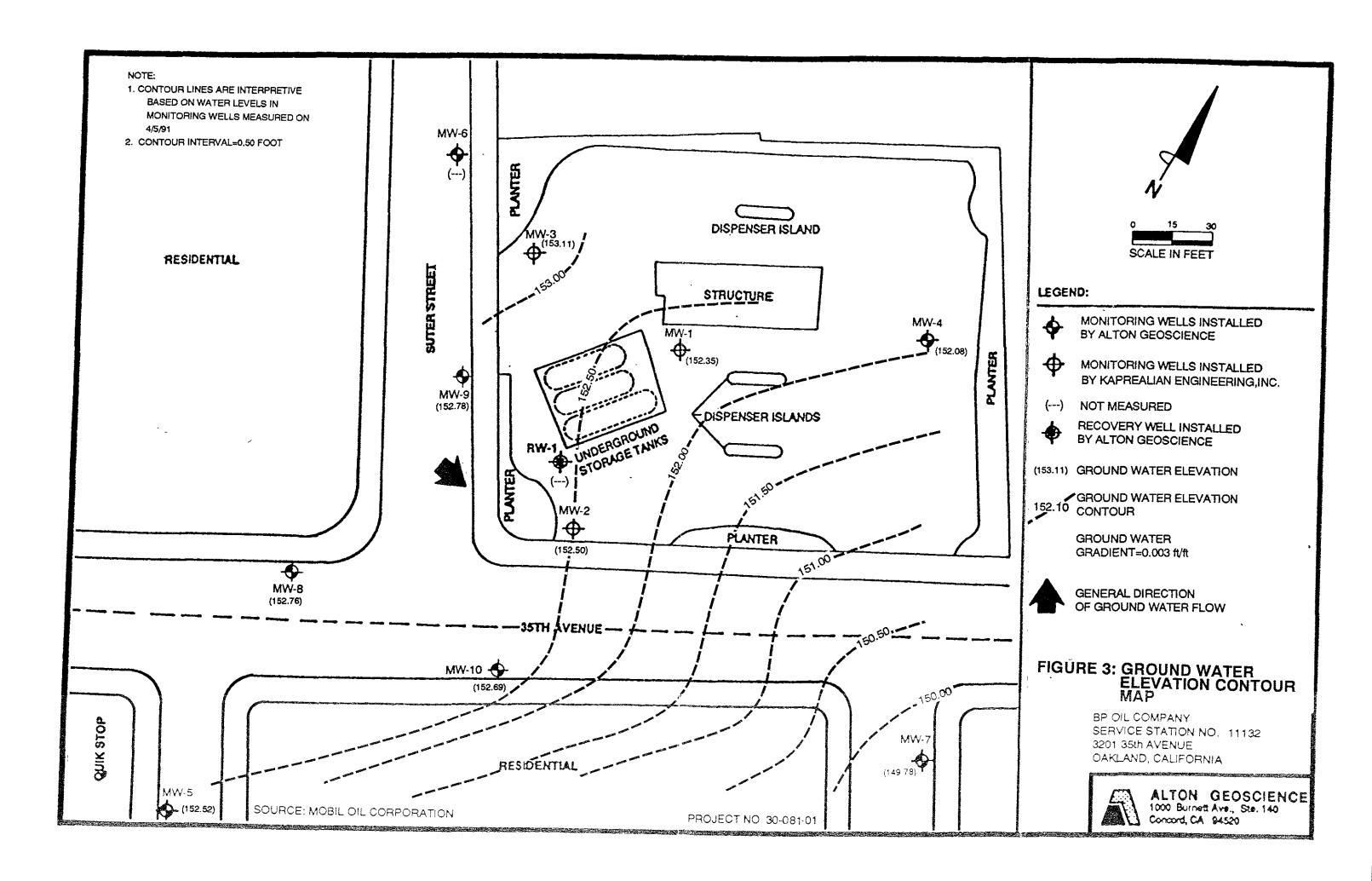
PROJECT NO, 30-081-01

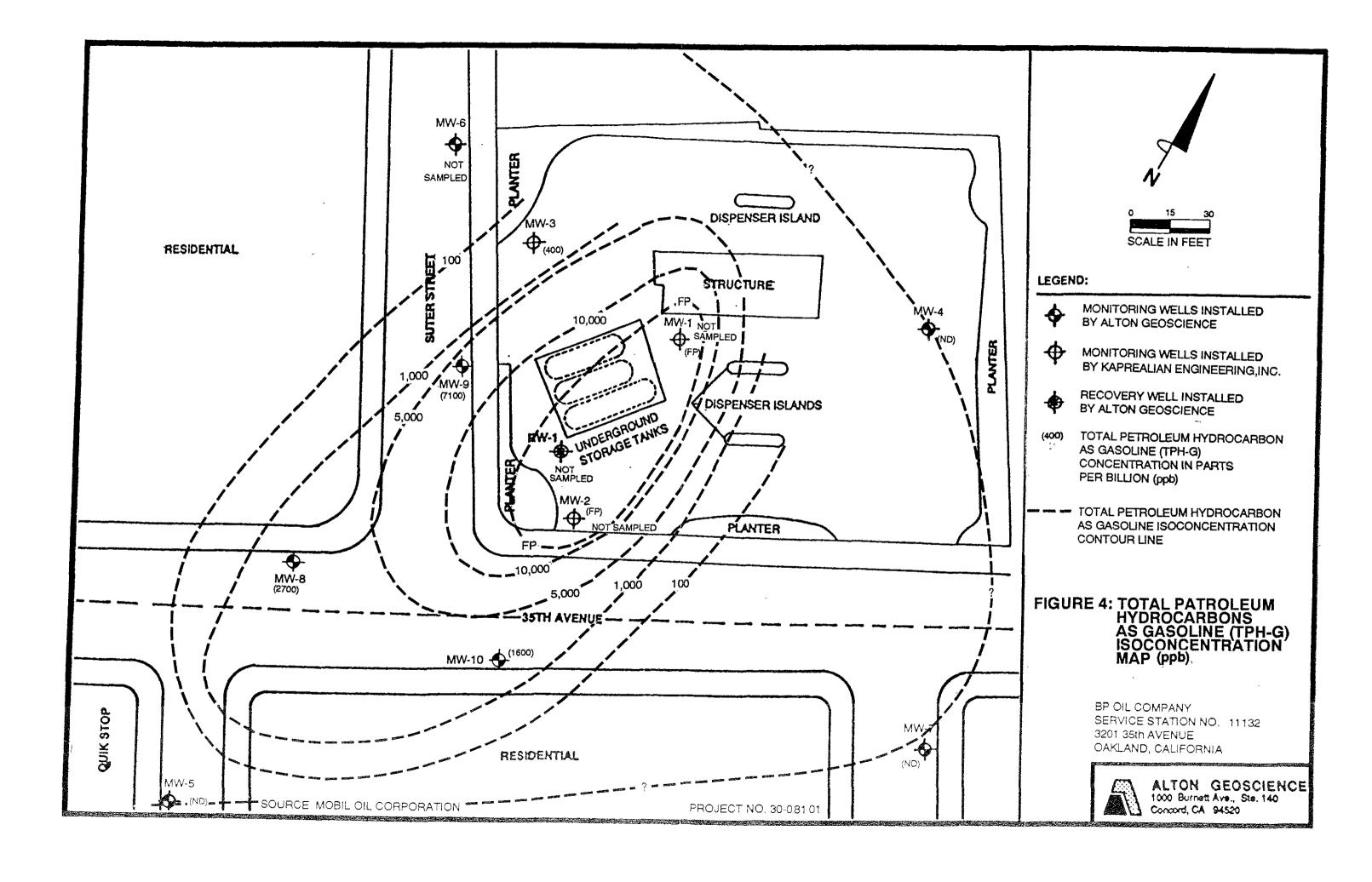


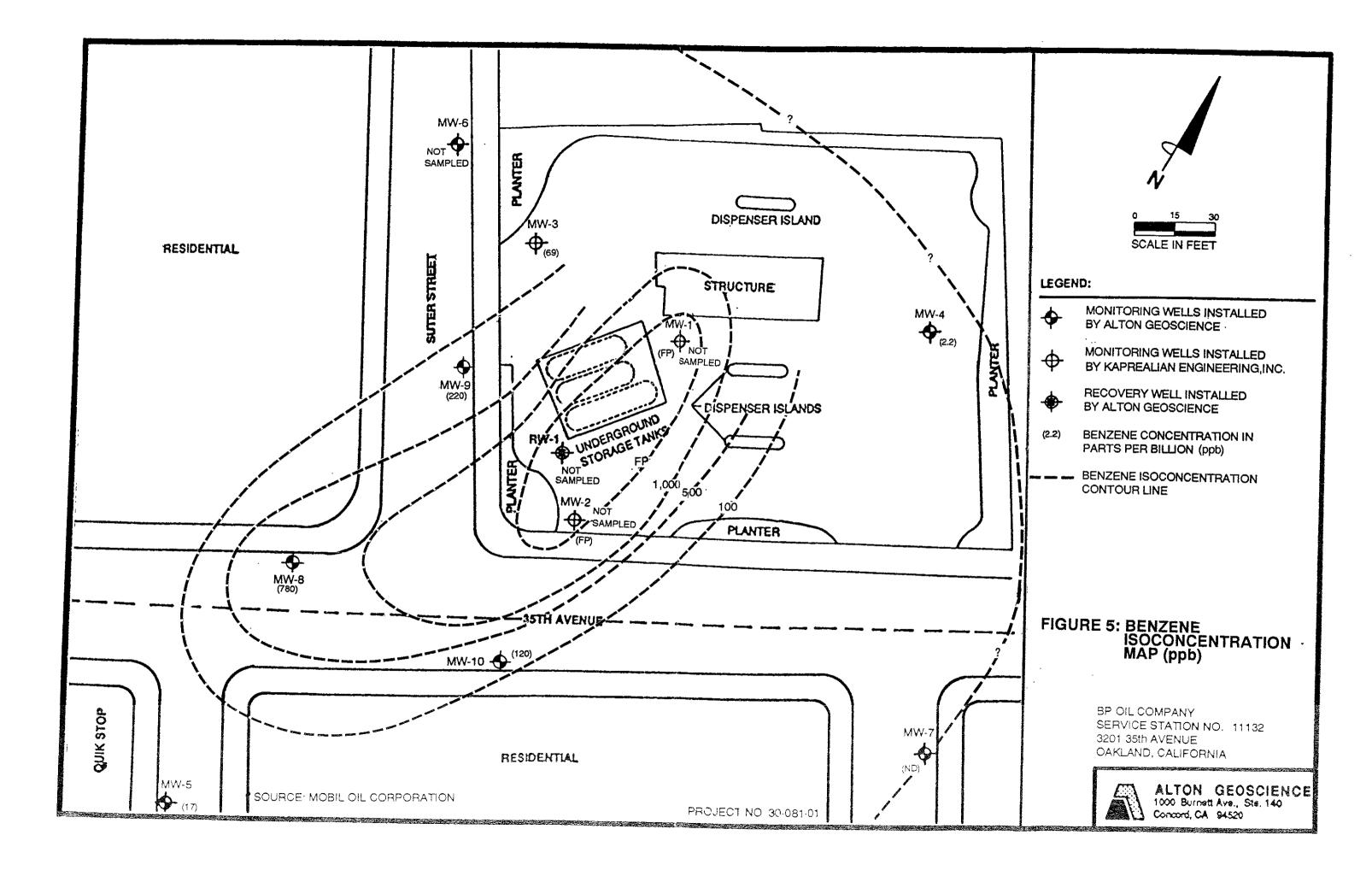
ALTON GEOSCIENCE

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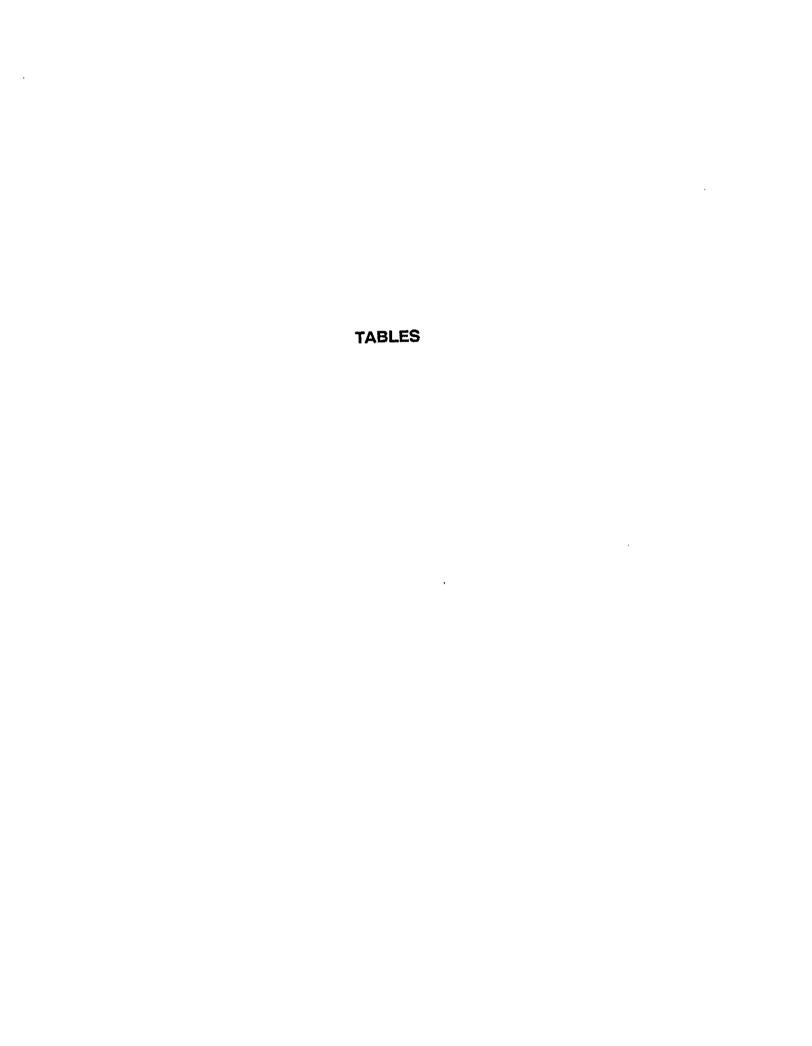


TABLE 1
SURVEY AND WATER LEVEL MONITORING DATA
April 1991

Well Number	Elevation (Feet)	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
	169.75	17.18		152.35
MW-2	168.14	15.64		152.50
MW-3	167.17	14.06		153.11
MW-4	170.36	18.28		152.08
MW-5	165.14	12.62		152.52
MW-6	165.40	**		**
MW-7	167.61	17.82		149.78
MW-8	165.74	12.98		152.76
MW-9	166.20	13.42		152.78
MW-10	167.01	14.32		152.69
RW-1	168.01	***	***	***

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.
- ** MW-6 could not be accessed due to the presence of an abandoned vehicle over the well.
- *** Depth to water in the recovery well was not recorded due to the presence of an oily substance.

TABLE 2 11132

RESULTS OF LABORATORY ANALYSIS OF SOIL SAMPLES March 1991

Boring	Sample Depth (ft)	TPH-G (Conce	B ntrations i	T n Parts	E Per Milli	X on)
SB-8	10.5-11.0	ND<1	ND<0.003	0.004	ND<0.003	ND<0.003
	20.5-21.0	390	1.8	16	6.7	37
	25.5-26.0	ND<1	0.013	0.028	0.009	0.05
SB-9	10.5-11.0	ND<1	ND<0.003	0.004	ND<0.003	0.006
	20.5-21.0	120	1.7	7.1	1.7	11
	25.5-26.0	130	0.47	3.9	1.6	12
SB-10	10.5-11.0	ND<1	ND<0.003	0.007	ND<0.003	0.017
	20.5-21.0	73	0.49	3.3	1.3	6.9
	25.5-26.0	1	0.41	0.009	0.007	0.019

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline

= Benzene = Toluene T

E X

= Ethylbenzene
= Total Xylenes
= Not Detected at Method Detection Limit shown ND

TABLE 3

RESULTS OF

LABORATORY ANALYSIS OF GROUND WATER SAMPLES

April 1990

Monitoring Well	TPH-G (Concen	B trations i	T n Parts	E per Bill:	X Lon)
MW-1	*	*	*	*	*
MW-2	*	*	*	*	*
MW-3	400	69	22	6.1	57
MW-4	ND<50	2.2	3.8	1.5	2.8
MW-5	ND<50	17	0.9	0.7	1.6
MW-6	**	**	**	**	**
MW-7	ND<50	ND<0.3	0.4	0.3	2.4
MW-8	2700	780	450	64	310
MW-9	7100	220	4	2.4	2400
MW-10	1600	120	190	32	230
RW-1	***	***	***	***	***

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 due to the presence of free
product

** = No sample collected due to the presence of an abandoned vehicle located over the well

*** = The recovery well was not sampled due to the presence of an oily substance

APPENDIX A SENSITIVE RECEPTORS SURVEY

SENSITIVE RECEPTORS SURVEY SITE SURVEY AND LITERATURE SEARCH

Client	:	BP	Oil	Compa.	n <u>y</u>		Projec	t No.:	30-081-0
Statio	n No	· · · ·	///-	32					
Locati	on:	_	3201	35TH	Ave.	Ox			
City/S	tate	e: .	OKKI	end	CA		-		
I.	Prov	vide	answer	s to the	follow	ing	question	s:	
	Α.	Is wit	there a hin 250	public 0 feet?			ly well istance	Y/N -	<i>N</i> ft.
		wit	hin 100	0 feet?	If Yes	s, D:	ply well	-	<i>N</i> ft.
					1	-, -		-	<u>ν</u> ft.
	D.	Is	there a	baseme	nt with: If Yes	in 1	000 feet? istance	Y/N _	ν —_ft.
	E.	Is	there a	school	within If Yes	100 s, D	0 feet? istance	Y/N	<i>yes</i> 1000 ft.
	F.	Is wit	there a	surfac 00 feet?			ater istance	Y/N _	yes 500 ft. POTATTA CreeK
II.	Des	crit	oe type	of loca	l water	sup	ply.		
	Pub	lic	: <u>X</u>						
	- 5	Supp.	liers S	ame: _@ ource: _ Site: _	Sierra	Snow	MeIT, P	Wate ardee	r District Dam
	Pri	ivat	e:						

SENSITIVE RECEPTORS SURVEY SITE SURVEY AND LITERATURE SEARCH

Page 2

III.	Distance to Nearest Adjacent Properties:	
	Residential Commercial Industrial Hospital School (Allandale School) Name	50 ft. ft. ft. ft. ft.
IV.	Aquifer Classification, if available.	
	Class I - Special Ground Waters - Irreplaceable Drinking Water Source - Ecologically Vital	
	Class II - Current and Potential Drinking Water Sources	
	Class III - Not Potential Source of Drinking Water	X
v.	Describe observation wells, if any.	
	Number	Y/N //
	Free Product?	1/11
VI.	Signature of Preparer: Matte A. Ta	<u></u>
	Date: 2 - 20 - 9	/
	Date.	<u> </u>

VII. Sketch of Site

APPENDIX B GENERAL FIELD PROCEDURES AND BORING LOGS

APPENDIX B

GENERAL FIELD PROCEDURES

A description of general field procedures conducted during drilling activities is presented below.

Drilling and Soil Sampling

Soil borings/monitoring wells were drilled utilizing 10-inch-diameter, continuous-flight, hollow-stem augers. To avoid cross-contamination, the augers were steam-cleaned prior to drilling each boring.

Soil samples were obtained for soil description, field, and laboratory analysis. Soil samples collected at 5-foot intervals were retrieved ahead of the lead auger utilizing an 18-inch-long by 2-inch-diameter, split spoon sampler lined with 1.5-inch-diameter, stainless steel sample tube inserts. The sampler and sample tubes were washed with a sodium tripolyphosphate solution and rinsed before each sampling event. The sampler was driven by a 30-inch free fall of a 140-pound hammer. Blow counts were recorded for three successive 6-inch intervals.

Upon retrieval from the sampler, the sample tubes were removed and securely sealed with Teflon sheeting and polyurethane caps. The samples were labeled with sample identification, sample depth, geologist's initials, and date of collection. The soil samples were kept on ice prior to and during transport to a state-certified laboratory.

The soil recovered was described in accordance with the Unified Soil Classification System. For each soil type, field estimates of density/consistency, moisture, color, grading, and soil type were recorded on the boring logs.

Monitoring Well Installation and Construction Details

Included in this appendix are monitoring well installation and construction details for monitoring wells installed as part of this study.

Monitoring wells were constructed of 4-inch-diameter, flush-threaded, Schedule 40 PVC blank and screened (0.020-inch slot size) casing. The annular space surrounding the screened portion was backfilled with No. 3 Monterey sand (filter pack) to approximately 2 feet above the top of the screened section. A 1-foot-thick bentonite annular seal was placed above the filter pack and the remaining annulus was grouted with neat cement to the surface. Utility boxes were

installed slightly above grade to minimize infiltration of surface waters. Locking, watertight well caps were installed to ensure the integrity of the well.

	G O	FE		SCIENCE, LORATOR			<u>\</u>	CLIENT BP (30-081-01 [Oil Company 1201 35th Ave, Oal M. Taylor APF	kland		BORING NO. SB-8 WELL NO. MW-8		
FIELD	SKE	TCI	1 OF	BORING LOC	ATION			LOGGED B1	71 1 A 1	TIOVED DI <u>WII.</u>		Page 1 of 2		
									HOD Hollow ste		HOLE DI	AM. <u>8"</u>		
									Modified split					
TOPO	F C	ASII	NG E	LEVATION _1	65.74'				See well consti Is Exploration Se					
								DRIELLA				· · · · · · · · · · · · · · · · · · ·		
æ				ACT:			_ w	ATER LEVEL			<u> </u>	· · · · · · · · · · · · · · · · · · ·		
1 (E)	PPtv	7E	Ę	DE E			1	ATE						
BLOWS PER FOOT(N)	cai(PPM)	SAMPLE	DEPTH	WELL CONSTRUCT! ORBORING CLOSURE	\$38 8	Ě		IME		SCRIPTION				
	Christy Roy									ONIT HON				
	0 Crimsty Box							0" Concrete						
5,13,25			4 6 8	2" sch. 40 PVC	GI	S		GRAVELLY SILT: g	RAVELLY SILT: green, damp, hard, low plasticity					
7,14,11			- 10 - 12	Casi ng	М	L	,	SANDY SILT: green	ANDY SILT: greenish brown, damp, very stiff, low plasticity, gravelly					
5,14,16			- 14 - 16 - 18		e e		,	SILTY CLAY: brown fine s	•	very stiff, low to m	edium pl	asticity, with		
2,6,10		<u> </u>	20 22		c	L		Same, becomes mo	ist, stiff, medium p	lasticity, with med	dium san	ď		
5,9,12		1	- 24 - 26	sch. 40 PVC 0.020*			A	Same, becomes bro	own, moist to wet,	very stiff, medium	n plasticit	у		
3,9,14		T	- 28 - 30 - 32 - 34					Same, becomes bro	wnish green, wet, \	with medium sand	and gra	vel		

.

LC		F		SCIENCE, In LORATORY	с. Д			CLIENT <u>BP</u> LOCATION	Oil Company 3201 35th Ave		BORING NO. SB-8 WELL NO. MW-8
FIEL	D SKE	TCł	HOF	BORING LOCATI	ON						Page 2 of 2
тоР	OF C	ASII	NG E	LEVATION <u>165.</u>	74'	-			E <u>Modified</u> See well co		DIAM8"
65				TION			W	ATER LEVEL			
BLOWS PER FOOT(N)	CGI (PPM) SAMPLE DEPTH WELL CONSTRUCTK ORBORING CLOSURE USCS PROFILE							ATE			
	SAMP SAMP CONST ONBOR CLOSUS USCS							ME			
7,11,1	1,14							ILTY CLAY: brown, and gr ame, becomes mois	wet, very stiff avel	i, medium to high plasticity, w	ith medium sand
20			42			····	BO	ORING TERMINATI	D AT 41.5 FE	ET BELOW GRADE	
	,20, Elid Cap										
			- 50								
			- 52								
			•								
			-54 -								
			· 56								
			- 58								
			- 60				R -	ortland Cement Sand #3 Lonestar		Sample Driven interval	
							•	Sentonite Pellets		Water level encountered du	ring drilling

LO(BOI	G C RIN	F E	EXP	SCIENCE, LORATOR BORING LOC	Y		<u>,</u>	CLIENT BP (LOCATION 3 LOGGED BY DRILLING METI	30-081-01 E Oil Company 3201 35th Ave, Oal M. Taylor APF HOD Hollow ste	kland PROVED BY <u>M. H</u> m auger		BORING NO. SB-9 WELL NO. MW-9 Page 1 of 2
TOPC	F C	ASII	NG E	LEVATION 1	66.20	_		CASING DATA	See well constr ils Exploration Se	ruction details		NV 1
BLOWS PER FOOT(N)	CGI(PPIM)	SAMPLE	DEPTH	WELL CONSTRUCTION OR BORING CLOSURE	\$36N	PROFILE	D/	ATER LEVEL ATE ME	DES	SCRIPTION		
			_	Christy Box								***************************************
6,11,14 4,5,13			-0 -2 -4 -6 -8 -10 -12	2" sch. 40 PVC Casing	ML SSEASO			" Asphalt (street) SANDY SILT: redd	·	ery stiff, low plas	sticity, wit	h gravel
5,12,14			- 16 - 18	200000000000000000000000000000000000000			S	SILTY CLAY: brown	with green streak	s, moist, very stif	f, mediun	n plasticity
2,6,9			20		CL		8	same, becomes mo	ist to wet, stiff			;
5,8,10			- 24 - 26 - 28	2" sch. 40 PVC 0.020" Slot			⊼	same, becomes bro 26'	wn, wet to saturate	ed, very stiff		
3,5,10		1	30 - 32 - 34	End Cap			9	same, becomes sati	urated, stiff, with fir	ne to medium sar	nd	

LO(BOI	G O RIN	F E	XPL	ORATORY			\	CLIENT BP (Oil Con 3201 35	npany th Ave.	DATE DRILLED 2/26/91 Oakland APPROVED BY M. Hopwood	BORING NO. SB-9 WELL NO. MW-9
FIELD	SKE	TCH	OF E	BORING LOCATI	ON							Page 2 of 2
тор с	OF C	ASIN	IG EL	EVATION 166	.20'				E <u>Mo</u>	dified s		AM8"
œ				WELL CONSTRUCTION OR BORING CLOSURE			W	ATER LEVEL		· • · · · · · · · · · · · · · · · · · ·		
BLOWS PER FOOT(N)	CGI (PPM)	Щ		HVCT HVG HVG		PROFILE	D/	ATE				
BLOWS P	3) (F	SAMPLE	씸	AL NSTE	soen	₩	П	ME				
B 4				₹ 8 69		7777		_	_		PESCRIPTION	
6,12,17			36		CL		SI	LTY CLAY: reddish	brown,	satura	ted to wet, very stiff, medium	plasticity
	li		38				B	ORING TERMINATE	ED AT 3	6.5 FEE	T BELOW GRADE	
			.									
			40									
			- 42									
			44									
			-									·
			- 46 -									
			- 48									
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			- 60									
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								Portland Cement			Sample	
						XX		Sand #3 Lonestar			Driven interval	
						3	<u> </u>	Bentonite Pellets		조	Water level encountered du	ring drilling
	1_	[<u> </u>									

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L		OF		SCIENCE, In PLORATORY	ic.			CLIENT BP LOCATION 3	30-081-01 Oil Company 3201 35th Ave, Oa M. Taylor API	ıkland		BORING NO. SB-10 WELL NO. MW-10
FIE	_D Sk	ETC	H OF	BORING LOCAT	ION						······································	Page 1 of 2
									HOD Hollow ste		HOLE DIA	AM. 8"
									See well const			
TOF	OF	CAS	ING E	LEVATION 167	.01'	-		DRILLER So	ils Exploration Se	ervices , Inc.		···
g;	T	Τ		2 0			W	ATER LEVEL				
BLOWS PER FOOT(N)	GGI (PPM	<u></u>	F	WELL CONSTRUCT OR BORING CLOSURE		ROFILE	D/	ATE.				
BLOWS P		SAMPLE	2	WELL CONSTRUC OR BORING CLOSURE	ğ	ĝ.	TI	ME				
	10	100	 		-				DES	SCRIPTION	:	
			10	Christy Box		(tr	10	0" Concrete				
6,12, ⁻ 6,14, ⁻ 7,10, ⁻	17		-2 -4 -6 -8 -10 -12 -14 -18	Casing #3	CL		s	SILTY CLAY: tan, disame, becomes tan	to brown wn with green stre	eaks, moist, medi	um plastic	city, with gravel
3,8,1 11,1 25			- 22 - 24 - 26 - 28 - 30 - 32	sch. 40 PVC 0.020" Slot	CL			SANDY CLAY: brow	sticity, with slight g	ravel		
			34	End Cap							· ··· · · · · · · · · · · · · · · · ·	

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ALTON GEOSCIENCE, Inc. LOG OF EXPLORATORY BORING FIELD SKETCH OF BORING LOCATION				\	CLIENT BP Oil (LOCATION 3201 LOGGED BY M. DRILLING METHOD SAMPLER TYPE	Company 1 35th Ave., Taylor A D Hollows Modified s	PPROVED BY M. Hopwood stem auger HOLE DI	BORING NO. \$B-10 WELL NO. MW-10 Page 2 of 2 AM8"
TOP OF CASING ELEVATION 167.01'			CASING DATA <u>Se</u> DRILLER <u>Soils E</u>					
BLOWS PER FOOT(N) CGI (PPM) SAMPLE DEPTH	WELL CONSTRUCTION ORBORING CLOSURE	sæn	PROFILE	D _i	ATER LEVEL ATE ME		ESCRIPTION	Airenand
7,8,11		CL		В	Portland Cement Sand #3 Lonestar Bentonite Pellets		Sample Driven interval Water level encountered du	

APPENDIX C PERMITS



ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

5997 PARKSIDE DRIVE

PLEASANTON, CALIFORNIA 94566

(415) 484-2600

121989

GROUNDWATER PROTECTION ORDINANCE PERMIT APPLICATION

FOR APPLICANT TO COMPLETE	FOR OFFICE USE			
LOCATION OF PROJECT 3201 35th Avenue On Kland CA	PERMIT NUMBER 91057 LOCATION NUMBER			
CLIENT Nome BP Oil Company Address 2868 Prospect Dr Phone 916 631 6733 City Reache Drive Zip 95670	PERMIT CONDITIONS Circled Permit Requirements Apply			
APPLICANT Name AITON Geoscience, Inc. Addression Burnett Ave St. 140Phone 41.5 6.82 15.82 City Concord CA Zip 94520 TYPE OF PROJECT Well Construction Geotechnical investigation Cathodic Protection General Water Supply Contamination Monitoring Well Destruction PROPOSED WATER SUPPLY WELL USE Domestic Industrial Other X Municipal irrigation DRILLING METHOD: Mud Rotary Air Rotary Auger X Cable Other DRILLER'S LICENSE NO. C - 5.7 5.826.96 WELL PROJECTS Drill Hole Diameter 8 in. Maximum Casing Diameter 2 in. Depth 40 ft. Surface Seal Depth 15 ft. Number 3 GEOTECHNICAL PROJECTS Number of Borings Maximum Hole Diameter in. Depth ft. ESTIMATED STARTING DATE 2 - 25 - 91 ESTIMATED COMPLETION DATE 2 - 27 - 91	A. GENERAL 1. A permit application should be submitted so as arrive at the Zone 7 office five days prior proposed starting date. 2. Submit to Zone 7 within 60 days after completed of permitted work the original Department of Water Resources Water Well Drillers Report of equivalent for well projects, or drilling log and location sketch for geotechnical projects. 3. Permit is void if project not begun within 9 days of approval date. B. WATER WELLS, INCLUDING PIEZOMETERS 1. Minimum surface seal thickness is two inches of coment grout placed by tremie. 2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet. C. GEOTECHNICAL. Backfill bore hole with compacted cuttings or heavy bentonite and upper two feet with compacted material. In areas of known or suspected contamination, tremied cement grout shall be used 1 place of compacted cuttings. D. CATHODIC. Fill hole above anode zone with concret placed by tremie. E. WELL DESTRUCTION. See attached.			
I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.	IM II			

CONFIDENTIAL

STATE OF CALIFORNIA DWR WELL COMPLETION REPORT (WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR WELL COMPLETION REPORT (WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR WELL COMPLETION REPORT (WELL LOGS)

REMOVED

		CITY OF OAKLAND		RIMITH X9102234
. 3	10.2 (FEX.1910)	PERMIT TO EXCAVATE IN STREETS		
		OR OTHER WORK AS EFECTIED		Sec. (42):00
	LOCATION OF WORK SUTE	LAUIS LAUIS	et 🧻	160 Fre 30.00
	LOCATION OF WORK: (Street or Address)	Booth	y)	165.00
•	PERMISSION TO EXCAVATE IN THE PUBLIC PROPERTY IS			
	APPLICANT Soils EXPLORATION			MPPL 30.00
	ADDRESS 561 Buckeye	The Lorentz State of the Control of	9213	EXCV 135.00
	TYPE OF WORK: GAS ELECTRIC WIRE A STEER			165.00
•	NATURE OF WORK:	Spealty		OFFICIAL USE ONE 5.00
	THE PROPERTY OF THE PARTY OF TH			ICL 9661 11:28Tr
. [I hereby affirm that I am exempt from the Contractor's License Like for matical registering (Sec. 7031.5: Business and Professions Code: Any only or country shifting the shifting for the construct, after improve, denoted, or repeir any structure, actor to this session or judy or quites the applicant for such permit to the a eigned statement that his inflames of provisions of the Contractor's License Suns Officials of propriessority with Sec. 2008.		7/	
	to construct, alter, improve, demokan, or repert any source of parts to the second parts to such permit to file a signed statement that his histories pursuant		1 -	
1	to the provisions of the Contractor's License Law Offspter 9 boyesteebite with Sec. 7000 of Division 3 of the Susiness and Professions Cade, or live; as in present section basis for the alleged exemption. Any violation of Beautic Section as permit subjects the applicant to a civil penetry of not make the profession.			CALL COMMENTOR'S REPORT
			-X-	
띮	1, as owner of the property, or my employees with wages as the work control of the work, and the structure is not intended or offered for see place. 2004a, Bullineau	CALSTON STATE SECTION NO.		et in a second the second second
9	who builde or improves thereon, and who does each work things or though one considered that such improves the control of the c	ON, SHEER PROPERTY.	- X	
E E	and Professions Code: The Contractor's License Law does not apply to an exercise statement who builds or improves thereon, and who does excit to the statement of the profession of the statement	NO.		
EB	L as owner of the property, an exempt from the sale regularisates of the short dea	THE RESERVE OF THE PARTY OF THE	3	
N	L, as owner of the property, am exempt from the sale requirements of the store due to: (f) I am improving my principal place of residence or appartments; thereto, (5) the limit be performed prior to sale. (5) I have resided in the residence or, (5). C manifest to competition of the work, and (6) I have not charried assumption. The study of the contraction of the contraction.		RUCTION.	Street, Care St. Phys. Street, Street, St. Co.
0	then two structures more than once during any three year parties. The District structure professions Code.			170
3.2	L as owner of the property, are exclusively contracting with highest scattering to contract the project (Sec. 7044, Business and Professions Code: The Contracting to Contract the project (Sec. 7044, Business and Professions Code: The Contracting to Contract the Contracting to Contra			
	does not apply to an owner of property who builds or improves thereby and who contractor for euch projects with a contractor(s) licensed pursuant to the Continuous's License Land	La Charle and American State Control of the Control	wo work- permit is	Orange Basille
	I am exempt under Sec, BARC for this leaser.	/rotated the spin and	ecued by	Paring ineq.
	Signature Date			The Strateg Replaced
	I hereby affirm that I have a certificate of coreant to self-insure, or a destificate of Warten	Section 1	d Municipal	Approved
- 	Compensation insurance, or a certified copy thereof (Sec. 3800, Lab City		· · · · · · · · · · · · · · · · · · ·	Dest 15-71
<u>Ô</u>	Policy Company COMP (AS FEW)	wasser to the first the first term of the first	g out of per-	Dete
Z.	Certified copy is filed with the etc-building inspector digits.		ione becuping	Deto
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Σ	(dkeb- 2/15/9)	Control of the Contro		A STATE OF THE STA
COMPENS	(This section need not be completed if the permit to for one fairness and inflored (1905) at the			
S	I certify that in the performance of the work for which this penult is leaded, fahalf not emplo any person in any manner so as to become subject to the Workers Companyanting Life		y Bosnes	Description of the Control of the Co
WORKER'	of California.		275 H	DIRECTION THUS WORKS -17-9
旁	Signature Date	A STATE OF THE STA	7731	A SECTION ASSESSMENT
¥	NOTICE TO APPLICANT, If, after making this Cartificate of Exemption, journalists assess			ETALLIC CHATTER IN
	subject to the Workers' Compensation provisions of the Labor Code, you must firstwitt imply with such provisions or this parmit shall be deemed swithed.	The state of the s	No.	S inte

NOTICE TO APPLICANT. If, after making this Certificate of Exemption, you should become subject to the Workers' Compensation provisions of the Labor Code, you must forthwith imply with such provisions or this permit shall be deemed revolud.

CITY OF OAKLAND

PERMIT TO EXCAVATE IN STREETS

		ON UINER WURK AS SPECIFIED
٠.	LOCATION OF WORK: 3201 35Th AVE	Menzyle-
	LOCATION OF WORK (Street or Address)	(Specify)
	PERMISSION TO EXCAVATE IN THE PUBLIC RIGHT OF WAY IS HE	REBY GRANTED TO
	APPLICANT Soils Exploration Sorvi	(OS) VC
	ADDRESS _ 56/ Purkeye st Vac	aville : Ca Ment . (707)451-9713
	TYPE OF WORK GAS ELECTRIC WATER TELEPIS	ONE CARE TO SEMEST THERE
	NATURE OF WORK: MONICEUR WELL TELES	
	(Sec. 70315. Business and Professions Code: Any oity or county which requires a permit to construct, after, improve, demolish, or repair any structure, prior to It's issuance, also requires the applicant for such permit to file a signed statement that he is isomesed pursuant to the provisions of the Contractor's License Law Chapter 9 (commencing with Sec. 700 Fibrision 3 of the Suciness and Professions Code, or that he is exemple therefrom and the basis for the attended exemption. Any violation of Section 20315 threat applicants and	PERMIT VOID SO DANS FROM DATE OF BRUE LINLESS EXTENSION GRANTED BY DIRECTOR OF PUBLIC WORKS. Approximate Starting Date Approximate Controlled Date VOLIDE SIGNIFICATION (1 NOV. 2) (AND
	It, as owner of the property, or my employees with wages as their against additional will do the work, and the structure is not intended or offered for sale (libes, 7004). Business and Professions Code: The Contractor's Libense Law does not apply to an event of property who builds or improves thereon, and who does such work himself or theough his own amployees, provided that such improvements are not intended or offered for sale. If, however, the building or improvement is sold within one year of completion, the ownerwinder will have the burden of proving that he did not build or improve for the purpose of sale).	CHITTED OPERATION AND THE TEST OF THE COLOR
	It, as owner of the property, are exempt from the sale requirements of this above time to: (1) I am improving my principal place of residence or appuriremences thereto, (2) the work will be performed prior to sale. (3) I have resided in the residence for the 12 months will be performed prior to sale. (3) I have not cleared exemption in this subdivision on more than two structures more than once during any three-year period. (800, 1944, Business and Protessions Code).	PHONE: N/MORE) PERMIT NOW AND DIVISION OF HOUR NUMBER. Telephone 273 2005 Polity signs see Care Service Actual Construction.
	Li, as owner of the property, are exclusively contracting with iterated contractors to construct the project (Sec. 7044, Business and Probestons Code: The Contractor's License Law does not apply to an owner of property who builds or improves thereon, and who contracts for such projects with a contractor(s) licensed pursuant to the Contractor's License Law).	State tow requires that contraction comercial Uniterpresent Stavics Alert two working days before assesseting to have below ground distributionated. This permit is
١	1 am exempt under Sec, B&RC for this reason	ing days before expending to have below ground wildfree teased. This permit is not valid uness applicant has excused at inquiry treatification number lesued by Underground Service Alert.
	Signature Date	Call Toll Free 800 648 2014 108A 10 Marston
_	t hereby affirm that I have a certificate of consent to self-incure, one certificate of Workers' Compensation insurance, or a certified copy thereof (Sec. 3805, Lab C). Policy Compeny	This peaks travely program is all programs of the control of the Coldent Municipal Coldent Col
2	Name STATE COMP IN PU	all contracts to be the set of th
ζ	Ceglified copy is hereby furnished.	
	Signature Date Date Date	This search is got to be a search of the sea
5	(This section need not be completed if the permit is fer one hundred dollars (\$100) or issue)	
50	I certify that in the performance of the work for which this parmit is leased, I shall not employ any person in any manner so as to become subject to the Workers' Compensation Laws of California.	CONTRACTOR I hereby affirm that I have having stiller acquaiting of Causer & Commencing with Section 7000 of Disease 2 of the Sections and Professions Gods, and my license in that topic and office.
ピピロ	Signature Cate	1

Run # X9100232 2-15-91

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DATE.	2-15-91	
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No.	SERVICE CHEROLOGICAL CO.	

APPENDIX D

WELL DEVELOPMENT AND WATER SAMPLING PROCEDURES, FIELD SURVEY FORMS, AND SURVEY DATA FIELD NOTES

APPENDIX D

WELL DEVELOPMENT AND WATER SAMPLING PROCEDURES AND FIELD SURVEY FORMS

All purging and ground water sampling equipment was cleaned prior to use to minimize cross-contamination between wells. All equipment in contact with ground water was triple-rinsed prior to each sampling event in successive baths consisting of tripolyphosphate solution, tap water, and deionized water. Prior to sampling, the well was developed and purged in accordance with EPA protocol. During purging, pH, temperature, and conductivity were measured periodically until these parameters stabilized, indicating formation water had entered the well casing. The purged water was pumped into 55-gallon D.O.T. approved drums prior to disposal or recycling at an appropriate waste disposal facility.

Ground water samples were collected by lowering a 4-inch-diameter, bottom-fill, Teflon bailer just below the water level in the well. The samples were carefully transferred from the check-valve-equipped Teflon bailer to zero-headspace 1-liter and 40-milliliter glass containers fitted with Teflon -sealed caps. All samples were inverted to ensure that entrapped air was not present. Each sample was labeled with sample number, well number, sample date, and engineer's/geologist's initials. The samples remained on ice prior to laboratory analysis.

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

JOB NUMBER 30-081-01

TECHNICIAN DONNIE BUTC!

DATE 3/6/91

JOB LOCATION OFKIAND

JOB FOC	ATION DY	<u> </u>		- Unit		
PUMPOUT	DATE OF LAST PUMPOUT:			WEATHER: SUNNY		
YES NO				TIME:		COMMENTS (Notes, conditions, etc.)
	HOLD	сит	LEVEL			(10183, 0010110110, 010.)
WELL #	DEPTH TO WATER	DEPTH TO PRODUCT	PROD. THICKNESS (FT)	TOTAL DEPTH	DEPTH TO PUMP	
mw-8	15.72			39.00		
	15.72			39.00		
	15.72			39.00		
mw-9	17.23			27.99		
	17.23		<u> </u>	27.99		
	17.23			27.99		
mw-10	18.19			34.04		
	18:19	ļ <u>.</u>		34.04		
	18.19			34.07		
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ALTUM GEUSCIENCE, II.C. Well Development and Water Sampling Field Survey

Project 30-081-01 Site: B-	
Well: bw-8 Sampling Te	am: Dannie Burel
Well Development Method:	Burbe
Sampling Method:	
Describe Equipment Before Samp	ling This Well: Tryple Purse
Well Development/ Well Sampling Data	
Total Well Depth: 39.00 feet Time:	Water level Before Pumping: 15.72
Water Casing Diameter Column 2-inch 4-inch	Aothus sucros so shids
23.28 feet x 0.16 0.65	3.7 10 37.2
Depth Purging From: feet.	Time Purging Bégins:
Notes on Initial Discharge:	
Time Volume pH Conduc	tivity I Notes
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
Time Field Parameter Heasureme	
Rep_11	Rep 12 Rep 11 Rep 14
pH Conductivity Temperature (F)	• • • • • • • • • • • • • • • • • • • •
Presample Collection Gallons P	urged: 37.5
Time Sample Collection Begins:	$m{arphi}$.
Time Sample Collection Ends:	200
Total Gallons Purged:	325
Comments:	

ALIUM GEUSCIENCE, IIIG. Well Development and Water Sampling Field Survey

Project 120-181-01 site: B-P Date: 3/6/91 Well: Mw-9 Sampling Team: Downie Bure!
Well Development Method: Barbe
Describe Equipment Before Sampling This Well: Truple Runse
Well Development/Well Sampling Data
Total Well Depth: 27.59 feet Time: Water level Before Pumping: 17.23 Volume
Water Casing Diameter Volume Factor to Purge
10.76 feet x 0.16 0.65 1.7 10 17.2
Depth Purging From: feets Time Purging Begins:
Notes on Initial Discharge:
. o indicate the Notes
3:14 3.5 7.74 2.38 63.2 LT BROWN ISILTY (mus) 3:14 3.5 7.58 1.55 69.8 3:124 10.5 7.45 1.59 63.2 3:32 14 7.5 7.20 1.30 65.3 11 1/2
Time Field Parameter Heasurement Begins:
PR Rep. 12 Rep. 11 Rep. 14
Temperature (F)
Presample Collection Gallons Purged: 17.5
Time Sample Collection Begins:
Time Sample Collection Ends: 17.5

ALTUM GEUSCIENCE, Inc. Well Development and Water Sampling Field Survey

Project 130-08/-0/site: B-P Date: 3/6/9/. Well: MW-10 Sampling Team: Downie Bure!	
Well: MW-10 Sampling Team: Downie Bure!	
Well Development Method: Bruler	
Sampling Method:	
Describe Equipment Before Sampling This Well: Tryple Rus	•
Well Development/Well Sampling Data	
Total Well Depth: 34.04 feet Time: Before Pumping: 18.19	
Water Casing Diameter Volume Volume Column 2-inch 4-inch Volume Factor to Purge	
15.85 feet x 0.16 0.65 2.5 10 25	
Depth Purging From: feet. Time Purging Begins:	
Notes on Initial Discharge:	
XICO'U XICO'U Notes	
The second of the second	
7.47	
219/ 13 7:17 1:11 58:9	
2:25 25 6.91 103 61.2 11 1/	
Time Field Parameter Heasurement Begins:	
Rep 11 Rep 12 Rep 14	
p#	
Conductivity Temperature (F)	
Presample Collection Gallons Purged: 25	
Time Sample Collection Begins:	!
Time Sample Collection Ends:	
Total Gallons Purged: 25	
Coments:	

ALTON GEOSCIENCE, INC 1170 Burnett Ave., Ste. S

Concord, CA 94520 TECHNICUM Downse Burel JOB NUMBER 36-08/-01 DATE_3/7/9/ JOB LOCATION OAKIA~O

		AKIA~	0	DATE_		/4/	
JOB LOCATION DATE OF LAST PUMPOUT:				WEATHER: BUNNY			
PUMPOUT YES	DATE OF DISTITUTION			TIME:		COMMENTS (Notes, conditions, etc.)	
□ NO						(140169, 001100101010101	
1	HOLD	CUT	LEVEL				
	DEPTHTO	DEPTHTO	PROD. THICKNESS	TOTAL DEPTH	DEPTH TO PUMP		
WELL #	WATER	PRODUCT	(FT)	34.30			
mw-3	17,40			38.52			
	2012	ļ		31.30			
mw-S	16.00						
3 mw-6	19 04	-		34.30	<u> </u>		
mw-7 mw-8	16.72			38.80	-		
mw-9	16.29			29.00			
MW-10	19.09			34.01			
m w = 2	17.88			194.10			
m W - 1	20,55			38.40			
RW-1	17.62			1	7	MW-6 CAR OVER	
			_			Well CAN NOT	
			_			SAMPIE	
						KNW-1 HAS	
						SIME GAS SMEIL	
		-				TAP HAO SOME	
						F.P ON IT	
					_		
					- 3	+ 19w-1 . HAS	
						SUMS BACK OR M	
				_	·	IT AND AGAS	
						SMEII	
						N 6 11 2 1145 60	
						A SMANI SHEEN	
						AT THE TOP OF BAKEN	
L							

ALTUM GEUSCIENCE, IIII... Well Development and Weller Sampling Field Survey

Project 130-081-01 site: B-P Date: 3/9/91. Well: Mw-1 Sampling Team: Down, C Dure!
sampling Teams Nownic Durel
Method!
Sampling Method: Bould Russelling This Well: Truple Rus
Sampling Method:
Describe ado-t-
Well Development/ Well Sampling Data Nater level 20.59
Total Well Depth: 4410feet Time: Water level Before Pumping: 20.59 Volume
Casing Diameter Factor to Purge .
Column 2-inch 4-inch Volume 3.7 3 1/
23.37 teet x (0.10)
Depth Purging From: feet. Time Purging Begins:
" Notes on Initial Discharge:
Notes
Time Volume of Conductivity
<u> </u>
3:8
Time Field Parameter Heasurement Begins:
Rep. 11 Rep. 12 Rep. 11 Rep. 14
pH
Conductivity Temperature (F)
Presemple Collection Gallons Purged:
Time Sample Collection Begins:
Time Sample Collection Ends:
Total Gallons Purged!

ALTUH GEUSCIENCE, IIIC. Well Development and Water Sampling Field Survey

Project 130-08/0/site: B-P Date: 3/2/9/. Well: Mw-2 Sampling Team: Downie Bure/	
Project Donnie Durel	
Well: MW- 2	
Well: Mell Development Hethod:	
Sampling Method: Gurler Walls Tourk Runs	•
Sampling Method:	`
Well Development/ Well Sampling Date Water level	
Total Well Time: Water level Before Pumping: 19.19	
Total Well Depth: 34.19 feet Time: Depth: 34.19 feet Volume	
Casing Diameter Volume Eactor to Purge	
Column 2-Inch 1-Inch 1.65 2.4 3	
. 15.01 Real a Comming Reginal	
Depth Purging From: feet. Time Purging Begins:	
"Notes on Initial Discharge:	
Notes	
Time Yolune of Conductivity I Notes	
1.4	
<u> </u>	
Time Field Parameter Heasurement Begins: Rep. #4	
Rep. 12 Rep. 13 Rep. 14	
,	
Conductivity	
Presample Collection Gailons Purged:	
Presample Collection Reginal	
Time Sample Collection Begins:	
Total Gallons Purged: Total Gallons Purged: TOTAL CALLONS PURGED TO TOTAL TOTAL SAMPLE	

ALTUM GEUSCIENCE, IIIG. Well Development and Water Sampling Field Survey

30-08/- Project mw-3	site: B-P	Date: 3/7/91.
Well: MW-3	Sampling Team:	swall Durel
Well Development M	ethod: Jung	2
a a sa handa	Bailer	
Describe Equipment	Before Sampling This	Well: Triple Ruse
Well Development/ Well Se		
Total Well	Time:	Water level Before Fumping: 17.40
Water Cas Column 2-1	ing Diameter Inch 4-inch Yoluma, 16 0.65 2.7	Factor to Rurge
16.93 feet x (0.1	16 0.65 2.1	
Depth Purging From	a: feet. Time	Purging Begins:
" Notes on Initial'	VIO €	
Z:07 1.6 2:08 3.2 2:09 4.8	7.55 10.34 7.40 7.35 7.05	70.3 11 11 69.3 11
2:12 3	显 基	68.6
Time Field Parame	ter Heasurement Begins	
	Rep. 12	Rep 13 Rep 14
pH Conductivity Temperature (F)		
Presemple Collect	ion Gallons Purged:	8
Time Sample Colle	ection Begins:	3,32
Time Sample Coll	ection Ends:	3:35
Total Gallons Pu		83

• . . .

ALIUM GEUSCIENCE, IIRC. Well Development and Water Sampling Field Survey

والمراب والمراب والمرابع والمستون والمرابع والمرابع والمتعاد والمتعاد والمتعاد والمتعاد والمتعاد والمتعادية والمتعادية				
Project 130-08/-0	site: B	-P	Date: _	3/7/21
Project De on on	عربي ١٠٠٠	\mathcal{D}	1000	orel
Well: MW-4	Sampling I	dam!	2	
Well Development	Hethod:	- Cum	72	
Sampling Method:	Co	ula		
Sampling Method: Describe Equipmen	. Before Sam	pling Thi	* Well: The	ple Kush
		_		<u> </u>
Well Development/ Well S	empling Data			
			Water lev	el 20.72
Depth: 39.82 feet	Time: _		Peroje	Volume
· - -	nlemete	P	Factor	• •
· · · · · · · · · · · · · · · · · · ·	inch 4-inch	7 </td <td>•</td> <td>8.S</td>	•	8. S
17.8 feet x 0.	16 0.65			
Depth Purging Fro		. Time	Purging Be	gins:
		, 12mg		
Notes on Initial	Discharge: _			
	XI	00 uctivity	ī	Notes
Time Yolume		-	(22 4	T. Blown
2:46 1.7	8.19	0.06	69.3	1
2.98 3.9 2.99 3.1	7.82	6.23	<u>69.1</u>	
250 6.9 252 9.5	7.48	13.	68.8	
Time Field Param	ter Heasure	ment Begi	ns:	and the second
1786 STOTO Lerem.	•	Rep_12	Rep_£	Rep.14
3	Rep_11_	977474		
pH				
Conductivity Temperature (F)				
•			8.5	
Presample Collec				
Time Sample Coll			. 3;42	
Time Sample Coll			3:45	
		•	9	
Total Gallons Po	raa.			

ALTUM GEUSCIENCE, IIIC. Well Development and Water Sampling Field Survey

Project 1 30-081-01 Site: B-P Date: 3/7/91.
Well: MV-5 Sampling Team: Downie Bure!
Pump
Well Development Method: Pump Baulu Baulu
Describe Equipment Before Sampling This Well: Truple Purse
Describe Equipment Berote Sampling III
Well Development/ Well Sampling Deta
Total Well Depth: 31.30feet Time: Before Pumping: 16.60
Water Casing Diameter Water Casing Diameter Casing Diame
Column 14.7 teet x 0.16 0.65 2.3 3 7
Depth Purging From: feet. Time Purging Begins:
Notes on Initial Discharge: X1000
a conductivity T NOICS
11me Volume pH Conductivity 12.18 1.4 7.08 1.54 69.9 17 Blown /51/7
12:19 2.6 7.09 1.12 66.9
$\frac{12!20}{12!27} \frac{9.2}{5.6} \frac{7.21}{7.21} \frac{1:05}{1:01} \frac{66.1}{66.3} \frac{1!}{1!}$
Time Field Parameter Heasurement Begins:
Rep 11 Rep 12 Rep 14
Conductivity Temperature (F)
Presample Collection Gallons Purged: 3:00
Time Sample Collection Degine.
Time Sample Collection Ends:
Total Gallons Purged:

ALTUM GEUSCIENCE, IIN. Well Development and Water Sampling Field Survey

				_	
Project # 30-08/-0/ \$1	:e: <u>B</u>	-P	Dates	3/2	191
- my-6 381	mpling Te	am: 1/	ONNIE	1)0	10
Well: Hell Development Heth		9	1	_	
		7 / 1			
Sampling Method:		- Ju			P. (3)
Sampling Method: Describe Equipment Be	fore Samp	ling This	Well:/	Ma	
Well Development/ Well Samplic	ng Dete				
manal Well	.		Hater 16 Before P	rei Teriod	.
Total Well Depth: feet	TIME:	- The same of the			Volume
Water Casing	plameter 4-inch	Yoluma	Fact	or !	to Rurge
Column Peet x 0.16	0.65				
		-1	ouraina	Regins	1
Depth Purging From:	(eet	. 17ma	Baidrua		A STATE OF THE PERSON NAMED IN
Notes on Initial Disc	charge:				
Time Yolune pH				Note	4
Time Yolung Da	\$1,500mm		٠		

Time Field Parameter	Heasuren	ent Begin	81		- ••
_	ـــالـــــ	Rep_12	Bep	_لا	Rep. 14
ря					***************************************
Conductivity Temperature (F)					911241114111411111111111111111111111111
Presemple Collection	Gallons	Purgeds			
Time Sample Collect	lon Begin	61	·		
Time Sample Collect	ion Ends:			-	
• • • • • • • • • • • • • • • • • • • •		•	NOT 8	- HM T/C	<u> </u>

ALTUM GEUSCIENCE, INC. Well Development and Water Sampling Field Survey

•
Project \$30-081-01 Site: B-P Date: 3/7/21
Well: Mw-7 Sampling Team: Jonnie Durie
Sampling Method: Surfer
Sampling Method: Sauler
Sampling Method:
west flevelopment/ West Sampring Date
Total Well Depth: 34.50 feet Time: Before Pumping:
Water Casing Diameter Water 2-inch 4-inch Volume Factor to Purge
15.26 feet x 0.16 0.65 2.4 3 7
Depth Purging From: feet. Time Purging Begins: Notes on Initial Discharge: Time Yolume pH Conductivity T Notes
Conductivity Temperature (F)
Presample Collection Gallons Purged: 3:20
Time Sample Collection
Time Sample Collection Bilds.
Total Gallons Purged:
Comments:

ALTUM GEUSCIENCE, INC. Well Development and Water Sampling Field Survey

المنزل المراجع والمقارض والمراجع والمراجع المناجع والمراجع والمراجع والمناجع والمناجع والمناجع والمناجع والمناجع			•	
Project 30-08/-0	/ Site:	BP	Date:	3/7/91
Project 1		7	7 ~~ 7	ine.
Well: <u>mw-8</u>	Sampling Te	am:	ENNIC 9	
Well Development F	fethod:	Ju	~~	
an an atamaha		arler		
Sampling Method:	- Before Sami	oling This	Hell: True	ple Kure
Describe Equipment	; perore came			
Well Development/ Well St	empling Date			
			Water leve	1 1/27
Total Well Depth: 38.80 feet	Time: _		Before Pump	ing: 16.72
				Volume
			Factor	to Purge
25.0% feet x 0.	0.65	3,5	_· _ <u></u>	10.5
Depth Purging Fro	m: feet	. Time	Purging Beg	jins:
Notes on Initial	Discharge: _			
, -	Y 10	00 `		Notes
Time Yolume	pH Condu	ctivity	_	Moua (SILT)
1:40 2.1	7.45	7.71	71.5	Variation of the state of the s
1:42 4.2	7.29	1.45	67.1	
1:45 8:9		1.43	66.5	1)
		1.3/	•	
Time Field Parame	ster Heasure	ment Begli	181	
	Rep 11	Rep_12	Rep 13	Rep #4
pH	****			
Conductivity Temperature (F)		***************************************		
16mbergrara /				
Presample Collec	tion Gallons	Purgedi	10.5	
Time Sample Coll	ection Begin	81		
Time Sample Coll	ection Ends:		3:30	
•		•		
Total Gallons Pu	iE Å a m :			
Comments:				

ALTUM GEUSCIENCE, Inc. Well Development and Water Sampling Field Survey

والمراجعة بالمراجعة والمراجعة والمراجعة والمراجعة والمراجعة والمراجعة والمراجعة والمراجعة والمراجعة		
- 70 -001-	Walson R-P B	ate: 3/7/9/
Project 130-081	Site:	Bull
Well: MW-9	Sampling Team: Down	e porci
Well Development	Method: Sun	70
	tauler	
Sampiting indicion.	t Before Sampling This Wel	1: Truple Real
Describe Equipmen	E Belote gambling	
Well Development/ Well S		
	Wat	er level 16.29
Total Hell Depth: 2900feet	Time: Befo	er level 16.79 re Pumping: 16.79
•		Volume
	lask fainch volume	Factor to Purge
12 21 6000 0	16 0.65 <u>1.9</u>	
	•	
mark number Fro	m: feet. Time Purg	ing Begins:
Debcu kardrud		·
Notes on Initial	Discharge:	
	oh Conductivity I	Notes
Time Yoluma	66 65	3 17 Brawn / SILZY
2:26 1.2	7.45 12.50 68.	2 1
2:28 2:4	7.36 10.36	9.
2:30 4.8	7.36 10.02 61.	<u> </u>
2:2/ 6	***************************************	_
Time Field Param	eter Measurement Begins:	Rep #3 Rep #4
	Rep 11 Rep 12	Rep 13 Rep 14
pĦ		
Conductivity		
Temperature (F)		
Duncannia Collec	tion Gallons Purged:	2
		.5 7
Time Sample Coll	SCIOU DAATHS!	40
Time Sample Coll	ection Ends:	~
Total Gallons Pu		<u> </u>
	•	
Comments:		

ALTUM GEUSCIENCE, Inc. Well Development and Water Sampling Field Survey

Project 130-081-01 site: B-P	Date: 3/7/91
Project 100 1011 3,000.	Dane Bures
Well: Mw-10 Sampling Team:	D ma
Well Development Method:	They
Sampling Method:	failer
Describe Equipment Before Sampling 1	this Well: Truple (Kinsk
Well Development/ Well Sampling Data	
Total Well Depth: 340/feet Time:	Before Pumping: 18.09
Water Casing Diameter	Volume Factor to Purge
15.92 feet x 0.16 0.65 2.	<u>s</u> <u>3</u> <u>8</u> .
Depth Purging From: feet. T	ime Purging Begins:
Notes on Initial Discharge:	
X 100 X 100 Conductivit	v I Notes
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	68.0
12:43 4:8 7:54	67.0
12:47 8 7:34 6.94	66.0
Time Field Parameter Measurement Be	gins:
Rep \$1 Rep	
pH	
Conductivity	
Presample Collection Gallons Purge	d1 <u>&</u>
Time Sample Collection Begins:	. 313
Time Sample Collection Ends:	3;20
	8.5
Total Gallons Purged:	
a-manital	الكريم و مصر مسيد التاريخ المسيد المسيد و المسيد

ALIUM GEUSCIENCE, IIRC. Well Development and Water Sampling Field Survey

Project 130-081. Well: RW-1	of sites 1	3-P	Date: 3/7	181.
Project 50001		DOWA	ve Bur	e/
Well: KW-1	- 28mbrrud	(D)	P	
Well Development	: Hethod:	3-14	U	
Well: Rw-1 Well Development Sampling Method	1	mich	Trust	Bus
Describe edark.		pling This M	111 77 974	
Well Development/We	# Sampling Data		4 9	
govel Well		# Be	later level fore Pumping	17.62
Total Hell Depth: 38.40 fee	f Ilmer "		•	Volume
Water	Casing Diamete	Yoluna	Eactor	to Rurge .
feet ×	0.16 0.65	· • · · · · · · · · · · · · · · · · · ·	***************************************	
Depth Purging "Notes on Initi	al'Discharge: .	uctivity		
Time Volume	, 100			
				·
	remeter Heasure	ment Begins		
Time Field Per	Rep_£1_	Rep 12	Rep_11_	Rep. #4
pH Conductivity Temperature (F)			
Presample Col	lection Gallon	s Purged: _		
Time Sample C	collection Begi	n s : '_		
Time Sample C	ollection Ends			
Total Gallons				
Tocas delication	•			

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

JOB NUMBER -	30-081-	1-081-01		TECHNICIAN AWWAD		
			DATE	4-5-91		
TOP FOOTHOR						

TOP FOO	ATION					
PUMPOUT	DATE	OF LAST PU	APOUT:	WEATHER:		
YES NO		<u></u>		TIME:		COMMENTS
	HOLD	CUT	LEVEL			(Notes, conditions, etc.)
WELL #	DEPTH TO WATER	DEPTH TO PRODUCT	PROD. THICKNESS (FT)	TOTAL DEPTH	DEPTH TO PUMP	
MW-1	17.18					
MW-2	15.64		·····			
MW-3	14.06					
MW -4	18.28					
MW-5						
MW-6	No Access					
MW-7	17.82				ļ	
MW-8	12.98				 	
MW-9	13.42					
MW-10	14.32					Florting Product
RW-1				<u> </u>		
		<u> </u>				
		<u> </u>	<u></u>			
		<u> </u>				
		<u> </u>		4		
		<u> </u>			<u> </u>	
						
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DATE:_	4		5 -	9	/		
SURVEY	RY	Au	WA	۵	ŧ	TAYL	.oR

		<u>.</u> .			Howar	
PROJECT A	IUMBER:	30 - 0	81-0) / <u>-</u>		
ADDRESS:	3201	35 TH	AVEN	ue	*******	~~~~~
	Oak	lend,	CA			
LEVATION	REFERENC	E DESCRIP	TION:	MW - 2	(168.	14-)
					~~~~~	****
					***	~~~~
CEEDENCE	COURCE	R M.	: A	1W-2	= 168	14 47
_	-	an Sea				
	(+)		(-)			
CTA				EL EU		
STA.	B.S.	H.I.	r.3.	ELEV.	_	
MW-2			:	168.14		
	4.54	172.68	<b>!</b>	168.14	Ī	
MW- 9				1// 25	ŀ	
/·( <i>p</i> v = (	<b>;</b>		6.48	166,20	}	
			<u>-</u>	-[		
MW-8	!		6.94	165.74	!	
	!	· !		' 	•	
mw-10		,	5.67	167.01		
		•	<del>-</del>	•		
	•	•	-	- : ;		
				- [		
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				:		
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				<b>!</b> !		
)TES:			~			

## ALTUM GEUSCIENCE, IIIC. Well Development and Water Sampling Field Survey

Project 130-08/-01 site: B-P Date: 3/7/91.  Well: Mw-8 Sampling Team: Jonne Fore!	
d and Tame Fire!	
	,
Well Development Method:	•
Karley	-
Describe Equipment Before Sampling This Well: Inche Ru	22
Describe Equipment Berote Soupering	•
Well Development/ Well Sampling Date	
Water level	
Total Hell  Depth: 38.80 feet Time: Before Pumping: 16.72	-
ACTAMA	_
Column 2-1nch 3-1nch 3.5 3 10.5	<b>.</b>
Depth Purging From: feet. Time Purging Begins:	
Depth Purging From.	_
Notes on Initial Discharge:	_
VIOO Notes	
Time yourse	SILTS
1:45 61.2	
7.15 11.43	 
1:50 10.5 7.19 11.87 00.5	
Time Field Parameter Measurement Begins: Rep_#3 Rep_#3	4.4
Rep. 11 Rep. 12 Rep. 13 Rep.	.3.
PH Conductivity	
Temperature (F)	_
and Callons Purged: 10.5	
Presample Collection Guardine	
et-a cample Collection Begins:	
Time Sample Collection Ends:	
Total Gallons Purged:	
Comments:	

### ALTUM GEUSCIENCE, INC. Well Development and Water Sampling Field Survey

20-001	of site: $B-P$ Sampling Team: $Po$	Date: 3/7/9/	_
Project 50-081	Sice:	Burch	•
Well: Mw-9	Sampling Team:	) N	•
Well Development	Method:	ungo	•
Sampling Method:	Burley		•
Describe Equipmen	nt Before Sampling This	Hell: Touple (Ke	ngl_
Well Development/ Well			
		Water level Before Pumping: 16.79	Ž
Depth: 29,00 eet		Volume	
Water C	asing Diameter -inch 4-inch Volume	Factor to Purge	<b>.</b>
Column	.16 0.65 <u>1.9</u>	. 3 6	-
sunning fr	om: feet. Time	Purging Begins:	-
Debeu sardrud er	Discharge:	•	···
" Notes on Initial			
Time Yolume	ph Conductivity	I Notes	
<del></del>	7.45 12.95	68.3 27 Bland/S.	TUZY T
2:28 2:4	7.43 10.82	68.9	
2:30 3:6	7.36 10.26	67.6	net)
2:21 6	7.32 10.02	2	-
Time Field Paras	meter Measurement Begins	***************************************	
·	Rep_11 Rep_12	Rep 13 Rep 1	<b>1</b>
PH			
Conductivity Temperature (F)			<b></b>
•			
Presample Colle	ction Gallons Purged:	<u></u>	
Time Sample Col	lection Begins:	3157	
Time Sample Col	lection Ends:	3:40	
		65	
Total Gallons P	ardeai		
Comments:			<del>='</del>

# Well Development and Water Sampling Field Survey

Project 130-081-01 site: B-P	Date: 3/7/9/
Well: Mw-10 Sampling Team: 1	Downe Bures
Well: Mosto	~ <del>***</del>
Well Development Method: Pa	
Sampling Method:	ull
Describe Equipment Before Sampling This	Hell: Jouple Klinsk
Well Development/ Well Sampling Data	
	Water level Before Pumping: 18.07
Depcii.	
Water Casing Diameter 2-inch 4-inch Volume	Factor to Purge
15.92 feet x 0.16 0.65 2.5	3 9
13.72 feet x (0.16)	
Depth Purging From: feet. Time	Purging Begins:
Notes on Initial Discharge:	
X 100	- Notes
Time Yolume pH Conductivity	
12.40  1.6  7.86  7.23  7.77	69.5 LT Blown /51274
12:42 3:E 7:56 7:62	67.0
$\frac{12.145}{12.145}$ $\frac{9.9}{6.99}$ $\frac{7.37}{7.39}$ $\frac{7.09}{6.99}$	66.8
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Rep #1 Rep #2	Rep 11 Rep 14
pH Hq	
Conductivity	
Temperature (F)	
Presample Collection Gallons Purged:	-346
Time Sample Collection Begins:	<u>-3115</u>
Time Sample Collection Ends:	3;20
Total Gallons Purged:	8.5
Comments:	

### ALIUM GEUSCIENCE, INC. Well Development and Weler Sampling Field Survey

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Project 150-017-07		DOWA	ve Bure	e/
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Time Sample Colle	ction Ends:			
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#### ALTON GEOSCIENCE, INC 1170 Burnett Ave., Ste. S Concord, CA 94520

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APPENDIX E ANALYTICAL METHODS, OFFICIAL LABORATORY REPORTS AND CHAIN OF CUSTODY RECORDS

APPENDIX E

ANALYTICAL METHODS, OFFICIAL LABORATORY REPORTS, AND CHAIN OF CUSTODY RECORDS

This appendix includes copies of the official laboratory reports and chain of custody records for soil and ground water samples selected for laboratory analysis.

Chain of custody protocol was followed for all samples. The chain of custody forms accompanies the samples from the sampling locality to the laboratory, providing a continuous record of possession prior to actual analysis.

825 ARNOLD, STE. 114 • MARTINEZ, CALIFORNIA 94553 • (415) 229-1512

DOHS #319 DOHS #220

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 82571 CLIENT: Alton Geoscience CLIENT JOB NO.: 30-081-01 DATE RECEIVED: 03/04/91 DATE REPORTED: 03/11/91

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

			Concentration(ug/Kg) Ethyl				
LAB #	Sample Identification	Benzene	Toluene	Benzene	Xylenes		
1 2 3 4 5 6 7 8	SB-8-10.5-11 SB-8-20.5-21 SB-8-25.5-26 SB-9-10.5-11 SB-9-20.5-21 SB-9-25.5-26 SB-10-10.5-11 SB-10-20.5-11 SB-10-25.5-26	ND<3 1800 13 ND<3 1700 470 ND<3 490 410	4 16000 28 4 7100 3900 7 3300 9	ND<3 6700 9.0 ND<3 1700 1600 ND<3 1300 7	ND<3 37000 50 6 11000 12000 17 6900		

ug/Kg - parts per billion (ppb)

Method Detection Limit in Soil: 3 ug/Kg

QAQC Summary:

Daily Standard run at 20ug/L: RPD = <15%

MS/MSD Average Recovery =93%: Duplicate RPD = <4

Richard Srna, Ph.D.

Caboratory Manager

825 ARNOLD, STE. 114 • MARTINEZ, CALIFORNIA 94553 • (415) 229-1512

DOHS #319 DOHS #220

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 82571

DATE RECEIVED: 03/04/91

DATE REPORTED: 03/11/91

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

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

LAB #	Sample Identification	Concentration (mg/Kg) Gasoline Range
1 2 3 4 5 6 7 8 9	SB-8-10.5-11 SB-8-20.5-21 SB-8-25.5-26 SB-9-10.5-11 SB-9-20.5-21 SB-9-25.5-26 SB-10-10.5-11 SB-10-20.5-11 SB-10-25.5-26	ND<1 390 ND<1 ND<1 120 130 ND<1 73

mg/kg - parts per million (ppm)

Method Detection Limit for Gasoline in Soil: 1 mg/Kg

QAQC Summary:

Daily Standard run at 2mg/L: RPD Gasoline = <15 MS/MSD Average Recovery =94%: Duplicate RPD = 0

Richard Srna, Ph.D.

Laboratory Manager

825 ARNOLD, STE. 114 . MARTINEZ, CALIFORNIA 94553 . (415) 229-1512

DOHS #319 DOHS #220

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 82613 CLIENT: Alton Geoscience CLIENT JOB NO.: 30-081-01 DATE RECEIVED: 03/08/91 DATE REPORTED: 03/15/91

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

LAB #	Sample Identification	Concentration (mg/L) Gasoline Range
1 2	MW-5 MW-10	ND<0.05 1.6 ND<0.05
3 4	MW-7 MW-8	2.7
5	MW-3	0.4 7.1
6 7	MW-9 MW-4	ND<0.05

mg/L - parts per million (ppm)

Method Detection Limit for Gasoline in Water: 0.05 mg/L

QAQC Summary:

Daily Standard run at 2mg/L: RPD Gasoline = <15 MS/MSD Average Recovery = 92%: Duplicate RPD = 3%

Richard Srna, Ph.D.

825 ARNOLD, STE. 114 • MARTINEZ, CALIFORNIA 94553 • (415) 229-1512

DOHS #319 DOHS #220

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 82613 CLIENT: Alton Geoscience DATE RECEIVED: 03/08/91 DATE REPORTED: 03/15/91

CLIENT JOB NO.: 30-081-01

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

			Concentration(ug/L) Ethyl					
# 	Sample Identification	Benzene	Toluene	Benzene	Xylenes			
1 2 3 4 5 6 7	MW-5 MW-10 MW-7 MW-8 MW-3 MW-9	17 120 ND<0.3 780 69 220 2.2	0.9 190 0.4 450 22 4 3.8	0.7 32 0.3 64 6.1 2.4 1.5	1.6 230 2.4 310 57 2400 2.8			

ug/L - parts per billion (ppb)

Method Detection Limit in Water: 0.3 ug/L

QAQC Summary:

Daily Standard run at 20ug/L: RPD = <15%

MS/MSD Average Recovery = 88%: Duplicate RPD = <1%

Richard Srna, Ph.D.

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APPENDIX F PUMP TEST DATA

AQUIFER TESTING AND ANALYSIS

The analysis of aquifer characteristics for the purpose of estimating the fate and transport characteristics of contaminants in ground water involves several steps. The first step is the exploratory stage, using surface and subsurface geological and geophysical techniques to define the water-bearing formation. Next is the evaluation stage to determine the hydrogeologic parameters and physical characteristics of the aquifer necessary for the proper design and construction of recovery or extraction wells, and for the control of contaminant migration. The last step is the confirmation stage to optimize the design and operation of each well for the management and remediation of ground water.

Literature Review and Basis of Analysis

The hydraulic properties of aquifers and unsaturated soil materials that define the rate of water movement into, through, and out of subsurface materials, and its effect on the piezometric surfaces or water tables, are hydraulic conductivity (K), transmissivity (T), and the storage coefficient (S) or specific yield for unconfined aquifer.

Hydraulic conductivity is defined as the rate at which water moves through a porous media under a unit hydraulic gradient. It is primarily dependent upon the porosity and permeability of the soil and the density and viscosity of the water. However, not all water occupying pore spaces in a saturated aguifer will be readily move through the aguifer. measure of the water-yielding ability of an aquifer is the storage coefficient (S). The storage coefficient of an aquifer is defined as the volume of water produced per unit horizontal area by a unit drop in the water table level (unconfined aquifers) or the piezometric surface (confined aquifers). Another term indicative of the water yielding capacity of an aquifer is its transmissivity or transmissibility. The transmissivity of an aquifer is the product of the hydraulic conductivity (K) in feet/day and the saturated thickness (b) in feet, or :

T = Kb

The movement or yielding capabilities of the water-bearing formation is important to understand aquifer characteristics. It is necessary to obtain values for one or more of the aquifer properties to determine these parameters. Various techniques have been developed for obtaining values for these properties or parameters.

The pumping test technique is generally used to evaluate the hydraulic properties of aquifers. The results of this test

are used to predict well yields, position of water tables and piezometric surfaces, and recharge rates of aquifers. Other techniques, such as the auger-hole and slug test methods (rate-of-rise or rate-of-fall techniques), have been developed to measure the localized hydraulic conductivity (K) of the soil profile in shallow ground water.

Pumped-Well Technique or Pumping Test

With the pumped-well technique, often called pumping test, hydraulic properties of the aquifer are calculated by pumping a well at a constant rate and observing the drawdown of the piezometric surfaces or water table in observation wells at some distance from the pumped well. Two types of tests are used; the steady-state and the non-steady or transient-state test. With the steady-state test, pumping is conducted for a sufficient period of time for the water levels in the observation wells to approach equilibrium. The equilibrium drawdown then enables the calculation of transmissivity (T). With the transient pumping tests, the change in water level in the observation wells is measured in relation to time to calculate the properties T and S.

Due to time constraints transient-state pumping tests are more commonly used than steady-state tests. Certain assumptions have to be made in calculating T and S from the pumping-test data, such as whether the aquifer is homogeneous or isotropic. In this study, only the transient-state method was used. A Theis curve matching procedure was used to evaluate T and S.

The transient flow differential equation developed by Theis is:

$$s = Q W(u)/(4 T)$$

where: s = Drawdown of piezometric surface
Q = Pumping rate

 $W(u) = Well function = e^{-y} dy$

Y

and:

$$u = r^2 S/(4Tt)$$

where: r = Distance between the pumping and observation wells
 t = time

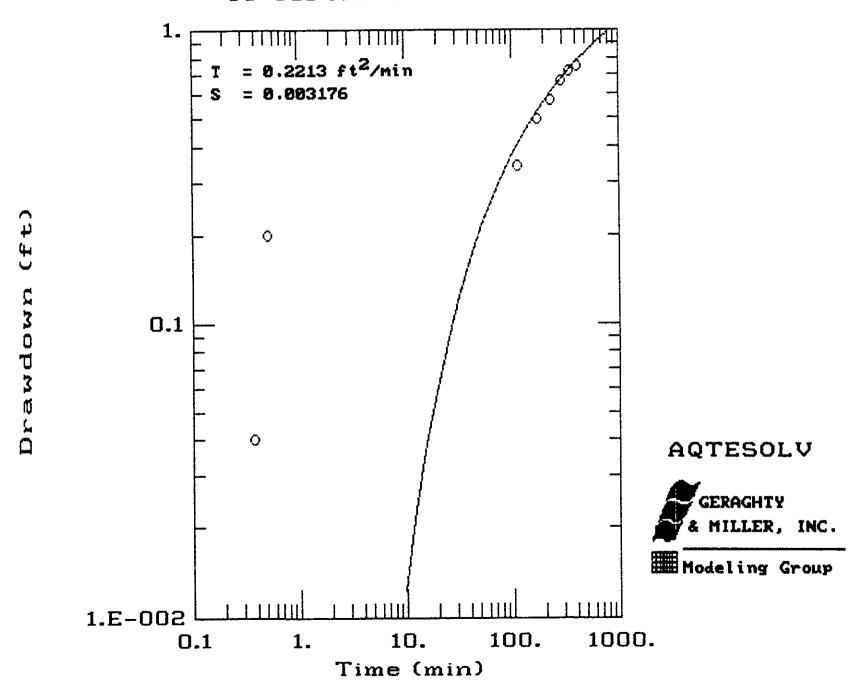
Rearranging and taking logarithms of both equations yields:

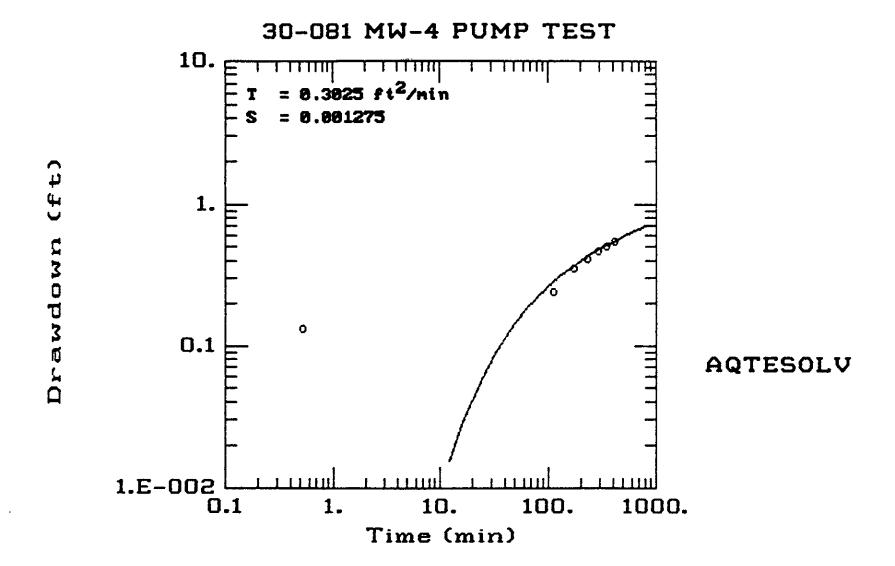
log (s) = log (Q/4 T) + log W(u)
and:
$$\log r^2/t = \log (4T/S) + \log (u)$$

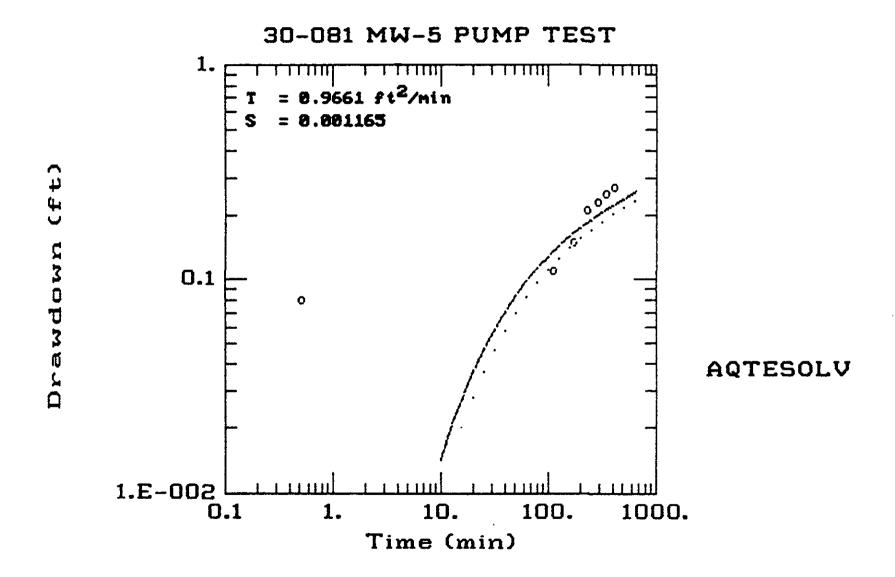
Given the above relationships, a logarithmic plot of s versus

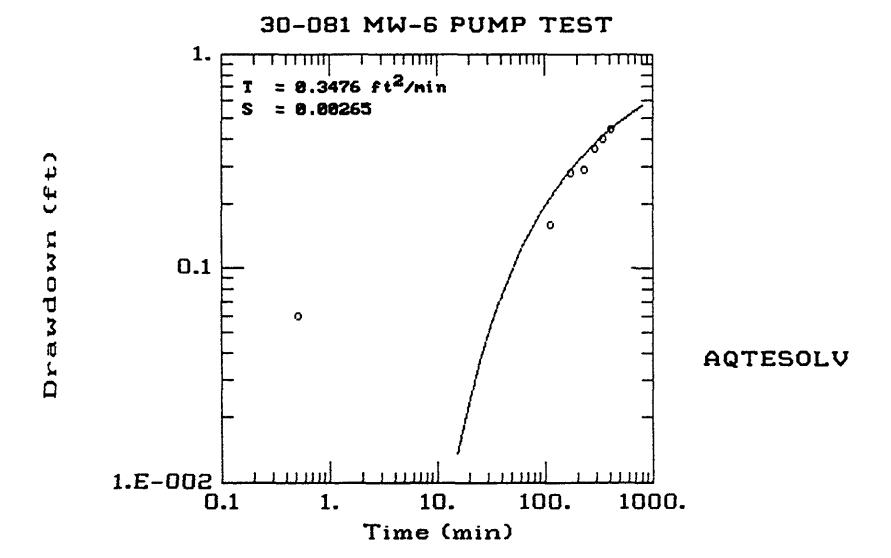
 $r^{2/t}$ and a log-log plot of W(u) versus u will be similar. A match point is determined by superimposing these two plots. Using the four coordinates of the match point and the above equations, the transmissivity (T) and storage coefficient (S) of the aquifer can then be determined.

30-081 MW-3 PUMP TEST









PHASE III - SUPPLEMENTAL SITE INVESTIGATION STUDY

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

Project No. 30-081-01

Prepared for:

BP Oil Company 2868 Prospect Park Drive, Suite 360 Rancho Cordova, California

Prepared by:

Alton Geoscience 1000 Burnett Avenue, Suite 140 Concord, California

August 21, 1991

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- B General Field Procedures, and Boring Logs
- C Permits
- D Well Development and Water Sampling Procedures, Field Survey Forms, and Survey Data Field Notes
- E Analytical Methods, Official Laboratory Reports and Chain of Custody Records
- F Pump Test Data

1.0 INTRODUCTION AND BACKGROUND

BP Oil Company retained Alton Geoscience, Inc. to conduct a Phase III - Supplemental Site Investigation Study related to subsurface contamination at BP Oil Company Service Station No. 11132, 3201 35th Avenue, Oakland, California. The site location is shown in Figure 1, while a site plan is shown in Figure 2.

1.1 Purpose and Scope

This Phase III - Supplemental Site Investigation Study was performed to: (1) address the concerns of the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) and the Alameda County Department of Environmental Health (ACDEH) regarding petroleum hydrocarbon contamination at the site; and (2) determine the extent of hydrocarbon concentrations in the subsurface soil and ground water.

Alton Geoscience supervised and/or performed the following tasks during this investigation:

- 1. Drilled three soil borings for conversion into offsite ground water monitoring wells.
- 2. Collected and analyzed soil and ground water samples.
- 3. Analyzed field data and laboratory results.
- 4. Prepared this technical report presenting the results, findings, and recommendations of the investigation.

The results of these tasks provide the basis for evaluating the remedial planning and feasibility study.

1.2 Site Description

The site is currently an operating BP Oil service station located on the northeast corner of the intersection of 35th Avenue and Suter Street, Oakland, California. The adjacent properties are residential and commercial developments. The site is located at an elevation of approximately 160 feet above mean sea level. The location and layout of the underground storage tanks are shown in Figure 2, Site Plan.

A sensitive receptors survey was conducted to identify nearby environmental elements and land uses that may be affected by

or affect the subsurface environment at the site. The findings of the survey are as follows:

- o The properties adjacent to the site are a mixture of residential and commercial developments. The site is surrounded by residential property except to the south across 35th avenue where a Quik Stop store is located. The Quik Stop has underground gasoline storage tanks but there are no records of any unauthorized release reported.
- o A review of RWQCB files indicate that there are three confirmed fuel releases within a 1/2-mile radius of the site. Two of the confirmed releases are upgradient of the site. These release are separated from the site by Highway 580, a topographic low.
- o There are no known municipal or private water supply wells within a 1/2-mile radius of the site.
- o Peralta Creek is the nearest surface body of water located approximately 500 feet north of the site.
- o Allandale School is the nearest school, located approximately 1,000 feet south of the site.

A copy of the sensitive receptors survey is presented in Appendix A.

1.3 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 the former Mobil Oil service station. Monitoring and sampling of the wells, performed by KEI, detected concentrations of total petroleum hydrocarbons (TPH) in both MW-1 and MW-2 at concentrations up to 210 parts per million (ppm), (Alton Geoscience 1990).

On January 26 and February 1, 1990, as part of a qualitative shallow ground water survey, Alton Geoscience supervised the drilling of 10 soil borings to various depths, ranging from 25 to 33 feet below grade. The borings were advanced 3 to 4 feet beyond the depth at which ground water was encountered. Following drilling, the borings were converted into temporary wells (TW-1 through TW-10) by inserting clean, 2-inch-diameter, schedule 40 polyvinyl chloride (PVC) casing with 0.020-inch slots. Ground water samples were collected from each temporary well, then the temporary casing was removed from each boring, backfilled with grout slurry and capped with asphalt. Additionally, ground water samples were collected from the three existing monitoring wells.

The sample from Monitoring Well MW-1 contained 0.1 foot of free product and Monitoring Well MW-2 contained 0.05 foot. Samples from the other monitoring and temporary wells contained concentrations of dissolved-phase total petroleum hydrocarbons as gasoline (TPH-G) and benzene, toluene, ethylbenzene and xylenes (BTEX) ranging from nondetectable (ND) to 240,000 parts per billion (ppb), (Alton Geoscience, 1990).

On May 16, 1990, Alton Geoscience supervised the drilling of two soil borings which were converted into one 4-inch-diameter ground water monitoring well (MW-4) and one 6-inch-diameter recovery well (RW-1). On June 25, 1990, Alton Geoscience supervised the drilling of three offsite soil borings which were converted into 2-inch-diameter ground water monitoring wells (MW-5, MW-6, and MW-7).

Laboratory analysis of water samples indicated TPH-G concentrations ranging from nondetectable in Monitoring Wells MW-4, MW-6, and MW-7, to 140 and 280 ppb detected in MW-3 and MW-5, respectively. The laboratory analysis for BTEX in Monitoring Wells MW-4, MW-6, and MW-7 indicated nondetectable concentrations. However, the laboratory analysis indicated 5.3 and 200 ppb of benzene in MW-3 and MW-5, respectively (Alton Geoscience, 1990).

1.4 Regional Geology and Hydrogeology

The site is located approximately 160 feet above mean sea level in Oakland, California (USGS Topographic Map, Oakland East Quadrangle - 7.5 Minute Series) as shown in Figure 1.

The topography of the surrounding area is characterized by rolling hills, gentle slopes, and broad valleys. Undivided Quaternary deposits (QU) form the underling unit in this region. The composition and physical properties of QU vary. The QU unit consists predominantly of Temescal Formation, probably including covered or unrecognized San Antonio Formation and gravel, sand, and clay (Qg), as well as recent alluvium and colluvium, and artificial fill. The site is located in a 580-square-mile basin drained by the Guadalupe River, and Alameda, Coyote, Redwood and San Francisquito Creeks.

The water-bearing material is comprised of younger and older alluvium. Regional surface and ground water flow in the region is to the southwest, towards San Francisco Bay. The nearest surface water drainage is Peralta Creek, about 500 feet north of the site. The water supply of the City of Oakland is obtained from Pardee Dam, which receives water from the Sierra snow melt.

2.0 FIELD METHODS

This investigation included the drilling of three soil borings, as outlined in the drilling and sampling protocol shown in Appendix B. The borings were used to install Monitoring Wells MW-8, MW-9, and MW-10, following the design and installation procedures shown in Appendix B.

2.1 Soil Borings and Sampling

On January 31, 1991, prior to commencement of offsite drilling activities, Ground Water Protection Ordinance Permit No. 91057 was obtained from the Alameda County Flood Control and Water Conservation District. Additionally, on February 15, 1991, Street Excavation Permit Nos. 9100232 and 9100234 were obtained from the City of Oakland Department of Public Works. Copies of the ground water protection ordinance permit and street excavation permits are presented in Appendix D.

On February 25 and 26, 1991, Alton Geoscience supervised the drilling of three offsite soil borings (SB-8, SB-9, and SB-10), which were converted into ground water monitoring wells (MW-8, MW-9, and MW-10). The borings were drilled using an 8-inch-diameter, hollow-stem augers to total depths of approximately 35 to 40 feet below grade, respectively.

During drilling, soil samples were collected from the soil borings at 5-foot intervals below grade and at significant lithologic changes until the first ground water was encountered at a depth of approximately 25 feet below grade in each well.

Drilling activities were performed by Soils Exploration Services, Inc. of Vacaville, California, using a high-torque CME-55 drilling rig. The soil samples were collected using a split-spoon sampler lined with brass tubes. The samples recovered for laboratory analysis were covered with aluminum foil, capped with polyurethane caps, wrapped with clear tape, labeled, and placed immediately in an iced cooler. A description of drilling procedures and soil sampling protocol, and copies of boring logs, are presented in Appendix B.

2.2 Ground Water Monitoring Well Construction

The soil borings were completed as Ground Water Monitoring Wells MW-8, MW-9, and MW-10. The monitoring wells were constructed of clean, 2-inch-diameter, flush-threaded, Schedule 40 PVC blank casing and 0.020-inch, slotted casing to a total depth of approximately 35 to 40 feet below grade. Well installation procedures and construction details are presented in Appendix B.

2.3 Monitoring Well Development and Sampling

Well development and sampling procedures were conducted in accordance with the RWQCB and ACDEH guidelines. A description of Alton Geoscience general field procedures for well development and sampling is presented in Appendix C.

Monitoring wells were developed by removing approximately 47.7 gallons from MW-8, 23.2 gallons from MW-9, and 33 gallons from MW-10. Development of the monitoring wells was conducted on March 6, 1991. Prior to well development, a clear PVC bailer was used in each well to check for the presence of floating product.

Prior to sampling of the wells on March 7, 1991, a minimum of 3 casing volumes of water was purged from each well. Water samples were collected after stabilization of temperature, pH, and conductivity readings in the purged water was observed. Each well was observed for the presence of free product and sheen. The water samples were decanted from a bailer into clean containers. Samples were immediately placed in an iced cooler prior to and during transportation to a California-certified laboratory for analysis following proper chain of custody procedures. Water sampling field survey forms documenting field observations during well development, purging, and sampling are presented in Appendix C. Analytical methods, official laboratory reports and chain of custody records are presented in Appendix E.

2.4 Ground Water Level Monitoring and Surveying

Permanent reference marks at the top of each well casing of Monitoring Wells MW-8, MW-9, and MW-10 were surveyed on April 5, 1991, to the nearest 0.01 foot in reference to Monitoring Well MW-2 which has a top of casing elevation of 168.14 feet above mean sea level. The purpose of the survey was to determine the relative top of casing elevations of the monitoring wells for use in calculating the ground water elevation at each well. The water table elevation data is used to estimate the general direction of ground water flow and average hydraulic gradient beneath the site. The survey data field notes are presented in Appendix D.

Ground water level monitoring and survey data collected on April 5, 1991 is presented in Table 1. A ground water elevation contour map based on interpretation of the monitoring data is shown in Figure 3.

2.5 Aguifer Analysis by Pumping Test

A pumping test was performed at the site on April 25, 1991. The purpose of the test was to estimate aquifer parameters which are used for remedial engineering design.

Prior to initiating the pumping test, transducers were placed in the pumping well (RW-1) and two observation wells (MW-1 and MW-2). An Instrumentation Northwest TERRA 8 data logger was programed to record readings from the transducers every 15 seconds for the first 30 minutes after pumping began, every minute for the next 2 hours, and then every 2 minutes for the duration of the test. Depth to water Measurements were taken every hour from MW-3, MW-4, MW-5, and MW-6 using an electronic probe.

A 2-inch diameter, variable flow rate pump was submersed in the well. The water was pumped into 55 gallon drums prior to proper offsite disposal.

The test began at 10:13 a.m. on April 25, 1991. Flow rates were measured using a stopwatch and a 5-gallon bucket marked with 1/4-gallon increments. The flow rate was maintained at 0.9 gallons per minute (GPM) to 1 GPM. Drawdown was observed in MW-1 and MW-2 after 20 minutes of pumping, and in all the monitored wells within an hour of the onset of the test.

After approximately 8 hours of continuous pumping 5.5 feet of drawdown had occurred in the pumping well, and between 0.27 and 1.38 feet of drawdown was recorded in the observation wells. The pump was then turned off and removed from the well. Ground water elevation readings continued after pump removal until ground water levels had recovered to approximately the initial static water level.

3.0 ANALYTICAL METHODS

All laboratory analyses of soil and ground water samples were performed by Superior Analytical Laboratories, Inc., a California-certified analytical laboratory, using standard test methods of the U.S. Environmental Protection Agency (EPA) and the California Department of Health Services (DHS). The laboratory reports and listing of the analytical methods used are presented in Appendix E.

3.1 Soil Analysis

Soil samples from the three borings were analyzed for the following constituents:

- o TPH-G using EPA Methods 5030/8015
- o BTEX constituents using EPA Methods 5030/8020

The results of the laboratory analyses of the soil samples are presented in Table 2; the official laboratory reports and chain of custody records are included in Appendix E.

3.2 Water Analysis

Ground water samples collected from all monitoring wells except MW-1 and MW-2, which exhibited sheen, were analyzed for the following constituents:

- o TPH-G using EPA Methods 5030/8015
- o BTEX constituents using EPA Methods 5030/8020

The results of the laboratory analyses of the ground water samples are presented in Table 3; the official laboratory reports and chain of custody records are included in Appendix E.

4.0 SITE GEOLOGY AND HYDROGEOLOGY

A brief description of the pertinent information on the site geology and hydrogeology is presented below.

4.1 Site Geology

A review of the boring logs generated during this phase, and previous phases, of the investigation indicated that the stratigraphy beneath the site is relatively consistent. Silty clay was the predominant soil type encountered throughout each new boring to a depth of approximately 35 to 40 feet below grade and is generally consistent with the results of previous investigations at the site.

4.2 <u>Site Hydrogeology</u>

As presented in Table 1, the depth to ground water in MW-1 through MW-5 and MW-7 through MW-10, as measured from the top of casing on April 5, 1991, ranged from 12 to 18 feet below grade. The depth to water in MW-6 could not be obtained due to the presence of an abandoned vehicle over the well box. The depth to water was not measured in RW-1 due to the presence of an oily substance on the water surface.

The ground water elevations as measured on April 5, 1991, were used to develop the ground water elevation contour map shown in Figure 3. The data indicates a southeasterly ground water flow direction at the site, with an average hydraulic gradient of approximately 0.003 foot per foot across the site.

5.0 DISCUSSION OF RESULTS

The results of the field activities and laboratory analysis of soil and ground water samples collected during this investigation are presented in Tables 2 and 3, and are discussed below.

5.1 Soil

A total of 21 soil samples was collected, 9 of which were * analyzed as part of this site investigation study to assess the extent of subsurface soil contamination. The results are discussed below.

- o Laboratory analysis indicates low to nondetectable levels of TPH-G and BTEX constituents detected in soil samples collected from Soil Borings SB-8, SB-9, and SB-10 at the 10.5 to 11.0 foot interval below grade.
- o The highest levels of TPH-G in the soil samples were detected at 20.5 to 21.0 feet below grade, with levels ranging from 73 to 390 ppm.

5.2 Ground Water

Results of the field survey and laboratory analysis of the ground water samples collected from the new and existing monitoring wells were used to assess the extent of ground water contamination. The results of the laboratory analysis are discussed below and summarized in Table 3.

- o Ground water samples collected from MW-1 and MW-2 exhibited sheen and were not analyzed. Recovery Well RW-1 was not sampled due to the presence of an oily substance on the water surface. Monitoring Well MW-6 was not sampled due to the presence of an abandoned vehicle parked over the monitoring well.
- O Laboratory analysis of ground water samples indicated TPH-G concentrations ranging from nondetectable in Monitoring Wells MW-4, MW-5, and MW-7, with concentrations of 400, 1,600, 2,700, and 7,100 ppb detected in ground water samples collected from MW-3, MW-10, MW-8, and MW-9, respectively.
- o The laboratory analysis of ground water samples for benzene revealed concentrations ranging from nondetectable in Monitoring Well MW-7 to 780 ppb detected in MW-8.
- o The laboratory analysis of ground water samples for toluene revealed concentrations ranging from 0.9 ppb detected in MW-8%.

- o The laboratory analysis of ground water samples analyzed for ethylbenzene revealed concentrations ranging from 0.7 ppb detected in MW-5 to 64 ppb detected in MW-8.
- o The laboratory analysis of ground water samples for total xylenes revealed concentrations ranging from 1.6 ppb detected in MW-5 to 2,400 ppb detected in MW-9.

5.3 Analysis of Aguifer Parameters by Pumping Test

As described in section 2.5, an aquifer pumping test was performed on well RW-1 with six observation wells located between 30 and 200 feet from the pumping well. After pumping for about 8 hours, measurable drawdown was observed in all the wells.

Storativity (S) and transmissivity (T) were calculated using the computer program AQTESOLY, (Geraghty & Miller Modelling Group), based on the Theis (1935) solutions. Storativity (S) and transmissivity (T) values are indicated below:

Well ID	S	T (ft2/min)
MW-1	0.0027	0.239
MW-2	0.0030	0.276
MW-3	0.0032	0.221
MW-4	0.0013	0.302
MW-5	0.0011	0.966
MW-6	0.0026	0.348

These values will be used to calculate the parameters for the design of the remediation system. A graphical representation of the drawdown curve is presented in Appendix F.

6.0 FINDINGS AND CONCLUSIONS

The findings and conclusions of this site investigation study are summarized below:

- o The concentrations of TPH-G and BTEX constituents detected in the soil samples from the offsite soil borings ranged from nondetectable to 300 ppm. The adsorbed phase petroleum hydrocarbon constituents in the soil extends offsite to the south.
- o Samples from two of the monitoring wells (MW-1 and MW-2) exhibited free product and therefore were not sampled. Recovery Well RW-1 was not sampled due to the presence of an oily substance.
- o The shallow ground water beneath the site has been impacted by free-floating and dissolved-phase

hydrocarbon constituents, the extent of which can be defined generally to the north, east, and west of the site.

- 4. The dissolved-phase hydrocarbon plume has migrated offsite south of the property. This is consistent with the general flow direction of the shallow ground water.
- 5. The average equilibrated depth to ground water in the monitoring wells at the site is 15 feet below grade.
- 6. The ground water elevation contour map, developed from the water level and survey data, indicates an overall southeasterly ground water flow direction beneath the site, with an average hydraulic gradient of approximately 0.003 foot per foot.
- 7. Based on the pumping test data, the average transmissivity of the aquifer beneath the site was calculated to be 0.392 ft²/min. The calculated average hydraulic conductivity beneath the site was determined to be 0.016 ft/min. The average linear velocity of the aquifer beneath the site was determined to be approximately 4.80 X 10⁻⁵ ft/min.
- 8. Soil types encountered at the site during drilling generally consisted of silty clay.
- There are no existing domestic water supply wells in the immediate vicinity or within a 1/2-mile radius of the site.

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

ALTON GEOSCIENCE

Matthew A. Taylor

Staff Engineer

Matthew Hopwood Project Manager

Jefferey W. Wiegand, C.E.G. 331

Vice President

REFERENCES

- Alton Geoscience, A., 1990. Phase II Supplemental Site Investigation Report
- Geraghty & Miller Modeling Group, AQTESOLV: Aquifer Test Solver, by G. M. Duffield and J. O. Rumbaugh, 1989.
- Theis, C. V., 1935. "The Relation Between the Lowering of the Piezometric Surface and Duration of Discharge of a Well using Ground Water Storage", American Geophysical Union Transactions, Vol. 16, pp. 519-524.

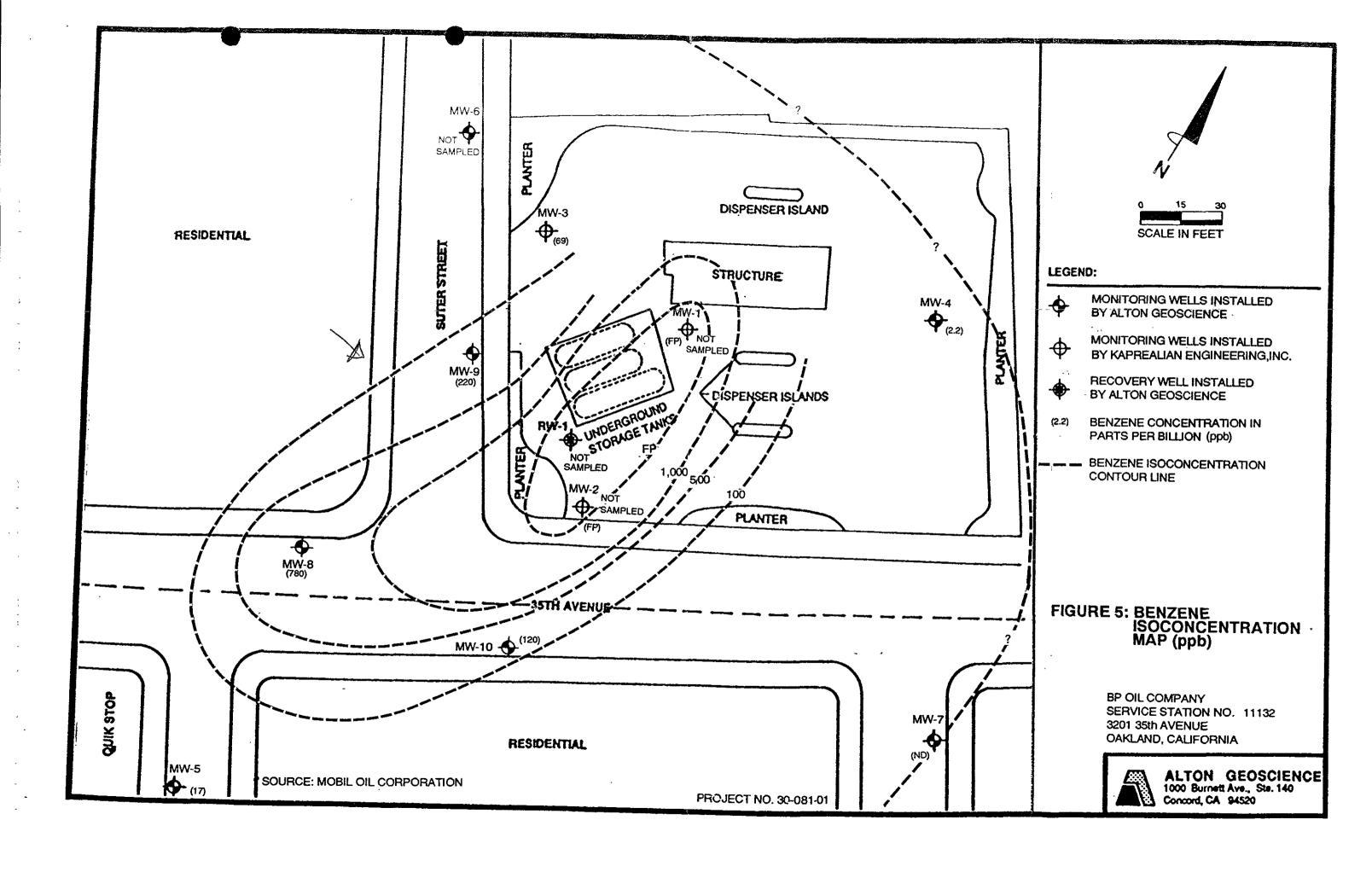


TABLE 1
SURVEY AND WATER LEVEL MONITORING DATA
April 1991

Well Number	Elevation (Feet)	Depth to Water (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Feet)*
MW-1	169.75	17.18		152.35
MW-2	168.14	15.64		152.50
MW-3	167.17	14.06		153.11
MW-4	170.36	18.28		152.08
MW-5	165.14	12.62		152.52
MW-6	165.40	**		**
MW-7	167.61	17.82		149.78
MW-8	165.74	12.98		152.76
MW-9	166.20	13.42		152.78
MW-10	167.01	14.32		152.69
RW-1	168.01	***	***	***

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.
- ** MW-6 could not be accessed due to the presence of an abandoned vehicle over the well.
- *** Depth to water in the recovery well was not recorded due to the presence of an oily substance.

TABLE 2

RESULTS OF
LABORATORY ANALYSIS OF SOIL SAMPLES
March 1991

Boring	Sample Depth (ft)	TPH-G (Concer	B ntrations i	T n Parts	E Per Milli	X.on)
	10 5 13 0	ND < 1	ND<0.003	0.004	ND<0.003	ND<0.003
SB-8	10.5-11.0 20.5-21.0	ND<1 390	MD<0.003	16	6.7	37
		-	0.013	0.028	0.009	0.05
	25.5-26.0	ND<1	0.013	0.020	0.009	0.05
SB-9	10.5-11.0	ND<1 ?	ND<0.003	0.004	ND<0.003	0.006
	20.5-21.0	120	1.7	7.1	1.7	11
	25.5-26.0	130	0.47	3.9	1.6	12
	23.3-20.0	150	0.47	3.7	1.0	,
SB-10	10.5-11.0	ND<1	ND<0.003	0.007	ND<0.003	0.017
	20.5-21.0	73	0.49	3.3	1.3	6.9
	25.5-26.0	1	0.41	0.009	0.007	0.019

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline

B = Benzene T = Toluene

E = Ethylbenzene X = Total Xylenes

ND = Not Detected at Method Detection Limit shown

TABLE 3 RESULTS OF April 1990 LABORATORY ANALYSIS OF GROUND WATER SAMPLES

Monitoring Well	TPH-G (Concen	B trations i	T n Parts	E per Bill:	X ion)
MW-1	*	*	*	*	*
MW-2	*	~*	* *	* , *	*
MW-3	400	69	22	6.1	57
MW-4	ND<50	2.2	3.8	1.5	2.8
MW-5	ND<50	17.	0.9	0.7	1.6
MW-6	***	**	**,	**	**
MW-7	ND<50	ND<0.3	0.4	0.3	2.4
MW-8	27.00	780	450	64	310
MW-9	7100	220	4	2.4	2400
MW-10	1600	120	190	32	230
RW-1	* * *	***	***	***	***

Notes:

TPH-G = Total Petroleum Hydrocarbons as Gasoline

= Benzene \mathbf{T} = Toluene

E = Ethylbenzene = Total Xylenes X

ND = Not Detected at Method Detection Limit

= No sample collected due to the presence of free product

= No sample collected due to the presence of an

abandoned vehicle located over the well

= The recovery well was not sampled due to the presence of an oily substance

SENSITIVE RECEPTORS SURVEY SITE SURVEY AND LITERATURE SEARCH

Client: BP	Oil Company Project No.: 30-081-0
Station No.:	///32
	3201 35TH AVE. Ox
City/State:	Oakland CA
I. Provide	answers to the following questions:
A. Is with	there a public water supply well nin 2500 feet? If Yes, Distance Y/N //ft.
B. Is with	there a private water supply well hin 1000 feet? If Yes, Distance Y/Nft.
C. Is	there a subway within 1000 feet? Y/N $\frac{\mathcal{N}}{$
D. Is	there a basement within 1000 feet? Y/N $\frac{\mathcal{V}}{$
E. Is	there a school within 1000 feet? Y/N ½s /000 ft.
F. Is wit	there a surface body of water hin 1000 feet? If Yes, Distance Name Y/N Yes For ITA Creek
II. Describ	e type of local water supply.
Public:	X
- Suppl - Suppl - Dista	iers Name: East Bay Municipal Water District liers Source: Sierra Snow MelT, Pardee Dam ance to Site:
Private	9:

SENSITIVE RECEPTORS SURVEY SITE SURVEY AND LITERATURE SEARCH

Page 2

III.	Distance to Nearest Adjacent Properties:	
	Residential Commercial Industrial Hospital School (Allandale School Name	50 ft. 00 ft. ft. //,000ft. //000 ft.
IV.	Aquifer Classification, if available.	
	Class I - Special Ground Waters - Irreplaceable Drinking Water Source - Ecologically Vital	
	Class II - Current and Potential Drinking Water Sources	
	Class III - Not Potential Source of Drinking Water	X
v.	Describe observation wells, if any.	
	Number Free Product?	Y/N <u>//</u>
VI.	Signature of Preparer: Matte A. Tag	1
	Date: 2-20-9	/
VII.	Sketch of Site	

ALTON GEOSCIENCE, Inc. LOG OF EXPLORATORY BORING FIELD SKETCH OF BORING LOCATION	PROJECT NO. 30-081-01 DATE DRILLED 2-25-91 CLIENT BP Oil Company LOCATION 3201 35th Ave, Oakland LOGGED BY M. Taylor APPROVED BY M. Hopwood Page 1 of 2				
	DRILLING METHOD Hollow stem auger HOLE DIAM. 8" SAMPLER TYPE Modified split spoon CASING DATA See well construction details				
TOP OF CASING ELEVATION 165.74'	DRILLER Soils Exploration Services , Inc.				
PPN) T(N) T(N) T(N) T(N) T(N) T(N) T(N) T(VATER LEVEL ATE IME DESCRIPTION				
Christy Box					
5,13,25 2° casi ng GM	GRAVELLY SILT: green, damp, hard, low plasticity				
14	SANDY SILT: greenish brown, damp, very stiff, low plasticity, gravelly SILTY CLAY: brownish green, damp, very stiff, low to medium plasticity, with fine sand				
2,6,10 20 CL CL	Same, becomes moist, stiff, medium plasticity, with medium sand				
	Same, becomes brown, moist to wet, very stiff, medium plasticity - 27'				
30	Same, becomes brownish green, wet, with medium sand and gravel				

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ALTON GEOSCIENCE, Inc. LOG OF EXPLORATORY BORING							7	PROJECT NO. CLIENT BP LOCATION CLOGGED BY				
FIELD SKETCH OF BORING LOCATION											Page 2 of 2	
TOP OF CASING ELEVATION 165.74'								DRILLING METHOD Hollow stem auger HOLE DIAM. 8" SAMPLER TYPE Modified split spoon CASING DATA See well construction detail DRILLER Soils Exiplorations Services, Inc.				
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FIELD SKETCH OF BORING LOCATION							·		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		,	Page 1 of 2
TOP OF CASING ELEVATION 166.20								DRILLING METHOD Hollow stem auger HOLE DIAM. 8" SAMPLER TYPE Modified split spoon CASING DATA See well construction details DRILLER Soils Exploration Services, Inc.				AM. 8*
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a a .	ŏ	Š			5				DES	SCRIPTION		
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5,8,10			- 24 - 26 - 28	2" sch. 40 PVC 0.020" Slot			五	Same, becomes bro 26'	wn, wet to satura	ted, very stiff		
3,5,10			- 30 - 32 - 34	End Cap	00000000000000		5	Same, becomes sati	urated, stiff, with f	ine to medium sa	and	

										•	,	
ALTON GEOSCIENCE, Inc. LOG OF EXPLORATORY BORING						**************************************	<u> </u>	CLIENT BP LOCATION	Oil Cor 3201 35	npany th Ave		
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							f	Portland Cement			Sample	
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LO(BO	G O RIN	F E	EXP	SCIENCE, In LORATORY BORING LOCATI			PROJECT NO. 30-081-01 DATE DRILLED 2-27-91 CLIENT BP Oil Company LOCATION 3201 35th Ave, Oakland LOGGED BY M. Taylor APPROVED BY M. Hopwood Page 1 of 2				
TOPO	FC	ASII	NG E	LEVATION 167	.01'	_	DRILLING METHOD Hollow stem auger HOLE DIAM. 8" SAMPLER TYPE Modified split spoon CASING DATA See well construction details DRILLER Soils Exploration Services, Inc.				
BLOWS PER FOOT(M)	CGI (PPM) CGI (PPM) SAMPLE DEPTH CONSTRUCTION ORBORING CLOSURE		nece	PROFILE	WATER LEVEL DATE TIME DESCRIPTION						
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			- 0			1111	10" Concrete				
6,12,17 6,14,17 7,10,14			- 8 - 10 - 12 - 14 - 16 - 18	2" sch. 40 PVC Casing	CL		SILTY CLAY: tan, damp, very stiff, low plasticity, with gravel Same, becomes tan to brown Same, becomes brown with green streaks, moist, medium plasticity, with gravel	Ī			
4,8,13			- 20 - 22 - 24				Same, becomes moist to wet, with fine sand and gravel				
3,8,18			26 - 28	2" sch. 40 PVC 0.020" Slot	-		SANDY CLAY: brownish white, wet to saturated, very stiff, low to medium plasticity, with slight gravel				
11,19, 25			30 32 34	End Cap	UL		Same, becomes brown, wet, hard, medium plasticity, with slight gravel				

ALTON GEOSCIENCE, Inc. LOG OF EXPLORATORY BORING FIELD SKETCH OF BORING LOCATION								CLIENT BP	Oil Con 3201 35	npany th Ave.	_ DATE_DRILLED_2/27/9 , Oakland APPROVED BY M. Hopwo	SB-10 - WELLNO.
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ALTON GEOSCIENCE, INC 1170 Burnett Ave., Ste. S Concord, CA 94520

JOB NUMBER 30-081-01	TECHNICIAN AWWAD & TAYLOR
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JOB LOCATION Ockland 35 TH AVE DATE___4-5-91

JOB LOCATION DE L'AMILIA DATE 4								
PUMPOUT	DATE	OF LAST PU	APOUT:	WEATHER:		COMMENTS		
YES NO				TIME:				
		0.5	LEVEL			(Notes, conditions, etc.)		
	HOLD	CUT	LEVEL					
	DEPTH TO	DEPTH TO	PROD. THICKNESS	TOTAL	DEPTH			
WELL#	WATER	PRODUCT	(FT)	DEPTH	TO PUMP			
MW-1	17.18				<u> </u>			
MW-2	15.64				<u> </u>			
MW-3	14.06			· · · · · · · · · · · · · · · · · · ·				
MW -4	18.28				<u> </u>			
MW-5	12.62				ļ			
MW-6	No Access							
MW-7								
MW-8	12.98				<u> </u>			
MW-9	13.42			,, , , , , ,		T/ - 0-1.7		
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AOUIFER TESTING AND ANALYSIS

The analysis of aquifer characteristics for the purpose of estimating the fate and transport characteristics of contaminants in ground water involves several steps. The first step is the exploratory stage, using surface and subsurface geological and geophysical techniques to define the water-bearing formation. Next is the evaluation stage to determine the hydrogeologic parameters and physical characteristics of the aquifer necessary for the proper design and construction of recovery or extraction wells, and for the control of contaminant migration. The last step is the confirmation stage to optimize the design and operation of each well for the management and remediation of ground water.

Literature Review and Basis of Analysis

The hydraulic properties of aquifers and unsaturated soil materials that define the rate of water movement into, through, and out of subsurface materials, and its effect on the piezometric surfaces or water tables, are hydraulic conductivity (K), transmissivity (T), and the storage coefficient (S) or specific yield for unconfined aquifer.

Hydraulic conductivity is defined as the rate at which water moves through a porous media under a unit hydraulic gradient. It is primarily dependent upon the porosity and permeability of the soil and the density and viscosity of the water. However, not all water occupying pore spaces in a saturated aquifer will be readily move through the aquifer. One measure of the water-yielding ability of an aquifer is the storage coefficient (S). The storage coefficient of an aquifer is defined as the volume of water produced per unit horizontal area by a unit drop in the water table level (unconfined aquifers) or the piezometric surface (confined aquifers). Another term indicative of the water yielding capacity of an aquifer is its transmissivity or transmissibility. The transmissivity of an aquifer is the product of the hydraulic conductivity (K) in feet/day and the saturated thickness (b) in feet, or :

T = Kb

The movement or yielding capabilities of the water-bearing formation is important to understand aquifer characteristics. It is necessary to obtain values for one or more of the aquifer properties to determine these parameters. Various techniques have been developed for obtaining values for these properties or parameters.

The pumping test technique is generally used to evaluate the hydraulic properties of aquifers. The results of this test

are used to predict well yields, position of water tables and piezometric surfaces, and recharge rates of aquifers. Other techniques, such as the auger-hole and slug test methods (rate-of-rise or rate-of-fall techniques), have been developed to measure the localized hydraulic conductivity (K) of the soil profile in shallow ground water.

Pumped-Well Technique or Pumping Test

With the pumped-well technique, often called pumping test, hydraulic properties of the aquifer are calculated by pumping a well at a constant rate and observing the drawdown of the piezometric surfaces or water table in observation wells at some distance from the pumped well. Two types of tests are used; the steady-state and the non-steady or transient-state test. With the steady-state test, pumping is conducted for a sufficient period of time for the water levels in the observation wells to approach equilibrium. The equilibrium drawdown then enables the calculation of transmissivity (T). With the transient pumping tests, the change in water level in the observation wells is measured in relation to time to calculate the properties T and S.

Due to time constraints transient-state pumping tests are more commonly used than steady-state tests. Certain assumptions have to be made in calculating T and S from the pumping-test data, such as whether the aquifer is homogeneous or isotropic. In this study, only the transient-state method was used. A Theis curve matching procedure was used to evaluate T and S.

The transient flow differential equation developed by Theis is:

$$s = Q W(u)/(4 T)$$

where: s = Drawdown of piezometric surface
Q = Pumping rate

 $W(u) = Well function = e^{-Y} dy$

Y

and:

$$u = r^2 S/(4Tt)$$

where: r = Distance between the pumping and observation wells
 t = time

Rearranging and taking logarithms of both equations yields:

 $\log (s) = \log (Q/4 T) + \log W(u)$

and:

 $\log r^2/t = \log (4T/S) + \log (u)$

Given the above relationships, a logarithmic plot of s versus $r^{2/t}$ and a log-log plot of W(u) versus u will be similar. A match point is determined by superimposing these two plots. Using the four coordinates of the match point and the above equations, the transmissivity (T) and storage coefficient (S) of the aquifer can then be determined.

30-081 MW-3 PUMP TEST

