



KAPREALIAN ENGINEERING, INC.

Consulting Engineers

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KEI-P89-0805.R7

March 9, 1992

Unocal Corporation
2000 Crow Canyon Place, Suite 400
P.O. Box 5155
San Ramon, California 94583

Attention: Mr. Ron Bock

RE: Continuing Ground Water Investigation and
Quarterly Report
Unocal Service Station #0746
3943 Broadway
Oakland, California

Dear Mr. Bock:

This report presents the results of Kaprealian Engineering, Inc.'s. (KEI) soil and ground water investigation for the referenced site, in accordance with KEI's proposal KEI-P89-0805.P6 dated April 15, 1991. The purpose of the investigation was to determine the degree and extent of ground water contamination at and in the vicinity of the site. This report also presents the results of the most recent quarter of monitoring and sampling of the existing wells at the site during December 1991 through January 1992. The scope of the work performed by KEI consisted of the following:

Coordination with regulatory agencies

Geologic logging of two borings for the installation of two monitoring wells

Soil sampling

Ground water monitoring, purging, and sampling

Laboratory analyses

Data analysis, interpretation, and report preparation

SITE DESCRIPTION AND BACKGROUND

The subject site is presently used as a gasoline station. The site is situated on gently sloping, south-southwest trending topography, and is located at the southwest corner of the intersection of Broadway and 40th Street in Oakland, California. A Location Map, Site Vicinity Maps, and a Site Plan are attached to this report.

KEI's initial work at the site began on August 16, 1989, when KEI was asked to collect soil samples following the removal of two underground gasoline storage tanks and one 280 gallon waste oil tank at the site. The fuel tanks consisted of one 10,000 gallon unleaded gasoline tank and one 10,000 gallon super unleaded gasoline tank. The tanks were made of steel and no apparent holes or cracks were observed in any of the tanks. Water was encountered in the fuel tank pit at a depth of about 10 feet below grade, thus prohibiting the collection of any soil samples from immediately beneath the tanks. Six soil samples, designated as SW1 through SW6, were collected from the sidewalls of the gasoline tank pit approximately six inches above the water table. One soil sample was collected from the bottom of the waste oil tank excavation at a depth of 8 feet below grade. Soil sample point locations are shown on the attached Site Plan, Figure 2.

On August 17, 1989, approximately 1,500 gallons of ground water were pumped from the fuel tank pit. One water sample, labeled W1, was then collected from the fuel tank pit.

To accommodate the installation of new, larger tanks, additional soil was excavated approximately 14 feet laterally along the north wall of the tank pit, in the vicinity of sample points SW1 and SW2. On August 18, 1989, KEI returned to the site to collect additional soil samples. One soil sample, labeled SW2(R), was collected from the north sidewall of the fuel tank pit (after additional excavation) at a depth of 9.5 feet below grade. Also on August 18, 1989, four soil samples, labeled P1 through P4, were collected from the product pipe trenches at depths ranging from 5 to 6.5 feet below grade. After soil sampling, the pipe trenches were excavated to the sample depths. Collection points for the soil samples are shown on the attached Site Plan, Figure 2.

KEI again returned to the site on August 24, 1989, to collect an additional ground water sample. After approximately 5,000 gallons of contaminated ground water were pumped from the fuel tank pit, one ground water sample, labeled W2, was collected.

All soil and water samples were analyzed by Sequoia Analytical Laboratory in Redwood City, California, for total petroleum hydrocarbons (TPH) as gasoline, and benzene, toluene, xylenes, and ethylbenzene (BTX&E). The soil sample collected from beneath the waste oil tank was analyzed for TPH as gasoline, BTX&E, TPH as diesel, total oil and grease (TOG), and EPA method 8010 constituents.

Analytical results of soil samples collected from the fuel tank pit indicated non-detectable levels of TPH as gasoline and BTX&E for all samples, except samples SW1 and SW2, which showed levels of TPH

as gasoline at 13 ppm and 290 ppm, respectively. However, the entire area of sample points SW1 and SW2 was excavated as described above, and the new sample, SW2(R), showed non-detectable levels of TPH as gasoline and BTX&E. Analytical results of the soil sample collected from the waste oil tank pit showed non-detectable levels of all constituents analyzed, except for TPH as gasoline at 1.6 ppm, and toluene at 1.3 ppm. Analytical results of soil samples collected from pipe trenches showed levels of TPH as gasoline ranging from 3.8 ppm to 36 ppm, and benzene ranging from non-detectable to 0.52 ppm. The analytical results of ground water samples collected from the tank pit (W1) showed 4,700 ppb of TPH as gasoline and 180 ppb of benzene (after purging 1,500 gallons), while W2 showed 1,200 ppb of TPH as gasoline and 12 ppb of benzene (after purging an additional 5,000 gallons). Analytical results of the soil samples are summarized in Table 7, and the analytical results of the water samples are summarized in Table 8. Documentation of soil sample collection techniques and sample results are presented in KEI's report (KEI-J89-0805.R1) dated August 30, 1989. To comply with the requirements of the regulatory agencies and based on the analytical results, KEI proposed the installation of three monitoring wells.

On October 17, 1989, three two-inch diameter monitoring wells, designated as MW1, MW2, and MW3 on the attached Site Vicinity Map, Figure 1, were installed at the site. The three wells were drilled and completed to total depths ranging from 20 to 22.5 feet below grade. Ground water was encountered at depths ranging from 11 to 13 feet beneath the surface during drilling. The wells were developed on October 26 and 30, 1989, and were initially sampled on November 1, 1989.

Water and selected soil samples were analyzed by Sequoia Analytical Laboratory in Redwood City, California, for TPH as gasoline and BTX&E. Analytical results of all soil samples collected from the borings for monitoring wells MW1 and MW2 showed non-detectable levels of TPH as gasoline and BTX&E, except for sample MW1(5), collected at a depth of 5 feet below grade, which showed TPH as gasoline at 8.5 ppm, and xylenes at 0.14 ppm. Soil samples collected from the boring for well MW3 showed TPH as gasoline at levels ranging from 3.1 ppm to 1,100 ppm, and benzene levels ranging from 0.068 ppm to 16 ppm. The analytical results of water samples collected from wells MW2 and MW3 showed TPH as gasoline concentrations at 200 ppb and 13,000 ppb, respectively. Benzene was detected in well MW3 only at a concentration of 57 ppb. Analytical results for the soil samples are summarized in Table 5, and water samples in Table 2. Based on analytical results of the soil and ground water samples, KEI recommended the installation of three additional monitoring wells to further define the extent of contamination. Documentation of the well installation protocol,

sampling techniques, analytical results, and recommendations for further work are presented in KEI's report (KEI-P89-0805.R4) dated November 30, 1989.

On January 26, 1990, two additional two-inch diameter monitoring wells (designated as MW4 and MW5 on the attached Site Vicinity Map, Figure 1) were installed at the site. A third proposed monitoring well could not be installed because of underground utilities and an on-site storage shed. The two wells were each drilled and completed to total depths of 20 feet below grade. Ground water was encountered at depths of approximately 12.5 feet beneath the surface during drilling. The new wells (MW4 and MW5) were developed on February 9, 1990, and all of the wells were sampled on February 15, 1990.

Water samples from all of the existing wells, and soil samples from the borings for wells MW4 and MW5, were analyzed at Sequoia Analytical Laboratory in Redwood City, California, for TPH as gasoline and BTX&E. Analytical results of the soil samples collected from the borings for monitoring wells MW4 and MW5 indicated levels of TPH as gasoline ranging from 2.5 ppm to 370 ppm. Benzene was detected at concentrations ranging from non-detectable to 1.8 ppm. Analytical results of the water samples collected from monitoring well MW2 showed non-detectable levels of all constituents analyzed. In wells MW1 and MW4, TPH as gasoline was detected at 170 ppb and 150 ppb, respectively, and benzene was detected at 7.9 ppb and 8.0 ppb, respectively. In wells MW3 and MW5, TPH as gasoline was detected at 20,000 ppb and 24,000 ppb, respectively, and benzene was detected at 1,700 ppb and 1,500 ppb, respectively. Results of the soil analyses are summarized in Table 5, and results of the water analyses are summarized in Table 2.

Based on the analytical results, KEI recommended the installation of four additional monitoring wells (two on-site, and two off-site) to further define the extent of detected contamination. In addition, KEI recommended continuation of the monthly monitoring and quarterly sampling program. The details of the monitoring well installation activities and recommendations for further work are presented in KEI's report (KEI-P89-0805.R5) dated March 16, 1990.

On October 23, 1990, four additional two-inch diameter monitoring wells (designated as MW6, MW7, MW8, and MW9 on the attached Site Vicinity Map, Figure 1) were installed at the site. The four wells were drilled and completed to total depths ranging from 20 to 22 feet below grade. Ground water was encountered at depths ranging from 11.7 to 12.7 feet beneath the surface during drilling. All wells were surveyed by a licensed surveyor (Kier & Wright of Pleasanton, California) to Mean Sea Level (MSL) and to a vertical accuracy of 0.01 feet. The new wells (MW6, MW7, MW8, and MW9) were

developed on October 26, 1990, and all wells were sampled on November 7, 1990. Water samples from all of the existing wells, and selected soil samples from the borings for wells MW6 through MW9, were analyzed at Sequoia Analytical Laboratory in Concord, California, for TPH as gasoline and BTX&E.

The analytical results of the soil samples collected from the borings for monitoring wells MW6 through MW9 showed non-detectable levels of TPH as gasoline and benzene in all analyzed samples, except in MW7(5), MW9(10) and MW9(12), which showed TPH as gasoline levels of 11 ppm, 84 ppm and 120 ppm, respectively, with benzene levels detected only in samples MW9(10) and MW9(12) at 0.32 ppm and 0.19 ppm, respectively. The analytical results of the ground water samples showed non-detectable levels of TPH as gasoline and BTX&E in wells MW1, MW2, MW6, and MW7, except for TPH as gasoline detected at a level of 45 ppb in well MW1. In wells MW3, MW4, MW5, MW8, and MW9, TPH as gasoline was detected at levels of 42,000 ppb, 180 ppb, 20,000 ppb, 4,700 ppb, and 480 ppb, respectively, with benzene detected at levels of 1,400 ppb, 1.5 ppb, 640 ppb, 28 ppb, and 7.8 ppb, respectively. Results of the soil analyses are summarized in Table 6, and results of the water analyses are summarized in Table 2. Documentation of well installation protocol, sample collection techniques, and sample results are presented in KEI's report (KEI-P89-0805.R6) dated December 17, 1990. Based on the analytical results, KEI recommended continuation of the monthly monitoring and quarterly sampling program.

In, KEI's report (KEI-P89-0805.QR2) dated April 12, 1991, KEI recommended the installation of three additional off-site monitoring wells to further define the extent of ground water contamination downgradient of the site.

Based on the analytical results collected and evaluated through August 28, 1991, KEI recommended the continuation of the current monitoring and sampling program of the existing wells, per KEI's proposal (KEI-P89-0805.P5) dated December 17, 1990. In addition, KEI also recommended that wells MW3, MW4, MW5, and MW8 continue to be purged on a bi-weekly basis, in an attempt to reduce levels of contamination in the vicinity of these wells (until the lateral extent of contamination has been delineated).

On October 22, 1991, water recovery tests were performed on wells MW3, MW5, MW8, and MW9. The wells were uniformly pumped of various amounts of ground water, and the water levels were measured at periodic time intervals to determine the ground water recovery rate for each well. The water recovery tests were performed to obtain information about relative recovery rates at various locations at the site, and to better determine locations of recovery wells. Well recovery data are summarized in Table 4. Additional recommen-

tions for remedial action will be proposed after the installation of the additionally proposed off-site monitoring wells, which are designed to define the extent of contamination.

RECENT FIELD ACTIVITIES

On January 7, 1992, two additional two-inch diameter monitoring wells (designated as MW10 and MW11 on the attached Site Vicinity Map, Figure 1) were installed at the site. The wells were each drilled, constructed, and completed in accordance with the guidelines of the Regional Water Quality Control Board (RWQCB) and the California Well Standards (per Bulletin 74-90).

The subsurface materials penetrated and details of the construction of the wells are described in the attached Boring Logs.

The two wells were each drilled to depths of 21 to 22 feet below grade and completed to total depths ranging from 19 to 22 feet below grade. Ground water was encountered during drilling at depths below grade ranging from 20 feet at MW10 to about 10.5 feet at MW11. Soil samples were taken for laboratory analysis and for lithologic logging purposes at a maximum spacing of 5 foot intervals, at significant changes in lithology, at obvious areas of contamination, and at or within the soil/ground water interface, beginning at a depth of approximately 4.5 feet below grade and continuing until ground water was encountered. Soil sampling conducted below the ground water table was for lithologic logging purposes only. The undisturbed soil samples were taken by driving a California-modified split-spoon sampler ahead of the drilling augers. The two-inch diameter brass liners holding the samples were sealed with aluminum foil, plastic caps and tape, and stored in a cooled ice chest for delivery to a certified laboratory. Each well casing was installed with a watertight cap and padlock. A round, watertight, flush-mounted well cover was cemented in place over each well casing.

The surface of each well cover was surveyed by Kier & Wright of Pleasanton, California, to MSL and to a vertical accuracy of 0.01 feet.

Wells MW10 and MW11 were developed on January 10, 1992. Prior to development, all wells were checked for depth to water table (by the use of an electronic sounder) and the presence of free product (by the use of an interface probe or paste tape). No free product was noted in any of the wells. After recording the monitoring data, wells MW10 and MW11 were each purged with a surface pump of 26 to 42 gallons (until the evacuated water was clear and reasonably free of suspended sediment). However, during development of well MW11, 18 gallons of drinking water were added for development

purposes, due to very poor recovery and well dewatering. Monitoring and well development data are summarized in Table 1.

All wells, except MW5, were sampled on February 6, 1992. Prior to sampling, monitoring data were collected, the wells were each purged of between 4 to 8.5 gallons, and water samples were then collected by the use of a clean Teflon bailer. Well MW5 was not sampled due to the presence of 0.01 feet of free product. MW5 was purged of two gallons of water and less than one ounce of product. Samples were decanted into clean VOA vials and/or one-liter amber bottles, as appropriate, then sealed with Teflon-lined screw caps and stored in a cooler, on ice, until delivery to a State certified laboratory.

ANALYTICAL RESULTS

Water samples from all wells (except MW5), and selected soil samples from borings of MW10 and MW11, were analyzed at Sequoia Analytical Laboratory in Concord, California. All samples analyzed were accompanied by properly executed Chain of Custody documentation. The samples were analyzed for TPH as gasoline by EPA method 5030 in conjunction with modified 8015, and BTX&E by EPA method 8020.

Analytical results of the soil samples collected from borings MW10 and MW11 indicated non-detectable levels of TPH as gasoline and BTX&E in all analyzed samples, except for 0.021 ppm of xylenes detected in sample MW10(5). Analytical results of the water samples collected from MW1, MW6, MW7, MW10, and MW11 indicated non-detectable levels of TPH as gasoline and BTX&E. TPH as gasoline was also non-detectable in well MW2. In wells MW3, MW4, MW8, and MW9, TPH as gasoline was detected at concentrations of 24,000 ppb, 5,700 ppb, 2,600 ppb, and 660 ppb, respectively. In wells MW2, MW3, MW4, MW8, and MW9, benzene was detected at levels of 0.36 ppb, 600 ppb, 2,200 ppb, 4.1 ppb, and 41 ppb, respectively. Well MW5 was not sampled due to the presence of free product. Results of the soil analyses are summarized in Table 3, and results of the water analyses are summarized in Table 2. The concentrations of TPH as gasoline and benzene detected in the ground water samples collected on February 6, 1992, are presented on the attached Site Vicinity Maps, Figures 1a and 1b, respectively. Copies of the laboratory analyses and Chain of Custody documentation are attached to this report.

HYDROLOGY AND GEOLOGY

The water table stabilized in all monitoring wells at depths ranging from 8.17 to 13.91 feet below the surface on the sampling date. The ground water flow direction appeared to vary between the

south and the southwest on February 6, 1992, with an average hydraulic gradient of approximately 0.027 (based on water level data collected from the monitoring wells prior to purging). The water levels in wells MW1 through MW9 have fluctuated since August 28, 1991, and show a net increase of 0.04 to 0.11 feet in wells MW1, MW2, MW3, MW5, MW6, and MW8, and a net decrease of 0.02 to 0.33 feet in wells MW4, MW7, and MW9.

Based on review of regional geologic maps (U.S. Geological Survey Miscellaneous Geologic Investigations Map I-239 "Areal and Engineering Geology of the Oakland West Quadrangle, California" by D.H. Radbruch, 1957), the site is underlain by Quaternary-age alluvium fan deposits (Temescal Formation), which typically consists of lenses of clayey gravel, sandy silty clay and sand-clay-silt mixtures.

The results of our subsurface studies indicate that the site and immediate vicinity are directly underlain by artificial fill materials that range in thickness from about 2 feet to just less than 6 feet. The fill materials are in turn underlain predominantly by clay soil materials that extend to depths below grade of approximately 5 feet at MW11 to about 11.5 feet at MW9. This predominant clayey zone contains a sand lens at MW4 and at MW10, and locally includes clayey silt. This clay zone is further underlain by a coarse-grained zone, varying from about 2 to 6.5 feet in thickness and extending to depths below grade of approximately 10 feet at MW6 and MW11 to approximately 15.5 feet below grade at MW5 and MW9. Generally, ground water was encountered within the coarse-grained zone at the time of drilling, except at MW6, MW10, and MW11, where ground water was not encountered until a depth below the base of this coarse-grained zone of less than 1 foot up to 8 feet. This coarse-grained zone is in turn underlain by clay and/or silt materials that extend to the maximum depths explored (20 to 22.5 feet below grade), except at MW1, MW10, and MW11, where a second coarse-grained zone (composed of clayey gravel or clayey to silty sand) extends to depths of about 19 to 20 feet below grade. At MW1, this second coarse-grained is less than 1 foot thick and is further underlain by silt. At MW10 and MW11, the thickness of this zone was not established.

DISCUSSION AND RECOMMENDATIONS

Based on the analytical results, KEI recommends the continuation of the monitoring and sampling program of the existing monitoring wells. Results of the monitoring program will be documented and evaluated after each monitoring and sampling event. Recommendations for altering or terminating the program will be made as warranted.

Proposed well MW12 has not been installed because the City of Oakland Encroachment permit has not yet been approved (as of the date of this report). Based on review of the current analytical data, it appears that the ground water contaminant plume is reasonably well defined, except at the area of proposed well MW12.

KEI therefore recommends the installation of a six-inch diameter recovery well, followed by a subsequent pump test of the aquifer. Our work plan/proposal for this work is attached for your review and consideration. The data collected during the pump test will be used to determine if an additional recovery well(s) will be necessary to hydraulically control and remediate the contaminant plume. This data will also be used in the design of a ground water remediation system for the site.

DISTRIBUTION

A copy of this report should be sent to Mr. Gil Wistar of the Alameda County Health Care Services Agency, and to Mr. Lester Feldman of the Regional Water Quality Control Board, San Francisco Bay Region.

LIMITATIONS

Soil deposits and rock formations may vary in thickness, lithology, saturation, strength and other properties across any site. In addition, environmental changes, either naturally-occurring or artificially-induced, may cause changes in the extent and concentration of any contaminants. Our studies assume that the field and laboratory data are reasonably representative of the site as a whole, and assume that subsurface conditions are reasonably conducive to interpolation and extrapolation.

The results of this study are based on the data obtained from the field and laboratory analyses obtained from a State certified laboratory. We have analyzed this data using what we believe to be currently applicable engineering techniques and principles in the Northern California region. We make no warranty, either expressed or implied, regarding the above, including laboratory analyses, except that our services have been performed in accordance with generally accepted professional principles and practices existing for such work.

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Should you have any questions regarding this report, please do not hesitate to call me at (707) 746-6915.

Sincerely,

Kaprealian Engineering, Inc.



Thomas J. Berkins
Senior Environmental Engineer



Don R. Braun
Certified Engineering Geologist

License No. 1310
Exp. Date 6/30/92



Timothy R. Ross
Project Manager

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Attachments: Tables 1 through 8
Location Map
Site Vicinity Maps - Figures 1, 1a & 1b
Site Plan - Figure 2
Boring Logs
Laboratory Analyses
Chain of Custody documentation
Work Plan/Proposal

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TABLE 1

SUMMARY OF GROUND WATER MONITORING AND PURGING DATA

<u>Well #</u>	<u>Ground Water Elevation (feet)</u>	<u>Depth to Water (feet)</u>	<u>Product Thickness</u>	<u>Sheen</u>	<u>Gallons Pumped</u>	<u>Product Purged (ounces)</u>
(Monitored and Sampled on February 6, 1992)						
MW1	72.55	8.52	0	No	8	0
MW2	71.78	9.84	0	No	7.5	0
MW3	71.58	10.43	0	No	8.5	0
MW4	71.07	10.41	0	No	7	0
MW5	71.43	10.16	0.01	N/A	2	<1
MW6	72.30	8.17	0	No	8.5	0
MW7	72.74	9.09	0	No	7	0
MW8	70.27	11.44	0	No	8	0
MW9	69.92	11.21	0	No	8	0
MW10	67.99	13.91	0	No	6	0
MW11	66.33	12.10	0	No	4	0

(Monitored on January 21, 1992)

MW1	72.44	8.63	0	--	0	0
MW2	71.65	9.97	0	--	0	0
MW3	71.39	10.62	0	--	35	0
MW4	70.85	10.63	0	--	0	0
MW5	71.24	10.35	Trace	N/A	35	0
MW6	72.15	8.32	0	--	0	0
MW7	72.62	9.21	0	--	0	0
MW8	70.09	11.62	0	--	35	0
MW9	69.76	11.37	0	--	0	0
MW10	67.80	14.10	0	--	0	0
MW11	66.08	12.35	0	--	0	0

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TABLE 1 (Continued)

SUMMARY OF GROUND WATER MONITORING AND PURGING DATA

<u>Well #</u>	<u>Ground Water Elevation (feet)</u>	<u>Depth to Water (feet)</u>	<u>Product Thickness</u>	<u>Sheen</u>	<u>Gallons Pumped</u>	<u>Product Purged (ounces)</u>
(Monitored and Developed on January 10, 1992)						
MW1*	73.07	8.00	0	--	0	0
MW2*	72.35	9.27	0	--	0	0
MW3*	72.30	9.71	0	--	0	0
MW4*	70.54	10.94	0	--	0	0
MW5*	72.18	9.41	0	--	0	0
MW6*	72.85	7.62	0	--	0	0
MW7*	73.02	8.81	0	--	0	0
MW8*	71.19	10.52	0	--	0	0
MW9*	70.83	10.30	0	--	0	0
MW10	68.05	13.85	0	--	42	0
MW11	64.25	14.18	0	--	26♦	0
(Monitored on January 6, 1992)						
MW3	72.30	9.71	0	--	35	0
MW5	72.15	9.44	0	--	35	0
MW8	71.47	10.24	0	--	35	0
(Monitored on December 17, 1991)						
MW1	72.15	8.92	0	--	0	0
MW2	71.03	10.59	0	--	0	0
MW3	71.09	10.92	0	--	22	0
MW4	69.63	11.85	0	--	8	0
MW5	70.91	10.68	0	--	35	0
MW6	71.89	8.58	0	--	0	0
MW7	72.36	9.47	0	--	0	0
MW8	69.66	12.05	0	--	20	0
MW9	69.19	11.94	0	--	0	0

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TABLE 1 (Continued)

SUMMARY OF GROUND WATER MONITORING AND PURGING DATA

<u>Well #</u>	<u>Ground Water Elevation (feet)</u>	<u>Depth to Water (feet)</u>	<u>Product Thickness</u>	<u>Sheen</u>	<u>Gallons Pumped</u>	<u>Product Purged (ounces)</u>
(Monitored on December 3, 1991)						
MW3	71.14	10.87	0	--	34	0
MW4	69.43	12.05	0	--	6.5	0
MW5	70.97	10.62	0	--	35	0
MW8	66.48	11.94	0	--	23	0

<u>Well #</u>	<u>Surface Elevation** (feet)</u>
MW1	81.07
MW2	81.62
MW3	82.01
MW4	81.48
MW5	81.59
MW6	80.47
MW7	81.83
MW8	81.71
MW9	81.13
MW10	81.90
MW11	78.43

-- Sheen determination was not performed.

* Monitored only.

** Elevations of the tops of the well covers have been surveyed relative to mean sea level.

◆ Includes 18 gallons of drinking quality water added to facilitate well development.

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TABLE 2

SUMMARY OF LABORATORY ANALYSES
 WATER

<u>Date</u>	<u>Well #</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethylbenzene</u>	
2/06/92	MW1	ND	ND	ND	ND	ND	
	MW2	ND	0.36	0.66	0.62	ND	
	MW3	24,000	600	1,800	5,800	1,200	
	MW4	5,700	2,200	140	980	57	
	MW5	NOT SAMPLED DUE TO PRESENCE OF FREE PRODUCT					
	MW6	ND	ND	ND	ND	ND	
	MW7	ND	ND	ND	ND	ND	
	MW8	2,600	4.1	7.0	93	31	
	MW9	660	41	1.0	15	33	
	MW10	ND	ND	ND	ND	ND	
	MW11	ND	ND	ND	ND	ND	
11/19/91	MW1	ND	ND	ND	ND	ND	
	MW2	ND	ND	ND	ND	ND	
	MW3	22,000	250	440	3,000	660	
	MW4	55	9.2	4.5	6.7	1.4	
	MW5	NOT SAMPLED DUE TO PRESENCE OF FREE PRODUCT					
	MW6	ND	ND	ND	ND	ND	
	MW7	32	ND	ND	ND	ND	
	MW8	1,600	8.1	1.8	52	19	
	MW9	360	17	0.45	11	15	
8/28/91	MW1	ND	ND	ND	ND	ND	
	MW2	ND	ND	ND	ND	ND	
	MW3	16,000	650	2,200	5,400	1,100	
	MW4	2,000	1,500	20	300	120	
	MW5	NOT SAMPLED DUE TO PRESENCE OF FREE PRODUCT					
	MW6	ND	ND	ND	ND	ND	
	MW7	ND	ND	ND	ND	ND	
	MW8	1,800	3.2	1.9	74	19	
	MW9	450	17	0.9	14	13	
5/28/91	MW1	ND	ND	ND	ND	ND	
	MW2	ND	ND	ND	ND	ND	
	MW3	24,000	570	1,100	4,200	810	
	MW4	38	ND	ND	1.9	ND	
	MW5	24,000	2,300	3,400	6,000	1,300	
	MW6	ND	ND	ND	0.42	ND	
	MW7	39	ND	ND	0.73	ND	
	MW8	4,800	4.2	1.3	170	5.1	
	MW9	590	6.0	0.43	1.4	6.8	

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TABLE 2 (Continued)

SUMMARY OF LABORATORY ANALYSES
 WATER

<u>Date</u>	<u>Well #</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl- benzene</u>
2/25/91	MW1	ND	ND	ND	ND	ND
	MW2	ND	0.68	0.42	0.86	ND
	MW3	37,000	730	2,900	7,300	1,300
	MW4	22,000	600	1,300	2,800	780
	MW5	25,000	950	1,300	3,500	900
	MW6	ND	0.37	0.40	1.5	0.35
	MW7	70	ND	ND	0.52	ND
	MW8	5,300	17	6.1	300	53
	MW9	390	13	1.1	14	2.8
11/07/90	MW1	45	ND	ND	ND	ND
	MW2	ND	ND	ND	ND	ND
	MW3	42,000	1,400	5,000	7,500	1,800
	MW4	180	1.5	0.37	26	6.3
	MW5	20,000	640	1,100	3,000	670
	MW6	ND	ND	ND	ND	ND
	MW7	ND	ND	ND	ND	ND
	MW8	4,700	28	38	7,200	86
	MW9	480	7.8	1.2	47	13
8/16/90	MW1	ND	ND	ND	ND	ND
	MW2	ND	ND	6.7	ND	ND
	MW3	6,800	600	660	160	760
	MW4	3,600	480	17	260	230
	MW5	16,000	1,400	1,900	660	2,800
2/15/90	MW1	170	7.9	ND	2.8	2.2
	MW2	ND	ND	ND	ND	ND
	MW3	20,000	1,700	2,100	3,100	750
	MW4	150	8.0	8.0	45	10
	MW5	24,000	1,500	1,700	3,600	260

KEI-P89-0805.R7
March 9, 1992

TABLE 2 (Continued)

SUMMARY OF LABORATORY ANALYSES
WATER

<u>Date</u>	<u>Well #</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl- benzene</u>
11/01/89	MW1	ND	ND	ND	0.30	ND
	MW2	200	ND	ND	1.2	3.0
	MW3	13,000	57	48	120	1.7
Detection Limits		30	0.30	0.30	0.30	0.30

ND = Non-detectable.

-- Indicates analysis not performed.

Results in parts per billion (ppb), unless otherwise indicated.

KEI-P89-0805.R7
March 9, 1992

TABLE 3
SUMMARY OF LABORATORY ANALYSES
SOIL

<u>Date</u>	<u>Sample Number</u>	<u>Depth (feet)</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl-benzene</u>
1/07/92	MW10(5)	5.0	ND	ND	ND	0.021	ND
	MW10(7)	7.0	ND	ND	ND	ND	ND
	MW10(11.5)	11.5	ND	ND	ND	ND	ND
	MW10(14.5)	14.5	ND	ND	ND	ND	ND
	MW10(19.5)	19.5	ND	ND	ND	ND	ND
	MW11(5)	5.0	ND	ND	ND	ND	ND
	MW11(10)	10.0	ND	ND	ND	ND	ND
	MW11(12.5)	12.5	ND	ND	ND	ND	ND
Detection Limits		1.0	0.0050	0.0050	0.0050	0.0050	

ND = Non-detectable.

Results in parts per million (ppm), unless otherwise indicated.

KEI-P89-0805.R7
March 9, 1992

TABLE 4

SUMMARY OF WELL RECOVERY DATA

(Measured on October 22, 1991)

<u>Well #</u>	<u>Average Flow Rate (gpm)</u>	<u>Casing Volume (gallons)</u>	<u>Amount Purged (gallons)</u>	<u>Purged Casing Volume</u>	<u>Recovery (%)</u>	<u>Recovery Time (hours)</u>
MW3	0.79	1.97	15	7.62	50	0.07
					70	0.11
					90	0.23
					95	0.33
					99	0.73
MW5	1.68	1.62	47	29.1	60	0.03
					70	0.08
					80	0.13
					90	0.53
					95	1.33
96	1.58					
MW8	1.08	1.66	14	8.43	50	0.06
					70	0.11
					90	0.19
					97	0.43
MW9	1.11	1.88	30	15.93	50	0.02
					70	0.05
					90	0.08
					95	0.16
					99	0.50

KEI-P89-0805.R7
 March 9, 1992

TABLE 5
 SUMMARY OF LABORATORY ANALYSES
 SOIL

<u>Date</u>	<u>Sample Number</u>	<u>Depth (feet)</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl-benzene</u>	
10/17/89	MW1 (5)	5.0	8.5	ND	ND	0.14	ND	
	MW1 (10)	10.0	ND	ND	ND	ND	ND	
	MW2 (5)	5.0	ND	ND	ND	ND	ND	
	MW2 (10)	10.0	ND	ND	ND	ND	ND	
	MW2 (12.5)	12.5	ND	ND	ND	ND	ND	
	MW3 (5)	5.0	3.1	0.068	ND	ND	ND	
	MW3 (10)	10.0	69	0.89	2.6	7.9	2.0	
	MW3 (11)	11.0	1,100	16	85	150	35	
	1/26/90	MW4 (5)	5.0	22	0.059	ND	ND	ND
MW4 (7)		7.0	2.5	ND	ND	ND	ND	
MW4 (10)		10.0	250	1.2	0.66	20	1.4	
MW4 (11)		11.0	280	1.0	4.0	36	7.6	
MW5 (5)		5.0	25	0.21	ND	ND	ND	
MW5 (7.5)		7.5	46	0.25	0.28	0.20	0.46	
MW5 (10)		10.0	140	1.5	1.7	10	4.0	
MW5 (11.5)		11.5	370	1.8	14	51	11	
Detection Limits			1.0	0.05	0.1	0.1	0.1	

ND = Non-detectable.

Results in parts per million (ppm), unless otherwise indicated.

KEI-P89-0805.R7
March 9, 1992

TABLE 6
SUMMARY OF LABORATORY ANALYSES
SOIL

<u>Date</u>	<u>Sample Number</u>	<u>Depth (feet)</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl-benzene</u>	
10/23/90	MW6(5)	5.0	ND	ND	ND	ND	ND	
	MW6(9)	9.0	ND	ND	ND	0.010	ND	
	MW6(11.5)	11.5	ND	ND	ND	ND	ND	
	MW7(5)	5.0	11	ND	ND	0.032	0.0064	
	MW7(8.5)	8.5	ND	ND	ND	0.019	ND	
	MW7(11.5)	11.5	ND	ND	ND	0.036	ND	
	MW8(5)	5.0	ND	ND	ND	ND	ND	
	MW8(10)	10.0	ND	ND	ND	0.0080	ND	
	MW9(5.5)	5.5	ND	ND	ND	ND	ND	
	MW9(10)	10.0	84	0.32	0.27	0.51	0.63	
	MW9(12)	12.0	120	0.19	0.11	0.69	0.14	
	Detection Limits			1.0	0.0050	0.0050	0.0050	0.0050

ND = Non-detectable.

Results in parts per million (ppm), unless otherwise indicated.

KEI-P89-0805.R7
March 9, 1992

TABLE 7

SUMMARY OF LABORATORY ANALYSES
SOIL

(Collected on August 16, 17, 18 & 24, 1989)

<u>Sample #</u>	<u>Depth (feet)</u>	<u>TPH as Diesel</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethyl- benzene</u>
SW1	9.5	--	13	ND	0.13	0.39	0.15
SW2	9.5	--	290	0.82	8.7	44	7.6
SW2 (R)	9.5	--	ND	ND	ND	ND	ND
SW3	9.5	--	ND	ND	ND	ND	ND
SW4	9.5	--	ND	ND	ND	ND	ND
SW5	9.5	--	ND	ND	ND	ND	ND
SW6	9.5	--	ND	ND	ND	ND	ND
P1	6.5	--	6.1	ND	ND	ND	ND
P2	6.5	--	36	0.52	4.4	8.0	1.4
P3	5.0	--	20	0.30	2.5	5.6	1.1
P4	5.0	--	3.8	0.11	0.19	0.23	0.1
WO1*	8.0	ND	1.6	ND	1.3	ND	ND
Detection Limits		1.0	1.0	0.05	0.1	0.1	0.1

* TOG and all EPA method 8010 constituents were non-detectable.

-- Indicates analysis not performed.

ND = Non-detectable.

Results in parts per million (ppm), unless otherwise indicated.

KEI-P89-0805.R7
March 9, 1992

TABLE 8

SUMMARY OF LABORATORY ANALYSES
WATER

<u>Date</u>	<u>Sample #</u>	<u>TPH as Gasoline</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Xylenes</u>	<u>Ethylbenzene</u>
8/17/89	W1	4,700	180	420	860	150
8/24/89	W2*	1,200	12	10	88	5.9
Detection Limits		30	0.30	0.30	0.30	0.30

* Sample (W2) was collected after pumping 5,000 gallons of ground water from the fuel tank pit.

Results in parts per billion (ppb), unless otherwise indicated.



KAPREALIAN ENGINEERING, INC.
Consulting Engineers

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(707) 746-6915 • (707) 746-6916 • FAX: (707) 746-5581



LOCATION MAP

Unocal S/S #0746
3943 Broadway
Oakland, CA

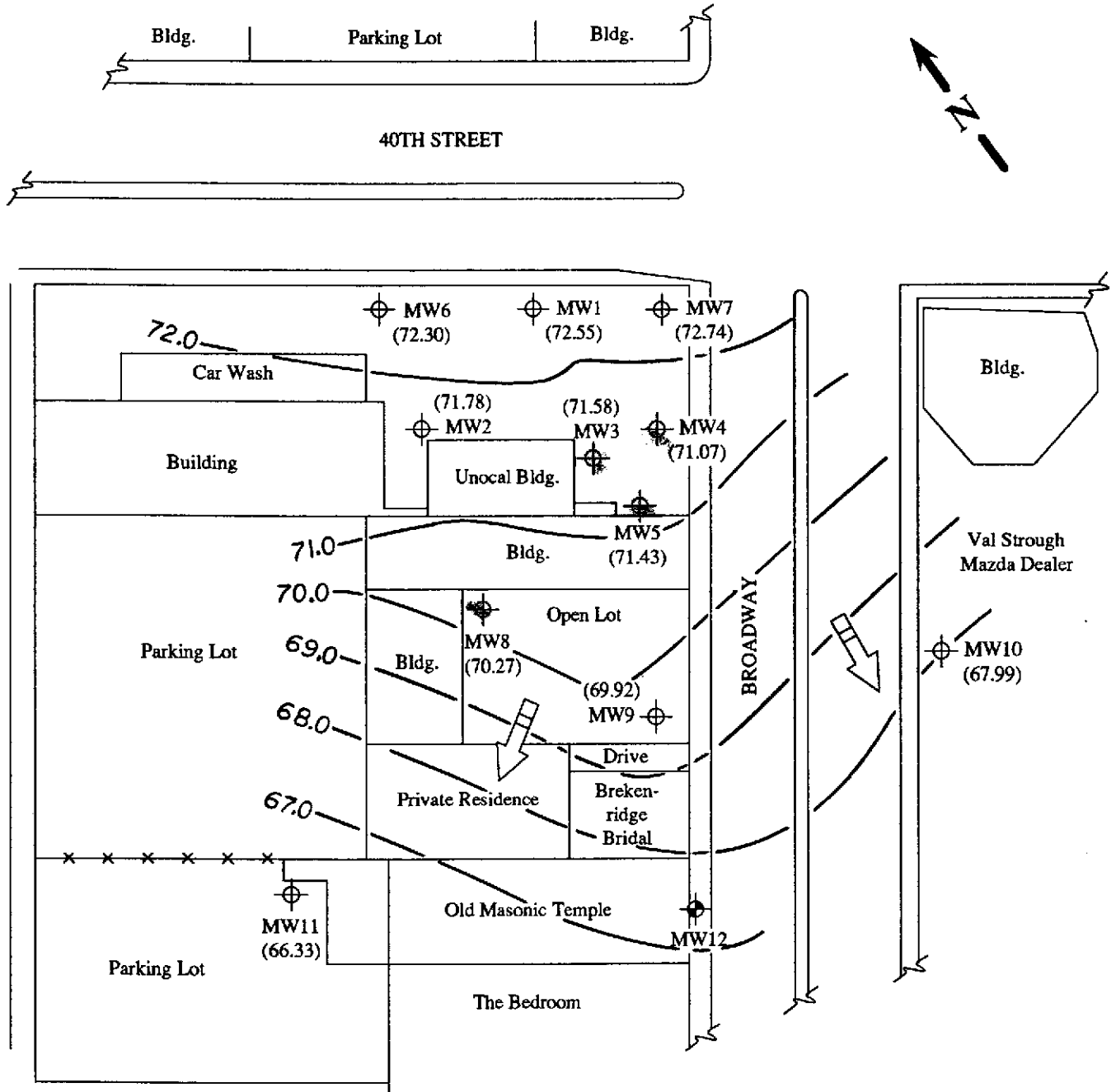


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LEGEND

- Monitoring well (existing)
- Monitoring well (previously proposed)
- () Ground water elevation in feet above Mean Sea Level on 2/6/92
- Direction of ground water flow
- Contours of ground water elevation

SITE VICINITY MAP

Figure 1

0 60 120
 Approx. scale feet

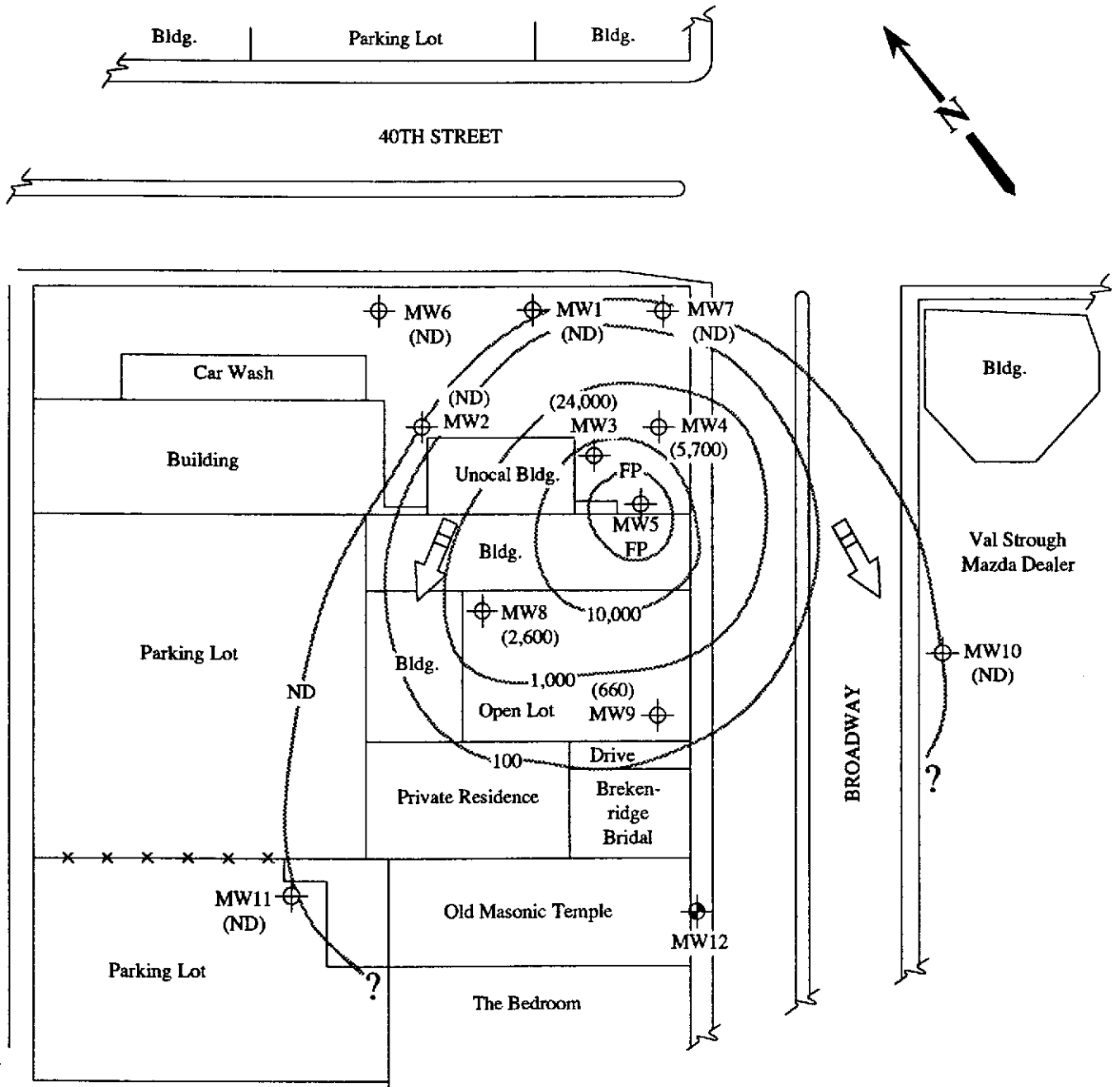
Unocal Service Station #0746
 3943 Broadway
 Oakland, CA



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LEGEND

- ⊕ Monitoring well (existing)
- ⊙ Monitoring well (previously proposed)
- () Concentration of TPH as gasoline in ppb
- ➡ Direction of ground water flow
- Approximate iso-concentration contours of TPH as gasoline contamination in ground water

ND = Non-detectable

FP = Free product

SITE VICINITY MAP

Figure 1a
 (Samples Collected on 2/6/92)



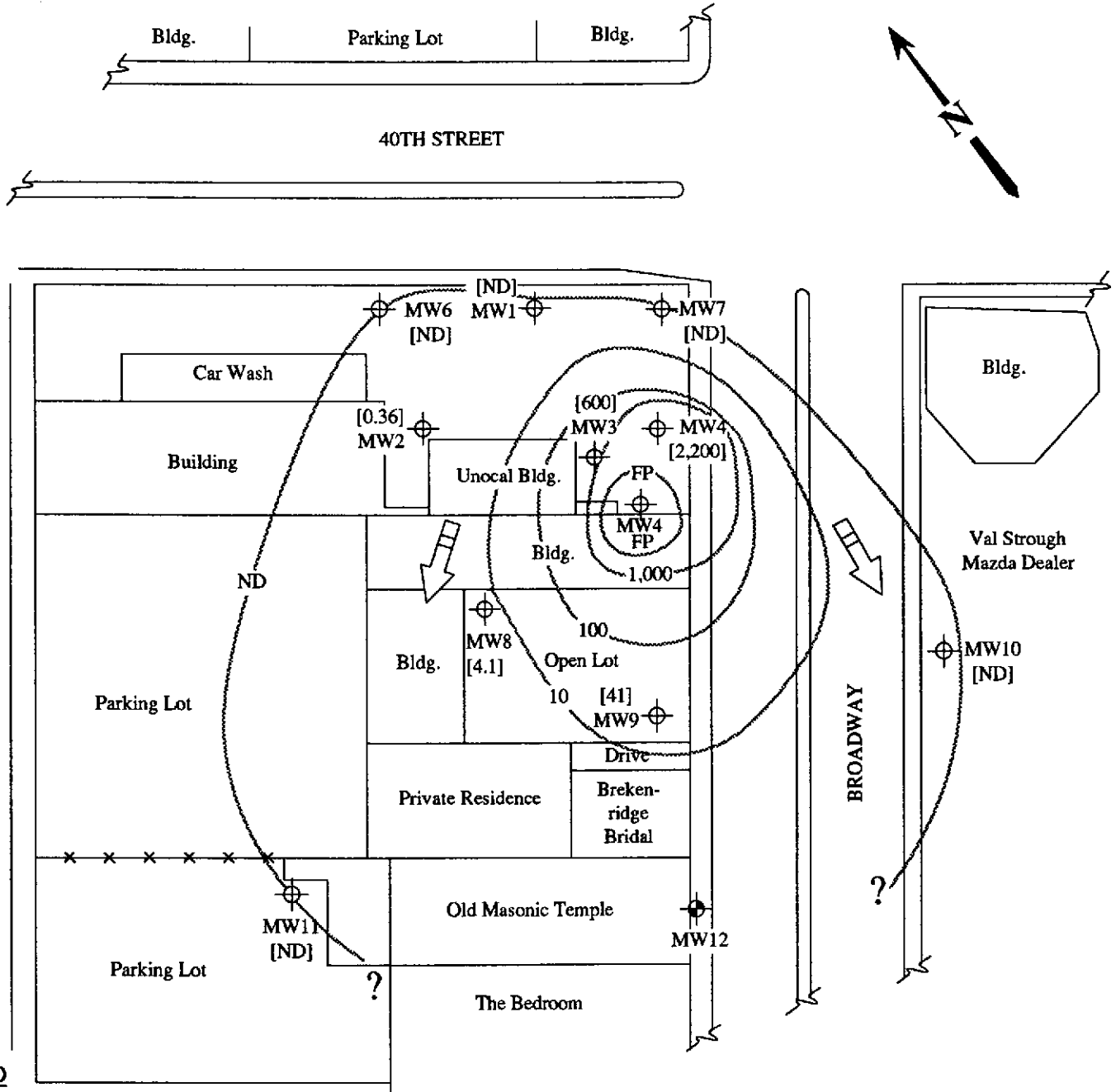
Unocal Service Station #0746
 3943 Broadway
 Oakland, CA



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LEGEND

- ⊕ Monitoring well (existing)
- ⊙ Monitoring well (previously proposed)
- [] Concentration of benzene in ppb
- ➡ Direction of ground water flow
- Approximate iso-concentration contours of benzene contamination in ground water

ND = Non-detectable

FP = Free product

SITE VICINITY MAP

Figure 1b
 (Samples Collected on 2/6/92)



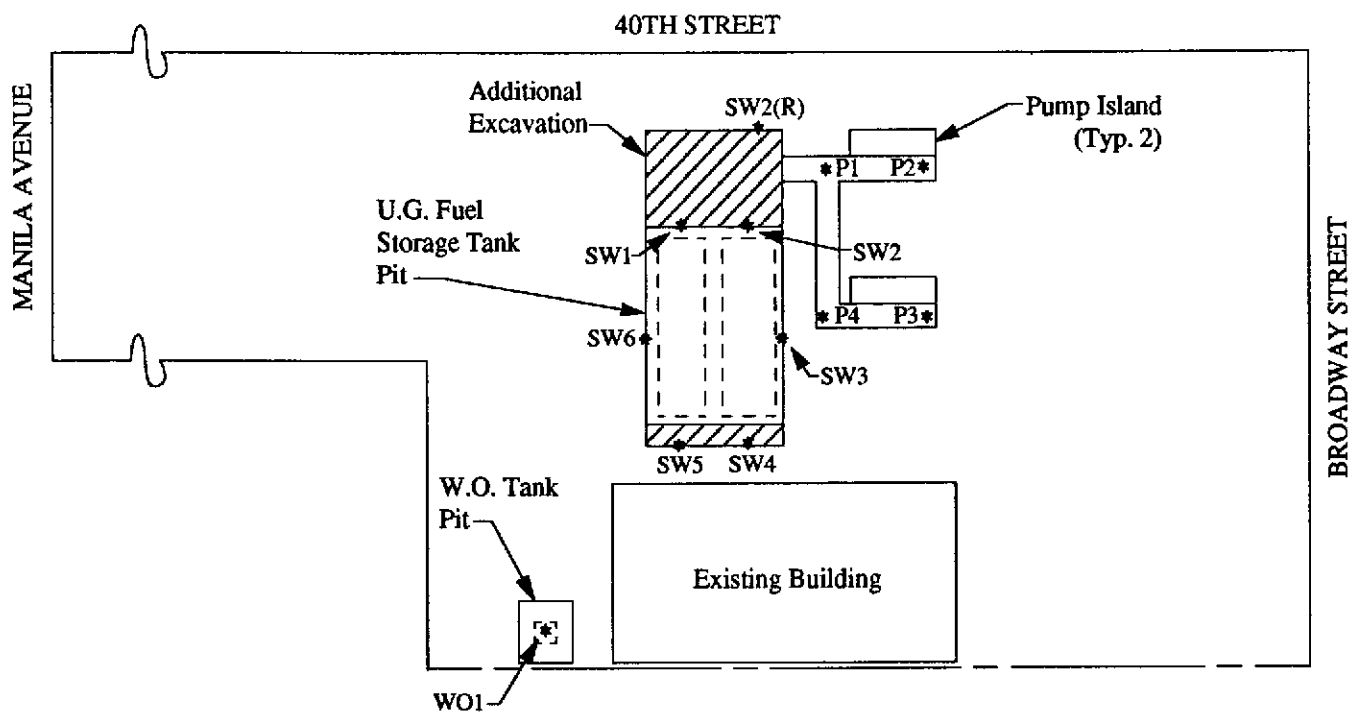
Unocal Service Station #0746
 3943 Broadway
 Oakland, CA



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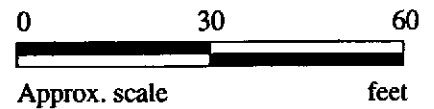


SITE PLAN

Figure 2

LEGEND

- * Sample Point Location



Unocal Service Station #0746
3943 Broadway Street
Oakland, CA



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Consulting Engineers


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MAJOR DIVISIONS	SYMBOLS	TYPICAL SOIL DESCRIPTIONS
<p>GRAVELS</p> <p>(More than 1/2 of coarse fraction > No. 4 sieve size)</p>	GW	Well graded gravels or gravel - sand mixtures, little or no fines
	GP	Poorly graded gravels or gravel - sand mixtures, little or no fines
	GM	Silty gravels, gravel - sand - silt mixtures
	GC	Clayey gravels, gravel - sand - clay mixtures
<p>SANDS</p> <p>(More than 1/2 of coarse fraction < No. 4 sieve size)</p>	SW	Well graded sands or gravelly sands, little or no fines
	SP	Poorly graded sands or gravelly sands, little or no fines
	SM	Silty sands, sand - silt mixtures
	SC	Clayey sands, sand - clay mixtures
<p>SILTS & CLAYS</p> <p>LL < 50</p>	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
<p>SILTS & CLAYS</p> <p>LL > 50</p>	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils
DUAL (TRANSITION) SOILS		Soil characteristics are transitional between the soil classifications listed above

CLASSIFICATION CHART (Unified Soil Classification System)

BORING LOG

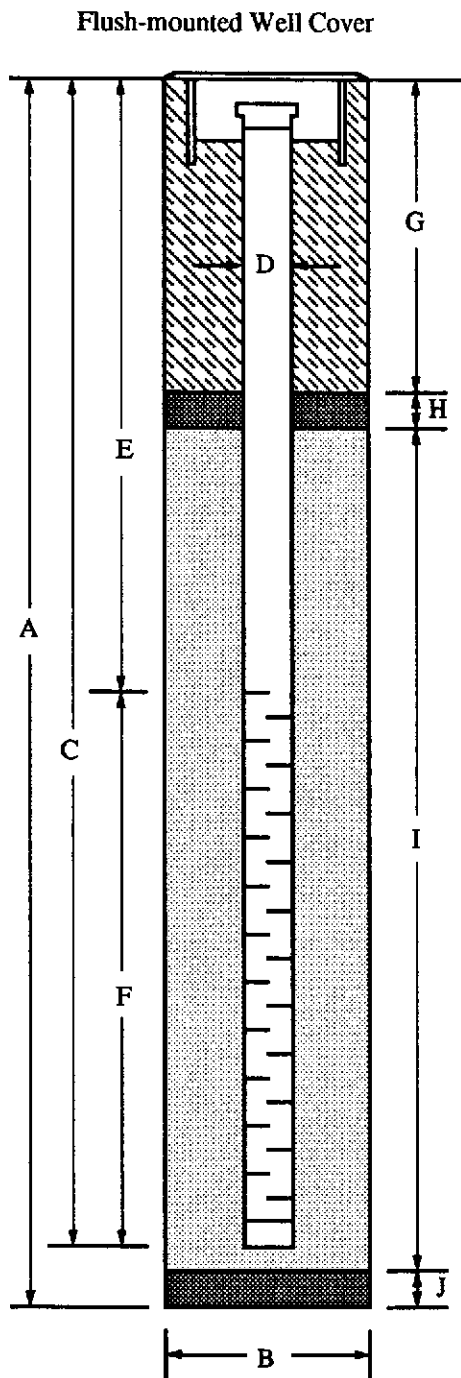
Project No. KEI-P89-0805		Boring & Casing Diameter 9" 2"		Logged By D.L.
Project Name Unocal Oakland, Broadway		Well Cover Elevation		Date Drilled 1/7/92
Boring No. MW10		Drilling Method Hollow-stem Auger	Drilling Company Woodward Drilling	
Penetration blows/6"	G. W. level	Depth (feet) Samples	Strati- graphy USCS	Description
		0		Asphalt pavement over sand and gravel.
				Silty clay with minor sand, stiff, moist, dark greenish gray and black mottled (fill).
				Clayey sand with gravel, very stiff, moist, brown, pocketed with silty clay as above (fill).
8/11/14		5	SM	Silty sand with gravel, estimated at 5 to 10% clay content, gravel is angular to rounded, to 3/4" diameter, medium dense, moist, brown.
11/12/14				
6/11/19			CH	Sandy clay, variable clay content estimated at 15 to 30%, trace gravel below 9', very stiff, moist, olive brown,
7/16/24		10	GC	Clayey gravel with sand, gravel to 1" diameter, some gravel is decomposed, medium dense to dense, moist, dark yellowish brown.
11/17/32				
11/17/32		15	CL	Gravelly clay with sand, gravel to 3/4" diameter, hard, moist, brown. <hr/> Clay with silt and trace sand, clay is slickensided, hard, moist, olive.
13/20/20				<hr/> Sandy clay with trace gravel, very stiff, moist, pale olive.
7/11/17		20	ML	Silty clay with organic matter, very stiff to hard, moist, pale olive, locally grades to clayey silt.
			SC	Sandy silt, stiff, moist, olive brown.
				Clayey sand, est. at 15 to 20% clay, med. dense, moist, olive brown, lenses of well graded sand, gravel at 20'. TOTAL DEPTH: 22'

WELL COMPLETION DIAGRAM

PROJECT NAME: Unocal - Oakland, Broadway WELL NO. MW10

PROJECT NUMBER: KEI-P89-0805

WELL PERMIT NO.: ACFD&WCD 91219



- A. Total Depth : 22'
- B. Boring Diameter* : 9"
- Drilling Method: Hollow Stem Auger
- C. Casing Length: 22'
- Material: Schedule 40 PVC
- D. Casing Diameter: OD = 2.375"
ID = 2.067"
- E. Depth to Perforations: 6'
- F. Perforated Length: 16'
- Perforation Type: Machined Slot
- Perforation Size: 0.010"
- G. Surface Seal: 2'
- Seal Material: Neat Cement
- H. Seal: 2'
- Seal Material: Bentonite
- I. Filter Pack: 18'
- Pack Material: RMC Lonestar Sand
- Size: #2/16
- J. Bottom Seal: none
- Seal Material: N/A

* Boring diameter can vary from 8-1/4" to 9" depending on bit wear.

BORING LOG

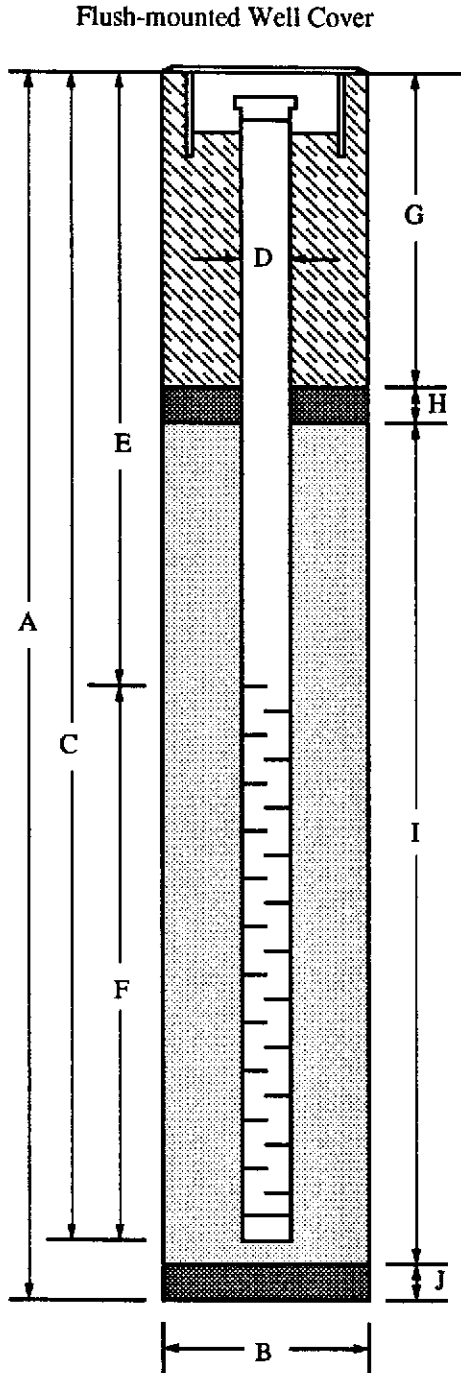
Project No. KEI-P89-0805		Boring & Casing Diameter 9" 2"		Logged By D.L.	
Project Name Unocal Oakland, Broadway		Well Cover Elevation		Date Drilled 1/7/92	
Boring No. MW11		Drilling Method Hollow-stem Auger		Drilling Company Woodward Drilling	
Penetration blows/6"	G. W. level	Depth (feet) Samples	Strati- graphy USCS	Description	
		0		Asphalt pavement over sand and gravel.	
				Silty gravel with sand, bricks and concrete, dense, moist to very moist, black (fill).	
9/14/19		5	CH	Sandy clay, estimated at 5 to 10% gravel to 1-1/4" diameter, very stiff, very moist, very dark grayish brown.	
			SC	Clayey sand with gravel, estimated at 15 to 20% clay, sand is coarse- to fine-grained, dense, moist, very dark grayish brown and dark brown, mottled.	
5/11/14		10	GC	Clayey gravel with sand, angular gravel to 1-1/2" diameter, medium dense, moist to very moist, dark greenish gray and olive brown.	
4/8/14	▽			Clay, high plasticity, trace silt and sand, stiff to very stiff, moist, olive brown and dark yellowish brown.	
6/13/29		15	CH	Silty clay with trace organic matter, very stiff to hard, moist, olive and olive brown mottled.	
13/16/21				Clay, with trace organic matter, slickensided, very stiff to hard, moist, olive and olive brown mottled.	
9/17/28		20	SW/ SM	Well graded sand with silt and gravel, estimated at 15 to 20% gravel to 1/4" diameter, medium dense to dense, wet, dark yellowish brown. TOTAL DEPTH: 21'	

WELL COMPLETION DIAGRAM

PROJECT NAME: Unocal - Oakland, Broadway WELL NO. MW11

PROJECT NUMBER: KEI-P89-0805

WELL PERMIT NO.: ACFD&WCD 91219



- A. Total Depth : 21'
- B. Boring Diameter* : 9"
Drilling Method: Hollow Stem Auger
- C. Casing Length: 19'
Material: Schedule 40 PVC
- D. Casing Diameter: OD = 2.375"
ID = 2.067"
- E. Depth to Perforations: 5'
- F. Perforated Length: 14'
Perforation Type: Machined Slot
Perforation Size: 0.010"
- G. Surface Seal: 2'
Seal Material: Neat Cement
- H. Seal: 2'
Seal Material: Bentonite
- I. Filter Pack: 15'
Pack Material: RMC Lonestar Sand
Size: #2/16
- J. Bottom Seal: 2'
Seal Material: Bentonite

* Boring diameter can vary from 8-1/4" to 9" depending on bit wear.



SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(510) 686-9600 • FAX (510) 686-9689

Kaprealian Engineering, Inc.	Client Project ID: Unocal/ 3943 Broadway, Oakland	Sampled: Feb 6, 1992
P.O. Box 996	Matrix Descript: Water	Received: Feb 6, 1992
Benicia, CA 94510	Analysis Method: EPA 5030/8015/8020	Analyzed: Feb 10, 1992
Attention: Mardo Kaprealian, P.E.	First Sample #: 202-0315	Reported: Feb 18, 1992

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons	Benzene	Toluene	Ethyl Benzene	Xylenes
		$\mu\text{g/L}$ (ppb)	$\mu\text{g/L}$ (ppb)	$\mu\text{g/L}$ (ppb)	$\mu\text{g/L}$ (ppb)	$\mu\text{g/L}$ (ppb)
202-0315	MW-1	N.D.	N.D.	N.D.	N.D.	N.D.
202-0316	MW-2	N.D.	0.36	0.66	N.D.	0.62
202-0317	MW-3	24,000	600	1,800	1,200	5,800
202-0318	MW-4	5,700	2,200	140	57	980
202-0319	MW-6	N.D.	N.D.	N.D.	N.D.	N.D.
202-0320	MW-7	N.D.	N.D.	N.D.	N.D.	N.D.
202-0321	MW-8	2,600	4.1	7.0	31	93
202-0322	MW-9	660	41	1.0	33	15
202-0323	MW-10	N.D.	N.D.	N.D.	N.D.	N.D.
202-0324	MW-11	N.D.	N.D.	N.D.	N.D.	N.D.

Method Detection Limits:	30	0.30	0.30	0.30	0.30
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Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director



SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(510) 686-9600 • FAX (510) 686-9689

Kaprealian Engineering, Inc.
P.O. Box 996
Benicia, CA 94510

Client Project ID: Unocal/ 3943 Broadway, Oakland

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2020315-0324

Reported: Feb 18, 1992

QUALITY CONTROL DATA REPORT

SURROGATE

	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Method:	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020
Analyst:	K.N.	K.N.	K.N.	K.N.	K.N.	K.N.	K.N.
Reporting Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992
Sample #:	202-0315	202-0316	202-0317	202-0318	202-0319	202-0320	202-0321

Surrogate							
% Recovery:	110	110	110	94	110	110	85

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$



SEQUOIA ANALYTICAL

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Client Project ID: Unocal/ 3943 Broadway, Oakland

P.O. Box 996

Benicia, CA 94510

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2020315-0324

Reported: Feb 18, 1992

QUALITY CONTROL DATA REPORT

SURROGATE

	EPA	EPA	EPA	EPA
Method:	8015/8020	8015/8020	8015/8020	8015/8020
Analyst:	K.N.	K.N.	K.N.	K.N.
Reporting Units:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992
Sample #:	202-0322	202-0323	202-0324	Blank

Surrogate				
% Recovery:	110	100	98	110

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$

2020315.KEI <3>



SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(510) 686-9600 • FAX (510) 686-9689

Kaprealian Engineering, Inc.
P.O. Box 996
Benicia, CA 94510

Client Project ID: Unocal/ 3943 Broadway, Oakland

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2020315-0324

Reported: Feb 18, 1992

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl- Benzene	Xylenes
	EPA	EPA	EPA	EPA
Method:	8015/8020	8015/8020	8015/8020	8015/8020
Analyst:	K.E./K.N./J.F.	K.E./K.N./J.F.	K.E./K.N./J.F.	K.E./K.N./J.F.
Reporting Units:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992	Feb 10, 1992
QC Sample #:	Matrix Blank	Matrix Blank	Matrix Blank	Matrix Blank
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	20	20	20	60
Conc. Matrix Spike:	21	21	22	67
Matrix Spike % Recovery:	105	105	110	111
Conc. Matrix Spike Dup.:	19	19	20	61
Matrix Spike Duplicate % Recovery:	95	95	100	102
Relative % Difference:	10	10	9.5	9.4

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$



KAPREALIAN ENGINEERING, INC.

CHAIN OF CUSTODY

SAMPLER JOE		SITE NAME & ADDRESS Unocal/Oakland 3943 Broadway					ANALYSES REQUESTED			TURN AROUND TIME: Regular
WITNESSING AGENCY							TPHG, BTXE	REMARKS		
SAMPLE ID NO.	DATE	TIME	SOIL	WATER	GRAB	COMP		NO. OF CONT.	SAMPLING LOCATION	
MW-1	2/6/92			✓	✓			2	MW	✓ 2020315AB
MW-2	"			✓	✓			"	"	✓ 2020316AB
MW-3	"	P.M. 3:45		✓	✓			"	"	✓ 2020317AB
MW-4	"			✓	✓			"	"	✓ 2020318AB
MW-6	"			✓	✓			"	"	✓ 2020319AB
MW-7	"			✓	✓			"	"	✓ 2020320AB
MW-8	"	A.M. 10:45		✓	✓			"	"	✓ 2020321AB
MW-9	"			✓	✓			"	"	✓ 2020322AB
MW-10	"			✓	✓			"	"	✓ 2020323AB
Relinquished by: (Signature) <i>See Quisen</i>		Date/Time 2/6/92	Received by: (Signature) <i>A. Wagner</i>		The following MUST BE completed by the laboratory accepting samples for analysis: 1. Have all samples received for analysis been stored in ice? <u>YES</u> 2. Will samples remain refrigerated until analyzed? <u>YES</u> 3. Did any samples received for analysis have head space? <u>NO</u> 4. Were samples in appropriate containers and properly packaged? <u>YES</u>					
Relinquished by: (Signature) <i>K. Wall</i>		Date/Time 2/7/92	Received by: (Signature) <i>[Signature]</i> 12:20PM							
Relinquished by: (Signature)		Date/Time	Received by: (Signature)							
Relinquished by: (Signature)		Date/Time	Received by: (Signature)							
					Signature: <i>A. Wagner</i> Title: <i>Analyst</i> Date: <u>2/6</u>					

VOA-S preserved



KAPREALIAN ENGINEERING, INC.

CHAIN OF CUSTODY

SAMPLER JOE	SITE NAME & ADDRESS Unocal/Oakland 3943 Broadway	ANALYSES REQUESTED TPHG, BTEX	TURN AROUND TIME: Regular
WITNESSING AGENCY			

SAMPLE ID NO.	DATE	TIME	SOIL	WATER	GRAB	COMP	NO. OF CONT.	SAMPLING LOCATION	ANALYSES REQUESTED	REMARKS
MW-11	2/6/92		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			2	MW	2020 324 AB	Vials preserved

Relinquished by: (Signature) Joe [Signature]	Date/Time 2/6/92	Received by: (Signature) A. Nagra	The following MUST BE completed by the laboratory accepting samples for analysis: 1. Have all samples received for analysis been stored in ice? YES 2. Will samples remain refrigerated until analyzed? YES 3. Did any samples received for analysis have head space? NO 4. Were samples in appropriate containers and properly packaged? YES
Relinquished by: (Signature) K. Walker	Date/Time 2/7/92	Received by: (Signature) [Signature] 12:20 PM	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	
		Signature A. Nagra	Title Analyst Date 2/6



SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(510) 686-9600 • FAX (510) 686-9689

Kaprealian Engineering, Inc. P.O. Box 996 Benicia, CA 94510 Attention: Mardo Kaprealian, P.E.	Client Project ID: Unocal #0746, 3943 Broadway, Oakland Matrix Descript: Soil Analysis Method: EPA 5030/8015/8020 First Sample #: 201-0186	Sampled: Jan 7, 1992 Received: Jan 9, 1992 Analyzed: Jan 15, 1992 Reported: Jan 23, 1992
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TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
201-0186	MW10(5)	N.D.	N.D.	N.D.	N.D.	0.021
201-0187	MW10(7)	N.D.	N.D.	N.D.	N.D.	N.D.
201-0188	MW10(11.5)	N.D.	N.D.	N.D.	N.D.	N.D.
201-0189	MW10(14.5)	N.D.	N.D.	N.D.	N.D.	N.D.
201-0190	MW10(19.5)	N.D.	N.D.	N.D.	N.D.	N.D.
201-0191	MW11(5)	N.D.	N.D.	N.D.	N.D.	N.D.
201-0192	MW11(10)	N.D.	N.D.	N.D.	N.D.	N.D.

Method Detection Limits:	1.0	0.0050	0.0050	0.0050	0.0050
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Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

2010186.KEI <1>



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Kaprealian Engineering, Inc.

Client Project ID: Unocal #0746, 3943 Broadway, Oakland

P.O. Box 996

Benicia, CA 94510

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2010186-192

Reported: Jan 23, 1992

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-Benzene	Xylenes
Method:	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020
Analyst:	K.E.	K.E.	K.E.	K.E.
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992
QC Sample #:	Matrix Blank	Matrix Blank	Matrix Blank	Matrix Blank
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.40	0.40	0.40	1.2
Conc. Matrix Spike:	0.38	0.38	0.40	1.2
Matrix Spike % Recovery:	95	95	100	100
Conc. Matrix Spike Dup.:	0.36	0.36	0.39	1.2
Matrix Spike Duplicate % Recovery:	90	90	98	100
Relative % Difference:	5.4	5.4	2.5	0.0

SEQUOIA ANALYTICAL

Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$

2010186.KEI <2>



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Kaprealian Engineering, Inc.

Client Project ID: Unocal #0746, 3943 Broadway, Oakland

P.O. Box 996

Benicia, CA 94510

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2010186-192

Reported: Jan 23, 1992

QUALITY CONTROL DATA REPORT

SURROGATE

	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Method:	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020	8015/8020
Analyst:	K.E.	K.E.	K.E.	K.E.	K.E.	K.E.	K.E.
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992
Sample #:	201-0186	201-0187	201-0188	201-0189	201-0190	201-0191	201-0192

Surrogate % Recovery:	110	98	98	98	97	99	99
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SEQUOIA ANALYTICAL

Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$

2010186.KEI <3>



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Kaprealian Engineering, Inc.
P.O. Box 996
Benicia, CA 94510

Client Project ID: Unocal #0746, 3943 Broadway, Oakland

Attention: Mardo Kaprealian, P.E. QC Sample Group: 2010186-192

Reported: Jan 23, 1992

QUALITY CONTROL DATA REPORT

SURROGATE

Method:	EPA 8015/8020
Analyst:	K.E.
Reporting Units:	mg/kg
Date Analyzed:	Jan 15, 1992
Sample #:	Blank

Surrogate	
% Recovery:	89

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$



KAPREALIAN ENGINEERING, INC.

CHAIN OF CUSTODY

SAMPLED <i>[Signature]</i>		SITE NAME & ADDRESS UNOCAL #0746 / OAKLAND 3943 BROADWAY						ANALYSES REQUESTED				TURN AROUND TIME: REGULAR
WITNESSING AGENCY												
SAMPLE ID NO.	DATE	TIME	SOIL	WATER	GRAB	COMP	NO. OF CONT.	SAMPLING LOCATION	TOXIC	OTHER	REMARKS	
MW10(S)	1-7-92		X		X		1	SEE SAMPLE ID NO.	X	X	2010186	
MW10(7)	1-7-92		X		X		1	↓	X	X	187	
MW10(11S)	1-7-92		X		X		1		X	X	188	
MW10(14S)	1-7-92		X		X		1		X	X	189	
MW10(19S)	1-7-92		X		X		1		X	X	190	
MW10(S)	1-7-92		X		X		1		X	X	191	
MW10(10)	1-7-92		X		X		1		X	X	192	

Relinquished by: (Signature) <i>[Signature]</i>	Date/Time 1-8-92 5:10 AM	Received by: (Signature) <i>[Signature]</i>	The following MUST BE completed by the laboratory accepting samples for analysis: 1. Have all samples received for analysis been stored in ice? YES 2. Will samples remain refrigerated until analyzed? YES 3. Did any samples received for analysis have head space? NO 4. Were samples in appropriate containers and properly packaged? YES
Relinquished by: (Signature) <i>[Signature]</i>	Date/Time 1-8-92 5:28	Received by: (Signature) <i>[Signature]</i>	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	
Signature: <i>[Signature]</i> Title: Project Manager Date: 1-8-92			



SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(510) 686-9600 • FAX (510) 686-9689

Kaprealian Engineering, Inc.	Client Project ID: Unocal #0746, 3943 Broadway, Oakland	Sampled: Jan 7, 1992
P.O. Box 996	Sample Descript.: Soil, MW11 (12.5)	Received: Jan 9, 1992
Benicia, CA 94510	Analysis Method: EPA 5030/8015/8020	Analyzed: Jan 15, 1992
Attention: Mardo Kaprealian, P.E.	Lab Number: 201-0193	Reported: Jan 23, 1992

TOTAL PETROLEUM FUEL HYDROCARBONS WITH BTEX DISTINCTION (EPA 8015/8020)

Analyte	Method Detection Limit mg/kg (ppm)	Sample Results mg/kg (ppm)
Low to Medium Boiling Point Hydrocarbons.....	1.0	N.D.
Benzene.....	0.0050	N.D.
Toluene.....	0.0050	N.D.
Ethyl Benzene.....	0.0050	N.D.
Xylenes.....	0.0050	N.D.

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director



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Kaprealian Engineering, Inc.

Client Project ID: Unocal #0746, 3943 Broadway, Oakland

P.O. Box 996

Benicia, CA 94510

Attention: Mardo Kaprealian, P.E. QC Sample Group: 201-0193

Reported: Jan 23, 1992

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-Benzene	Xylenes
		EPA	EPA	EPA
Method:	8015/8020	8015/8020	8015/8020	8015/8020
Analyst:	K. E.	K. E.	K. E.	K. E.
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992	Jan 15, 1992
QC Sample #:	Matrix Blank	Matrix Blank	Matrix Blank	Matrix Blank
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.40	0.40	0.40	1.2
Conc. Matrix Spike:	0.38	0.38	0.40	1.2
Matrix Spike % Recovery:	95	95	100	100
Conc. Matrix Spike Dup.:	0.36	0.36	0.39	1.2
Matrix Spike Duplicate % Recovery:	90	90	98	100
Relative % Difference:	5.4	5.4	2.5	0.0

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$



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Kaprealian Engineering, Inc.
P.O. Box 996

Client Project ID: Unocal #0746, 3943 Broadway, Oakland

Benicia, CA 94510

Attention: Mardo Kaprealian, P.E. QC Sample Group: 201-0193

Reported: Jan 23, 1992

QUALITY CONTROL DATA REPORT

SURROGATE

	EPA	EPA
Method:	8015/8020	8015/8020
Analyst:	K. E.	K. E.
Reporting Units:	mg/kg	mg/kg
Date Analyzed:	Jan 15, 1992	Jan 15, 1992
Sample #:	201-0193	Blank

Surrogate		
% Recovery:	97	89

SEQUOIA ANALYTICAL

Belinda C. Vega
Belinda C. Vega
Laboratory Director

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$



KAPREALIAN ENGINEERING, INC.

CHAIN OF CUSTODY

SAMPLER <i>[Signature]</i>		SITE NAME & ADDRESS UNOAK #0746/OAKLAND 3943 BROADWAY					ANALYSES REQUESTED				TURN AROUND TIME: REGULAR	
WITNESSING AGENCY							<div style="display: flex; justify-content: space-around;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);"> 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 </div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);"> 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 </div> </div>				REMARKS	
SAMPLE ID NO.	DATE	TIME	SOIL	WATER	GRAB	COMP	NO. OF CONT.	SAMPLING LOCATION				
MW11/25/7-92			X		X		1	SEE SAMPLE ID NO.	2010193			
Relinquished by: (Signature) <i>[Signature]</i> (KEI)		Date/Time 1-8-92/5:40PM		Received by: (Signature) <i>[Signature]</i>		The following MUST BE completed by the laboratory accepting samples for analysis: 1. Have all samples received for analysis been stored in ice? <u>YES</u> 2. Will samples remain refrigerated until analyzed? <u>YES</u> 3. Did any samples received for analysis have head space? <u>NO</u> 4. Were samples in appropriate containers and properly packaged? <u>YES</u> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: center;"> <i>[Signature]</i> Signature </div> <div style="text-align: center;"> <i>[Signature]</i> Project Manager Title </div> <div style="text-align: center;"> <u>1-8-92</u> Date </div> </div>						
Relinquished by: (Signature) <i>[Signature]</i>		Date/Time 1-8-92 5:28		Received by: (Signature) <i>[Signature]</i>								
Relinquished by: (Signature)		Date/Time		Received by: (Signature)								
Relinquished by: (Signature)		Date/Time		Received by: (Signature)								



KAPREALIAN ENGINEERING, INC.

Consulting Engineers

P.O. BOX 996 • BENICIA, CA 94510

(707) 746-6915 • (707) 746-6916 • FAX: (707) 746-5581

KEI-P89-0805.P7

March 9, 1992

Unocal Corporation
2000 Crow Canyon Place, Suite 400
P.O. Box 5155
San Ramon, California 94583

Attention: Mr. Ron Bock

RE: Work Plan/Proposal
Unocal Service Station #0746
3943 Broadway
Oakland, California

Dear Mr. Bock:

This work plan has been prepared in order to gather information about the characteristics of the aquifer beneath the surface of the subject site, and to subsequently use this information in the design and implementation of a ground water remediation system for the site.

Additional background information, recent field activities, and a discussion of previous recommendations are contained in our report (KEI-P89-0805.R7) dated March 9, 1992.

PROPOSED FIELD WORK

PHASE III - INSTALLATION OF AN INITIAL RECOVERY WELL FOR GROUND WATER REMEDIATION

1. KEI proposes to install one six-inch diameter well (designated as RW1 on the attached Site Vicinity Map) for the purpose of ground water remediation. The well will be installed by the use of hollow-stem auger equipment. Permits will be obtained from the Alameda County Flood Control Agency prior to beginning work.

Based on review of geologic boring logs of adjacent wells (MW3, MW4, MW5, MW8, and MW9), the recovery well will be drilled to just below the coarse-grained soil zone, which is anticipated to be encountered at depths of about 10 to 15.5 feet below grade. The well will be screened to less than 2 feet above the top of the coarse grained zone. Existing well MW5, located approximately 15 feet northwest of the proposed location of recovery well RW1, encountered this coarse-grained soil zone between depths of 11 to 15.5 feet below grade, and

therefore it is anticipated that well RW1 will be drilled to a depth of about 16 to 17 feet below grade, and screened at depths between approximately 10 to 16 feet below grade.

2. Soil samples will be collected for lithologic logging purposes only, corresponding to a maximum spacing of 5 foot intervals and significant changes in lithology, beginning at a depth of about 5 feet below grade, and continuing below the water table to the total depth drilled. Sampling below the water table will be conducted at near continuous intervals to verify when the aquifer has been fully penetrated. Also, several soil samples will be collected for particle size analysis to verify the proposed casing slot and filter pack design. Classification of soil will be done using the Unified Soils Classification System (USCS) by KEI's field engineer or geologist. Samples will be collected in a California modified split-spoon sampler with two-inch diameter brass liners. The sampler will be advanced ahead of the drilling augers at designated depths by dropping a 140 pound hammer 30 inches. Blow counts will be recorded.
3. Finalized Boring Logs will be prepared from field logs and submitted to the Alameda County Flood Control Agency, and to the Regional Water Quality Control Board (RWQCB), San Francisco Bay Region.
4. Static ground water is anticipated at approximately 10 to 10.5 feet below grade, based on the ground water level found in the existing adjacent monitoring wells.
5. Well Construction:

Casing Type: Schedule 40 PVC, flush threaded joints, 0.010 inch factory slot, six-inch diameter. Screened portions of the well casing to run from total depth of the well to approximately 1 foot above the depth of the saturated aquifer. It is anticipated that the screened interval of the well casing will extend from approximately 16 feet to approximately 10 feet below grade. Monterey sand (#2/12) will fill the annular space from total depth to 2 feet above the perforated casing interval. A 2 foot thick bentonite seal will be placed in the annular space on top of the sand pack. The well will be partially developed after placement of the sand filter pack, but prior to placement of the bentonite seal, to ensure that the filter pack is adequately installed and that no voids exist. Neat cement grout with a 5% bentonite content will be placed on top of the bentonite seal to the surface.

The proposed well screen slot size and associated filter pack sand was selected primarily because the aquifer consists of clayey sand and clayey gravel; therefore, the finer slot and filter pack sand size will significantly reduce the amount of fines drawn into the recovery well and pump.

The well casing will be secured with a waterproof cap and a padlock. A round, watertight, flush-mounted well cover of up to approximately 36-inches in diameter will be concreted in place over the top of the casing.

6. Water level in the recovery well will be measured with an electronic sounder. The well will be developed by the use of a surface pump in conjunction with a surge block, approximately one week after well completion. The well will be pumped until expelled water is clear and free of turbidity. Effluent generated during well development will be contained in DOT-approved drums and hauled from the site by a licensed hazardous materials hauler.

7. Pump Test

A pump test is proposed to be performed on well RW1, once this well is installed. A submersible pump will be lowered into the recovery well and suspended approximately 1 foot from the bottom of the well. Ground water will be initially pumped from the well at a rate of approximately 1.5 gallons per minute (gpm), through a flow meter, through an oil/water separator, and finally to a temporary holding tank on-site. Ground water in the holding tank will be pumped and hauled from the site by a licensed hazardous materials hauler. Water level data loggers with pressure transducers will be used in nearby existing monitoring wells in order to determine the radius of influence from the recovery well (at the equilibrium pumping rate). This information will be used in order to determine the location and number of additional recovery wells that may be necessary to achieve hydraulic control of the contaminated ground water plume, and for the design of a ground water remediation system for the site.

8. Conclusions:

Conclusions and results of Phase III will be described in a technical report. The recovery well is anticipated to be incorporated into an active ground water remediation system.

The technical report will be submitted to the Alameda County Health Care Services Agency and to the RWQCB, San Francisco Bay Region.

LIMITATIONS

Soil deposits and rock formations may vary in thickness, lithology, saturation, strength and other properties across any site. In addition, environmental changes, either naturally-occurring or artificially-induced, may cause changes in the extent and concentration of any contaminants. Our studies assume that the field and laboratory data generated will be reasonably representative of the site as a whole, and assume that subsurface conditions are reasonably conducive to interpolation and extrapolation.

The results of this proposed study will be based on the data obtained from the field and laboratory analyses obtained from a state certified laboratory. We will analyze all data generated using what we believe to be currently applicable engineering techniques and principles in the Northern California region. We make no warranty, either expressed or implied, regarding the above, including laboratory analyses, except that our services will have been performed in accordance with generally accepted professional principles and practices existing for such work.

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March 9, 1992
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Should you have any questions regarding this work plan/proposal,
please do not hesitate to call me at (707) 746-6915.

Approved by:



Aram B. Kaloustian
Project Engineer



Don R. Braun
Certified Engineering Geologist

License No. 1310
Exp. Date 6/30/92



Timothy R. Ross
Project Manager

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Attachments: Location Map
Site Vicinity Map
Typical Well Completion Diagram



KAPREALIAN ENGINEERING, INC.
Consulting Engineers

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LOCATION MAP

Unocal S/S #0746
3943 Broadway
Oakland, CA

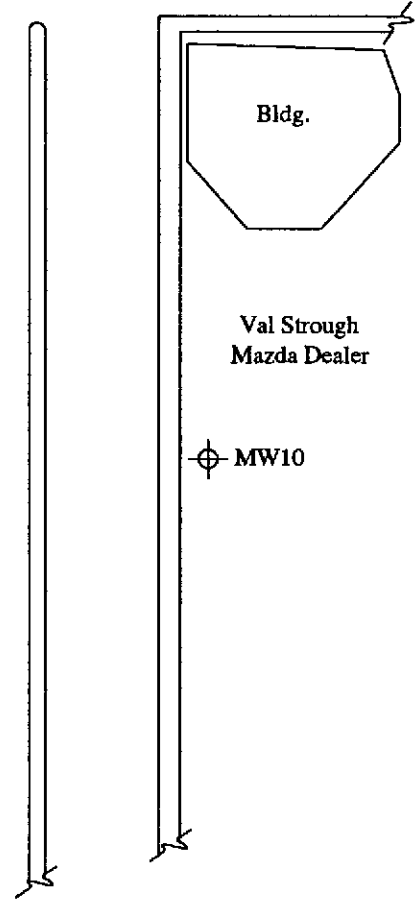
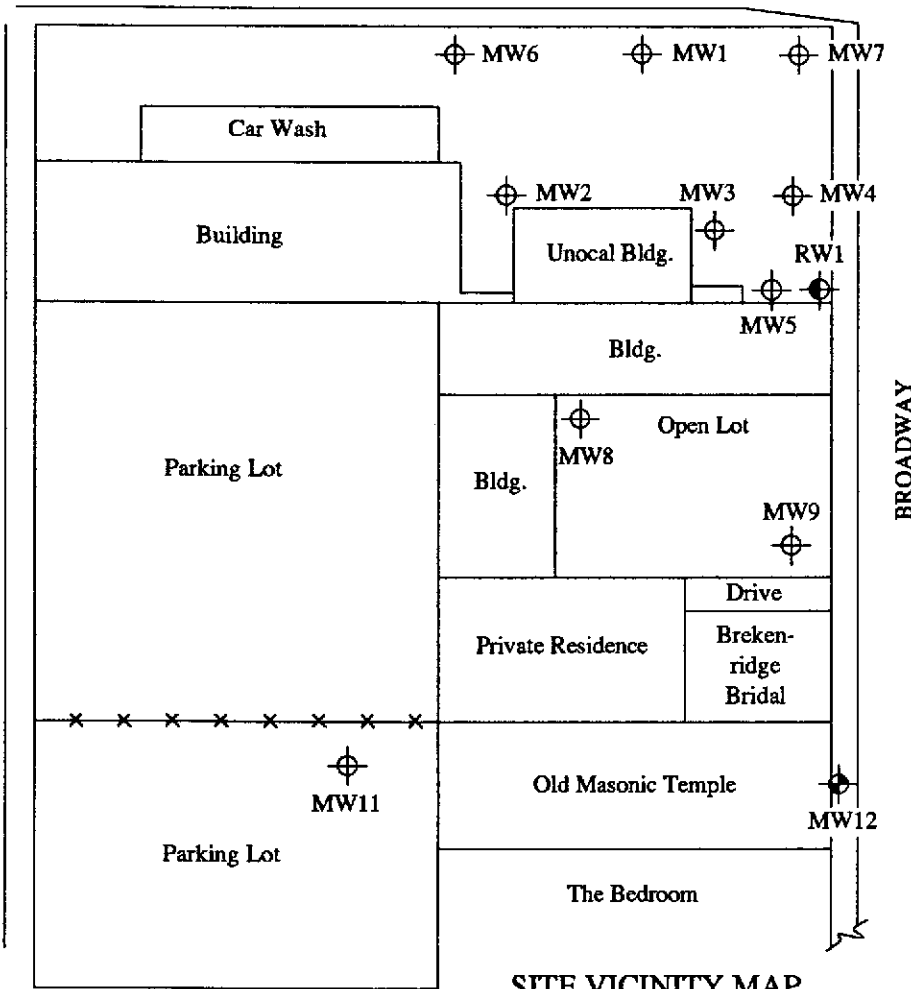
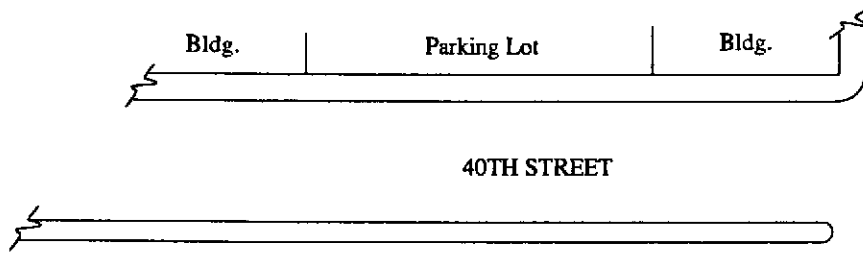


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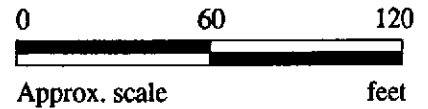
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SITE VICINITY MAP

LEGEND

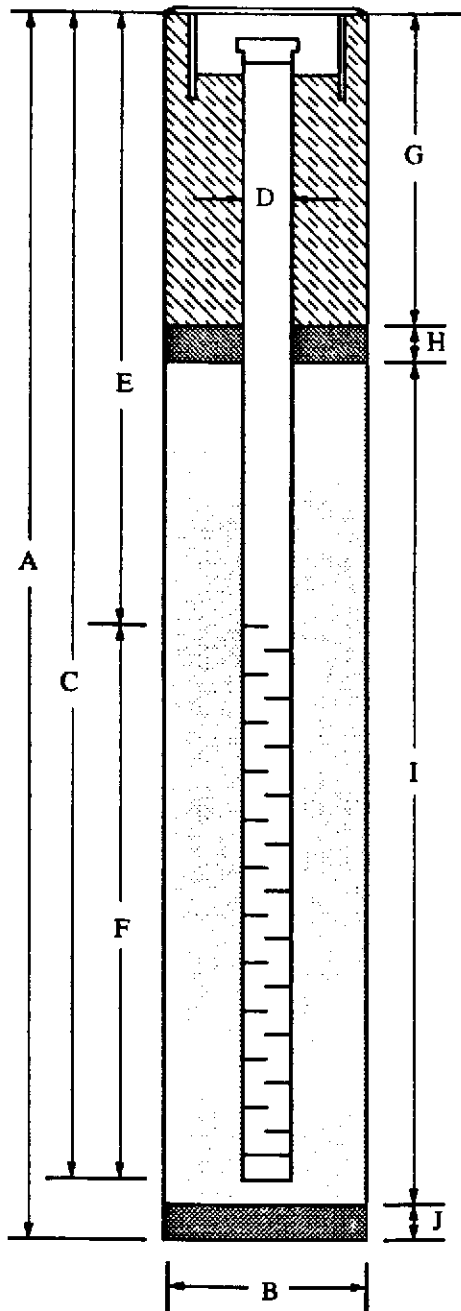
- ⊕ Monitoring well (existing)
- ⊕ 2-inch diameter Monitoring well (proposed)
- ⊕ 6-inch diameter Recovery well (proposed)



Unocal Service Station #0746
3943 Broadway
Oakland, CA

WELL COMPLETION DIAGRAM (SCHEMATIC)

Flush-mounted Well Cover



WELL DETAILS*

1. Well will be terminated 10 to 15 feet into first ground water unless a five foot thick aquitard is encountered below the water table, in which case the aquitard will be backfilled with bentonite pellets and the well terminated at the top of this aquitard [A].
2. Boring diameter [B] is 9 inches for 2 inch wells and 12 inches for 4 inch wells.
3. Perforated interval [F] will extend from bottom of casing to five feet above first ground water table (unless water <5 feet deep).
4. Schedule 40, PVC casing, 2 inch in diameter [D], will be used [C]. Screen is 0.020 or 0.010 inch factory machined slots, depending on filter pack grain size.
5. Filter pack will be placed from bottom of casing to two feet above perforated interval [I]. (Bottom seal [J] is not installed unless required.) One foot of bentonite [H] will be placed above the filter pack. Concrete grout [G] will be placed from top of bentonite seal to the surface (unless modified due to shallow water). Blank casing [E] will extend from the top of the perforated casing to the top of the hole.
6. The well will be installed with a waterproof cap, padlock and a flush-mounted well cover.

* See text for additional information.