REPORT FOR A HYDROLOGIC INVESTIGATION FOR AN UNAUTHORIZED RELEASE OF PETROLEUM CONSTITUENTS

Hooshi's Auto Service
1499 MacArthur Boulevard
Oakland, California 94602

Prepared For

Mr. Tom English
1545 Scenic Drive
San Leandro, California 94578

Prepared By

Questa Engineering Corporation
1220 Brickyard Cove Road, Suite 206
Point Richmond, California 94807

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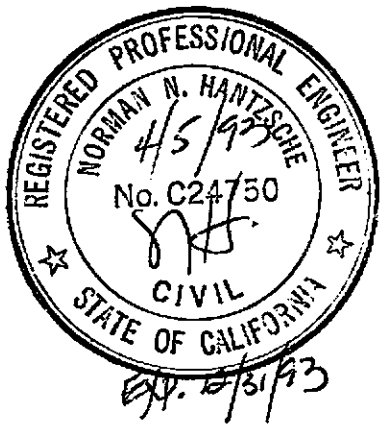
Report Prepared In Accordance To:

"Tri-Regional Board Staff Recommendations for
Preliminary Evaluation and Investigation of
Underground Tank Sites"

Randall D. Smith
Staff Geologist

Norman N. Hantzsche, P.E.
Principal/Managing Engineer



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INTRODUCTION

This report presents the results of the subsurface investigation conducted in January 1993 by Questa Engineering Corporation (Questa) at Hooshi's Auto Service, located at 1499 MacArthur Boulevard in Oakland, California (Figure 1). The purpose of this investigation was to evaluate soil and groundwater contamination in the immediate area adjacent to previously removed underground storage tanks. The investigation was requested by the Alameda County Department of Environmental Health (DEH) and the San Francisco Bay Regional Water Quality Control Board (RWQCB).

SCOPE OF WORK

The scope of work for the subsurface investigation included the following:

1. Drill at least three (3) subsurface exploration borings within the immediate vicinity of the former underground storage tanks, and collect soil samples at approximately 5-foot intervals in depth. The borings were to be advanced a minimum of 10 feet into the water-bearing zone;

2. Complete three (3) of the exploratory borings as 2-inch diameter groundwater monitoring wells;

3. Develop the new monitoring wells and collect groundwater samples;

4. Deliver soil and groundwater samples, under chain-of-custody, to a state-certified laboratory for analysis. Samples would be analyzed for Total Petroleum Hydrocarbons as gasoline (TPH-g) by EPA Method 8015 and for aromatic hydrocarbons including benzene, toluene, ethylbenzene and total xylenes (BTEX) by EPA Method 8020;

5. Survey top-of-casing (TOC) elevations of the new wells to mean sea level (MSL) within 0.01 feet accuracy, measure depths to water and determine groundwater elevations for all wells at the site, and produce a potentiometric surface map of shallow groundwater; and

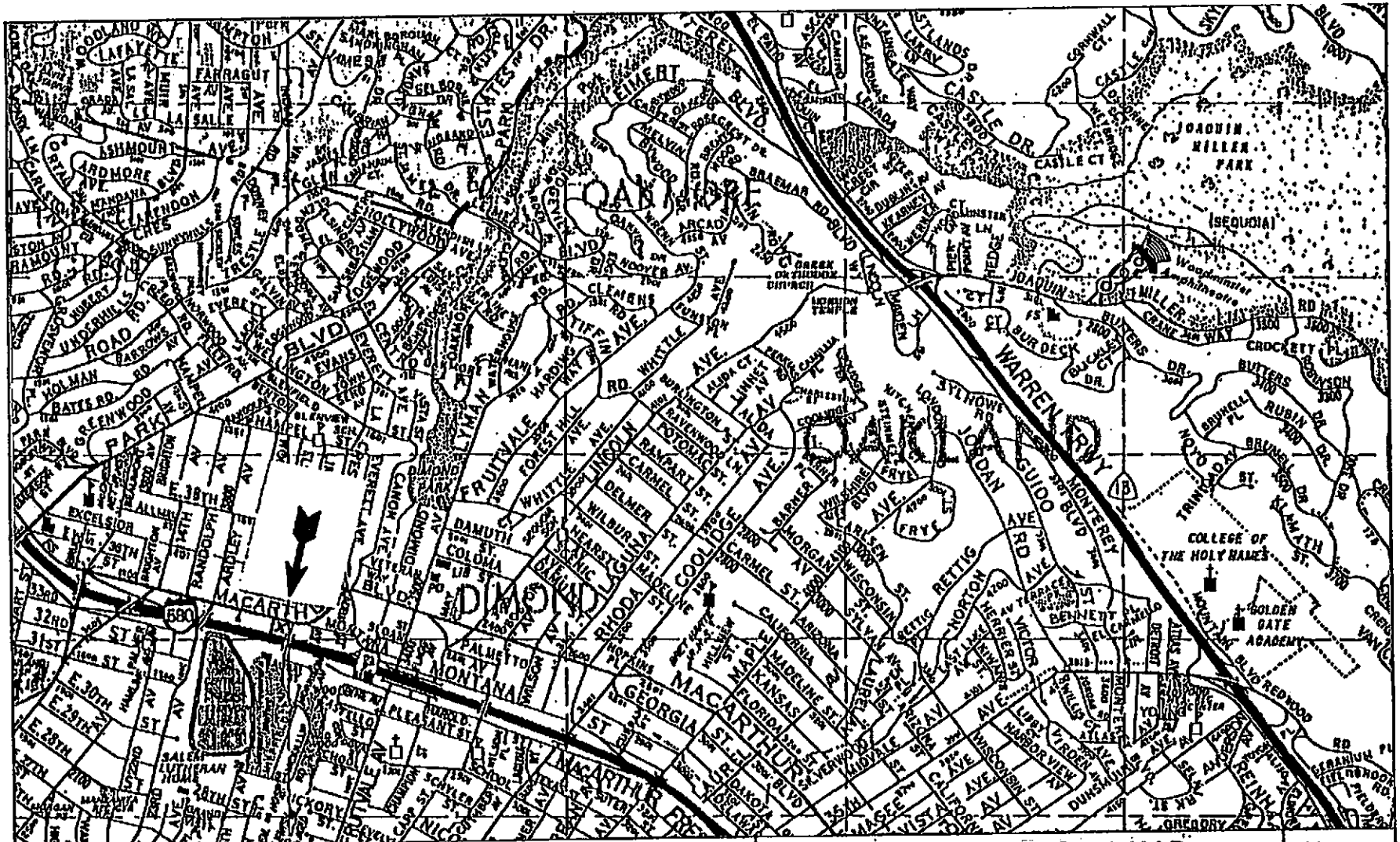
6. Review all field and laboratory data and prepare a report of this investigation.

SITE LOCATION

The subject property, located at the southwest corner of MacArthur Boulevard and 14th Avenue in Oakland, is the site of Hooshi's Auto Service, a small auto repair business. The property is currently owned by Mr. Tom English. Surrounding properties are predominantly small commercial establishments located along MacArthur Boulevard, and residential properties situated on adjacent streets to the north and south of MacArthur Boulevard.

SITE HISTORY

On October 3, 1990, three (3) underground storage tanks were removed from the site by KTW and Associates of Fremont, California. Two of the tanks had 1,000-gallon capacities, whereas the third tank had a capacity of 500 gallons. All three had been used for gasoline storage. Five (5) soil samples were collected from the tank excavation and one (1) additional soil sample was obtained from below the pipelines. Analytical testing of the soil samples indicated that concentrations of TPH-g ranged from 450 parts-per-million (ppm) to non-detectable (ND) and benzene concentrations varied from



Questa Engineering Corporation Point Richmond, California	SITE LOCATION MAP 1499 MacARTHUR BLVD. OAKLAND, CA	Figure 1

8.7 ppm to ND. Some over-excavation was completed at the time of tank removal by KTW; but the results of the over-excavation and soil disposition are poorly documented.

In June 1991, a Workplan for Monitoring Well Installation at the subject site was submitted to the DEH by David C. Glick Associates of Los Altos, California. The workplan was approved by the DEH in July 1991.

SUBSURFACE INVESTIGATION

Soil Borings and Sampling

The subsurface conditions at the subject site were investigated by Questa on January 7, 1993, by drilling three monitoring well borings (MW-1, MW-2 and MW-3) in the locations shown on Figure 2. Monitoring well borings were drilled using a Mobile B-55 truck-mounted hollow-stem auger drill rig. Questa personnel supervised the placement, drilling, classification and sampling of the test boring/monitoring wells. Soil boring logs are included in Appendix A.

Monitoring well locations were based on the estimated direction of groundwater flow, feasibility of access and information provided in the June 1991 Workplan submitted to the DEH by David C. Glick Associates.

MWs were in different locations

Soil samples were collected using a 3.0-inch diameter split-spoon sampler with brass liners of 2-inch inside diameter (ID) at a maximum of 5-foot depth intervals for lithologic and hydrogeologic description and chemical analysis. The sample was driven through the soil formation by a 140-pound hammer dropped from a standard height of 30 inches. Soils were classified in accordance with the Unified Soil Classification System (USCS). Field estimates of permeability were based on grain size distribution, sorting, sedimentary fabric and cementation. The Questa standard operating procedure for soil samples is included in Appendix B. A photoionization detector (PID) was used at the site to screen soil samples for the presence of volatile hydrocarbons.

The following soil handling procedures were followed in sequence for each boring advanced and sampled:

- Sampling equipment and brass tubes were cleaned with a tri-sodium phosphate (TSP) solution and rinsed with deionized water before sampling to reduce the potential of cross-contamination. Clean disposable gloves were used for the handling of each soil sample.

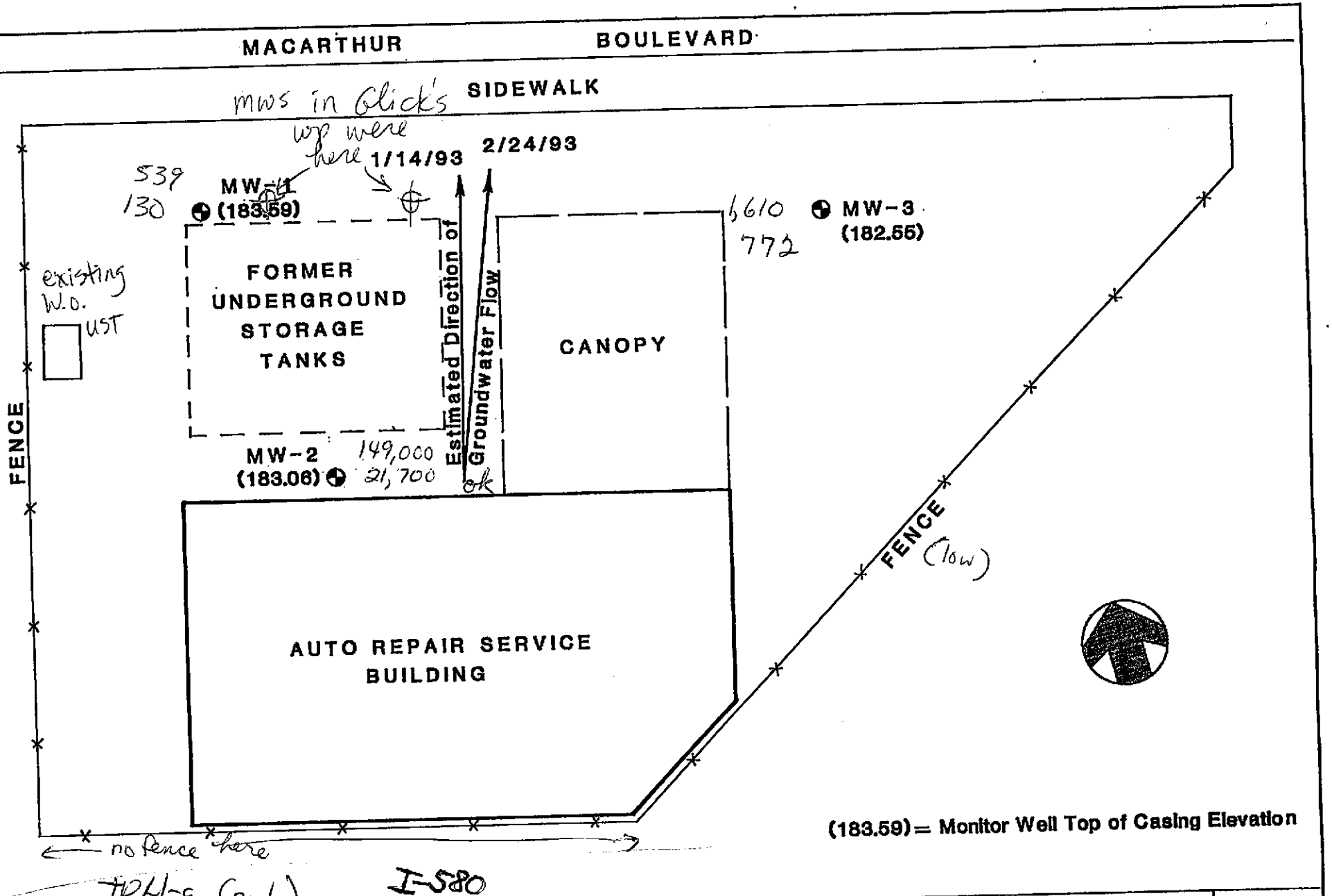
- Upon completion of each sampling run, soil samples were immediately sealed in the brass liners using aluminum foil and plastic end caps, sealed with duct tape, labeled and stored in a cooler (4 degrees C). The samples were subsequently delivered under chain-of-custody to Carter Environmental Laboratories, Inc. (CEL) of Campbell (a California-certified laboratory), for analysis.

- The remaining soil samples were noted for field indications of contamination and/or changes in lithologies, with total sample recovery denoted on the boring logs. The concentration of volatile hydrocarbons was measured in the remaining samples utilizing a HNU PID. The reading for each sample was recorded on the boring logs.

- Soil cuttings from the drilling operation were transferred into 55-gallon steel drums and stored on site.

follow up

- All downhole drilling equipment was pre-cleaned with a steam/pressure washer prior to



QUESTA ENGINEERING, INCORPORATED POINT RICHMOND, CALIFORNIA	SITE MAP WITH MONITOR WELL LOCATIONS 1499 MACARTHUR BLVD. OAKLAND, CA.	FIGURE 2

drilling of individual borings and prior to leaving the site. Rinseate water was collected in a steel trough and pumped into a labeled 55-gallon steel drum upon completion of the soil borings (currently stored on site). follow up

Monitoring Well Installation and Development

Each of the three (3) borings were completed as 2-inch diameter groundwater monitoring wells MW-1, MW-2 and MW-3, respectively, on January 7, 1993. The wells were installed in accordance with applicable RWQCB and Alameda County guidelines. Each well was constructed using a 2-inch diameter Schedule 40 PVC flush-threaded casing with a 10-foot slotted section consisting of 0.020-inch factory perforations. The screened portions were placed to extend above and below the depth of static water level encountered during drilling.

Since groundwater was first encountered in each of the well borings at approximately 13 feet below-ground-surface (BGS) and the potential exists for substantial seasonal variations in groundwater levels, up to 3 feet of screen casing was installed above first encountered groundwater. Unperforated casing was installed above the screened portion to within 3 inches of ground surface. Sand filter pack (No. 3 Monterey Sand) was installed from the bottom of the screened portion to 1-foot above the screened interval. A 2-foot bentonite pellet seal was placed above the filter material and hydrated. The remainder of the monitoring well construction consisted of a cement slurry grout, up and into the traffic box installed in concrete, flush with the site surface. Monitoring well construction details are included in Appendix B.

The new monitoring wells were developed on January 12, 1993, by Questa personnel according to Questa standard operating procedure for monitoring well installation and development included in Appendix B. Each of the three wells were developed by utilizing a surge-block to flush the well and purged with a surface pump. This was performed in an attempt to remove suspended sediments from the well and to grade the filter pack into more complete contact with the aquifer. Each well was allowed to recover to within 90% of static groundwater level before additional development occurred, except for monitoring well MW-2, which never recovered above 80% during development.

Water quality parameters, including pH, temperature and electrical conductivity, were measured before and during the development process until water quality parameters stabilized. Final stabilized results for water quality parameters are presented in Table 1. Field development forms are included in Appendix C.

Groundwater Sampling

After completion of well development, the monitoring wells were allowed to recover approximately 48 hours before well purging and sampling. On January 14, 1993, each well was purged until pH, temperature and electrical conductivity parameters stabilized. Approximately four (4) well volumes were purged, using a surface pump, before sampling.

Pre-cleaned disposable polyethylene bailers were used to obtain water samples. For all monitoring wells, water samples were collected into 40-ml VOA vials for TPH-g and BTEX analyses. Samples were labeled and stored in a cooler on blue ice (4 degrees C) until delivery to CEL under chain-of-custody protocol.

Purged groundwater from the well development and sampling operations were contained in labeled 55-gallon steel drums, temporarily stored on site, pending laboratory analysis for proper disposal.

TABLE 1

GROUNDWATER PARAMETERS
1499 MacArthur Boulevard
Oakland, California

MONITORING WELL	pH	TEMPERATURE (F°)	SPECIFIC CONDUCTANCE	WATER LEVEL (FT)
PRE-DEVELOPMENT - JANUARY 12 ,1993				
* MW-1 (183.59)	7.83	52.0	690	169.95
* MW-2 (183.06)	7.18	56.4	800	173.02
* MW-3 (182.55)	7.04	56.7	730	169.55
POST-DEVELOPMENT - JANUARY 12, 1993				
MW-1	7.48	53.8	920	-
MW-2	7.69	48.7	890	-
MW-3*	7.45	53.6	770	-
PRE-PURGE AND SAMPLING - JANUARY 14, 1993				
MW-1	7.69	57.5	890	169.76
MW-2	7.55	58.2	860	172.11
MW-3	7.73	60.1	820	169.79
POST-PURGE SAMPLING - JANUARY 14, 1993				
MW-1	7.73	56.4	960	-
MW-2	7.70	57.7	910	-
MW-3	7.95	59.5	880	-
GROUNDWATER SAMPLING - JANUARY 14, 1993				
MW-1	7.70	56.7	890	169.45
MW-2	7.61	57.9	870	170.03
MW-3	7.82	59.7	840	169.01

DTW
13.64
10.04
13.55

* Notes: MW-1 (183.59) = Top of Casing elevation, feet above mean sea level.

GROUNDWATER LEVELS - February 24, 1993

MW - 1	-	-	-	169.83
MW - 2	-	-	-	171.97
MW - 3	-	-	-	169.71

Ref.: 92150SSR.T1

Site Hydrology and Groundwater Gradient/Flow Direction

On January 14, 1993, initial groundwater level measurements were collected from the site for groundwater flow direction and gradient calculations. The measured groundwater levels on January 14 were 169.76 ft, 172.11 ft and 169.79 ft (MSL) for MW-1, MW-2 and MW-3, respectively. Groundwater elevations for February 24, 1993, were 169.83 ft, 171.97 ft and 169.71 ft for MW-1, MW-2 and MW-3, respectively. The estimated groundwater flow direction is toward the north (see Figure 2).

The groundwater gradient, determined from the groundwater elevations taken in January and February 1993, has been calculated at approximately 11% and 9%, respectively, which are unrealistically high. There is a possibility that MW-2 has penetrated a perched aquifer, while the other two monitoring wells have not. This would be one possible explanation for the substantial differences in groundwater elevation between MW-2 and the other two wells. A second possibility for the difference in groundwater elevations is that the backfill and concrete vaults left in place in the location of the former UGTs (which is situated between MW-2 and the other wells) is interfering with the normal movement of groundwater causing a mounding effect on the groundwater around MW-2. This theory may also be supported by the evidence of a depression in the paved surface near MW-2, which appears to allow rain water to pond and seep into the soils (and groundwater alongside MW-2. This seepage would contribute to the apparent "mounding" of groundwater at MW-2. While we have identified these two possible explanations, the groundwater data collected over this relatively short monitoring period is insufficient for a more definite determination.

The new monitoring wells were surveyed by Questa personnel on February 3, 1993. The wells were surveyed to a City of Oakland datum point, located on MacArthur Boulevard, west of Brighton Avenue. Top-of-casing (TOC) elevations above mean sea level (MSL) were surveyed to within 0.01 ft accuracy and converted to USGS controls. TOC elevations are included in Table 1.

Subsurface Conditions

For all three borings (MW-1, MW-2, and MW-3), the upper 0.5 to 1.0 feet of soil consisted of fill material characterized by a light brown, sandy to clayey gravel. Underlying the fill material to approximately 7 feet BGS, soil lithologies of sandy and silty clays, light brown to dark grey, damp to moist, and medium to high plasticity were encountered. Clayey gravel was logged for each of the three borings below the sandy and silty clay soil.

In the MW-1 boring, the clayey gravel was underlain by sandy clay and clayey sand before grading into gravelly sand at approximately 13 feet BGS, the point where groundwater was first encountered. The gravelly sand gave way to a more coarse gravelly soil extending from 16.25 feet to 18 feet BGS; this in turn was underlain by highly plastic, stiff clay extending below 20 feet.

The MW-2 and MW-3 borings went from clayey gravel at about 7.5 feet to clay and clayey sand before encountering first water at approximately 13 feet BGS for both. At approximately 12.5 to 13 feet BGS was a coarse gravelly sand which graded into clayey sand at 15.25 feet and 17 feet, respectively for MW-2 and MW-3. Each of these was underlain by very stiff clays, starting at approximately 18 feet BGS and extending below the bottom of each boring.

ANALYTICAL RESULTS

Soil Samples

Four (4) soil samples were submitted to CEL for laboratory analysis from each monitoring well boring. All of the soil samples (12 total) were analyzed for TPH-g by EPA Method 8015 and for BTEX by EPA Method 8020.

TPH-g was detected in three of the four soil samples collected from the boring for well MW-2. The concentrations of TPH-g ranged from 5.5 ppm for sample B2-5.0 (5 feet BGS) to 1460 ppm for sample B2-10.0 (10 feet BGS). TPH-g concentrations for boring MW-2 then declined to 17.8 ppm for sample B2-15.5 (15.5 feet BGS) and non-detectable (ND) for sample B2-20.5 (20.5 feet BGS). Concentrations of BTEX constituents were also detected in soil samples from the MW-2 boring; they ranged from 0.849 ppm benzene, 6.44 ppm toluene and 63.1 ppm xylenes for samples B2-10.0 and B2-15.5 to ND for samples B2-5.0 and B2-20.5.

All of the soil samples analyzed for borings MW-1 and MW-3 were ND for TPH-g and BTEX. See **Table 2** for a summary of the soil boring sample results. Laboratory analysis reports and chain-of-custody forms are attached as **Appendix D.**

Groundwater Samples

The groundwater samples collected from monitoring wells MW-1, MW-2 and MW-3 were analyzed for TPH-g by EPA Method 8015 and for BTEX by EPA Method 8020.

Monitoring well MW-2 samples had concentrations of TPH-g at 149 ppm, and benzene, toluene and xylenes at 21.7 ppm, 25.0 ppm and 7.76 ppm, respectively. Groundwater samples from monitoring well MW-1 had concentrations of TPH-g detected at 0.539 ppm, and 0.130 ppm benzene, 0.012 ppm toluene, 0.022 ppm ethylbenzene and 0.013 ppm xylenes. TPH-g was also detected in samples from MW-3 at concentrations of 1.61 ppm; with benzene, toluene and xylenes detected at 0.772 ppm, 0.014 ppm and 0.011 ppm, respectively. Analytical results for groundwater samples are presented in **Table 3.** Chain-of-custody forms and laboratory analytical reports are included in **Appendix D.**

CONCLUSIONS

Soil Contamination

Field observations and confirmatory laboratory analysis of soil samples indicate that hydrocarbon contamination exists in the immediate area of MW-2. It appears that the contamination is confined to the area between the former UGT location and the station building, since there was no field or laboratory evidence of hydrocarbons in the borings for MW-1 and MW-3. Hydrocarbons were detectable by PID and from soil sample analyses in the upper 15 feet of the boring for MW-2, with the highest concentrations at or near 10 feet BGS. However, sample analyses for hydrocarbons were ND at 20 feet BGS and PID readings were at 0 ppm below 15 feet for MW-2. It seems likely that the vertical extent of contamination is limited by the stiff clays present at approximately 18.5 feet BGS (see Boring Logs, **Appendix A**).

TABLE 2

ANALYTICAL RESULTS
1499 MacArthur Boulevard
Oakland, California

SOIL BORING SAMPLES
January 7, 1993

SAMPLE ID	DEPTH (feet)	TPH-g (ppm)	BENZENE (ppm)	TOLUENE (ppm)	ETHYLBENZENE (ppm)	XYLENES (ppm)
MONITORING WELL #1						
B1 - 5.0	5.0	ND	ND	ND	ND	ND
B1 - 10.0	10.0	ND	ND	ND	ND	ND
B1 - 15.0	15.0	ND	ND	ND	ND	ND
B1 - 20.0	20.0	ND	ND	ND	ND	ND
MONITORING WELL #2						
B2 - 5.0	5.0	5.5	ND	ND	ND	ND
B2 - 10.0	10.0	1,460	ND	6.44	ND	63.1
B2 - 15.5	15.5	17.8	0.849	0.125	ND	0.309
B2 - 20.5	20.5	ND	ND	ND	ND	ND
MONITORING WELL #3						
B3 - 5.0	5.0	ND	ND	ND	ND	ND
B3 - 10.0	10.0	ND	ND	ND	ND	ND
B3 - 15.0	15.0	ND	ND	ND	ND	ND
B3 - 20.0	20.0	ND	ND	ND	ND	ND

Notes:

TPH-g = Total Petroleum Hydrocarbons as gasoline
ppm = parts-per-million
ND = Not Detected (consult laboratory analytical reports for specific limits)

Ref.: 92150SSR.T2

TABLE 3

ANALYTICAL RESULTS
1499 MacArthur Boulevard
Oakland, California

INITIAL GROUNDWATER SAMPLING
January 14, 1993

SAMPLE ID	TPH-g (ppm)	BENZENE (ppm)	TOLUENE (ppm)	ETHYLBENZENE (ppm)	XYLENES (ppm)
MONITORING WELL #1					
114-01	0.539	0.130	0.012	0.022	0.013
MONITORING WELL #2					
114-02	149.0	21.7	25.0	ND	7.76
MONITORING WELL #3					
114-03	1.61	0.772	0.014	ND	0.011

Notes:

TPH-g = Total Petroleum Hydrocarbons as gasoline
ppm = parts-per-million
ND = Not Detected (consult laboratory analytical reports for specific limits)

Ref.: 92150SSR.T3

Groundwater Contamination

Based on field and laboratory data, the near-surface groundwater bearing zone (at approximately 13 feet BGS) has been significantly affected by hydrocarbon contamination in the area of MW-2.

Groundwater samples taken from MW-1 and MW-3 had low levels of hydrocarbons present, which indicates that the contamination movement is toward the north, originating from the area at MW-2. This is supported by: (1) ND laboratory analytical results from the soil borings for MW-1 and MW-3; and, (2) by groundwater elevation measurements, which indicate that groundwater flow was N 12°E for 14 January 1993 and N 19°E for February 24, 1993. There is also a possibility that the near-surface groundwater at MW-2 may be perched. The evidence for this is: (1) the surrounding surface topography has a significant downward slope toward the south, but the groundwater flow on-site appears to be to the north; (2) MW-2 has a significantly higher water table elevation than monitor wells MW-1 and MW 3, (3) there are heavy clay strata interbedded with sandy strata, which may form an impermeable layer upon which the groundwater collects.

RECOMMENDATIONS

The following recommendations are made, based on the findings of this investigation and subject to concurrence by DEH and RWQCB:

- Soil cuttings from borings for MW-1 and MW-3 should be considered non-hazardous and disposed of accordingly. Soil cuttings from MW-2 and development/purge water from all monitoring wells should be considered hazardous and need to be disposed of at an approved site by a certified hazardous waste disposal firm. ok

- Since it appears that hydrocarbon contaminated soils still in place are having a significant impact on groundwater, these soils should be excavated and removed for disposal. It is recommended that excavation begin between the former UGT location and MW-2, and proceed radially outward until all soils with hydrocarbon contamination above 1 ppm have been excavated. good!

- Consistent with DEH and RWQCB policies, the newly installed monitoring wells should undergo monthly groundwater level measurements and quarterly sampling for suspected contaminates. Quarterly sampling with groundwater quality measurements for the newly installed wells are recommended until a minimum of four consecutive quarters of non-detectable results are achieved. The three monitoring wells should continue to be monitored monthly for groundwater levels to confirm groundwater flow and gradient. Quarterly sampling and analysis for TPH-g and BTEX should be conducted until ND laboratory results are achieved consistently. ok

LIMITATIONS

1. In conjunction with this project, Questa can not and does not certify to non-contamination of the subject property and can not and will not indemnify the Client against all direct or indirect loss or damage that may occur should contamination exist which is not disclosed in this study. To provide such certification or indemnification would require analysis and testing of all natural and man-made substance at the subject property, which is technically impractical and economically unfeasible. This investigation, while it can not eliminate all risks, is intended to minimize risks consistent with the nature of the study which the Client

authorizes, and current accepted (state-of-the-art) techniques and procedures.

2. The total cumulative liability of Questa, its affiliates and their respective directors, officers, employees, and agents with respect to services performed or to be performed pursuant to this Agreement, whether for breach of contract, warranty, indemnity, contribution, tort, design defect, or otherwise, shall not exceed 100% of the gross compensation actually received by Questa under this Agreement. Further, the Client shall, to the fullest extent permitted by law, indemnity, defend and hold harmless Questa, its affiliates and their respective directors, officers, employees, agents, and subcontractors from and against all claims and actions, losses and liabilities including (without limitation) all expenses and attorneys' fees, incidental to any claim or action, based on, or arising out of, damages or injuries to persons or property, including, but not limited to those caused by, or arising out of, any hazardous and/or toxic substances.

3. For any damage caused by negligence other than professional negligence, Questa's liability, including that of its employees, agents and subcontractors, in the aggregate under this Agreement shall not exceed the limits of Questa's comprehensive general and automobile liability insurance coverage. Questa shall not be liable to Client for special, incidental, consequential, or penal losses or damages, including but not limited to lost profits and/or loss of use of the project that is the subject of this Agreement. Such limitations of liability shall apply to all actions of any character, whether in law or equity and whether sounding in contract, indemnity, contribution, warranty, tort, design defect or otherwise.

4. This study is solely for the benefit of the Client and is not for the benefit of any other person. Client shall have the right to use the materials resulting from Questa's efforts on the project (the "Materials") only for purposes expressly contemplated in this Agreement except by agreement in writing. Client agrees to indemnify, defend, and hold harmless Questa against all loss, damage, liability claim or suite (including attorneys' fees), resulting from any use of the Materials not expressly authorized by this Agreement.

5. In conjunction with this project, Questa assumes Client has fully disclosed to Questa all pertinent information regarding the subject property known to or available to the Client with reasonable investigation and inquiry by the Client. Client exclusively assumes the risk of undisclosed contamination of the subject property. Client will indemnify Questa and hold it, its officers, directors and employees harmless from any and all costs and expense in any way arising from contamination which is not disclosed by Client.

APPENDIX A

Soil Borings Logs

PROJECT: Mac Arthur	PROJECT NO: 92150 SHEET 1 OF 2
PROJECT LOCATION: 1499 MacArthur Blvd., Oakland	HOLE NUMBER: MW-1
DRILL METHOD: Hollow Stem Auger	DATE STARTED 1-7-93 TIME 825
BORING DIAMETER: 8" OD	DATE COMPLETED 1-7-93 TIME 1025
SAMPLER: 1.8" Modified Split Barrel OD: 2.5" ID: 2.0"	BORING DEPTH: 20.0 GROUNDWATER DEPTH: 13.25
DRILLING COMPANY: Clearheart	LOGGED BY: Randall D. Smith
DRILLER: Tim	CHECKED BY: Peter Almendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/ 6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
						0			Asphalt
		ND				0.5		CL	Sandy Clay (fill) light brown light brown, stiff, damp, low est K
						1.0			
						1.5			
						2.0		CL	Silty clay, dark grey, medium stiff, moist, high plasticity, low est K
		ND				2.5			
						3.0			
						3.5			
		ND			3	4.0			
					4	4.5			
Blank			B1-5.0	X	5	5.0			
						5.5			Same as above
						6.0			
Grout						6.5			
		ND				7.0		GC	Clayey Gravel, gray with red-yellow mottling, medium dense, damp, 20-30% fines, low est K
						7.5			
Bentonite						8.0			
						8.5			
		ND			5	9.0		CL	Sandy Clay, light grey, very stiff, moist, 15-20% fine to med. sand, low est K
					9	9.5			
Sand			B1-10.0	X	12	10.0			

PROJECT: MacArthur	PROJECT NO: 92150 SHEET 2 OF 2
PROJECT LOCATION: 1499 MacArthur Blvd., Oakland	HOLE NUMBER: MW-1
DRILL METHOD: Hollow Stem Auger	DATE STARTED 1-7-93 TIME 825
BORING DIAMETER: 8" OD	DATE COMPLETED 1-7-93 TIME 1025
SAMPLER: 18" Modified Split Barrel OD: 2.5" ID: 2.0"	BORING DEPTH: 20.0 GROUNDWATER DEPTH: 13.25
DRILLING COMPANY: Clearheart	LOGGED BY: Randall D. Smith
DRILLER: Tim	CHECKED BY: Peter Almendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/ 6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
						10.5		CL	Sandy Clay (Same as above)
		ND				11.0		SC	Clayey Sand, brown, medium dense, moist, 15-20% fines, low est K, occasional gravel up to ½"
						11.5			
						12.0			
						12.5			
						13.0			
						13.5		▽	First water at 13.25' Gravel % increases to 20-30% @ 13.25'
Sand		ND			8	14.0		SP	Gravelly Sand, gray-brown, dense, wet, 20-30% fine to coarse gravel, mod est K
					9	14.5			
			B1-15.0	X	12	15.0			
						15.5			
Sand						16.0			
						16.5		GW	Sandy Gravel, brown with reddish mottling, medium dense, wet, 30-40% fine to coarse sand, high est K
						17.0			
						17.5			
						18.0			
						18.5		SC	Clayey Sand, dark brown, stiff, wet, 25-35% fines, low est K
		ND			14	19.0			
Screen					21	19.5		CL	Clay, light brown, very stiff, highly plastic, moist, low est K
			B1-20.0	X	12	20.0	BOH		

PROJECT: Mac Arthur	PROJECT NO: 92150 SHEET 1 OF 2
PROJECT LOCATION: 1499 MacArthur Blvd., Oakland	HOLE NUMBER: MW-2
DRILL METHOD: Hollow Stem Auger	DATE STARTED 1-7-93 TIME 1040
BORING DIAMETER: 8" OD	DATE COMPLETED 1-7-93 TIME 1255
SAMPLER: 18" Modified Split Barrel OD: 2.5" ID: 2.0"	BORING DEPTH: 20.5' GROUNDWATER DEPTH: 13.0
DRILLING COMPANY: Clearheart	LOGGED BY: RDS
DRILLER: Tim	CHECKED BY: Peter Almendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
						0			Asphalt
		ND				0.5		CL	Sandy Clay, light brown, stiff, damp, low est K
						1.0			slight hydrocarbon odor
						1.5			
						2.0			
						2.5			
		ND				3.0			same as above
					3	3.5			
						4.0			
					6	4.5			
		ND	B2-5.0	X	12	5.0		CL	Silty Clay, dark grey, stiff, moist, high plasticity, low est K
						5.5			
						6.0			
Grout						6.5			same as above
						7.0			
						7.5			
		20 ppm				8.0		GC	Clayey Gravel, grey, medium dense, moist, 20-30% fines, low est K, strong hydrocarbon odor
Bentonite					8	8.5			
						9.0			
Blank					11	9.5		CL	Clay, light grey, stiff, moist, low est K
			B2-10.0	X	14	10.0			

PROJECT: Mac Arthur	PROJECT NO: 92150 SHEET 2 OF 2
PROJECT LOCATION:	HOLE NUMBER: MW-2
DRILL METHOD:	DATE STARTED 1-7-93 TIME 1040
BORING DIAMETER:	DATE COMPLETED 1-7-93 TIME 1255
SAMPLER: OD: ID:	BORING DEPTH: 20.5' GROUNDWATER DEPTH: 13.0
DRILLING COMPANY:	LOGGED BY: RDS
DRILLER:	CHECKED BY: Peter Ahmendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/ 6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
						10.5		CL	Clay (same as above)
		38 ppm				11.0		SC	Clayey Sand, light brown, med. dense, moist, 20-30% fines, low est K noticeable hydrocarbon odor
						11.5			
						12.0			
						12.5			
						13.0	▽		First water at 13.0'
						13.5			
					5	14.0		SP	Gravelly Sand, gray, dense, wet, 20-30% fine to coarse gravel, mod est K
		ND			11	14.5			
			B2-15.0	X	15	15.0			
						15.5			(dotted line)
						16.0		GW	Sandy Gravel, brown, med. dense, wet, 25-30% fine to coarse sand, 10-15% Franciscan chert, mod est K
						16.5			
						17.0			
		ND				17.5		SC	clayey Sand, dark brown, dense, wet, 20-30% fines, low est K
						18.0			
						18.5			
					11	19.0			
		ND			16	19.5		CL	Clay, light brown, v stiff, high plasticity, moist, low est K
			B2-20.0	X	18	20.0			

SAND
SAND
SCREEN

PROJECT: MacArthur	PROJECT NO: 92150 SHEET 1 OF 2
PROJECT LOCATION: 1499 MacArthur Bl., Oakland	HOLE NUMBER: MW-3
DRILL METHOD: Hollow Stem Auger	DATE STARTED 1-7-93 TIME 1345
BORING DIAMETER: 8" OD	DATE COMPLETED 1-7-93 TIME 1630
SAMPLER: 18" Modified Split Barrel OD: 2.5" ID: 2.0"	BORING DEPTH: 21.0' GROUNDWATER DEPTH: 13.25'
DRILLING COMPANY: Clearheart	LOGGED BY: RDS
DRILLER: Tim	CHECKED BY: Peter Almendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/ 6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
									Asphalt
		ND				0.5		CL	Sandy Clay, brown, stiff, damp, 20-30% fine to med. sand, low est K
						1.0			
						1.5			
						2.0		SC	Clayey Sand, light brown, med. dense, damp, 15-25% fines, low est K
		ND				2.5			
						3.0			
						3.5			
					2	4.0			
		ND			3			CL	Silty Clay, dark grey, med. stiff, damp, low est K
Grout			B3-5.0	x	5	5.0			
						5.5			
						6.0			Same as above
		ND				6.5			
						7.0			
						7.5			
Bentonite						8.0		GC	Clayey Gravel, reddish w/yellow brown mottling, med. dense, damp, 20-25% fines, low est K
						8.5			
Blank					5	9.0			
		ND			9			SC	Clayey Sand, brown, dense, moist, 20-30% fines, low est K
						9.5			
Sand			B3-10.0	x	11	10.0			

PROJECT: MacArthur	PROJECT NO: 92150 SHEET 2 OF 2
PROJECT LOCATION:	HOLE NUMBER: MW-3
DRILL METHOD: See Sheet 1	DATE STARTED 1-7-93 TIME 1345
BORING DIAMETER:	DATE COMPLETED 1-7-93 TIME 1630
SAMPLER: OD: ID:	BORING DEPTH: GROUNDWATER DEPTH:
DRILLING COMPANY:	LOGGED BY: RDS
DRILLER:	CHECKED BY: Peter Almendinger

WELL CONSTR.	RECOVERY	PID (PPM)	SAMPLE NUMBER	SUBMITTED SAMPLE	BLOWS/ 6 inches	DEPTH	LITHOLOGY	USCS SYMBOL	SOIL DESCRIPTION / FIELD NOTES
						10.5			Clayey Sand (same as above)
		ND				11.0			
						11.5			
						12.0			
						12.5			
						13.0			First water at 13.25'
						13.5		GW	Sandy Gravel, brown with red mottling, dense, wet, 20-30% fine to coarse sand, high est K
					10	14.0			
		ND			6	14.5			
			B3-15.0	X	14	15.0			
						15.5		SC	Clayey Sand, dark brown, dense, wet, 25-35% fines low est K
SAND						16.0			
		ND				16.5			
SAND						17.0			Same as above
						17.5			(dotted line)
						18.0			
						18.5		CL	Clay, light brown to reddish brown, very stiff, high plasticity damp, low est K
					7	19.0			
Screened		ND			12	19.5			
			B3-20.0	X	19	20.0			

APPENDIX B

Standard Operating Procedures for Soil Borings/Sampling, Monitor Well Construction and Development

BORINGS AND SOIL SAMPLING PROCEDURES

The following outline describes the equipment and procedures which are typically used by Gemini Petrographic Investigations personnel for drilling, logging, and for collecting soil samples. A typical logging data sheet is provided in Appendix C.

Equipment

Drill Rig: Hollow-Stem Auger; 8-inch O.D.;
CME, 5-foot Continuous Core Barrels: 6-inch O.D.;
3-inch diameter (O.D.) modified California Split-Spoon Drive Sampler;
2.5-inch or 2.0-inch Brass or Stainless Steel Liners and Sealing Materials (Foil & Plastic End-Caps);
2-inch diameter (O.D. Standard Penetration Sampler);
HNU PID-Organic Vapor Analyzer (OVA) or equivalent;
Sampler Cleaning Equipment

- Steam cleaner
- Generator
- Stiff-bristle brushes
- Buckets
- Tarp
- Trisodium phosphate TSP (soap)
- Methanol
- Deionized water
- Potable water
- Steel drums

Insulated Sample Storage and Shipping Containers (Ice Chests); and,
Personal Protective Equipment per Site Safety Plan (Generally level D protection).

TYPICAL PROCEDURES

- All applicable drilling and well-construction permits will be obtained prior to mobilization.
- Drilling locations will be cleared for underground utilities with the owner's site representative.
- All sample logging and boring construction will be under direct supervision of a Registered Geologist.
- Borings which will be drilled to construct shallow monitoring wells will be drilled with an auger drill rig using 8-inch O.D. hollow-stem augers.
- Soil samples for lithologic logging and chemical and physical analyses will be collected by driving a 3.0-inch diameter (O.D.) modified California split-spoon drive sampler in 5-foot increments below the depth of the auger bit with a rig mounted hammer. The Standard Penetration Resistance will be recorded. If the sample is pushed rather than driven, the push force will be recorded. The samplers will be driven with a 140-pound hammer falling a distance

of 30-inches. The hammer blows required to drive the 3-inch sampler, converted to equivalent standard penetration counts (N-value).

- The soils will be classified in accordance with the procedures of the Unified Soil Classification System (USCS).
- At each sampling interval, or change in lithology, one brass or stainless steel liner will be collected for laboratory analysis. This sample will be covered with aluminum foil and sealed with plastic caps. A completed sample label will be placed on the liner. Chain-of-custody forms will be completed in the field and the samples will be placed and transported in insulated containers at a temperature of approximately 4°C to a State Certified Analytical Laboratory.
- All samples will be collected in such a manner as to minimize the volatilization or oxidation of a sample due to agitation/mixing upon handling.
- At each sampling interval, the soil from one of the brass liners will be placed in an airtight glass jar and allowed to equilibriate, after which the air in the jar will be monitored using an OVA. If significant organic vapors are detected with the OVA the appropriate brass sample liners will be saved for laboratory analysis. Other field screening steps may be used for other analytes.

EQUIPMENT CLEANING

1. Downhole equipment (augers, well casing, sampler) will be steam cleaned prior to each boring.

2. Sampling equipment (split-spoon driver sampler) will be washed with a brush in a solution of TSP and potable water, then rinsed with potable water followed by rinsing with distilled water prior to each drive sample. Rinse water will be collected and stored in metal and/or plastic drums on-site.

3. All downhole equipment, and vehicles (when warranted) will be steam cleaned prior to leaving site.

4. All rinse water will be collected and transferred into metal and/or plastic drums and stored on-site until laboratory analysis results are made available to determine water disposition.

SPOILS AND CUTTINGS

Soil cuttings and other hazardous residuals from the drilling operations will be contained in labeled steel drums on-site until laboratory analysis determined material deposition. The final deposition of the material is the responsibility of the client, GPI will instruct the client of the necessary permits and dispositions procedures based on laboratory analysis results. Soil material determined to be contaminated, are required to be removed by a licensed hazardous waste hauler to an approved landfill. Non-contaminated soil material can be transported to County of Sonoma County Landfill or buried on site, upon approval and with documentation, by this agency. Wastes that are determined to be hazardous must be properly disposed of and cannot be stored on site for more than 90 days.

SAMPLE HANDLING/QA/QC ELEMENTS

Sample Labeling

All sample containers will be labeled in the field. All sample labels will contain the following:

Sample identification number;
Project number;
Project name;
Name and affiliation of sampler;
Date and time of collection;
Stratigraphic position of soil samples

Sample Handling

At no time will the elapsed time between sample collection and delivery to the laboratory exceed 72 hours. Under no circumstances will sealed sample containers be opened by other than laboratory personnel who will perform the requested analysis.

Custody Seal

When samples or a sample bottle container leaves the immediate control of the sampler prior to delivery to the laboratory, such as shipment by a courier service, a custody seal will be placed on each sample bottle container to ensure the samples have not been tampered with during transportation.

Chain-of-Custody

In order to document and trace sample possession from time of collection, a chain-of-custody record will be filled out by the sampler and accompany the sample(s) through laboratory analyses. The completed chain-of-custody record will be included in the analytical report for the laboratory.

Blanks

Blanks will be used or collected as part of the sampling program at the discretion of the project manager. Trip and/or field blanks will be supplied and analyzed along with the samples.

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN 200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGELY THAN NO.4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL–SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL–SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL–SAND–SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL–SAND–CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND–SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND–CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN 200 SIEVE)	SILT AND CLAYS LIQUID LIMIT LESS THAN 50		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 CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILT AND CLAYS LIQUID LIMIT GREATER THAN 50		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 SILTS
HIGHLY ORGANIC SOILS			PT		PEAT AND OTHER HIGHLY ORGANIC SOILS

QUESTA ENGINEERING CORPORATION

CIVIL AND ENVIRONMENTAL ENGINEERS

UNIFIED SOIL CLASSIFICATION SYSTEM

PLATE

TYPICAL WELL CONSTRUCTION AND DEVELOPMENT PROCEDURES

The following outlines the procedures which will be used by Questa personnel for well construction and development following completion of drilling. A typical monitoring well is shown in Plate 4.

EQUIPMENT

2-inch Schedule 40 PVC blank casing;
2-inch Schedule 40 PVC slotted casing (.010, .020, .030-inch slots);
2-inch Schedule 40 PVC threaded and slip caps;
Ground level traffic rated well housing enclosure;
Locking expansion plugs;
Combination lock;
Filter sand,(#2 x 12, #3; #2, 12 x 20, 8 x 16, 6 x 12 mesh);
Type II Portland cement;
1/4-inch bentonite pellets;
2-inch diameter surge block;
1-inch dedicated PVC hose for monitoring well development and purging purposes;
Centrifugal surface pump; and,
Stainless steel submersible pump.

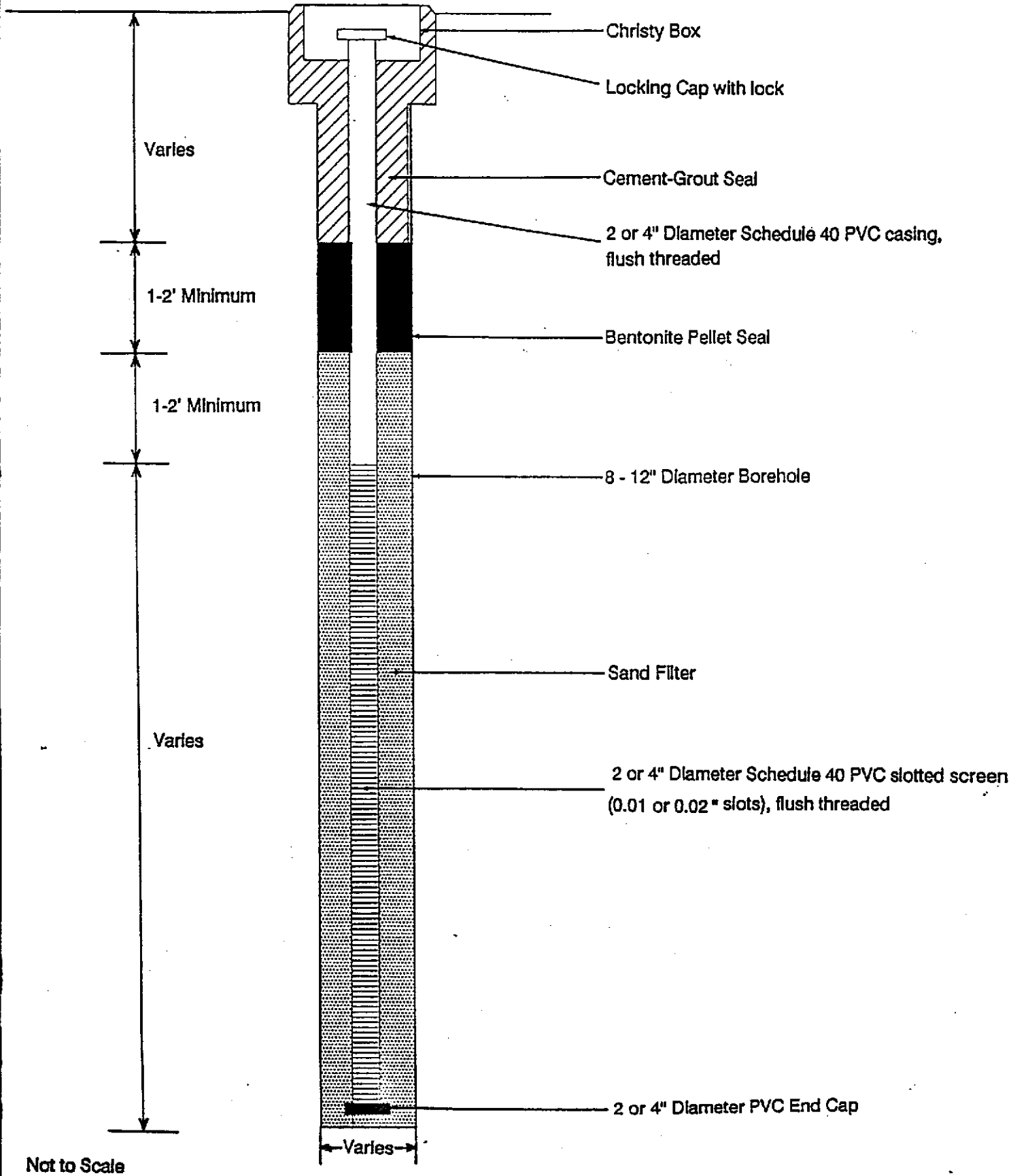
TYPICAL PROCEDURES

- Following completion of selected borings, the monitoring well casing will be installed through the center of the hollow-stem augers. The monitoring well will consist of 2 inch Schedule 40 slotted well casing and blank casing with threaded bottom caps and slip top caps. The casing string will be held in tension during initial installation. The screened portions will extend from the bottom up to depths of 2 to 4 feet below the ground surface.
- A threaded PVC bottom cap will be secured to the bottom of each well.
- Unperforated blank casings will be installed above the screened portion of each well to about 4 to 5 inches below the ground surface.
- Clean well-graded sand will be placed around the slotted section of monitoring wells as a filter pack. (Occasionally the screen size and sand pack will need to be selected based on grain size analysis of the formation material). The sand pack for each well will extend 1.0 to 1.5 feet above the top of the screened interval.
- The filter material will be adjusted to minimize turbidity of future water samples and maximize water yields. A sieve analysis of representative soil samples will be performed and included in the final report along with filter pack gradation.
- If required in the Well Construction Permit, the inspector shall be notified prior to placing the well seal.
- 1 to 2 foot thick bentonite pellet seal will be placed above the sand pack. If the seal is placed above the watertable, the bentonite pellets will be hydrated prior to placement.

- The remainder of the annulus between the well casing and borehole wall will be filled with cement/bentonite grout (with approximately 5 percent bentonite). The cement grout seal will extend up and into 8 inch diameter monitoring well boxes with metal lids secured by hex screws. If the water level is higher than the seal, a tremie will be used to place the grout.
- A locking watertight expansion plug will be installed on each monitoring well.
- Brass survey monuments are embedded in the concrete collars around the well cover at the surface for elevation reference. Well survey monuments will be surveyed from nearby survey benchmarks.
- Well information, including well type, date of installation, depth and screen interval, will be recorded inside of the monitoring well box.
- Following the curing of the grout, the well will be developed at a minimum of 72 hours after well installation.
- The depth to static water level and total casing depth will be measured.
- Prior to development, the water interface for the monitoring well will be checked with a clear acrylic bailer to inspect for the presence of floating product. If floating product is detected, the depth probe is reinserted with gas paste to the pre-measured water depth. When the depth probe signals contact with the water, the probe is removed and the measurement of discoloration is the product thickness.
- Each monitoring well with water levels shallower than 25 feet deep will be developed by using a centrifugal surface pump with dedicated 1 inch inside diameter clear flex suction hose placed with the hose intake near the casing bottom. For wells with water levels greater than 25 feet deep, a submersible pump will be used to develop the well. A 2 inch surge block will be moved gently up and down inside the screened section of the well casing to create a surging suction to hydraulically stress the filter pack.
- Before, during purging and upon completion of development and purging process, the following field parameter/observations will be recorded.

Development volume and time;
Depth to water;
Development rate;
Turbidity; and
Temperature;
Color
pH;
Specific conductance; and
Other observations, as appropriate (presence of odors or sheen, etc.).

- Water removed from development and purging process will be placed in steel drums and stored on-site until deposition can be determined.
- The monitoring well will be developed until relatively low turbidity water is being removed from the casing or at least three (3) well volumes of water are extracted.



QUESTA ENGINEERING CORPORATION CIVIL AND ENVIRONMENTAL ENGINEERS	MONITORING WELL CONSTRUCTION DETAIL	PLATE

DEVELOPMENT AND SAMPLING

Groundwater sampling procedures are broken down into four phases. First is the cleaning of sampling equipment. Second is the measurement of water levels. Third is the purging of stagnant well water. Fourth is the sample collection and preservation of non-stagnant formation water.

1. Equipment Cleaning

When dedicated purging and sampling equipment is not used, all equipment that may come in contact with the sample will be thoroughly cleaned prior to the first sampling and between the subsequent sampling points. Bailers, submersible pumps, airlift pumps, and positive gas displacement bladder pumps will be disassembled, and then either steam cleaned or washed with a biodegradable detergent and rinsed with steam distilled (Type II reagent grade) water and then reassembled. All wires, hoses and connectors will also be steam cleaned or washed and rinsed.

2. Water Level Measurements

Groundwater levels will be measured using an electronic sounder with the reference point being the top of the casing. A measurement of static water level will be made in each monitoring well prior to each sampling event. The groundwater level measurement will also include the depth to the bottom of the well when this is not prevented by the obstruction of dedicated pumps. All groundwater level measurements will be recorded to 0.01 foot. Bottom of well measurements will be recorded to 0.05 foot.

3. Well Purging

In order to obtain a representative sample of the water in the aquifer being sampled, stagnant water in the well casing must be removed to permit well recharge with non-stagnant aquifer water. The removal of stagnant water will be accomplished by the removal of the water to the surface where it will either be disposed of or stored for future disposal.

The purging rate used at a particular monitoring well will depend on the expected or known hydraulic yield of the well.

In moderate to high yield formation wells the purging device will be placed near the tip of the screened interval of the well to ensure that non-stagnant formation water will move upward in the screened interval. When purging low yield formation wells, water will be removed from the bottom of the screened interval.

When purging low-yield wells (wells which yield less than 3 casing volumes), the wells will be purged to dryness once. As soon as the well has recovered to a volume sufficient for sampling, samples will be collected. At no time will a well be purged to dryness if the rate of recharge is such that formation water will cascade down the sides of the casing.

During purging operations, the field parameters of pH, temperatures, and electrical conductivity (EC) will be monitored in the purged water.

Groundwater samples will be removed from the monitoring well only after a minimum of three (3)

casing volumes have been purged from the well casing, and purging has been of sufficient duration to result in the stabilization of pH, temperature, and EC readings. Occasionally turbidity readings may be used as an additional parameter. A well purging/sampling log will be maintained for purging of each monitoring well and will include the following:

Sample location	Sampling Method
Water level at start of purging	Sample type
Water level at end of purging	Containers
Well depth	Preservatives
Well casing volume	Name of sampler
Well casing volume removed	Time of parameter measurement
Purge rate	Volume Removed-Disposition of Purge Water
Weather conditions	Electrical Conductivity
Date(s) purged	pH
Purge method	Temperature
Date/time sampled	Turbidity (visual or meter)

The field parameters of pH, temperature, EC (and turbidity), will be monitored and recorded during the purging operations at a minimum rate of three (3) readings per casing volume purged. Stabilization of the parameters of pH, temperature and EC will be used to indicate that the well has been sufficiently purged for sampling. Parameter stabilization will be indicated by at least three near-constant pH, temperature, and EC values for a minimum of one (1) casing volume. The acceptable range of values for stabilization of the field parameters are $\pm$ 0.1°C for temperature, 0.1 unit for pH and $\pm$ 10 percent of the total value of EC.

Floating product and sheen will be detected, measured, and recorded using a clear acrylic bailer, or comparable device designed for floating product detection.

Standardization of field equipment will be done at the beginning of each use, according to manufacturer's specifications and consistent with methods described in EPA SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods.

Well Purge Water Disposal Plan

Water removed during the development process will be placed in 55 gallon metal or plastic drums and stored on-site upon determination of laboratory analysis. Based upon the non-detectable concentration of contamination, the water from development of the monitoring wells can be disposed in the normal fashion.

Sample Collection

Samples of non-stagnant formation water will be collected only after the minimum of three (3) casing volumes of water have been purged from the casing and field parameters have stabilized. In low yield formation wells which were purged to dryness, the sample(s) will be collected as soon as the well has recovered sufficiently for sample collection.

To ensure that groundwater samples are representative of the groundwater in the formation, it is

important to minimize physical or chemical alteration of the sample during the collection process. If dedicated sampling devices are not used, the following procedures will be strictly adhered to:

- One equipment blank will be collected for each sample during the final rinse of the cleaning process. This sample will be held for possible future analysis, depending on results of QC tests.
- Sampling equipment will be thoroughly cleaned between each well in accordance with the "cleaning" section of the Groundwater Sampling and Analysis Plan.
- Only Teflon and/or stainless steel sampling bladder pumps or bailers will be used when sampling for Volatile Organic Constituents (VOC's).
- Field and trip blanks will also generally be used, as determined on specific projects in consultation with regulatory agencies. These samples may be held pending receipt of preliminary lab data.

All samples will be collected in such a manner as to minimize the volatilization or oxidation of a sample due to agitation during transference from pump or bailer to sample container. When a bladder pump is used for the collection of volatile compounds, the flow rate will be adjusted to provide a constant flow stream of approximately 100 ml/minute. After samples for volatile compounds have been collected, higher flow rates may be used, particularly if larger volumes are necessary. The sampling flow rates will never exceed the flow rate during the purging process.

Additional QA/QC Elements

In addition to the groundwater sampling procedures outlined above, the elements discussed below are also incorporated in the Groundwater Sampling and Analysis Plan to assure data accuracy, precision and reliability. These additional elements are Sample Filtration, Sample Container, Sample Preservation, Sample Labeling, Sample Handling, Custody Seal, Chain-of-Custody, Sample Analysis, Blanks and Laboratory QA/QC Program.

Sample Filtration

When requested, Questa will filter samples in the field collected for metals, general mineral or general physical parameter (turbidity and color not included) analysis using a Geotech 2.4 liter Barrel Filter (or equivalent) or a Millipore field filtering apparatus. The Barrel Filter is an acrylic pressure filtration unit driven by nitrogen gas. Unless otherwise specified, 0.45 micron cellulose acetate filters will be used.

Sample Containers and Preservatives

Many chemical analytes and physical parameters monitored in groundwater are not chemically stable, and therefore preservation of those samples in the field is required. All preservation techniques utilized will be performed in accordance with standards as presented in "Sampling Preservation Procedures for Detection Monitoring" taken from the 1986 RCRA Groundwater Monitoring Technical Enforcement Guidance Document. All preservatives used will be supplied by the contract laboratory which will perform the requested analyses. All samples will be held at 4^{o}C by packing in ice in a covered, secured ice chest specifically designated for that purpose.

GROUNDWATER SAMPLING PROCEDURES

This summarizes Questa's Sampling, Analysis, and Quality Control procedures used during the purging, sampling and analysis of groundwater samples collected at a project site. In addition to groundwater sampling, the topics of sample container, filtration, preservation, transportation, chain-of-custody, analytical procedures and quality assurance and quality control (QA/QC) considerations are discussed. Appendix C exhibits examples of chain-of-custody and monitoring well forms used.

The following sampling procedures are used by Questa in order to obtain accurate, precise and reliable data. The sampling procedures used are based on the following publication:

1. Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, EPA/530/SW-611, August 1977.

2. RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September 1986.

3. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. EPA/SW-846, November 1986, 3rd Edition.

EQUIPMENT

Centrifugal surface pump; 1-inch PVC flex base;
Stainless steel, Teflon, or Lucite bailers;
Air lift or bladder pump;
pH, conductivity, turbidity, temperature meters;
Electric tape measure (water level sounder);
Steam cleaner;
TSP and wire brush;
55 gallon plastic/metal drums;
Chain-of-custody forms;
Well data sheets;
Ice chest and blue ice; and
Cleaned bottles, preservatives, labels.

Standardization of field equipment will be done at the beginning of each use, according to manufacture's specifications and consistent with methods described in EPA\SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods.

Free Product Measurements

Prior to sampling, the water interface for the monitoring well will be checked with a clear acrylic bailer to inspect for the presence of floating product. If floating product is detected, the depth probe is reinserted with gas paste to the pre-measured water depth. When the depth probe signals contact with the water, the probe is removed and the measurement of discoloration is the product thickness.

Sample Labeling

All sample containers will be labeled in the field. All sample labels will contain the following:

Sample identification number
Project Name
Date and time of collection.
Project Number;
Name and affiliation of sampler; and,

Sample Handling

At no time will the elapsed time between sample collection and delivery to the laboratory exceed 72 hours. Under no circumstances will sealed sample containers be opened by other than laboratory personnel who will perform the requested analysis.

Custody Seal

When samples or a sample bottle container leaves the immediate control of the sampler prior to delivery to the laboratory, (shipment by a courier service), a custody seal will be placed on each sample bottle container to ensure the samples have not been tampered with during transportation.

Chain-of-Custody

In order to document and trace sample possession from time of collection, a chain-of-custody record will be filled out by the sampler and accompany the sample(s) through laboratory analyses. The completed chain-of-custody record will be included in the analytical report from the laboratory.

Blanks

Blanks will be used or collected as part of the sampling program at the discretion of the project manager. Trip and/or field blanks will be supplied and analyzed along with the samples.

APPENDIX C

Well Development Field Forms

WILL USE THIS TYPE

FIELD LOG DATA SHEET
WELL PURGING AND SAMPLING

PROJECT: Mac Arthur
PROJECT NUMBER: 92150 WELL NUMBER MW-1
PROJECT LOCATION: @ 1499 MacArthur, Oakland

INITIAL SAMPLING	DATE
1st Quarter	DATE
2nd Quarter	DATE
3rd Quarter	DATE
4th Quarter	DATE
5th Quarter	DATE
6th Quarter	DATE

WELL IDENTIFICATION/CHARACTERISTICS

KEY NUMBER _____ WELL COMPLETION DATE 1-7-93
WELL CONSTRUCTION - SLOTTED 10 Feet/Meters,
BLANK 10 Feet/Meters WELL ELEVATION 183.59 Feet/Meters
TOTAL WELL DEPTH (From Top of Casing) _____ Feet/Meters WELL VOLUME _____

PRE-DEVELOPMENT WATER QUALITY MEASUREMENTS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth
1-12-93	815	7.83	690	52.0° F	13.64	NONE
1-12-93	950	7.40	690	50.7° F	13.88	"

DEVELOPMENT AND STABILIZATION TEST

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Beginning Water Level	Recovery Time	Purge Volume (gals.)
1-12-93	1000	7.47	890	52.6°F	13.88		4.75
↓	1018	7.52	860	51.6° F	14.80		4.25
↓	1032	7.57	930	52.3°F	14.72		4.5
↓	1048	7.48	920	53.8°F	14.77		4.5

PRE-PURGE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

SAMPLE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

NAME AND AFFILIATION OF SAMPLERS: _____

SAMPLING EQUIPMENT USED _____

OBSERVATIONS Recovery is fairly quick to approx. 80-85% of original well volume. Water is somewhat silty.

SAMPLE LOG

ANALYSIS	SAMPLE NUMBER	# OF SAMPLES	CONTAINER TYPE	NOTES
TPH-G				
TPH-G/BTX&E				
TPH-D				
OIL & GREASE				
METALS				
8010				
8240				
ORGANIC LEAD				

WILL USE THIS TYPE

FIELD LOG DATA SHEET
WELL PURGING AND SAMPLING

PROJECT: Mac Arthur
PROJECT NUMBER: 92150 WELL NUMBER MW-2
PROJECT LOCATION: 1499 Mac Arthur

INITIAL SAMPLING _____ DATE _____
1st Quarter _____ DATE _____
2nd Quarter _____ DATE _____
3rd Quarter _____ DATE _____
4th Quarter _____ DATE _____
5th Quarter _____ DATE _____
6th Quarter _____ DATE _____

WELL IDENTIFICATION/CHARACTERISTICS

KEY NUMBER _____ WELL COMPLETION DATE 1-7-93
WELL CONSTRUCTION - SLOTTED 10 Feet/Meters,
BLANK 10 Feet/Meters WELL ELEVATION 183.06 Feet/Meters
TOTAL WELL DEPTH (From Top of Casing) _____ Feet/Meters WELL VOLUME _____

PRE-DEVELOPMENT WATER QUALITY MEASUREMENTS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth
1-12-93	820	7.18	800	56.4° F	10.04'	Odor/sheen
1-12-93	1053	7.38	790	52.1° F	10.07'	

DEVELOPMENT AND STABILIZATION TEST

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Beginning Water Level	Recovery Time	Purge Volume (gals.)
1-12-93	1102	7.36	900	54.4° F	10.07		6.25
↓	1113	7.50	900	48.8° F	13.98		4.5
	1130	7.72	910	51.2°	13.22		3.75
	1140	7.66	890	49.3°	14.84		3.0
↓	1212	7.64	890	48.7°	13.02		4.5

PRE-PURGE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

SAMPLE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

NAME AND AFFILIATION OF SAMPLERS: _____

SAMPLING EQUIPMENT USED _____

OBSERVATIONS Recovers to 60% within approx. 10 min., then more slowly. Never did return to +80% during development. Noticeable sheen on water & hydrocarbon odor.

SAMPLE LOG

ANALYSIS	SAMPLE NUMBER	# OF SAMPLES	CONTAINER TYPE	NOTES
TPH-G				
TPH-G/BTX&E				
TPH-D				
OIL & GREASE				
METALS				
8010				
8240				
ORGANIC LEAD				

WILL USE THIS TYPE

FIELD LOG DATA SHEET
WELL PURGING AND SAMPLING

PROJECT: Mac Arthur
PROJECT NUMBER: 92150 WELL NUMBER MW-3
PROJECT LOCATION: 1499 Mac Arthur, Oakland

INITIAL SAMPLING	DATE
1st Quarter	DATE
2nd Quarter	DATE
3rd Quarter	DATE
4th Quarter	DATE
5th Quarter	DATE
6th Quarter	DATE

WELL IDENTIFICATION/CHARACTERISTICS

KEY NUMBER _____ WELL COMPLETION DATE 1-7-93
WELL CONSTRUCTION - SLOTTED 10 Feet/Meters,
BLANK 10 Feet/Meters WELL ELEVATION 182.55 Feet/Meters
TOTAL WELL DEPTH (From Top of Casing) _____ Feet/Meters WELL VOLUME _____

PRE-DEVELOPMENT WATER QUALITY MEASUREMENTS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth
1-12-93	818	7.04	730	56.7° F	13.00	None
					[illegible]	

DEVELOPMENT AND STABILIZATION TEST

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Beginning Water Level	Recovery Time	Purge Volume (gals.)
1-12-93	855	7.36	720	54.3°F	13.00		4.5
	905	7.42	770	53.3°	13.12		4.75
↓	928	7.53	760	53.9°	13.04		4.5
	945	7.45	770	53.6°	13.02		4.75

PRE-PURGE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

SAMPLE WATER QUALITY PARAMETERS

DATE	TIME	pH	Specific Conductance (umhos/cm2)	Temperature	Water Level	Free Product Indicate Depth

NAME AND AFFILIATION OF SAMPLERS: _____

SAMPLING EQUIPMENT USED _____

OBSERVATIONS Very fast recovery. Also, large amount of sand in casing. Water v. silty.

SAMPLE LOG

ANALYSIS	SAMPLE NUMBER	# OF SAMPLES	CONTAINER TYPE	NOTES
TPH-G				
TPH-G/BTX&E				
TPH-D				
OIL & GREASE				
METALS				
8010				
8240				
ORGANIC LEAD				

APPENDIX D

Laboratory Analysis Reports and Chain-of-Custody

CARTER ENVIRONMENTAL LABORATORY, INC.

WOMEN BUSINESS ENTERPRISE

ENVIRONMENTAL ANALYSIS

LAB NUMBER: 13281A-JP CERTIFICATION NO: 1661
RECEIVED: 1/08/93 ANALYZED: 1/12/93
REPORTED: 1/14/93 PAGE 1OF 1
METHOD: TPH-G/BTEX

RECEIVED
JAN 29 1993
Ans'd

CUSTOMER: Questa Engineering
CONTACT: Randall Smith
REFERENCE NO: MacArthur/92150
SITE: MacArthur/92150
SAMPLED DATE: 1/7/93
SAMPLE TYPE: Soil
NUMBER OF SAMPLES: 12

Lab ID	Customer Label	TPH-G	TPH-D	Benzene	Toluene	Ethyl Benzene	Xylene
L1	B1 5.0	LDL	NT	LDL	LDL	LDL	LDL
L2	B1 10.0	LDL	NT	LDL	LDL	LDL	LDL
L3	B1 15.0	LDL	NT	LDL	LDL	LDL	LDL
L4	B1 20.0	LDL	NT	LDL	LDL	LDL	LDL
L5	B2 5.0	5.50	NT	LDL	LDL	LDL	LDL
L6	B2 10.0	1460.	NT	LDL	6.44	LDL	63.1
L7	B2 15.5	17.8	NT	.849	.125	LDL	.309
L8	B2 20.5	LDL	NT	LDL	LDL	LDL	LDL
L9	B3 5.0	LDL	NT	LDL	LDL	LDL	LDL
L10	B3 10.0	LDL	NT	LDL	LDL	LDL	LDL
L11	B3 15.0	LDL	NT	LDL	LDL	LDL	LDL
L12	B3 20.0	LDL	NT	LDL	LDL	LDL	LDL
Detection Limits:							
	Liquid (mg/L):	0.050	0.050	0.0005	0.0005	0.0005	0.0005
	Air (mg/M^3):	1.00	1.00	0.005	0.005	0.005	0.005
	Solid (mg/Kg):	1.00	1.00	0.005	0.005	0.005	0.005
Average Percent Recovery		87.1	----	----	91.5	----	----

Dr. A. Edward Robinson TITLE Laboratory Manager

LDL = Less Than Detection Limit DL = Detection Limit NT = NOT TESTED

215 Hacienda Avenue, • Campbell, CA 95008 • (408) 364-3030 • Fax (408) 866-0319

uesta Engineering Corporation
vil, Environmental, and Water Resource Engineers

). Box 356
20 Brickyard Cove Road
lnt Richmond, CA 94807

(510) 236-6114
(TAX) 236-2423

CHAIN OF CUSTODY RECORD

Lab: Carter Analytical Lab

Attn: Dan Turgeon

Report To: Randall Smith

Bill to: Questa

P.O. # / Billing Reference

Project Name / No. MacArthur / 92150

Client No. 13281

Project Manager

Project No.

*Requested Due Date: Normal

Sampled By (PRINT): Randall D. Smith

Sampler Signature: R.D. Smith Date Sampled: 1-7-93

#	SAMPLE DESCRIPTION	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H2SO4	HNO3	VOA	Brass tubes	ANALYSES REQUEST: TPH-g/BTEX	REMARKS
	B1 - 5.0		Soil	1					X	X	
	B1 - 10.0										
	B1 - 15.0										
	B1 - 20.0										
	B2 - 5.0										
	B2 - 10.0										
	B2 - 15.5										
	B2 - 20.5										
	B3 - 5.0										
10	B3 - 10.0										
11	B3 - 15.0										
12	B3 - 20.0										
13											
14											

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	SHIPMENT METHOD RETURNED / DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME
					R.D. Smith	650 Mobile Unit	1-8-93	1151
					650 Mobile Unit		1/8/93	3p

Additional Comments

CARTER ENVIRONMENTAL LABORATORY, INC.

WOMEN BUSINESS ENTERPRISE

ENVIRONMENTAL ANALYSIS

LAB NUMBER: 13296A-JC CERTIFICATION NO: 1661
RECEIVED: 01/14/93 ANALYZED: 01/15/93
REPORTED: 01/18/93 PAGE 1 OF 1
METHOD: TPH-G/BTEX

CUSTOMER: Questa Engineering
CONTACT: Randall Smith
REFERENCE NO: 92150
SITE: MacArthur
SAMPLED DATE: 01/14/93
SAMPLE TYPE: Water
NUMBER OF SAMPLES: 9

RECEIVED
FEB 5 1993
Ans'd.....

Lab ID	Customer Label	TPH-G	TPH-D	Benzene	Toluene	Ethyl Benzene	Xylene
L1	114-01A	.539	NT	.130	.012	.022	.013
L4*	114-02A	149.	NT	21.7	25.0	LDL	7.76
L7	114-03A	1.61	NT	.772	.014	LDL	.011
Detection Limits:							
	Liquid (mg/L):	0.050	0.050	0.0005	0.0005	0.0005	0.0005
	Air (mg/M^3):	1.00	1.00	0.005	0.005	0.005	0.005
	Solid (mg/Kg):	1.00	1.00	0.005	0.005	0.005	0.005
Average Percent Recovery		94.3	----	----	106.	----	----

*Detection limit raised 250x due to dilution.

Dr. A. Edward Robinson TITLE Laboratory Manager

LDL = Less Than Detection Limit DL = Detection Limit NT = NOT TESTED

215 Hacienda Avenue, • Campbell, CA 95008 • (408) 364-3030 • Fax (408) 866-0319

Questa Engineering Corporation

Civil, Environmental, and Water Resource Engineers

P.O. Box 356
1220 Brickyard Cove Road
Point Richmond, CA 94807

(510) 236-6114
(FAX) 236-2423

Lab: Carter

Attn: Dan Turgeon

Report To: Randall Smith

Bill To:

P.O. # / Billing Reference

Project Name / No. MacArthur / 92150

CHAIN-OF-CUSTODY RECORD
Analytical Request

Client No.

Project Manager

Project No.

*Requested Due Date:

Sampled By (PRINT): R. D. Smith

Sampler Signature: R. D. Smith

Date Sampled: 1-14-93

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	PRESERVATIVES: H_2SO_4	PRESERVATIVES: HNO_3	PRESERVATIVES: VOA	PRESERVATIVES: HCl	ANALYSES REQUEST: TPH-g/BTEX	REMARKS
1	114-01-A, B, C		W	3				X	X	X	
2	114-02-A, B, C		↓	↓				↓	↓	↓	
3	114-03-A, B, C		↓	↓				↓	↓	↓	
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	SHIPMENT METHOD RETURNED / DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME
					Andy Lyle Questa 1-14-93 1625	[illegible]		

Additional Comments