Weiss Associates Environmental and Geologic Services

5500 Shellmound Street, Emeryville, CA 94608-2411 Fax: 510-547-5043 Phone: **510-450-6000**

July 12, 1994

Juliet Shin
Alameda County Department of
Environmental Health
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, CA 94621-1426

Re: Shell Service Station
WIC #204-0072-0403
1601 Webster Street
Alameda, California 94501
WA Job #81-434-104

Dear Ms. Shin:

This letter describes recently completed and anticipated activities at the Shell service station referenced above (Figure 1). This status report satisfies the quarterly reporting requirements prescribed by California Administrative Code Title 23 Waters, Chapter 3, Subchapter 16, Article 5, Section 265.d. Included below are descriptions and results of activities performed in the second quarter 1994 and proposed work for the third quarter 1994.

Second Quarter 1994 Activities:

- Dissolved Oxygen (DO) concentrations were measured by BTS in each water sample collected during the first quarter. DO concentrations ranged from 3.6 to 6.8 mg/l. Based on these results, Weiss Associates (WA) concurs that natural biodegradation is occurring at the site. Further evidence is seen by the fact that the hydrocarbon concentrations decreased by half in ground water from well MW-2. Further ground water oxygenation will only increase this microbial activity and WA proposes implementing ground water oxygenation as a remedial alternative. WA is currently investigating new innovative technologies to enhance biodegradation and will continue to monitor hydrocarbon and dissolved oxygen concentrations quarterly.

WA has received your letter of April 13, 1994 and both Shell and WA believe that since hydrocarbon concentrations are decreasing, further investigations are not warranted. However, we are preparing a workplan addressing ground water oxygenation at the site.

- Blaine Tech Services, Inc. (BTS) of San Jose, California measured ground water depths and collected water samples from the site wells. BTS' report describing these sampling activities and presenting analytic results for ground water is included as Attachment A.

- WA compiled the ground water elevation and analytic data (Tables 1 and 2) and prepared a ground water elevation contour map (Figure 2).

- California Regional Water Quality Control Board (RWQCB) personnel have indicated that the RWQCB will allow well sampling frequency reductions on a site specific basis if the frequency reductions are justified by site conditions. WA reviewed historic ground water data for this site to determine the appropriate well sampling frequencies. Our criteria used to determine sampling frequencies is described in detail in Attachment B. Our specific recommendations for this site are presented in Table 3. WA will implement these well sampling frequencies unless we are notified otherwise within 60 days.

Anticipated Third Quarter 1994 Activities:

- WA will continue investigating feasible ground water oxygenation technologies for the site.

- WA will submit a report presenting the results of the third quarter 1994 ground water sampling and depth measurements. The report will include tabulated chemical analytic results and a ground water elevation contour map.

Conclusions and Recommendations:

WA recommends continued ground water sampling according to the frequencies described above to monitor hydrocarbon and dissolved oxygen concentrations and the ground water flow direction at the site.

Please call if you have any questions.

Sincerely,
Weiss Associates

John Wolf
Technical Assistant

James W. Carmody, C.E.G.
Senior Project Hydrogeologist

JAW/JWC:jaw

J:\SHELL\425\QMRPTS\434QMMY4.DOC

Attachments: A - Blaine Tech's Associates' Ground Water Monitoring Report
B - Sampling Frequency Criteria

cc: Dan Kirk, Shell Oil Company, P.O. Box 5278, Concord, California 94520-9998
John Jang, Regional Water Quality Control Board - San Francisco Bay, 2101 Webster Street, Suite 500, Oakland, California 94612

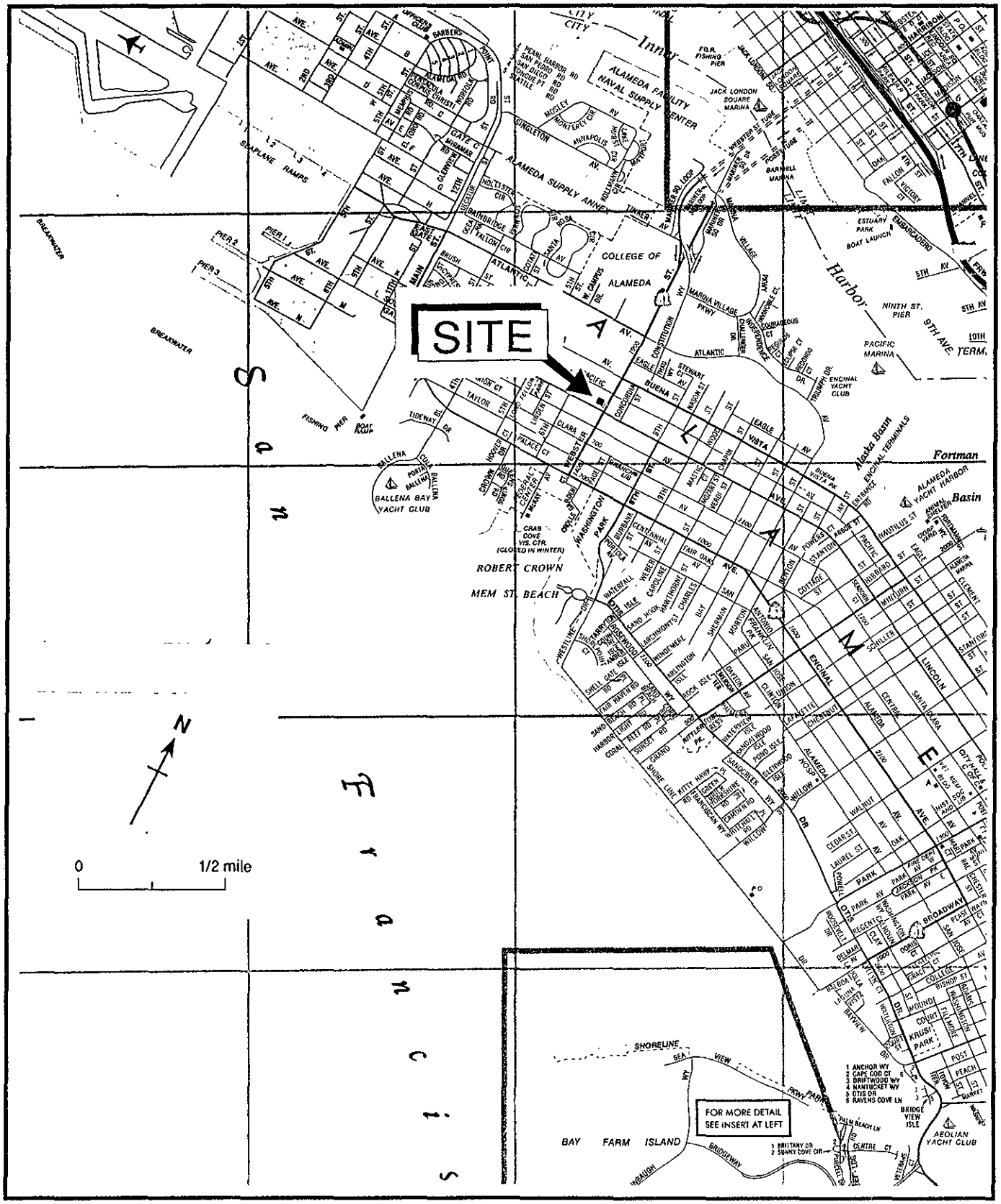


Figure 1. Site Location Map - Shell Service Station, WIC# 204-0072-0403, 1601 Webster Street, Alameda, CA

8/20/90

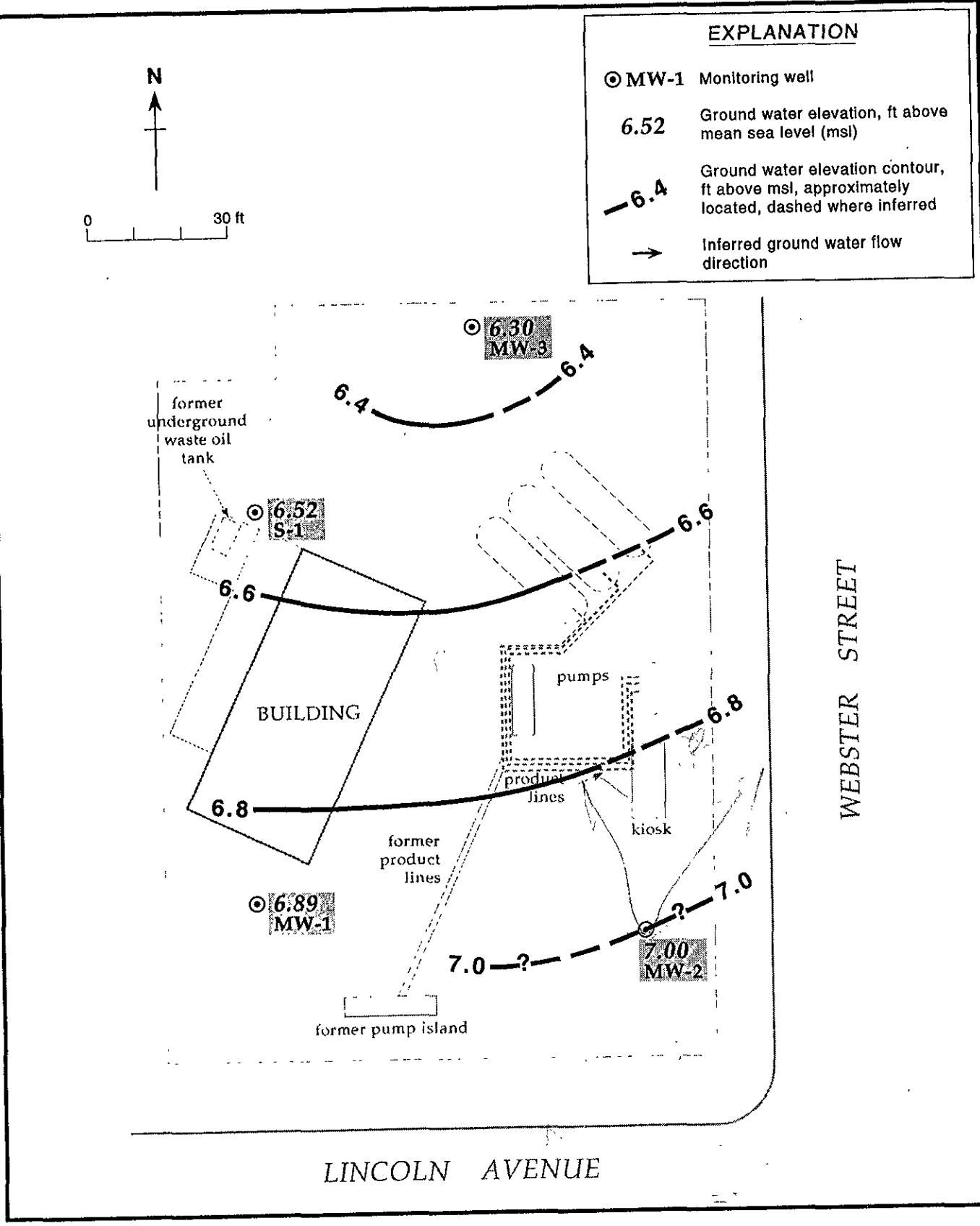


Figure 2. Monitoring Well Locations and Ground Water Elevations - April 13, 1994 - Shell Service Station WIC #204-0072-0403, 1601 Webster Street, Alameda, California

TABLE 1. Ground Water Elevations - Shell Service Station WIC #204-0072-0403, 1601 Webster Street Alameda, California

Well ID	Date	Top-of-Casing Elevation (ft above msl)	Depth to Water (ft)	Ground Water Elevation (ft above msl)
MW-1	04/11/90	13.80	8.22	45.58
	07/18/90		9.14	4.66
	10/18/90		10.37	3.43
	01/25/91		10.41	3.39
	04/11/91		7.37	6.43
	07/18/91		8.86	4.94
	10/17/91		10.47	3.33
	01/24/92		9.18	4.62
	04/23/92		6.95	6.85
	07/22/92		8.01	5.79
	10/02/92		9.81	3.99
	01/05/93		7.26	6.54
	04/08/93	13.80[a]	5.85	7.95
	07/20/93		6.83	6.97
	10/15/93		8.07	5.73
	01/07/94		7.82	5.98
	04/13/94		**6.91**	**6.89**
MW-2	04/11/90	13.20	7.69	5.51
	07/18/90		8.56	4.64
	10/18/90		9.76	3.44
	01/25/91		9.78	3.42
	04/11/91		6.87	6.33
	07/18/91		8.27	4.93
	10/17/19		9.89	3.31
	01/24/92		8.60	4.60
	04/23/92		6.48	6.72
	07/02/92		7.37	5.83
	10/02/92		9.20	4.0
	01/05/93		6.80	6.4
	04/08/93	13.20[a]	5.40	7.80
	07/20/93		6.05	7.15
	10/15/93		7.04	6.16
	01/07/94		6.99	6.21
	04/13/94		**6.20**	**7.00**
MW-3	04/08/93	12.80	5.48	7.32
	07/20/93		6.38	6.42

-- Table 1 continued on next page --

TABLE 1. Ground Water Elevations - Shell Service Station WIC #204-0072-0403, 1601 Webster Street Alameda, California (continued)

Well ID	Date	Top-of-Casing Elevation (ft above msl)	Depth to Water (ft)	Ground Water Elevation (ft above msl)
	10/15/93		7.53	5.27
	01/07/94		7.38	5.42
	04/13/94		**6.50**	**6.30**
S-1	09/11/89	13.77	9.82	3.95
	04/11/90		8.41	5.36
	07/18/90		9.31	4.46
	10/18/90		10.43	3.34
	01/25/91		10.49	3.28
	04/11/91		7.68	6.09
	07/18/91		8.95	4.82
	10/17/91		10.62	3.15
	01/24/92		9.32	4.45
	04/23/92		7.27	6.50
	07/02/92		8.19	5.58
	10/02/92		9.95	3.82
	01/05/93		7.64	6.13
	04/08/93	13.74[a]	6.10	7.64
	07/20/93		7.18	6.56
	10/15/93		8.39	5.35
	01/07/94		8.19	5.55
	04/13/94		**7.22**	**6.52**

a = Top of casing resurveyed on March 30, 1993

TABLE 2. Analytic Results for Ground Water - Shell Service Station, WIC #204-0072-0403, 1601 Webster Street, Alameda, California

Sample ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	B	E	T	X	c-1,2-DCE	1,2-DCA	TOG
			<----------parts per billion (ug/L)---------->								
MW-1	04-11-90	8.22	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10,000
	07-18-90	9.14	<50	---	<0.5	<0.5	<0.5	<0.5	3	<0.5	<5,000
	10-18-90	10.37	<50	---	<0.5	<0.5	<0.5	<0.5	7.9	<0.5	<5,000
	01-25-91	10.41	<50	---	<0.5	<0.5	<0.5	<0.5	5.6	<0.5	---
	04-11-91	7.37	<50	---	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	---
	07-18-91	8.86	<50	---	<0.5	<0.5	<0.5	<0.5	4.4	<0.5	---
	10-17-91	10.47	<50	---	<0.5	<0.5	<0.5	<0.5	7.2	<0.5	---
	01-24-92	9.18	<50	---	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	---
	04-23-92	6.95	<50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
	07-02-92	8.01	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
	10-02-92	9.81	<50	---	<0.5	<0.5	<0.5	<0.5	2	<0.5	---
	01-05-93	7.26	<50	---	<0.5	<0.5	<0.5	<0.5	2	<0.5	---
	04-08-93[a]	5.85	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
	07-20-93[f]	6.83	<50	---	<0.5	<0.5	<0.5	<0.5	0.76	<0.5	---
	10-15-93	8.07	<50	---	<0.5	<0.5	<0.5	<0.5	0.71	<0.5	---
	01-07-94	7.82	<50	---	<0.5	<0.5	<0.5	<0.5	3.1	0.85	---
	04-13-94	**6.91**	**<50**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**3.6**	**0.95**	**---**
									6ppb	.5ppb	MCL
MW-2	04-11-90	7.69	580	430	20	1.2	4.9	73	<0.5	1.1	<10,000
	07-18-90	8.56	1,400	---	110	71	310	310	<0.5	0.7	<5,000
	10-18-90	9.76	1,900	1,300[b]	110	89	470	400	<0.5	0.9	<5,000
	01-25-91	9.78	8,100	---	430	480	1,200	2,600	<0.5	0.8	---
	04-11-91	6.87	2,600	---	130	250	150	330	<0.5	<0.5	---
	07-15-91	8.27	1,300	---	100	84	59	120	<0.5	0.8	---
	10-17-91	9.89	2,100	---	180	150	260	520	<0.5	0.6	---
	01-24-92	8.60	7,100	---	450	960	450	1,600	110	<0.5	---
	04-23-92	6.48	16,000	---	320	650	740	2,600	<2.5	<2.5	---
	07-02-92	7.37	33,000	---	2,500	2,000	3,700	9,600	<50	<50	---
	10-02-92	9.20	7,000	---	960	570	650	1,200	<50	<50	---
	01-05-93	6.80	8,900	---	550	600	500	1,900	<2	<2	---
	04-08-93	5.40	13,000	---	670	900	580	2,900	0.68	<0.5	---
	04-08-93[dup]	5.40	13,000	---	830	1,100	740	3,700	0.64	<0.5	---
	07-20-93	6.05	10,000	---	1,200	1,100	630	4,000	0.87	<0.5	---
	07-20-93[dup]	6.05	12,000	---	1,200	1,100	600	3,800	0.80	<0.5	---
	10-15-93	7.04	24,000	---	1,400	1,200	3,400	5,200	<0.5	<0.5	---
	10-15-93[dup]	7.04	19,000	---	1,200	1,000	2,800	4,400	<0.5	<0.5	---

-- Table 2 continued on next page --

TABLE 2. Analytic Results for Ground Water - Shell Service Station, WIC #204-0072-0403, 1601 Webster Street, Alameda, California (continued)

Sample ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	B	E	T	X	c-1,2-DCE	1,2-DCA	TOG
			<----------parts per billion (ug/L)---------->								
	01-07-94	6.99	27,000	---	1,300	1,900	2,700	7,900	<10	<10	---
	01-07-94[dup]	6.99	33,000	---	1,100	1,700	2,300	6,900	<10	<10	---
	04-13-94	**6.20**	**16,000**	**---**	**460**	**820**	**93**	**2,700**	**<25**	**<25**	**---**
	04-13-94[dup]	**6.20**	**18,000**	**---**	**500**	**880**	**100**	**3,000**	**<25**	**<25**	**---**
MW-3	02-25-93	5.37	58	140	<0.5	2.5	<0.5	6.4	<0.5	1.5	<5,000
	04-08-93	5.48	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
	07-20-93[g]	6.38	<50	---	1.2	<0.5	<0.5	<0.5	<0.5	2.8	---
	10-15-93[h]	7.53	60	---	<0.5	<0.5	<0.5	<0.5	<0.5	0.55	---
	01-07-94	7.38	74	---	<0.5	<0.5	<0.5	0.76	<0.5	0.91	---
	04-13-94	**6.50**	**<50**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<1.3**	**<1.3**	**---**
S-1	09-04-87[d]		---	---	<5	<5	<5	<5	<0.5	<0.5	---
	09-11-89[e]	9.82	<50	<100	<0.5	<1	<1	<3	<0.5	<0.5	<1,000
	04-11-90	8.41	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10,000
	07-18-90	9.31	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5,000
	10-18-90	10.43	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5,000
	01-25-91	10.49	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-11-91	7.68	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-18-91	8.95	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-17-91	10.62	<50	---	<0.5	<0.5	<0.5	<5	---	---	---
	01-24-92	9.32	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-23-92	7.27	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-02-92	8.19	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-02-92	9.95	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	01-05-93	7.64	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-08-93	6.10	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-20-93	7.18	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-15-93	8.39	<50	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
	01-07-94	8.19	<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-13-94	**7.22**	**<50**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**---**	**---**	**---**
Trip Blank	07-18-90		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-18-90		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	01-25-91		<50	---	<0.5	<0.5	<0.5	0.8	---	---	---

-- Table 2 continued on next page --

TABLE 2. Analytic Results for Ground Water - Shell Service Station, WIC #204-0072-0403, 1601 Webster Street, Alameda, California

Sample ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	B	E	T	X	c-1,2-DCE	1,2-DCA	TOG
			<----------parts per billion (ug/L)---------->								
	04-11-91		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-18-91		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-17-91		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	01-24-92		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-23-92		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-02-92		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-02-92		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	01-05-93		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-08-93		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	07-20-93		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	10-15-93		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	01-07-94		<50	---	<0.5	<0.5	<0.5	<0.5	---	---	---
	04-13-94		**<50**	**---**	**<0.5**	**<0.5**	**<0.5**[i]	**<0.5**	**---**	**---**	**---**
DTSC MCLs			NE	NE	1	680	100[j]	1,750	6.0	0.5	NE

-- Table 2 continued on next page --

TABLE 2. Analytic Results for Ground Water - Shell Service Station, WIC #204-0072-0403, 1601 Webster Street, Alameda, California (continued)

Abbreviations:

TPH-G = Total petroleum hydrocarbons as gasoline by Modified EPA Method 8015
TPH-D = Total petroleum hydrocarbons as diesel by Modified EPA Method 8015
B = Benzene by EPA Method 602, 624, or 8020
E = Ethylbenzene by EPA Method 602, 624, or 8020
T = Toluene by EPA Method 602, 624, or 8020
X = Xylenes by EPA Method 602, 624, or 8020
c-1,2-DCE = cis-1,2-dichloroethene by EPA Method 601 or 624
1,2-DCA = 1,2-dichloroethane by EPA Method 601 or 624
TOG = Total non-polar oil and grease by American Public Health Association Standard Method 503E
<**n** = Not detected at detection limit of **n** ppb
DTSC MCL = California Department of Toxic Substances Control maximum contaminant level for drinking water
NE = Not established
--- = Not analyzed
dup = Duplicate sample

Notes:

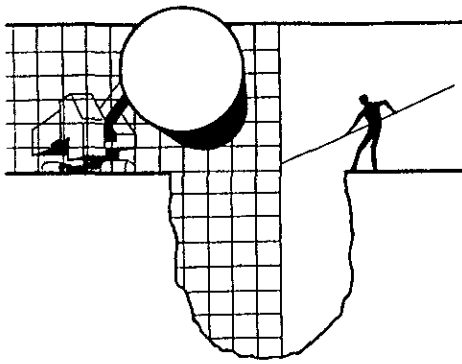
a = Chloroform detected at 0.0071 ppm by EPA Method 8010
b = Compounds detected and calculated as diesel appear to be the less volatile constituents of gasoline
c = Chloroform detected at 0.017 ppm and bromodichlorome at 0.0007 ppm by EPA Method 8010
d = 0.12 ppm acetone detected by EPA Method 624; no other volatile organic compounds detected
e = Metals detected by EPA Method 6010; 0.020 ppm chromium, 0.060 ppm lead and 0.030 ppm zinc; no cadmium detected above detection limit of 0.010 ppm; no PCBs or semi-volatile compounds detected by EPA Method 625
f = Chloroform detected at 1.1 ppb by EPA Method 8010
g = Chloroform detected at 1.5 ppb by EPA Method 8010
h = Chloroform detected at 3.6 ppb by Method 8010
i = 0.54 ppb Toluene detected in equipment blank
j = DTSC recommended action level for drinking water; MCL not established

Table 3. Recommended Sampling Frequency Modifications for Ground Water Monitoring Wells - Shell Service Station #WIC 204-0072-0403, 1601 Webster Street, Alameda, California

Monitoring Well	Current Sampling Frequency	Recommended Sampling Frequency	Rational for Recommended Sampling Frequency
MW-1	Quarterly	Annually - 1st Quarter	Crossgradient well; no TPH-G or BTEX detected in at least 3 consecutive years
MW-2	Quarterly	Quarterly	Upgradient well
MW-3	Quarterly	Quarterly	Downgradient Well
S-1	Quarterly	Annually - 1st Quarter	Crossgradient well; no TPH-G or BTEX detected in at least 3 consecutive years

ATTACHMENT A

GROUND WATER MONITORING REPORT AND ANALYTIC REPORT



BLAINE TECH SERVICES INC.

985 TIMOTHY DRIVE
SAN JOSE, CA 95133
(408) 995-5535
FAX (408) 293-8773

May 10, 1994

A CLUSTER OF NEARLY IDENTICAL
ANALYTICAL POSITIVES
FOUND IN EQUIPMENT RINSATE BLANKS
TAKEN WITH LABORATORY SUPPLIED
-- BUT UNTESTED AND UNCERTIFIED --
WATER

To whom it may concern:

Sequoia Analytical reports finding low level Toluene and Total Xylenes in a number of recent Equipment Rinsate Blanks, including the Equipment Blank from this site. Toluene was present in all of these Equipment Blank samples, but only in a narrow range between 0.52 ppb and 2.3 ppb. Total Xylenes were found in several of the samples in a range between 0.55 ppm and 0.71 ppb.

We reviewed our work and found no protocol or procedural errors which could have caused the contamination that was found. In fact, the contamination found in the blanks could not have come from any of the wells that were sampled *prior* to collecting the blanks since all these wells were, uniformly, none detected (as were the wells *following* the blanks). Moreover, positives were found in work performed at different sites, in work done on different days, and in work done by different personnel. These facts combined with the surprising uniformity of the results enabled us to rule out random airborne contamination such as would be detected by EPA Field Blanks. We identified the most likely source of the contamination as the unanalyzed water that the laboratory supplies to us and which we then use in collecting Equipment Rinsate Blanks and return to the laboratory.

By Friday April 22, 1994, Sequoia Analytical personnel informed us that they had reviewed their own work and found no indication of either in-lab contamination or contaminant carry-over in any particular instrument. Reshooting more sample material validated their earlier findings. On Monday April 25, 1994 Diane Lawver, Vice President of Sequoia Analytical and QA Director said she saw the water used in the blanks as a possible source, but thought the contamination was more likely to be coming from the commercially prepared sample bottles into which the commercial water was decanted. She indicated they have encountered certain batches of commercially prepared sample bottles that are contaminated with these same Toluene and Total Xylene constituents.

We conclude that these particular results are false positives which should be disregarded. However, the broader issue of Quality Control and QA on the materials used to take Equipment Rinsate Blanks will be explored further in discussions with the laboratory and Shell Oil Company.

Richard C. Blaine
President

BLAINE
TECH SERVICES INC.

985 TIMOTHY DRIVE
SAN JOSE, CA 95133
(408) 995-5535
FAX (408) 293-8773

May 11, 1994

Shell Oil Company
P.O. Box 5278
Concord, CA 94520-9998

Attn: Daniel T. Kirk

SITE:
Shell WIC #204-0072-0403
1601 Webster Street
Alameda, California

QUARTER:
2nd quarter of 1994

QUARTERLY GROUNDWATER SAMPLING REPORT *940413-L-2*

This report contains data collected during routine inspection, gauging and sampling of groundwater monitoring wells performed by Blaine Tech Services, Inc. in response to the request of the consultant who is overseeing work at this site on behalf of our mutual client, Shell Oil Company. Data collected in the course of our field work is presented in a TABLE OF WELL GAUGING DATA. The field information was collected during our preliminary gauging and inspection of the wells, the subsequent evacuation of each well prior to sampling, and at the time of sampling.

Measurements taken include the total depth of the well and the depth to water. The surface of water was further inspected for the presence of immiscibles which may be present as a thin film (a sheen on the surface of the water) or as a measurable free product zone (FPZ). At intervals during the evacuation phase, the purge water was monitored with instruments that measure electrical conductivity (EC), potential hydrogen (pH), temperature (degrees Fahrenheit), and turbidity (NTU). In the interest of simplicity, fundamental information is tabulated here, while the bulk of the information is turned over directly to the consultant who is making professional interpretations and evaluations of the conditions at the site.

STANDARD PROCEDURES

Evacuation

Groundwater wells are thoroughly purged before sampling to insure that the sample is collected from water that has been newly drawn into the well from the surrounding geologic formation. The selection of equipment to evacuate each well is based on the physical characteristics of the well and what is known about the performance of the formation in which the well has been installed. There are several suitable devices which can be used for evacuation. The most commonly employed devices are air or gas actuated pumps, electric submersible pumps, and hand or mechanically actuated bailers. Our personnel frequently employ USGS/Middleburg positive displacement pumps or similar air actuated pumps which do not agitate the water standing in the well.

Normal evacuation removes three case volumes of water from the well. More than three case volumes of water are removed in cases where more evacuation is needed to achieve stabilization of water parameters and when requested by the local implementing agency . Less water may be obtained in cases where the well dewaters and does not recharge to 80% of its original volume within two hours and any additional time our personnel have reason to remain at the site. In such cases, our personnel return to the site within twenty four hours and collect sample material from the water which has recharged into the well case.

Decontamination

All apparatus is brought to the site in clean and serviceable condition. The equipment is decontaminated after each use and before leaving the site. Effluent water from purging and on-site equipment cleaning is collected and transported to Shell's Martinez Manufacturing Complex in Martinez, California.

Free Product Skimmer

The column headed, VOLUME OF IMMISCIBLES REMOVED (ml) is included in the TABLE OF WELL GAUGING DATA to cover situations where a free product skimming device must be removed from the well prior to gauging. Skimmers are installed in wells with a free product zone on the surface of the water. The skimmer is a free product recovery device which often prevents normal well gauging and free product zone measurements. The 2.0" and 3.0" PetroTraps fall into the category of devices that obstruct normal gauging. In cases where the consultant elects to have our personnel pull the skimmers out of the well and gauge the well, our personnel perform the additional task of draining the accumulated free product out of the PetroTrap before putting it back in the well. This

recovered free product is measured and logged in the VOLUME OF IMMISCIBLES REMOVED column. Gauging at such site is performed in accordance with specific directions from the professional consulting firm overseeing work at the site on Shell's behalf.

Sample Containers

Sample material is collected in specially prepared containers which are provided by the laboratory that performs the analyses.

Sampling

Sample material is collected in stainless steel bailer type devices normally fitted with both a top and a bottom check valve. Water is promptly decanted into new sample containers in a manner which reduces the loss of volatile constituents and follows the applicable EPA standard for handling volatile organic and semi-volatile compounds.

Following collection, samples are promptly placed in an ice chest containing prefrozen blocks of an inert ice substitute such as Blue Ice or Super Ice. The samples are maintained in either an ice chest or a refrigerator until delivered into the custody of the laboratory.

Sample Designations

All sample containers are identified with a site designation and a discrete sample identification number specific to that particular groundwater well. Additional standard notations (e.g. time, date, sampler) are also made on the label.

Chain of Custody

Samples are continuously maintained in an appropriate cooled container while in our custody and until delivered to the laboratory under a standard Shell Oil Company chain of custody. If the samples are taken charge of by a different party (such as another person from our office, a courier, etc.) prior to being delivered to the laboratory, appropriate release and acceptance records are made on the chain of custody (time, date, and signature of the person releasing the samples followed by the time, date and signature of the person accepting custody of the samples).

Hazardous Materials Testing Laboratory

The samples obtained at this site were delivered to Sequoia Analytical Laboratory in Redwood City, California. Sequoia Analytical Laboratory is a California Department of Health Services certified Hazardous Materials Testing Laboratory and is listed as DOHS HMTL #1210.

Objective Information Collection

Blaine Tech Services, Inc. performs specialized environmental sampling and documentation as an independent third party. In order to avoid compromising the objectivity necessary for the proper and disinterested performance of this work, Blaine Tech Services, Inc. performs no consulting and does not become involved in the marketing or installation of remedial systems of any kind. Blaine Tech Services, Inc. is concerned only with the generation of objective information, not with the use of that information to support evaluations and recommendations concerning the environmental condition of the site. Even the straightforward interpretation of objective analytical data is better performed by interested regulatory agencies, and those engineers and geologists who are engaged in the work of providing professional opinions about the site and proposals to perform additional investigation or design remedial systems.

Reportage

Submission of this report and the attached laboratory report to interested regulatory agencies is handled by the consultant in charge of the project. Any professional evaluations or recommendations will be made by the consultant under separate cover.

Please call if we can be of any further assistance.

James Allen for

Richard C. Blaine

RCB/lp

attachments: table of well gauging data
chain of custody
certified analytical report

cc: Weiss Associates
5500 Shellmound Street
Emeryville, CA 94608-2411
ATTN: Michael Asport

TABLE OF WELL GAUGING DATA

WELL I.D.	DATA COLLECTION DATE	MEASUREMENT REFERENCED TO	QUALITATIVE OBSERVATIONS (sheen)	DEPTH TO FIRST IMMISCIBLES LIQUID (FPZ) (feet)	THICKNESS OF IMMISCIBLES LIQUID ZONE (feet)	VOLUME OF IMMISCIBLES REMOVED (ml)	DEPTH TO WATER (feet)	DEPTH TO WELL BOTTOM (feet)
MW-1	4/13/94	TOC	–	NONE	–	–	6.91	20.70
MW-2 *	4/13/94	TOC	SHEEN/ODOR	–	–	–	6.20	19.82
MW-3	4/13/94	TOC	–	NONE	–	–	6.50	19.38
S-1	4/13/94	TOC	–	NONE	–	–	7.22	19.75

* Sample DUP was a duplicate sample taken from well MW-2.

SHELL OIL COMPANY
RETAIL ENVIRONMENTAL ENGINEERING - WEST

CHAIN OF CUSTODY RECORD
Serial No: 940413-C2

Date: 4/13/94
Page 1 of 1

Site Address: 1601 Webster Street, Alameda

WIC#: 204-0072-0403

Shell Engineer: Dan Kirk — Phone No.: (510) 675-6168 Fax #: 675-6160

Consultant Name & Address: Blaine Tech Services, Inc. 985 Timothy Drive San Jose, CA 95133

Consultant Contact: Jim Keller — Phone No.: (408) 995-5535 Fax #: 293-8773

Comments:

Sampled by: Kent E. Brown

Printed Name: KENT E. BROWN

LAB: ~~Anametrix~~ Sequoia

Sample ID	Date	Sludge	Soil	Water	Air	No. of conts.	TPH (EPA 8015 Mod. Gas)	TPH (EPA 8015 Mod. Diesel)	BTEX (EPA 8020/602)	Volatile Organics (EPA 8240)	Test for Disposal	Combination TPH 8015 & BTEX 8020	EPA - 601	Asbestos	Container Size	Preparation Used	Composite Y/N	MATERIAL DESCRIPTION	SAMPLE CONDITION/ COMMENTS
MW-1	4/13/94			W		6						X	X						
MW-2						6						X	X						
MW-3						6						X	X						
S-1						3						X							
E.B.						3						X							
DUP.						6						X	X						
T.B.						2						X							

CHECK ONE (1) BOX ONLY — C1/01

Quarterly Monitoring	[X]	8441
Site Investigation	[ ]	8441
Soil Closure/Disposal	[ ]	8442
Water Closure/Disposal	[ ]	8443
Soil/Air Rem. or Sys. O & M	[ ]	8442
Water Rem. or Sys. O & M	[ ]	8443
Other	[ ]	

TURN AROUND TIME

- 24 hours [ ]
- 48 hours [ ]
- 15 days [X] (Normal)
- Other [ ] ____

NOTE: Notify Lab a soon as Possible of 24/48 hrs. TAT.

	Printed Name:	Date:	Time:	Received (signature):	Printed Name:	Date:	Time:
Relinquished By (signature): Kent E. Brown	KENT E. BROWN	4/14/94	0800		Greg Fulcher	4-14-94	0900
Relinquished By (signature):	Printed Name:	Date:	Time:	Received (signature):	Printed Name:	Date:	Time:
Relinquished By (signature):	Printed Name:	Date:	Time:	Received (signature):	Printed Name:	Date:	Time:

THE LABORATORY MUST PROVIDE A COPY OF THIS CHAIN-OF-CUSTODY WITH INVOICE AND RESULTS

Sequoia Analytical

680 Chesapeake Drive, Redwood City, CA 94063, (415) 364-9600, FAX (415) 364-9233
1900 Bates Avenue, Suite L, Concord, CA 94520, (510) 686-9600, FAX (510) 686-9689
819 Striker Avenue, Suite 8, Sacramento, CA 95834, (916) 921-9600, FAX (916) 921-0100

Blaine Tech Services, Inc.
985 Timothy Drive
San Jose, CA 95133
Attention: Jim Keller

Project: 940413-L2, Shell, 1601 Webster St.

Enclosed are the results from 7 water samples received at Sequoia Analytical on April 14,1994. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
4D80601	Water, MW-1	4/13/94	EPA 5030/8015 Mod./8020 EPA 601
4D80602	Water, MW-2	4/13/94	EPA 5030/8015 Mod./8020 EPA 601
4D80603	Water, MW-3	4/13/94	EPA 5030/8015 Mod./8020 EPA 601
4D80604	Water, S-1	4/13/94	EPA 5030/8015 Mod./8020
4D80605	Water, E.B.	4/13/94	EPA 5030/8015 Mod./8020
4D80606	Water, Dup	4/13/94	EPA 5030/8015 Mod./8020 EPA 601
4D80607	Water, TB	4/13/94	EPA 5030/8015 Mod./8020

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

Sequoia Analytical

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled: Apr 13, 1994
985 Timothy Drive	Sample Matrix:	Water	Received: Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 5030/8015 Mod./8020	Reported: Apr 26, 1994
Attention: Jim Keller	First Sample #:	4D80601	

TOTAL PURGEABLE PETROLEUM HYDROCARBONS with BTEX DISTINCTION

Analyte	Reporting Limit µg/L	Sample I.D. 4D80601 MW-1	Sample I.D. 4D80602 MW-2	Sample I.D. 4D80603 MW-3	Sample I.D. 4D80604 S-1	Sample I.D. 4D80605 E.B.	Sample I.D. 4D80606 Dup
Purgeable Hydrocarbons	50	N.D.	16,000	N.D.	N.D.	N.D.	18,000
Benzene	0.50	N.D.	460	N.D.	N.D.	N.D.	500
Toluene	0.50	N.D.	93	N.D.	N.D.	0.54	100
Ethyl Benzene	0.50	N.D.	820	N.D.	N.D.	N.D.	880
Total Xylenes	0.50	N.D.	2,700	N.D.	N.D.	N.D.	3,000
Chromatogram Pattern:		--	C4 - C12	--	--	C4 - C12	C4 - C12

Quality Control Data

Report Limit Multiplication Factor:	1.0	50	1.0	1.0	1.0	40
Date Analyzed:	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94
Instrument Identification:	GCHP-2	GCHP-2	GCHP-2	GCHP-2	GCHP-2	GCHP-2
Surrogate Recovery, %: (QC Limits = 70-130%)	95	97	101	84	93	105

Purgeable Hydrocarbons are quantitated against a fresh gasoline standard.
Analytes reported as N.D. were not detected above the stated reporting limit.

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled:	Apr 13, 1994
985 Timothy Drive	Sample Matrix:	Water	Received:	Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 5030/8015 Mod./8020	Reported:	Apr 26, 1994
Attention: Jim Keller	First Sample #:	4D80607		

TOTAL PURGEABLE PETROLEUM HYDROCARBONS with BTEX DISTINCTION

Analyte	Reporting Limit µg/L	Sample I.D. 4D80607 TB
Purgeable Hydrocarbons	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Total Xylenes	0.50	N.D.
Chromatogram Pattern:		--

Quality Control Data

Report Limit Multiplication Factor:	1.0
Date Analyzed:	4/18/94
Instrument Identification:	GCHP-2
Surrogate Recovery, %: (QC Limits = 70-130%)	94

Purgeable Hydrocarbons are quantitated against a fresh gasoline standard.
Analytes reported as N.D. were not detected above the stated reporting limit.

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled:	Apr 13, 1994
985 Timothy Drive	Sample Descript:	Water, MW-1	Received:	Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 601	Analyzed:	Apr 20, 1994
Attention: Jim Keller	Lab Number:	4D80601	Reported:	Apr 26, 1994

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	0.50	N.D.
Bromoform	0.50	N.D.
Bromomethane	1.0	N.D.
Carbon tetrachloride	0.50	N.D.
Chlorobenzene	0.50	N.D.
Chloroethane	1.0	N.D.
2-Chloroethylvinyl ether	1.0	N.D.
Chloroform	0.50	N.D.
Chloromethane	1.0	N.D.
Dibromochloromethane	0.50	N.D.
1,3-Dichlorobenzene	0.50	N.D.
1,4-Dichlorobenzene	0.50	N.D.
1,2-Dichlorobenzene	0.50	N.D.
1,1-Dichloroethane	0.50	N.D.
1,2-Dichloroethane	0.50	N.D.
1,1-Dichloroethene	0.50	N.D.
cis-1,2-Dichloroethene	**0.50**	**3.6**
trans-1,2-Dichloroethene	0.50	N.D.
1,2-Dichloropropane	0.50	N.D.
cis-1,3-Dichloropropene	0.50	N.D.
trans-1,3-Dichloropropene	0.50	N.D.
Methylene chloride	5.0	N.D.
1,1,2,2-Tetrachloroethane	0.50	N.D.
Tetrachloroethene	0.50	N.D.
1,1,1-Trichloroethane	0.50	N.D.
1,1,2-Trichloroethane	0.50	N.D.
Trichloroethene	**0.50**	**0.95**
Trichlorofluoromethane	0.50	N.D.
Vinyl chloride	1.0	N.D.

Analytes reported as N.D. were not present above the stated limit of detection.

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Project Manager

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled:	Apr 13, 1994
985 Timothy Drive	Sample Descript:	Water, MW-2	Received:	Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 601	Analyzed:	Apr 20, 1994
Attention: Jim Keller	Lab Number:	4D80602	Reported:	Apr 26, 1994

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	25	N.D.
Bromoform	25	N.D.
Bromomethane	50	N.D.
Carbon tetrachloride	25	N.D.
Chlorobenzene	25	N.D.
Chloroethane	50	N.D.
2-Chloroethylvinyl ether	50	N.D.
Chloroform	25	N.D.
Chloromethane	50	N.D.
Dibromochloromethane	25	N.D.
1,3-Dichlorobenzene	25	N.D.
1,4-Dichlorobenzene	25	N.D.
1,2-Dichlorobenzene	25	N.D.
1,1-Dichloroethane	25	N.D.
1,2-Dichloroethane	25	N.D.
1,1-Dichloroethene	25	N.D.
cis-1,2-Dichloroethene	25	N.D.
trans-1,2-Dichloroethene	25	N.D.
1,2-Dichloropropane	25	N.D.
cis-1,3-Dichloropropene	25	N.D.
trans-1,3-Dichloropropene	25	N.D.
Methylene chloride	250	N.D.
1,1,2,2-Tetrachloroethane	25	N.D.
Tetrachloroethene	25	N.D.
1,1,1-Trichloroethane	25	N.D.
1,1,2-Trichloroethane	25	N.D.
Trichloroethene	25	N.D.
Trichlorofluoromethane	25	N.D.
Vinyl chloride	50	N.D.

Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled:	Apr 13, 1994
985 Timothy Drive	Sample Descript:	Water, MW-3	Received:	Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 601	Analyzed:	Apr 20, 1994
Attention: Jim Keller	Lab Number:	4D80603	Reported:	Apr 26, 1994

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	1.3	N.D.
Bromoform	1.3	N.D.
Bromomethane	2.5	N.D.
Carbon tetrachloride	1.3	N.D.
Chlorobenzene	1.3	N.D.
Chloroethane	2.5	N.D.
2-Chloroethylvinyl ether	2.5	N.D.
Chloroform	1.3	N.D.
Chloromethane	2.5	N.D.
Dibromochloromethane	1.3	N.D.
1,3-Dichlorobenzene	1.3	N.D.
1,4-Dichlorobenzene	1.3	N.D.
1,2-Dichlorobenzene	1.3	N.D.
1,1-Dichloroethane	1.3	N.D.
1,2-Dichloroethane	1.3	N.D.
1,1-Dichloroethene	1.3	N.D.
cis-1,2-Dichloroethene	1.3	N.D.
trans-1,2-Dichloroethene	1.3	N.D.
1,2-Dichloropropane	1.3	N.D.
cis-1,3-Dichloropropene	1.3	N.D.
trans-1,3-Dichloropropene	1.3	N.D.
Methylene chloride	13	N.D.
1,1,2,2-Tetrachloroethane	1.3	N.D.
Tetrachloroethene	1.3	N.D.
1,1,1-Trichloroethane	1.3	N.D.
1,1,2-Trichloroethane	1.3	N.D.
Trichloroethene	1.3	N.D.
Trichlorofluoromethane	1.3	N.D.
Vinyl chloride	2.5	N.D.

Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Blaine Tech Services, Inc.	Client Project ID:	940413-L2, Shell, 1601 Webster St.	Sampled:	Apr 13, 1994
985 Timothy Drive	Sample Descript:	Water, Dup	Received:	Apr 14, 1994
San Jose, CA 95133	Analysis Method:	EPA 601	Analyzed:	Apr 20, 1994
Attention: Jim Keller	Lab Number:	4D80606	Reported:	Apr 26, 1994

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	25	N.D.
Bromoform	25	N.D.
Bromomethane	50	N.D.
Carbon tetrachloride	25	N.D.
Chlorobenzene	25	N.D.
Chloroethane	50	N.D.
2-Chloroethylvinyl ether	50	N.D.
Chloroform	25	N.D.
Chloromethane	50	N.D.
Dibromochloromethane	25	N.D.
1,3-Dichlorobenzene	25	N.D.
1,4-Dichlorobenzene	25	N.D.
1,2-Dichlorobenzene	25	N.D.
1,1-Dichloroethane	25	N.D.
1,2-Dichloroethane	25	N.D.
1,1-Dichloroethene	25	N.D.
cis-1,2-Dichloroethene	25	N.D.
trans-1,2-Dichloroethene	25	N.D.
1,2-Dichloropropane	25	N.D.
cis-1,3-Dichloropropene	25	N.D.
trans-1,3-Dichloropropene	25	N.D.
Methylene chloride	250	N.D.
1,1,2,2-Tetrachloroethane	25	N.D.
Tetrachloroethene	25	N.D.
1,1,1-Trichloroethane	25	N.D.
1,1,2-Trichloroethane	25	N.D.
Trichloroethene	25	N.D.
Trichlorofluoromethane	25	N.D.
Vinyl chloride	50	N.D.

Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Suzanne Chin
Project Manager

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Blaine Tech Services, Inc.
985 Timothy Drive
San Jose, CA 95133
Attention: Jim Keller

Client Project ID: 940413-L2, Shell, 1601 Webster St.
Matrix: Liquid
QC Sample Group: 4D80601-07
Reported: Apr 26, 1994

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD Batch#:	4D64103	4D64103	4D64103	4D64103
Date Prepared:	-	-	-	-
Date Analyzed:	4/18/94	4/18/94	4/18/94	4/18/94
Instrument I.D.#:	GCHP-2	GCHP-2	GCHP-2	GCHP-2
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Matrix Spike % Recovery:	95	95	95	97
Matrix Spike Duplicate % Recovery:	98	99	98	100
Relative % Difference:	3.1	4.1	3.1	3.0
LCS Batch#:	-	-	-	-
Date Prepared:	-	-	-	-
Date Analyzed:	-	-	-	-
Instrument I.D.#:	-	-	-	-
LCS % Recovery:	-	-	-	-
% Recovery Control Limits:	71-133	72-128	72-130	71-120

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

Please Note:
The LCS is a control sample of known, interferent free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

Sequoia Analytical

680 Chesapeake Drive, Redwood City, CA 94063, (415) 364-9600, FAX (415) 364-9233
1900 Bates Avenue, Suite L, Concord, CA 94520, (510) 686-9600, FAX (510) 686-9689
819 Striker Avenue, Suite 8, Sacramento, CA 95834, (916) 921-9600, FAX (916) 921-0100

Blaine Tech Services, Inc.
985 Timothy Drive
San Jose, CA 95133
Attention: Jim Keller

Client Project ID: 940413-L2, Shell, 1601 Webster St.
Matrix: Liquid
QC Sample Group: 4D80601-03, 06
Reported: Apr 26, 1994

QUALITY CONTROL DATA REPORT

ANALYTE	1,1-Dichloro-ethene	Trichloro-ethene	Chloro-benzene
Method:	EPA 601	EPA 601	EPA 601
Analyst:	D. George	D. George	D. George
MS/MSD Batch#:	4D41412	4D41412	4D41412
Date Prepared:	4/19/94	4/19/94	4/19/94
Date Analyzed:	4/19/94	4/19/94	4/19/94
Instrument I.D.#:	GCHP-16	GCHP-16	GCHP-16
Conc. Spiked:	25 µg/L	25 µg/L	25 µg/L
Matrix Spike % Recovery:	132	104	108
Matrix Spike Duplicate % Recovery:	88	88	92
Relative % Difference:	40	17	16
LCS Batch#:	-	-	-
Date Prepared:	-	-	-
Date Analyzed:	-	-	-
Instrument I.D.#:	-	-	-
LCS % Recovery:	-	-	-
% Recovery Control Limits:	28-167	35-146	38-150

SEQUOIA ANALYTICAL

Suzanne Chin
Project Manager

Please Note:
The LCS is a control sample of known, interferent free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

ATTACHMENT B

SAMPLING FREQUENCY CRITERIA

SAMPLING FREQUENCY CRITERIA

Weiss Associates (WA) has developed a technical approach for determining appropriate ground water monitoring well sampling frequencies for service station monitoring programs. Ground water monitoring wells are typically sampled quarterly at service stations to monitor the concentration and extent of hydrocarbons and/or volatile organic compounds (VOCs) in ground water. This satisfies California Regional Water Quality Control Board (RWQCB) ground water monitoring guidelines which state: "Quarterly (ground water) monitoring is the maximum sampling interval typically allowed when ground water contamination is present unless other arrangements are made with Regional (Water Quality Control) Board staff"[1]. San Francisco Bay RWQCB personnel have indicated that the RWQCB will allow well sampling frequency reductions on a site specific basis if the frequency reductions are justified by site conditions[2]. Presented below are generalized criteria we have developed for determining the appropriate well sampling frequencies based on specific site conditions.

CRITERIA FOR REDUCING SAMPLING FREQUENCY

The generalized criteria we have developed for determining whether sampling frequency should be modified for a given well includes:

- The reliability of the ground water analytic data,
- The trend of the dissolved hydrocarbon and/or VOCs concentrations in the well, and
- The location of the well in relation to the hydrocarbon and/or VOCs source.

Each of these factors is discussed below.

Reliability of Ground Water Analytic Data

The reproducibility of ground water analytic data is highly sensitive to geologic conditions, ground water elevations, field sampling procedures and laboratory analytic procedures. Of these

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[1] North Coast, San Francisco Bay, Central Valley Regional Water Quality Control Boards, June 2, 1988 (revised May 18, 1989), "Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks; pg. 12

[2] - Personal communication between Joseph Theisen, WA Project Geologist and Diane White, RWQCB-SFBR, November 29, 1989.

controlling factors, ground water fluctuations usually have the greatest impact on data reproducibility. Since ground water elevations at most sites fluctuate during the course of a year, ground water should be monitored for at least one year to assess the impact of ground water fluctuations on data reproducibility. RWQCB guidelines also stipulate sampling all monitoring wells at least quarterly for one year when hydrocarbons are detected in the well. Therefore, WA recommends reducing the sampling frequency only for wells which:

- Have been sampled at least four times over a period of one year, and
- Have consistent historic analytic results allowing a reliable assessment of the representative hydrocarbon concentrations in the ground water.

Although it may be possible to statistically quantify the reliability of the analytic data, this effort may not produce useful results. Therefore, we will evaluate the reliability of the data subjectively. If the variability of the analytic data prevents a reliable assessment of concentrations then we recommend sampling the well(s) quarterly until a reliable assessment can be made.

Concentration Trends

Sampling frequency should be reduced only for wells showing stable or decreasing concentration trends. Wells showing increasing concentration trends should be sampled quarterly to monitor the trends and determine whether the hydrocarbon concentration in a particular well is approaching a threshold, such as the saturation concentration, maximum contaminant level (MCL) or the recommended action level.

Well Location

For most sites, four to ten ground water monitoring wells are typically required to fully define the extent of hydrocarbons in ground water. These wells generally fall into one of four classifications relative to the hydrocarbon source:

1) Clean upgradient and crossgradient wells,
2) Source-area wells with high hydrocarbon concentrations,
3) Intermediate wells with low to high hydrocarbon concentrations located between the source-area wells and clean crossgradient and downgradient wells, and

4) Clean downgradient wells.

WA's recommended sampling frequency for each of these classifications is as follows:

1) If no hydrocarbons are detected in the upgradient and crossgradient wells, and if no offsite sources are suspected upgradient or crossgradient of the site, WA recommends sampling these wells annually.

2) Source-area wells are used to monitor concentrations from source-area releases and determine effectiveness of natural biodegradation and/or site remediation. To ensure that increasing source-area concentration trends are detected, WA recommends sampling these wells biannually.

3) Intermediate wells are used to track dissolved hydrocarbon concentrations and the rates of natural biodegradation or the effectiveness of site remediation. Therefore, WA recommends sampling these wells biannually. However, if there are more than four intermediate wells, we recommend sampling each of the intermediate wells annually during different quarters.

4) Since clean downgradient wells define the "leading edge" of dissolved hydrocarbons in ground water and are used to determine hydrocarbon breakthrough, WA recommends sampling these wells quarterly.

Other Considerations

If hydrocarbon concentrations in ground water from all site wells are near or below MCLs, we recommend sampling all site wells biannually or annually, depending on the number of wells, well locations with respect to potential source areas, and ground water depth fluctuations. Annual sampling should be sufficient for sites with:

- Large numbers of wells,
- Wells located immediately downgradient of potential source areas, and
- Stable ground water depths.

Sites without these characteristics may need biannual sampling.

Upgradient and/or crossgradient wells that contain hydrocarbons or other contaminants from offsite sources should be sampled biannually to monitor offsite contributions of contaminants to the site.

A decision flow chart graphically presenting the recommended sampling frequency based on these criteria is included as Figure 1. Although there may be wells that do not fall into the location and concentration classifications listed in the flow chart, the generalized criteria may be used to evaluate the appropriate sampling frequency on a case by case basis.

SUMMARY

In summary, WA recommends reducing sampling frequencies for all ground water monitoring wells with:

- Ground water samples collected for four consecutive quarters,
- Reliable ground water analytic results, and
- No significantly increasing concentration trends.

The sampling frequency for individual wells should be modified based on the well location relative to the contaminant source, as follows:

- Annually for clean upgradient and crossgradient wells,
- Biannually for upgradient and crossgradient wells containing hydrocarbons or other contaminants from an offsite, upgradient source,
- Biannually for high concentration source-area wells,
- Biannually or annually for intermediate wells, depending on the total number of intermediate wells, and
- Quarterly for clean downgradient wells.

Sampling frequency in all site wells should also be reduced to biannual or annual if contaminant concentrations in all site wells are near or below MCLs.

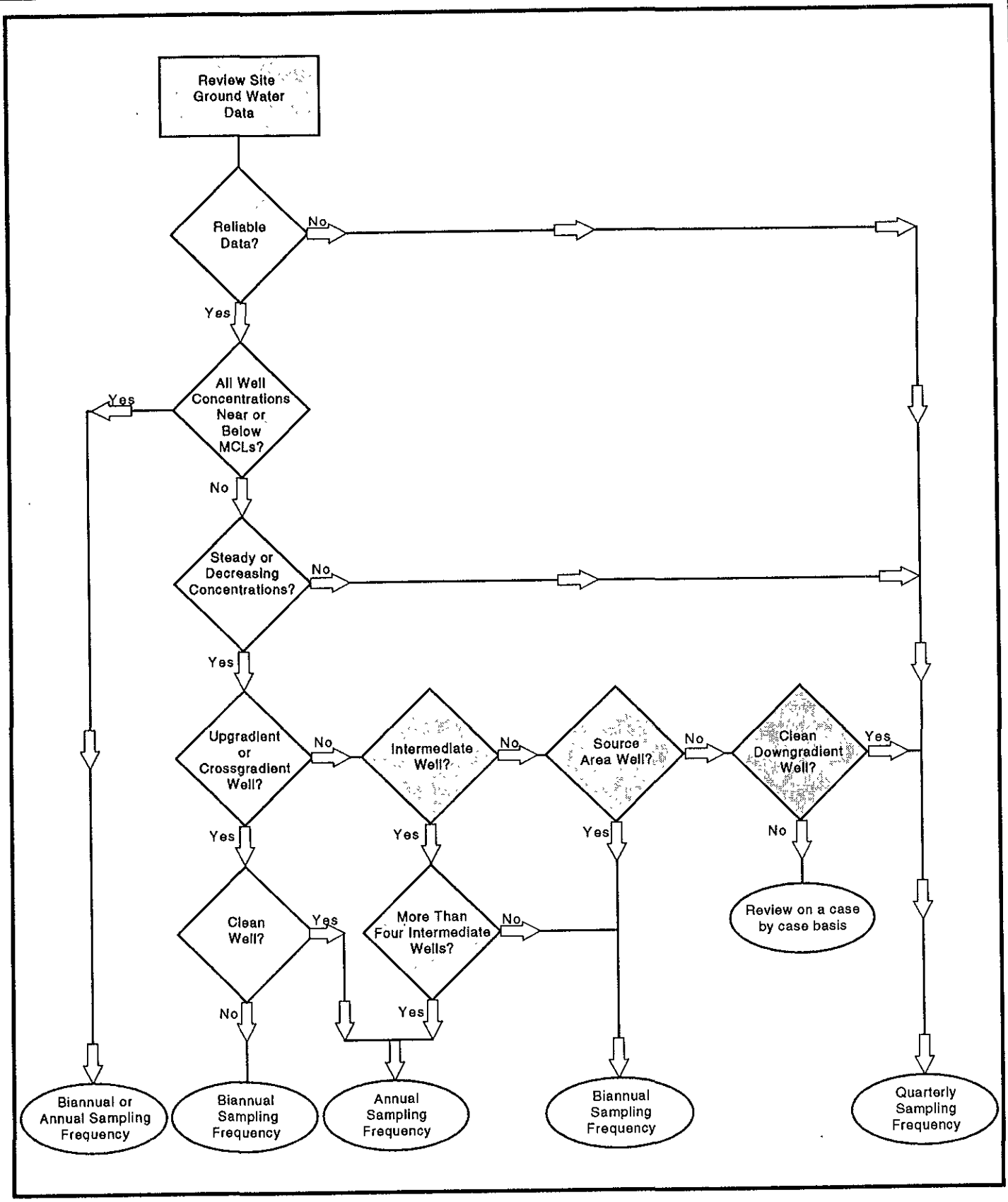

Figure 1. Ground Water Sampling Frequency Determination Chart