Once the fluid particles enter the West Coast Basin, the pathways are bounded by the Qus flow zone below the overburden.

The envelope of particle pathways, shown shaded on Figure 3.4-14, represents the area within, and downgradient of the PVLF, through which particles of water from the PVLF may migrate over 400,000 years. This is the area of interest for contaminant transport modeling and risk assessment studies, as discussed in Section 5.0 this report.

3.5 SOILS

This section discusses the results of the soil/sediment investigation. A total of 156 soil samples were taken as part of the remedial investigations. These samples came from sixteen background boreholes, 24 down-canyon boreholes, and three boreholes located on or adjacent to the landfill site. Section 3.5.1 discusses the overall analytical results from the core sample data.

Two methods of evaluating the analytical results were used. For each constituent the percent of non-detected values in the background samples was compared to the percent of non-detected values in the down-canyon samples. If the constituent has over 50 percent non-detected values for either the background or down-canyon samples, the constituent was analyzed qualitatively in Section 3.5.2. The remaining constituents (those where the compound was detected at least 50 percent of the time in both the background and down-canyon samples) were analyzed using the Wilcoxon Rank Sum test in Section 3.5.3.

3.5.1 Soil Sample Analytical Results

This section presents the analytical results of the soil sample data. A total of 156 soil samples were collected from borings located both up-canyon (background) and down-canyon of the landfill. These soil samples were collected during two field programs. The first 122 soil samples were collected from June 1990 through October 1990 as part of the downgradient and upgradient hydrogeologic field program conducted in accordance with the HCP (Sanitation Districts, 1989f). An additional 34 soil samples were collected in December 1993 and January 1994 as part of the additional downgradient field program conducted in accordance with the Work Plan for Additional Remedial

Investigation (Sanitation Districts, 1993b). The laboratory results for these samples are given in Appendix A.2.1.1. The results report the constituent concentrations for each soil sample. Each soil sample is identified by the borehole, sample depth, and formation. In the appendix, the data is grouped into three categories: (1) background samples; (2) down-canyon samples; and (3) landfill-gas affected samples. The landfill-gas affected samples consisted of eighteen soil samples taken from boreholes RFB1, M53B (RFB16), and RFB32. These three boreholes are located on or adjacent to the landfill site, and the chemical analysis of cores taken from these boreholes are considered to be subject to contamination from landfill gas. Therefore, although the analytical results of these cores are given in the appendix, the results were not used in this evaluation.

Each sample was analyzed for 128 constituents: seven general; 22 metal; 41 volatile organic; and 58 semi-volatile organic constituents. The seven general constituents include pH, conductivity, nitrate nitrogen, sulfate, chloride, oil and grease, and hydrocarbon. Sixty-nine of the 128 constituents analyzed had either no results or censored data for every sample. Data that had no results represented 0.44 percent of the sample results and included values in which the constituent was not analyzed or there was insufficient sample volume. Censored data included "not detected" values (marked with a "less than" sign in the raw data sheets), and those values which were below the MDL but above the IDL. The remaining 59 constituents where at least one sample had detected values were analyzed. This included seven general, 22 metal, seventeen volatile organic, and thirteen semi-volatile organic constituents. The remaining analysis of the soil samples will include these 59 constituents.

A summary table of the soil samples for the background and down-canyon samples is given in Table 3.5-1. The summary table includes the total number of samples analyzed, range of values and mean value for all of the samples collected. The overall mean value was calculated using one-half of the detection limit for the non-detected values. The results also include the number of non-detected samples along with the range and mean for the non-detected samples. The summary table does not include the results from cores taken from landfill-gas affected wellbores. The background sample results also do not include the VOC results from boring RFBL3 because of possible VOC contamination. This wellbore was drilled using a drilling polymer (Herzog, 1991b), and a field screening of the drilling polymer indicated that it contained VOCs. None of the other core samples in the summary table were obtained using a drilling polymer.

TABLE 3.5-1

BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	UNITS	ALL BACKGROUND SUBSURFACE SOIL SAMPLES					
		ALL VALUES			NON-DETECTED VALUES		
		NO. OF SAMPLES	RANGE	MEAN	NO. OF ND SAMPLES	RANGE	MEAN
GENERAL PARAMETERS							
PH	PH	51	6.9 - 9	8.06	0	NA - NA	NA
CONDUCTIVITY	UMHOS/CM	50	<0.01 - 3850	1035.1	1	0.01 - 0.01	NA
NITRATE NITROGEN	MG/KG N	50	<0.01 - 129	6.45	8	0.01 - 0.05	0.025
SULFATE	MG/KG SO4	50	3 - 2760	316.4	0	NA - NA	NA
CHLORIDE	MG/KG CL	50	5 - 1200	90.6	0	NA - NA	NA
OIL & GREASE	MG/KG	42	<150 - 3900	367.5	4	150 - 150	150
HYDROCARBONS-MODIFIED8015	MG/KG HC	53	<0.2 - 0.5	0.12	50	0.2 - 0.2	0.2
METALS							
CALCIUM	MG/KG CA	53	1130 - 171000	35523	0	NA - NA	NA
MAGNESIUM	MG/KG MG	53	682 - 99000	16856	0	NA - NA	NA
ARSENIC	MG/KG AS	53	0.17 - 58	4.995	0	NA - NA	NA
BARIUM	MG/KG BA	53	5.59 - 4400	408.55	0	NA - NA	NA
CADMIUM	MG/KG CD	53	<0.15 - 18.9	4.72	3	0.15 - 0.15	0.15
TOTAL CHROMIUM	MG/KG CR	53	16.2 - 193	86.73	0	NA - NA	NA
COBALT	MG/KG CO	53	<1.8 - 24.3	7.36	3	1.8 - 2	1.93
IRON	MG/KG FE	53	613 - 32900	11343	0	NA - NA	NA
LEAD	MG/KG PB	53	<2 - 5.31	1.60	40	2 - 2.5	2.23
MANGANESE	MG/KG MN	53	25.2 - 590	192.07	0	NA - NA	NA
MERCURY	MG/KG HG	50	<0.050 - 0.318	0.0961	11	0.05 - 0.05	0.05
NICKEL	MG/KG NI	53	13.4 - 294	69.88	0	NA - NA	NA
POTASSIUM	MG/KG K	53	262 - 7240	2514.2	0	NA - NA	NA
SELENIUM	MG/KG SE	53	<0.01 - 2.9	0.47	4	0.01 - 0.01	0.01
SILVER	MG/KG AG	53	<1 - 4.25	1.018	23	1 - 1	1.0
SODIUM	MG/KG NA	53	114 - 4560	979.4	0	NA - NA	NA
ZINC	MG/KG ZN	53	30.8 - 408	106.04	0	NA - NA	NA
ANTIMONY	MG/L SB	53	<0.5 - 5.5	1.17	18	0.5 - 0.5	0.50
BERYLLIUM	MG/KG BE	53	<0.5 - 2.94	0.90	18	0.5 - 0.5	0.50
MOLYBDENUM	MG/KG MO	53	<0.86 - 70.6	12.14	5	0.86 - 1	0.964
THALLIUM	MG/KG TL	53	<0.5 - <0.5	NA	53	0.5 - 0.5	0.50
VANADIUM	MG/KG V	53	37.5 - 645	184.3	0	NA - NA	NA

TABLE 3.5-1 (CONTINUED)

BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	UNITS	ALL BACKGROUND SUBSURFACE SOIL SAMPLES					
		ALL VALUES			NON-DETECTED VALUES		
		NO. OF SAMPLES	RANGE	MEAN	NO. OF ND SAMPLES	RANGE	MEAN
VOLATILE ORGANIC COMPOUNDS							
METHYLENE CHLORIDE	MG/KG	42	<0.02 - <0.02	NA	42	0.02 - 0.02	0.02
CHLOROFORM	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
1,1,1-TRICHLOROETHANE	MG/KG	42	<0.01 - 0.02	0.01	41	0.01 - 0.01	0.01
TRICHLOROETHYLENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
TETRACHLOROETHYLENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
DIBROMOCHLOROMETHANE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
BROMOFORM	MG/KG	42	<0.02 - 0.02	0.01	41	0.02 - 0.02	0.02
1,1-DICHLOROETHANE	MG/KG	42	<0.01 - 0.01	0.01	41	0.01 - 0.01	0.01
1,1,2-TRICHLOROETHANE	MG/KG	42	<0.01 - 0.01	0.01	41	0.01 - 0.01	0.01
1,2-DICHLOROETHANE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
BENZENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
TOLUENE	MG/KG	42	<0.01 - 0.06	0.01	34	0.01 - 0.01	0.01
ETHYL BENZENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
O-XYLENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
CIS-1,3-DICHLOROPROPENE	MG/KG	42	<0.01 - <0.01	NA	42	0.01 - 0.01	0.01
1,1,2,2-TETRACHLOROETHANE	MG/KG	42	<0.01 - 0.04	0.01	41	0.01 - 0.01	0.01
M+P-XYLENE	MG/KG	42	<0.01 - 0.01	0.01	41	0.01 - 0.01	0.01
SEMI-VOLATILE ORGANIC COMOUNDS							
ACENAPHTHENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
ACENAPHTHYLENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
ANTHRACENE	MG/KG	53	<1 - <1	NA	53	1 - 1	1.0
BENZO(A)ANTHRACENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
BENZO(A)PYRENE	MG/KG	53	<7 - 1	NA	53	1 - 7	6.9
BENZO(B)FLUORANTHENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
BENZO(K)FLUORANTHENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
DIETHYLHEXYL PHTHALATE	MG/KG	53	<10 - 2	NA	53	2 - 10	9.8
CHRYSENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
DI-N-BUTYL PHTHALATE	MG/KG	53	<4 - 2	NA	53	1 - 4	3.9
FLUORANTHENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0
PHENANTHRENE	MG/KG	53	<1 - <1	NA	53	1 - 1	1.0
PYRENE	MG/KG	53	<2 - <2	NA	53	2 - 2	2.0

NA - Not Applicable   ND - Non-Detected   < - Less Than (indicates a non-detected value)

TABLE 3.5-1 (CONTINUED)

BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

		ALL DOWN-CANYON SUBSURFACE SOIL SAMPLES					
		ALL VALUES			NON-DETECTED VALUES		
CONSTITUENT	UNITS	NO. OF SAMPLES	RANGE	MEAN	NO. OF ND SAMPLES	RANGE	MEAN
GENERAL PARAMETERS							
PH	PH	85	2.95 - 8.77	7.763	0	NA - NA	NA
CONDUCTIVITY	UMHOS/CM	82	50 - 6750	1291.3	0	NA - NA	NA
NITRATE NITROGEN	MG/KG N	85	<0.01 - 16.2	1.14	23	0.01 - 0.05	0.017
SULFATE	MG/KG SO4	84	1.7 - 14900	1109.6	0	NA - NA	NA
CHLORIDE	MG/KG CL	82	4 - 688	76.7	0	NA - NA	NA
OIL & GREASE	MG/KG	39	<150 - 1000	383.8	4	150 - 150	150
HYDROCARBONS-MODIFIED8015	MG/KG HC	81	<0.2 - 9600	234.3	66	0.2 - 10	6.25
METALS							
CALCIUM	MG/KG CA	85	683 - 298000	26452	0	NA - NA	NA
MAGNESIUM	MG/KG MG	85	565 - 36000	8433.4	0	NA - NA	NA
ARSENIC	MG/KG AS	85	<0.15 - 32.5	5.42	2	0.15 - 0.15	0.15
BARIUM	MG/KG BA	85	16.7 - 1650	279.45	0	NA - NA	NA
CADMIUM	MG/KG CD	85	<0.15 - 7.71	1.675	24	0.15 - 0.5	0.25
TOTAL CHROMIUM	MG/KG CR	85	<1 - 116	45.0	2	1 - 1	1.0
COBALT	MG/KG CO	85	<2 - 14.8	5.44	21	2 - 2.5	2.29
IRON	MG/KG FE	85	1330 - 261000	14758	0	NA - NA	NA
LEAD	MG/KG PB	85	<2.5 - 169	6.1	67	2.5 - 9	3.75
MANGANESE	MG/KG MN	85	14.8 - 559	165.1	0	NA - NA	NA
MERCURY	MG/KG HG	85	<0.05 - 1.03	0.079	33	0.05 - 0.05	0.05
NICKEL	MG/KG NI	85	<1.5 - 86.9	39.97	4	1.5 - 2.5	2.00
POTASSIUM	MG/KG K	85	388 - 5974	2897.3	0	NA - NA	NA
SELENIUM	MG/KG SE	85	<0.01 - 29.1	2.97	13	0.01 - 0.5	0.13
SILVER	MG/KG AG	85	<1 - 1.3	0.52	83	1 - 1.9	1.01
SODIUM	MG/KG NA	85	<50.0 - 2880	689.2	1	50 - 50	NA
ZINC	MG/KG ZN	85	7.6 - 195	76.0	0	NA - NA	NA
ANTIMONY	MG/KG SB	85	<0.15 - 3.7	0.52	53	0.15 - 0.5	0.49
BERYLLIUM	MG/KG BE	85	<0.5 - 1.43	0.49	64	0.5 - 1	0.77
MOLYBDENUM	MG/KG MO	85	<0.43 - 310	12.72	35	0.43 - 10	5.87
THALLIUM	MG/KG TL	85	<0.05 - 0.5	0.35	84	0.05 - 1	0.70
VANADIUM	MG/KG V	85	2.25 - 208	68.39	0	NA - NA	NA

TABLE 3.5-1 (CONTINUED)

BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	UNITS	ALL DOWN-CANYON SUBSURFACE SOIL SAMPLES					
		ALL VALUES			NON-DETECTED VALUES		
		NO. OF SAMPLES	RANGE	MEAN	NO. OF ND SAMPLES	RANGE	MEAN
VOLATILE ORGANIC COMPOUNDS							
METHYLENE CHLORIDE	MG/KG	85	<0.02 - 0.9	0.04	82	0.02 - 0.25	0.05
CHLOROFORM	MG/KG	85	<0.01 - 0.05	0.01	79	0.01 - 0.05	0.02
1,1,1-TRICHLOROETHANE	MG/KG	85	<0.01 - <0.05	NA	85	0.01 - 0.05	0.02
TRICHLOROETHYLENE	MG/KG	85	<0.01 - 0.02	0.01	83	0.01 - 0.05	0.02
TETRACHLOROETHYLENE	MG/KG	85	<0.01 - 0.04	0.01	84	0.01 - 0.05	0.02
DIBROMOCHLOROMETHANE	MG/KG	85	<0.01 - 0.02	0.01	84	0.01 - 0.05	0.02
BROMOFORM	MG/KG	85	<0.01 - 0.09	0.01	82	0.01 - 0.1	0.03
1,1-DICHLOROETHANE	MG/KG	85	<0.01 - <0.05	NA	85	0.01 - 0.05	0.02
1,1,2-TRICHLOROETHANE	MG/KG	85	<0.01 - 0.05	0.01	82	0.01 - 0.05	0.02
1,2-DICHLOROETHANE	MG/KG	85	<0.01 - 0.02	0.01	83	0.01 - 0.05	0.02
BENZENE	MG/KG	85	<0.01 - 0.03	0.01	83	0.01 - 0.05	0.02
TOLUENE	MG/KG	85	<0.01 - 0.04	0.01	81	0.01 - 0.05	0.02
ETHYL BENZENE	MG/KG	85	<0.01 - 0.03	0.01	84	0.01 - 0.05	0.02
O-XYLENE	MG/KG	85	<0.01 - 0.2	0.01	83	0.01 - 0.05	0.02
CIS-1,3-DICHLOROPROPENE	MG/KG	85	<0.01 - 0.02	0.01	83	0.01 - 0.05	0.02
1,1,2,2-TETRACHLOROETHANE	MG/KG	85	<0.01 - 0.17	0.01	78	0.01 - 0.05	0.02
M+P-XYLENE	MG/KG	85	<0.01 - 0.44	0.01	80	0.01 - 0.05	0.01
SEMI-VOLATILE ORGANIC COMOUNDS							
ACENAPHTHENE	MG/KG	85	<2 - 6	1.6	83	1 - 5	3.1
ACENAPHTHYLENE	MG/KG	85	<2 - 2	1.6	84	1 - 5	3.1
ANTHRACENE	MG/KG	85	<1 - 4	1.3	81	1 - 5	2.5
BENZO(A)ANTHRACENE	MG/KG	85	<2 - 3	1.6	83	1 - 5	3.1
BENZO(A)PYRENE	MG/KG	85	<5 - 6	3.0	84	1 - 7	5.5
BENZO(B)FLUORANTHENE	MG/KG	85	<2 - 4	1.6	82	1 - 5	3.1
BENZO(K)FLUORANTHENE	MG/KG	85	<2 - 2	1.6	84	1 - 5	3.1
DIETHYLHEXYL PHTHALATE	MG/KG	85	<10 - 37	5.1	84	1 - 10	9.4
CHRYSENE	MG/KG	85	<2 - 4	1.6	81	2 - 5	3.1
DI-N-BUTYL PHTHALATE	MG/KG	85	<4 - 14	2.4	83	1 - 5	4.3
FLUORANTHENE	MG/KG	85	<2 - 9	1.9	81	2 - 6	3.5
PHENANTHRENE	MG/KG	85	<1 - 3	1.5	83	1 - 6	2.9
PYRENE	MG/KG	85	<2 - 14	1.9	81	2 - 5	3.1

NA - Not Applicable   ND - Non-Detected   < - Less Than (indicates a non-detected value)

3.5.2 Qualitative Analysis of the Soil Sample Results

A comparison of the percent non-detected values for the background and down-canyon samples is shown in Table 3.5-2. The table lists the number of samples analyzed, the number of detections, and the percent of non-detected values for both the background and down-canyon samples by constituent. The constituents with over 50 percent non-detected values in either the background or down-canyon samples are highlighted. There were not enough detections of these constituents to perform the quantitative analysis. Therefore, they are analyzed qualitatively in this section. The remaining constituents are analyzed quantitatively using the Wilcoxon Rank Sum test in the next section.

Hydrocarbons

The modified 8015 hydrocarbons (extended scan) were detected more frequently in the down-canyon samples than the background samples (19 percent and 6 percent, respectively). Hydrocarbons were detected in three of the 53 background soil samples. The background hydrocarbon values ranged from not detected to 0.5 mg/kg with a mean value of 0.12 mg/kg. Hydrocarbons were detected in fifteen of 81 down-canyon soil samples. The down-canyon hydrocarbon values ranged from not detected to 9,600 mg/kg with a mean value of 234.3 mg/kg. Most of the hydrocarbon levels detected were identified at relatively low levels (the detection limit for hydrocarbons ranged from 0.2 to 10 mg/kg). Only five of the 81 down-canyon samples had hydrocarbon concentrations greater than 10 mg/kg. These five samples were from RFB8 (35 feet bgs) with a value of 18 mg/kg, M67B (AB8; 30 feet bgs) with a value of 4,500 mg/kg, M67B (AB8; 50 feet bgs) with a value of 9,600 mg/kg, M67B (AB8; 70 feet bgs) with a value of 4,500 mg/kg, and M68B (AB9; 25 feet bgs) with a value of 150 mg/kg.

The distribution of hydrocarbons in the down-canyon soil samples in relation to the PVLF boundary was random and did not show any pattern that would be expected from landfill affected soil contamination. This irregular distribution of the hydrocarbons in the soil samples suggest that they may have originated from sources not related to the landfill. The Monterey Formation is a source rock for oil in the Los Angeles area, and therefore detections of hydrocarbons is not unexpected. The modified 8015 analysis performed was an extended run which showed both the mid-

TABLE 3.5-2

COMPARISON OF PERCENT NON-DETECTED VALUES IN BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENTS	BACKGROUND SAMPLES			DOWN-CANYON SAMPLES		
	SAMPLES ANALYZED	NUMBER DETECTED	% NON-DETECTED VALUES	SAMPLES ANALYZED	NUMBER DETECTED	% NON-DETECTED VALUES
GENERAL						
PH	51	51	0.0%	85	85	0.0%
CONDUCTIVITY	50	49	0.0%	82	82	0.0%
NITRATE NITROGEN	50	42	16.0%	85	61	28.2%
SULFATE	50	50	0.0%	84	84	0.0%
CHLORIDE	50	50	0.0%	82	82	0.0%
OIL & GREASE	42	38	9.5%	39	35	10.3%
HYDROCARBONS - MOD. 8015	53	3	94.3%	81	15	81.5%
METALS						
CALCIUM	53	53	0.0%	85	85	0.0%
MAGNESIUM	53	53	0.0%	85	85	0.0%
ARSENIC	53	53	0.0%	85	83	2.4%
BARIUM	53	53	0.0%	85	85	0.0%
CADMIUM	53	50	5.7%	85	61	28.2%
TOTAL CHROMIUM	53	53	0.0%	85	83	2.4%
COBALT	53	50	5.7%	85	64	24.7%
IRON	53	53	0.0%	85	85	0.0%
LEAD	53	13	75.5%	85	18	78.8%
MANGANESE	53	53	0.0%	85	85	0.0%
MERCURY	50	39	22.0%	85	52	38.8%
NICKEL	53	53	0.0%	85	81	4.7%
POTASSIUM	53	53	0.0%	85	85	0.0%
SELENIUM	53	49	7.5%	85	72	15.3%
SILVER	53	30	43.4%	85	2	97.6%
SODIUM	53	53	0.0%	85	84	1.2%
ZINC	53	53	0.0%	85	85	0.0%
ANTIMONY	53	35	34.0%	85	32	62.4%
BERYLLIUM	53	35	34.0%	85	21	75.3%
MOLYBDENUM	53	48	9.4%	85	50	41.2%
THALLIUM	53	0	100.0%	85	1	98.8%
VANADIUM	53	53	0.0%	85	85	0.0%

TABLE 3.5-2 (CONTINUED)

COMPARISON OF PERCENT NON-DETECTED VALUES IN BACKGROUND AND DOWN-CANYON SUBSURFACE SOIL SAMPLES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENTS	BACKGROUND SAMPLES			DOWN-CANYON SAMPLES		
	SAMPLES ANALYZED	NUMBER DETECTED	% NON-DETECTED VALUES	SAMPLES ANALYZED	NUMBER DETECTED	% NON-DETECTED VALUES
VOLATILE ORGANIC COMPOUNDS						
METHYLENE CHLORIDE	42	0	100.0%	85	3	96.5%
CHLOROFORM	42	0	100.0%	85	6	92.9%
1,1,1-TRICHLOROETHANE	42	1	97.6%	85	0	100.0%
TRICHLOROETHYLENE	42	0	100.0%	85	2	97.6%
TETRACHLOROETHYLENE	40	0	100.0%	85	1	98.8%
DIBROMOCHLOROMETHANE	42	0	100.0%	85	1	98.8%
BROMOFORM	42	1	97.6%	85	3	96.5%
1,1-DICHLOROETHANE	42	1	97.6%	85	0	100.0%
1,1,2-TRICHLOROETHANE	42	1	97.6%	85	3	96.5%
1,2-DICHLOROETHANE	42	0	100.0%	85	2	97.6%
BENZENE	42	0	100.0%	85	2	97.6%
TOLUENE	42	8	81.0%	85	4	95.3%
ETHYL BENZENE	42	0	100.0%	85	1	98.8%
O-XYLENE	42	0	100.0%	85	2	97.6%
CIS-1,3-DICHLOROPROPENE	42	0	100.0%	85	2	97.6%
1,1,2,2-TETRACHLOROETHANE	42	1	97.6%	85	7	91.8%
M+P-XYLENE	42	1	97.6%	85	5	94.1%
ACID-BASE NEUTRAL EXTRACTS						
ACENAPHTHENE	53	0	100.0%	85	2	97.6%
ACENAPHTHYLENE	53	0	100.0%	85	1	98.8%
ANTHRACENE	53	0	100.0%	85	4	95.3%
BENZO(A) ANTHRACENE	53	0	100.0%	85	2	97.6%
BENZO(A)PYRENE	53	0	100.0%	85	1	98.8%
BENZO(B)FLUORANTHENE	53	0	100.0%	85	3	96.5%
BENZO(K) FLUORANTHENE	53	0	100.0%	85	1	98.8%
DIETHYLHEXYL PHTHALATE	53	0	100.0%	85	1	98.8%
CHRYSENE	53	0	100.0%	85	4	95.3%
DI-N-BUTYL PHTHALATE	53	0	100.0%	85	2	97.6%
FLUORANTHENE	53	0	100.0%	85	4	95.3%
PHENANTHRENE	53	0	100.0%	85	2	97.6%
PYRENE	53	0	100.0%	85	4	95.3%

Constituents with over 50% non-detected values are highlighted.

light end hydrocarbons and the heavier residuals such as diesel oil and gasoil fractions. The analysis of the chromatographs taken from the extended 8015 tests were examined to determine whether refined petroleum hydrocarbon products or naturally occurring crude oil deposits were indicated. The analysis of the chromatographs for these samples showed features that were characteristic of a naturally occurring background source as opposed to refined petroleum hydrocarbon products. Because the hydrocarbon detections appear to be naturally occurring, and because there does not appear to be any consistent distribution of hydrocarbon detections in the soil in relation to the PVLF boundary as would be expected from landfill affected soil contamination, the Sanitation Districts do not believe the detections indicate landfill effects.

Lead

Lead was detected slightly more frequently in the background samples than the down-canyon samples (25 percent and 21 percent, respectively). Lead was detected in 13 of the 53 background soil samples. The background lead values ranged from not detected to 5.31 mg/kg with a mean value of 1.60 mg/kg. Lead was detected in eighteen of 85 down-canyon soil samples. The down-canyon lead values ranged from not detected to 169 mg/kg with a mean value of 6.14 mg/kg. The down-canyon mean lead concentrations are approximately four times above background. Lead occurs naturally in soils, and lead concentrations found in common soils typically range from not detected to 300 mg/kg (Dragun, 1991). The detected lead values are all within the range found in common soils. Also, the distribution of the lead detections in the down-canyon soil samples in relation to the PVLF boundary was random and did not show any pattern that would be expected from landfill affected soil contamination. Because the concentrations of lead were typical to those found in common soils and because there was no consistent pattern of lead detection, the lead detections appear to be random fluctuations in soil quality, and not an indication of landfill contamination.

Silver

Silver was detected more frequently in the background samples than the down-canyon samples (57 percent and 2 percent, respectively). Silver was detected in 30 of the 53 background soil samples. The background silver values ranged from not detected to 4.3 mg/kg with a mean value of 1.02 mg/kg. Silver was detected in two of 85 down-canyon soil samples. The down-canyon silver values ranged from not detected to 1.3 mg/kg with a mean value of 0.52 mg/kg. Silver occurs naturally in soils, and silver concentrations found in common soils typically range from less than 0.5 to 5 mg/kg (Dragun, 1991). The detected silver values are all within the range found in common soils. Because the silver detections were more prevalent in the background samples, the detections of silver appear to be random fluctuations in soil quality, and not an indication of landfill contamination.

Antimony

Antimony was detected more frequently in the background samples than the down-canyon samples (66 percent and 38 percent, respectively). Antimony was detected in 35 of the 53 background soil samples. The background antimony values ranged from not detected to 5.5 mg/kg with a mean value of 1.17 mg/kg. Antimony was detected in 32 of the 85 down-canyon soil samples. The down-canyon antimony values ranged from not detected to 3.7 mg/kg with a mean value of 0.52 mg/kg. Antimony occurs naturally in soils, and antimony concentrations found in common soils typically range from less than 1 to 2 mg/kg (Dragun, 1991). The detected antimony values are within or very near the range found in common soils. Because the antimony detections were more prevalent in the background samples, the detections of antimony appear to be random fluctuations in soil quality, and not an indication of landfill contamination.

Beryllium

Beryllium was detected more frequently in the background samples than the down-canyon samples (66 percent and 25 percent, respectively). Beryllium was detected in 35 of the 53 background soil samples. The background beryllium values ranged from not detected to 2.9 mg/kg with a mean value of 0.9 mg/kg. Beryllium was detected in 21 of 85 down-canyon soil samples. The down-canyon beryllium values ranged from not detected to 1.4 mg/kg with a mean value of 0.49 mg/kg. Beryllium occurs naturally in soils, and beryllium concentrations found in common soils typically range from not detected to 3 mg/kg (Dragun, 1991). The detected beryllium values are all within the range found in common soils. Because the beryllium detections were more prevalent in the background samples, the detections of beryllium appear to be random fluctuations in soil quality, and not an indication of landfill contamination.

Thallium

There was one detection of thallium in the down-canyon samples. This was at location RFB10 at a depth of 75.0 feet with a reported value of 0.5 mg/kg. The reported detection was at a very low value (the detection limit for thallium is 0.5 mg/kg). Because there was just one detection of thallium, and because there was no overall trend identifying a continuous contamination source, the Sanitation Districts do not believe the detection indicates landfill effects.

Methylene Chloride

Methylene chloride was detected in three of 85 samples collected down-canyon. These detections were at RFB6 (125 feet bgs), RFB12 (110 feet bgs), and M52B (RFB13; 100 feet bgs) with corresponding concentrations of 0.9, 0.2, and 0.03 mg/kg, respectively. Methylene chloride was not detected in any of the 53 background samples. The detections of methylene chloride are plotted on Exhibit 3.5-1. The detections of methylene chloride in soil samples obtained during the 1987 SWAT are also included in the exhibit. The QA/QC program associated with the 1987 SWAT project was not as complete as that employed during the remedial investigations; therefore, they should be interpreted carefully. There does not appear to be any consistent pattern of methylene chloride detection as would be expected from landfill soil contamination. Methylene chloride is a common laboratory contaminant. Because there were so few detections of methylene chloride, and because there was no overall trend identifying a continuous contamination source, the Sanitation Districts do not believe the detections indicate landfill effects. The random low levels of methylene chloride may be attributable to laboratory contamination.

Trihalomethanes

The trihalomethane compounds detected in the soil samples include chloroform, bromoform, and dibromochloromethane. Chloroform was not detected in any of the 53 background soil samples and was detected in six of the 85 down-canyon soil samples. The down-canyon chloroform values ranged from not detected to 0.05 mg/kg with a mean value of 0.01 mg/kg. Dibromomethane was not detected in any of the 53 background soil samples and was detected in one of the 85 down-canyon soil samples. The down-canyon dibromochloromethane detection was at RFB2 (80 feet bgs) with a reported value of 0.02 mg/kg. Bromoform was detected in one of the 53 background soil samples and in three of the 85 down-canyon soil samples. The background bromoform detection was at L8 (RFBL2; 20 feet bgs) with a reported value of 0.02 mg/kg. The down-canyon bromoform values ranged from not detected to 0.09 mg/kg with a mean value of 0.014 mg/kg.

The detections of trihalomethanes are plotted on Exhibit 3.5-1. The detections of trihalomethanes in soil samples obtained during the 1987 SWAT project are also included. The QA/QC program associated with the 1987 SWAT project was not as complete as that employed during the remedial investigations; therefore, they should be interpreted carefully. The distribution of the trihalomethanes in the soil samples in relation to the PVLF boundary is not consistent with what would be expected from landfill affected soil contamination. Trihalomethanes occur in drinking water as a reaction product of water chlorination. The sporadic low levels of trihalomethanes may be attributed to drinking or tap water used in the area. Tap water from the Palos Verdes area will typically contain total trihalomethane concentrations of 60 to 80 ug/l (0.06 to 0.08 ppm). Because there were such few detections of trihalomethanes, and because there was no overall trend identifying a continuous source, the Sanitation Districts do not believe the detections indicate landfill effects.

BTEX Compounds

The BTEX compounds detected in the soil samples include benzene, toluene, ethyl benzene, o-xylene, and m+p-xylene. Benzene was not detected in any of the 53 background soil samples and was detected in two of the 85 down-canyon soil samples. The down-canyon benzene detections were at RFB8 (35 feet bgs) with a reported value of 0.01 mg/kg and at AB1 (45 feet bgs) with a reported value of 0.03 mg/kg. Ethyl benzene was not detected in any of the 53 background soil samples and was detected in one of the 85 down-canyon soil samples. The down-canyon ethyl benzene detection was at RFB8 (35 feet bgs) with a reported value of 0.03 mg/kg. Toluene was detected in eight of the 53 background soil samples and in four of the 85 down-canyon soil samples. The background toluene values ranged from not detected to 0.06 mg/kg with a mean value of 0.009 mg/kg. The down-canyon toluene values ranged from not detected to 0.04 mg/kg with a mean value of 0.008 mg/kg. o-Xylene was not detected in any of the 53 background soil samples and was detected in two of the 51 down-canyon soil samples. The down-canyon o-xylene detections were at RFB8 (35 feet bgs) and RFB15 (75 feet bgs) with reported values of 0.02 and 0.20 mg/kg, respectively. m+p-

Xylene was detected in one of the 53 background soil samples and in five of the 51 down-canyon soil samples. The background m+p-xylene detection was at L8 (RFBL2; 145 feet bgs) with a reported value of 0.01 mg/kg. The down-canyon m+p-xylene values ranged from not detected to 0.44 mg/kg with a mean value of 0.13 mg/kg.

BTEX compounds were detected at relatively low levels (the detection limit for BTEX compounds is 0.01 mg/kg). The detections of BTEX compounds are plotted on Exhibit 3.5-2. The detections of BTEX compounds in soil samples obtained during the 1987 SWAT project are also included. The QA/QC program associated with the 1987 SWAT project was not as complete as that employed during the remedial investigations; therefore, they should be interpreted carefully. Also included on the exhibit are the detections of BTEX compounds for boreholes L9 (RFBL3), RFB1, and M53B (RFB16). These borings were drilled using a drilling polymer (Herzog, 1991b), and a field screening of the drilling polymer indicated that it contained VOCs. The cores from these boreholes are not included in this discussion.

The distribution of the BTEX compounds in the soil samples in relation to the PVLF boundary is not consistent with what would be expected from landfill affected soil contamination. The irregular distribution of the BTEX compounds in the soil samples suggest that they may have originated from other sources not related to the landfill. The Monterey Formation is a source rock for oil in the Los Angeles area, and therefore detections of BTEX compounds is not unexpected. Also, BTEX compounds are commonly found in gasoline and in the exhaust of automobiles. The BTEX compounds found in the soils may be naturally occurring or a result of minor gasoline spills. Because the BTEX compounds were detected sporadically and at relatively low values, and because the distribution of BTEX compounds in relation to the PVLF boundary was not characteristic of landfill contamination, the Sanitation Districts do not believe the detections indicate landfill effects.

Chlorinated VOCs

The chlorinated VOCs detected in the soil samples included 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, 1,1-dichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, cis-1,3-dichloropropene, and 1,1,2,2-tetrachloroethane. 1,1,1-Trichloroethane was detected in one of the 53 background soil samples and was not detected in any of the 85 down-canyon soil samples. The background 1,1,1-trichloroethane detection was at M61B (RFB31; 65 feet bgs) with a reported value of 0.02 mg/kg. Trichloroethylene was not detected in any of the 53 background soil samples and was detected in two of the 85 down-canyon soil samples. The down-canyon trichloroethylene detections were at RFB2 (80 and 135 feet bgs) with values of 0.01 and 0.02 mg/kg, respectively. Tetrachloroethylene was not detected in any of the 53 background soil samples and was detected in one of the 85 down-canyon soil samples. The down-canyon tetrachloroethylene detection was at AB1 (35 feet bgs) with a value of 0.04 mg/kg. 1,1-Dichloroethane was detected in one of the 53 background soil samples and was not detected in any of the 85 down-canyon soil samples. The background 1,1-dichloroethane detection was at M61B (RFB31; 65 feet bgs) with a reported value of 0.01 mg/kg. 1,1,2-Trichloroethane was detected in one of the 53 background soil samples and was detected in three of the 85 down-canyon soil samples. The background 1,1,2-trichloroethane detection was at L8 (RFBL2; 20 feet bgs) with a reported value of 0.01 mg/kg. The detected down-canyon 1,1,2-trichloroethane values ranged from 0.01 to 0.05 mg/kg with a mean value of 0.03 mg/kg. 1,2-dichloroethane was not detected in any of the 53 background soil samples and was detected in two of the 85 down-canyon soil samples. The down-canyon 1,2-dichloroethane detections were at RFB2 (80 and 135 feet bgs) with values of 0.02 and 0.01 mg/kg, respectively. cis-1,3-Dichloropropene was not detected in any of the 53 background soil samples and was detected in two of the 85 down-canyon soil samples. The down-canyon cis-1,3-dichloropropene detections were at RFB2 (80 and 135 feet bgs) with values of 0.02 and 0.01 mg/kg, respectively. 1,1,2,2-Tetrachloroethane was detected in one of the 53 background soil samples and was detected in seven of the 85 down-canyon soil samples. The background 1,1,2,2-tetrachloroethane detection was at L8 (RFBL2; 20 feet bgs) with a reported value of 0.04 mg/kg. The detected down-canyon 1,1,2,2-tetrachloroethane values ranged from 0.01 to 0.17 mg/kg with a mean value of 0.05 mg/kg.

The chlorinated VOCs were detected at relatively low levels (the detection limit for chlorinated VOCs is 0.01 mg/kg). The detections of chlorinated VOCs are plotted on Exhibit 3.5-3. The detections of chlorinated VOCs in soil samples obtained during the 1987 SWAT project are also included. The QA/QC program associated with the 1987 SWAT project was not as complete as that employed during the remedial investigations; therefore, they should be interpreted carefully. Also included are the detections of chlorinated VOCs for boreholes L9 (RFBL3), RFB1, and M53B (RFB16). These borings were drilled using a drilling polymer (Herzog, 1991b), and a field screening of the drilling polymer indicated that it contained VOCs. The cores from these boreholes are not included in this discussion.

The low concentrations of these chlorinated VOCs found in the soil samples may potentially be a result of landfill gas migration; however, they may also be unrelated to the PVLF. Several of the compounds that were detected in the soil samples are seldom or never detected in ground water samples. Although 1,1,2,2-tetrachloroethane was detected in seven downgradient soil samples, it has never been detected in ground water samples. Although cis-1,3-dichloropropene was detected in two downgradient soil samples, it has been detected in only one ground water sample (cis-1,3-dichloropropene was detected once at location PV-3 at the detection limit). Several of the chlorinated VOC detections in the soil samples occurred at borings that encountered little or no ground water when they were drilled. Although low levels of these chlorinated VOCs were detected in soil samples from borings RFB2, RFB12, and RFB15, sparse or no water was encountered when the borings were drilled. The chlorinated VOC detections that occurred in soil samples at certain borings do not correspond to chlorinated VOC detections in the ground water from the wells installed at these locations. Although 1,1,2-trichloroethane and 1,1,2,2-tetrachloroethane were detected in soil samples taken from down-gradient boring M51B (RFB4), there have been no detections of these two chlorinated VOCs in the ground water samples from this well. Although 1,1-dichloroethane and 1,1,1-trichloroethane were detected in soil samples taken from background boring M61B (RFB31), there have been no detections of these two compounds in the ground water samples from this well. Finally, although 1,1,2-trichloroethane and 1,1,2,2-tetrachloroethane were detected in soil samples taken from background boring L8 (RFBL2), there have been no detections of these two chlorinated VOCs in the soil-pore water collected from this lysimeter.

Semi-Volatile Organic Compounds

Thirty-one semi-volatile organic compounds were detected in eight down-canyon samples. The soil sample from RFB8 (35 feet bgs) contained 2 mg/kg of acenaphthene, 1 mg/kg of anthracene, 3 mg/kg of benzo(b)fluoranthene, 2 mg/kg of chrysene, 3 mg/kg of fluoranthene, 3 mg/kg of phenanthrene, and 6 mg/kg of pyrene. The soil sample from RFB10 (75 feet bgs) contained 6 mg/kg of benzo(a)pyrene. The soil sample from AB5a (25 feet bgs) contained 5 mg/kg of di-n-butyl phthalate. The soil sample from M69B (AB6; 10 feet bgs) contained 37 mg/kg of diethylhexy phthalate.

Several soil samples from M76B (AB8) contained semi-volatile organic compounds. The soil sample from 30 feet bgs contained 1 mg/kg of anthracene, 2 mg/kg of chrysene, 2 mg/kg of fluoranthene, 3 mg/kg of phenanthrene, and 4 mg/kg of pyrene. The soil sample from 40 feet bgs contained 14 mg/kg of di-n-butyl phthalate. The soil sample from 50 feet bgs contained 6 mg/kg of acenaphthene, 2 mg/kg of acenaphthylene, 4 mg/kg of anthracene, 3 mg/kg of benzo(a)anthracene, 4 mg/kg of benzo(b)fluoranthene, 4 mg/kg of chrysene, 9 mg/kg of fluoranthene, and 14 mg/kg of pyrene. Finally, the soil sample from 70 feet bgs contained 1 mg/kg of anthracene, 2 mg/kg of benzo(a)anthracene, 3 mg/kg of benzo(b)fluoranthene, 2 mg/kg of benzo(k)fluoranthene, 2 mg/kg of chrysene, 4 mg/kg of fluoranthene, and 7 mg/kg of pyrene.

Three of the semi-volatile organic compounds that were detected in the soils are phthalates. The phthalates are ubiquitous plasticizers found in the environment and are common laboratory contaminants. Because the phthalate compounds were detected sporadically at relatively low concentrations, the Sanitation Districts do not believe the detections indicate landfill effects.

All of the other semi-volatile organic compounds that were detected in the soil samples are PAHs. The distribution of the PAH compounds in the soil samples in relation to the PVLF boundary is not consistent with what would be expected from landfill affected soil contamination. PAHs are formed from the incomplete combustion of hydrocarbons and are naturally present in many forms of vegetative and fossil fuel. Because the PAHs were detected sporadically, and because the distribution of PAH compounds in relation to the PVLF boundary was not characteristic of landfill contamination, the Sanitation Districts do not believe the detections indicate landfill effects.

3.5.3 Quantitative Analysis of the Soil Sample Results

The constituents in the soil samples that had 50 percent or more detected values for both the background and down-canyon samples were evaluated using the Wilcoxon Rank Sum test. A description of the Wilcoxon Rank Sum test is given in Section 2.4.4. The results of this test for the soil samples are shown in Table 3.5-3. The table gives the number of background samples analyzed, the number of down-canyon samples analyzed, the Wilcoxon test statistic (Z_{rs}), the comparative value (Z_{1-a}), and the population type. In order to interpret the results of the Wilcoxon test, a significance, or probability, level for the test must be chosen. Because statistical tests make conclusions about populations based on a small sample randomly drawn from that population, there always is a probability that the test conclusions are wrong. The significance level represents this probability. The significance level, a, used for this analysis is five percent. The computed test statistic Z_{rs} is compared to Z_{1-a} from a standard normal distribution table, or $Z_{0.95}$ for a five percent significance level, which is equal to 1.645. If Z_{rs} is greater than or equal to 1.645, the mean of the down-canyon samples is greater than the mean of the background samples. If Z_{rs} is less than or equal to -1.645, the mean of the background samples is greater than the mean of the down-canyon samples.

The results of the Wilcoxon Rank Sum test on the soil samples show that six of the constituents (conductivity, chloride, barium, iron, manganese, and potassium) had background and down-canyon populations that are statistically equivalent. For thirteen of the constituents the background samples are representative of a population having higher concentration levels than that of the down-canyon. The higher background concentration levels for pH, nitrate nitrogen, calcium, magnesium, cadmium, chromium, cobalt, mercury, nickel, sodium, zinc, molybdenum, and vanadium are believed to be a result of random fluctuations in soil/sediment data, and there is no indication of landfill based contamination for these constituents. The results also show that for four of the constituents (sulfate, oil and grease, arsenic, and selenium), the down-canyon samples are representative of a population having higher concentration levels than that of the background. These four constituents are discussed below.

Sulfate

Sulfate was detected in all of the 53 background and 85 down-canyon samples. The sulfate background values ranged from 3.0 to 2,760 mg/kg with a mean value of 316 mg/kg. The sulfate down-canyon values ranged from 1.7 to 14,900 mg/kg with a mean value of 1,110 mg/kg. Sulfate is a major anionic constituent commonly found in sediments and is not considered to be a landfill contaminant. The presence of sulfate at these concentrations is not indicative of contamination associated with the wastes disposed at the PVLF. Therefore, the sulfate detections appear to be random fluctuations in sediment quality, and not an indication of landfill contamination.

TABLE 3.5-3

WILCOXON RANK SUM TEST RESULTS FOR SUBSURFACE SOIL SAMPLES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	BACK-GROUND SAMPLES ANALYZED	DOWN-CANYON SAMPLES ANALYZED	WILCOXON TEST STATISTIC Zrs	COMP-ARATIVE VALUE Z(1-a*)	POPULATION TYPE
GENERAL					
PH	51	85	-1.84	-1.645	BACKGROUND
CONDUCTIVITY	50	82	0.14	1.645	COMMON
NITRATE NITROGEN	50	85	-3.49	-1.645	BACKGROUND
SULFATE	50	84	2.30	1.645	DOWN-CANYON
CHLORIDE	50	82	0.33	1.645	COMMON
OIL & GREASE	42	39	2.54	1.645	DOWN-CANYON
METALS					
CALCIUM	53	85	-1.78	-1.645	BACKGROUND
MAGNESIUM	53	85	-2.07	-1.645	BACKGROUND
ARSENIC	53	85	1.68	1.645	DOWN-CANYON
BARIUM	53	85	-1.11	-1.645	COMMON
CADMIUM	53	85	-5.42	-1.645	BACKGROUND
TOTAL CHROMIUM	53	85	-5.74	-1.645	BACKGROUND
COBALT	53	85	-2.51	-1.645	BACKGROUND
IRON	53	85	0.70	1.645	COMMON
MANGANESE	53	85	-1.51	-1.645	COMMON
MERCURY	50	85	-2.75	-1.645	BACKGROUND
NICKEL	53	85	-4.15	-1.645	BACKGROUND
POTASSIUM	53	85	1.64	1.645	COMMON
SELENIUM	53	85	3.86	1.645	DOWN-CANYON
SODIUM	53	85	-1.91	-1.645	BACKGROUND
ZINC	53	85	-2.89	-1.645	BACKGROUND
MOLYBDENUM	53	85	-2.80	-1.645	BACKGROUND
VANADIUM	53	85	-6.54	-1.645	BACKGROUND

Notes:

* the specified level of significance, a, is 5%.

Population Types:

Common - the background and down-canyon populations are statisticallly equivalent.

Background - the background population has statisticallly higher values than the down-canyon population.

Down-canyon - the down-canyon population has statistically higher values than the background population.

Oil and Grease

Oil and grease was detected in approximately 90 percent of the background and down-canyon samples. Oil and grease was detected in 38 of the 42 background soil samples. The background oil and grease values ranged from not detected to 3,900 mg/kg with a mean value of 368 mg/kg. Oil and grease was detected in 35 of 39 down-canyon soil samples. The down-canyon oil and grease values ranged from not detected to 1,000 mg/kg with a mean value of 384 mg/kg. Although the mean value of the down-canyon samples is slightly greater than that of the background samples, the down-canyon range of values are less than those of the background samples. These detections concerned the Sanitation Districts because a large portion of the nonhazardous and hazardous wastes accepted at the landfill were oil based wastes. Therefore, the landfill is a potential source of the oil and grease, although other evidence indicates otherwise.

First, the Monterey Formation is an organic rich sedimentary deposit. It is considered to be a source bed for oil throughout the Los Angeles area, and therefore, oil and grease detections would be expected in this formation. Second, nine of the ten background Malaga Mudstone samples were taken from the same borehole, while the down-canyon Malaga Mudstone samples were taken from seven different locations. The increase in down-canyon oil and grease concentrations may therefore be due to increased spatial variability in the down-canyon Malaga Mudstone. Third, the test method for oil and grease is not selective to petroleum based compounds. The method will quantify any non-volatile, freon soluble material, such as materials from animal and plant sources. Fourth, water samples collected during the remedial investigations do not show indications of higher down-canyon concentrations of oil and grease. Based on these findings, the Sanitation Districts do not believe that the higher levels of oil and grease in the down-canyon samples is a result of contamination emanating from the materials disposed of at the PVLF.

Arsenic

Arsenic was detected in all of the 53 background soil samples. The background arsenic values ranged from 0.17 to 58.0 mg/kg with a mean value of 4.9 mg/kg. Arsenic was detected in 83 of 85 down-canyon soil samples. The down-canyon arsenic values ranged from not detected to 32.5 mg/kg with a mean value of 5.4 mg/kg. Arsenic occurs naturally in soils, and arsenic concentrations found in common soils typically range from 0.3 to 69 mg/kg (Dragun, 1991). The detected arsenic values are all within or near the range found in common soils. No patterns of down-canyon arsenic contamination is observed in the soil samples. Therefore, the Sanitation Districts believe that the higher levels of arsenic down-canyon of the landfill are indicative of sediment variability rather than landfill based contamination.

Selenium

Selenium was detected more frequently in the background samples than the down-canyon samples (92 percent and 85 percent, respectively). Selenium was detected in 49 of the 53 background soil samples. The background selenium values ranged from not detected to 2.9 mg/kg with a mean value of 0.5 mg/kg. Selenium was detected in 72 of 85 down-canyon soil samples. The down-canyon selenium values ranged from not detected to 29.1 mg/kg with a mean value of 2.96 mg/kg. Selenium is a common element found in sediments originating from a marine environment. No patterns of down-canyon selenium contamination is observed in the soil samples. Therefore, the Sanitation Districts believe that the higher levels of selenium down-canyon of the landfill are indicative of sediment variability rather than landfill based contamination.

3.6 GROUND WATER

This section discusses the ground water and vadose zone monitoring systems at the PVLF. Specifically, Section 3.6.1 provides background information regarding ground water monitoring at the PVLF. Section 3.6.2 presents the ground water quality monitoring results. Section 3.6.3 presents the determination of background water quality at the landfill. Section 3.6.4 discusses general water quality at the landfill. Sections 3.6.5 and 3.6.6 discuss the nature and extent of metals and VOC contamination, respectively. Section 3.6.7 discusses the extent of semi-volatile organic compound (semi-VOC) detection at the PVLF. Section 3.6.8 discusses the vadose monitoring system at the PVLF, and then presents the results and implications of vadose zone water monitoring. Complete ground water monitoring results for the monitoring wells, sumps, and lysimeters are presented in Appendix A.3.1.1.