

## 6. NATURE AND EXTENT OF COPCS IN GROUNDWATER

This section presents the results of the RI field investigations and evaluates these data to establish the nature and extent of COPCs in groundwater underlying the former Rayonier Mill Site.

The data collected from the RI field investigations form the primary basis for establishing the nature and extent of COPCs in groundwater at the Site. These data are screened against water quality criteria to identify the media-specific COPCs. COPCs identified by this screening process are then evaluated to assess their nature and extent at the Site. Historic Site data are also considered, where appropriate, to provide a comprehensive understanding of the occurrence of COPCs in groundwater at the Site.

Data collected during the RI to characterize groundwater included testing or measuring physical properties of the aquifer and chemical analysis of groundwater samples collected during the sampling effort. This section presents and evaluates these data.

### 6.1 Physical Properties

Physical properties of the aquifer were tested, including the materials comprising the aquifer, groundwater flow direction and gradient, tidal influence, and hydraulic conductivity.

#### 6.1.1 Aquifer Materials

As noted in Section 6.4.3, onsite monitoring wells are screened in the shallowmost water-bearing zone beneath the Site. Groundwater occurs under unconfined conditions in fill and alluvium materials. The shallow water-bearing zone is variable in thickness; the base (generally defined by the top of the Vashon Till unit) varies from 12 ft bgs to greater than 30 ft bgs (Foster Wheeler 1997). Detailed descriptions of the shallow aquifer materials are presented in Section 5.1, and generalized cross-sections of the Site are presented in Figures 6-1 and 6-2.

The Vashon Till was encountered at depths of 12 to 30 feet beneath ground surface in approximately 50 percent of the borings drilled at the site. The Vashon Till is the most common surficial geologic unit in the Port Angeles area resulted from the most recent glacial advances and retreats. Geological maps (Schasse 2003) show that the Vashon Till is in direct contact with underlying bedrock (mudstones and sandstones of the Pysht Formation). The depth of this contact (and the thickness of the Vashon Till) beneath the site is unknown, but local geology shown on the maps indicates that it is on the order of 10's of feet. Neither the Vashon Till nor the underlying bedrock are expected to significantly influence or provide groundwater transport pathways for the near- surface aquifer.

### 6.1.2 Groundwater Elevations

Groundwater elevations were measured on June 17, 2003 within 2 hours of the low tide (Table 6-1). Measurements were collected with an oil/water interface probe. No LNAPL was detected in any of the wells. Depth to groundwater ranged from 4.2 to 15 ft bgs (PZ-13 was dry at the time of water level measurements). Groundwater elevation measurements were also collected during earlier sampling events (Table 6-1).

Groundwater hydrographs illustrate the temporal changes in groundwater elevation in each well (Figures 6-3 and 6-4). With the exception of two apparent anomalies (PZ-7 on August 20, 2001 and MW-20 on August 27, 1997), the hydraulic responses to seasonal changes have a good correlation. For example, the water levels in the wells are relatively high in the winter months and low in the summer months. The degree of correlation of hydraulic responses indicates the shallow aquifer is hydraulically well connected in the vertical direction, with respect to seasonal fluctuations. In general, groundwater elevations are 2-3 feet lower in summer months compared to winter months, corresponding to seasonal rainfall patterns. Maximum and minimum seasonal changes occurred at MW-51 (3.91 ft) and MW-52 (0.84 ft), respectively, for the period of record.

The elevations at each well and groundwater potentiometric surface contours (Figures 6-5 through 6-13) indicate that groundwater flow directions are consistently northward. Groundwater flow gradients (Table 6-2) were calculated for each monitoring event using selected well pairs to represent the northern portion (PZ-3 and PZ-4) and the southern portion of the Site (PZ-5 and PZ-12). In the southern portion of the Site, horizontal hydraulic gradients ranged from approximately 0.014 to 0.017 ft/ft for the period of record. Gradients ranged from 0.002 to 0.009 ft/ft in the northern portion. Gradients in the northern portion of the Site are influenced by tidal fluctuations, but differences in gradient between high and low tide measurements (August 1993 and February 1997) were within 0.002 ft/ft.

### 6.1.3 Tidal Monitoring

A 14-day tidal assessment was conducted between July 7 and July 21, 2003. The assessment consisted of collecting water levels with pressure transducers from selected wells. The wells selected for the tidal assessment were based on a 24-hour tidal assessment conducted in 1993 (HLA 1993). The 1993 tidal assessment showed that responses to tidal fluctuations are limited to low-lying wells in the northern portion of the Site.

The following wells were included in the 2003 tidal monitoring event:

- MW-51, MW-52, MW-55, MW-56, MW-59, PZ-2, and PZ-9 are located near the shoreline.
- MW-23, MW-57, MW-58, and PZ-4 are located in the main process area and are influenced by tidal fluctuations, but to a lesser degree than the shoreline wells.

- PZ-5 is located near Ennis Creek. Although a minimal response was measured in 1993, this well was included in the tidal assessment to evaluate conditions near Ennis Creek.

The actual tidal fluctuation was measured at the Rayonier dock during the same 14-day period.

Plots of the tidal monitoring in the wells and from a stilling well on the dock are shown in Figures 6-14 through 6-18. The maximum daily tidal fluctuation measured at the Rayonier dock (Figure 6-14) was 11.8 ft and occurred during the middle of the monitoring period. The periods of least daily tidal extremes occurred toward the beginning and end of the monitoring period, ranging from 4.5 to 5.5 ft.

In general, the shoreline wells showed the largest tidal response, with decreasing response with distance from the shoreline. However, the relationship between distance and tidal response was not linear (Figure 6-19). For example, the maximum daily extreme for MW-51 was 5.1 ft and 2.4 ft for MW-56. Both wells are located at similar distances from the shoreline (60 to 70 ft). PZ-4 showed a maximum tidal extreme of 0.36 ft at a relatively large distance from the shoreline (580 ft) and a larger extreme than the 0.15 ft recorded at MW-23, which is located 300 ft from the shoreline. The non-linear trend in tidal extremes versus distance indicates that the fill material in the northern portions of the Site has a large range in seepage velocities.

#### **6.1.4 Hydraulic Conductivity**

Hydraulic conductivity was assessed with slug tests in 2001 (Landau 2001c) on wells PZ-2, PZ-4, PZ-10, PZ-12, MW-20, MW-51, MW-53, and MW-56. The wells were selected to provide information from different portions of the Site and different soil types. The soil in screened intervals of the eight wells consisted of fill material composed primarily of silty sands and gravels. A rising head slug test was performed in each well, and the well recovery was measured using a pressure transducer. The Bower and Rice Method was used to analyze the slug test data.

The range of hydraulic conductivity values measured during these tests is consistent with the silty-sand and gravel soil types present at the Site. Furthermore, the range in hydraulic conductivity estimated for the eight wells is generally within one order of magnitude, which is small given the nature of the test method. Wells MW-51 and PZ-4 had hydraulic conductivities that were more than an order of magnitude smaller than the mean. The soil logs of these wells do not indicate that the aquifer materials within the screened interval of these wells differ significantly from the other tested wells. Therefore, the reason for the relatively low hydraulic conductivity measured in these two wells is unclear.

Well	Hydraulic Conductivity (cm/s)
MW-20	8.90E-03
MW-51	1.40E-04
MW-53	4.38E-03
MW-56	1.67E-03
PZ-2	3.28E-03
PZ-4	1.20E-04
PZ-10	2.80E-03
PZ-12	1.42E-03
<b>Mean</b>	2.8E-03
<b>Standard Deviation</b>	2.9E-03

As noted in Section 6.1.3, the non-linear trend in tidal extremes versus distance indicates that the fill material in the northern portions of the Site has a larger range in seepage velocities than may be indicated by the slug tests.

### 6.1.5 Groundwater Flow Velocity and Discharge Calculations

Using the available data, average interstitial groundwater flow (seepage) velocity and discharge can be estimated from the hydraulic gradient and hydraulic conductivity of the shallow aquifer system.

The average seepage velocity of the shallow aquifer can be estimated using the range of gradients and conductivities observed and an effective porosity of 0.3:

$$v = Ki/\alpha$$

Where:

- $v$  = seepage velocity (cm/sec)
- $K$  = hydraulic conductivity (cm/sec)
- $i$  = average gradient
- $\alpha$  = porosity

Discharge calculations for the shallow aquifer can be performed with the following calculation:

$$Q = KiA$$

Where:

- $Q$  = discharge at the groundwater, ocean interface (ft<sup>3</sup>/day)
- $K$  = hydraulic conductivity (ft/day)
- $i$  = average gradient
- $A$  = area =  $b \times l$

The area is equal to the product of the aquifer thickness ( $b$ ) and the width of the flow front ( $l$ ). The aquifer thickness is variable and undefined in some areas. An average saturated thickness of 10 ft was used. The width of the flow front (MW-52 to PZ-4 to MW-59) is 2,700 ft.

Seepage (interstitial) velocity and discharge estimated for the northern portion of the Site are summarized below:

	Hydraulic Conductivity		Hydraulic Gradient	Seepage Velocity (cm/s)	Discharge	
	(cm/s)	(ft/day)			(ft <sup>2</sup> /day)	(gallons/min)
Minimum	0.00012	0.34	0.0026	0.003	24	0.1
Maximum	0.0089	25.23	0.0095	0.796	6,444	34
Average	0.0028	7.94	0.0058	0.154	1,249	6.5

## 6.2 Chemicals of Potential Concern

This section presents the June 2003 groundwater analytical results and screens the results to applicable criteria.

### 6.2.1 June 2003 Data

The June 2003 groundwater analytical results are shown in Table 6-3. To achieve the project data quality objectives (DQOs), the laboratory typically extracted 2 times the volume normally used for the method and concentrated the final extract volume by a factor of 2. This process also concentrates any interferences that are present in the samples. In many cases, the laboratory was required to dilute the subsequent extract to resolve the interferences sufficiently to analyze the samples. The laboratory added qualifiers to the result to indicate when the results were generated from a diluted extract (D) or when interferences were encountered (i). This understanding of the laboratory method is necessary to interpret some of the results discussed in the following sections, particularly for pesticides.

### 6.2.2 Screening

MTCA identifies several criteria for evaluating groundwater (WAC 173-340-720). Groundwater criteria are based on estimates of the highest beneficial use and reasonable maximum exposure expected under both current and future site use conditions. Since the water-bearing zone does not serve as a drinking water supply, and the former Rayonier Mill Site does not meet Washington State minimum requirements for construction of drinking water supply wells [WAC 173-160-171 (i.e., depth to groundwater and location outside the 100-year floodplain)], drinking water standards are not applicable to the groundwater onsite.

The Site is immediately adjacent to Port Angeles Harbor, which is the primary receptor for Site groundwater. Thus, screening criteria were selected based on the potential discharge to marine water to provide a conservative measure for evaluating Site groundwater. Both state and federal ambient surface water quality standards were selected as screening criteria that are protective of 1) aquatic marine organisms, and 2) human health associated with consumption of the aquatic marine organisms (Table 6-4). Where more than one

numerical criterion is available for a chemical, the most stringent one was used for the screening evaluation. MTCA Method A criteria were used as screening criteria for diesel- and residual-range hydrocarbons and arsenic (MTCA Table 720-1). Sources for the criteria in Table 6-4 are listed below:

Criteria	Regulatory Citation	Notes
Human health – State of Washington	MTCA – Method B Surface Water Criteria	Criteria are based on human health exposure to consumption of organisms.
Human health – Federal	Section 304 of the Clean Water Act, updated by the National Toxics Rule, from National Recommended Water Quality Criteria (USEPA 2002), EPA-822-R-02-047(USEPA 2002)  National Water Quality Criteria, 40CFR 131.36 (USEPA 2002 )	Criteria based on protection of human health to consumption of organisms.
Aquatic organisms – State of Washington	Ambient Water Quality Criteria – State of Washington (Ecology WAC Chapter 173-201A-240, Table 240(3))	Criteria are based on protection of aquatic organisms (chronic marine criteria).
Aquatic organisms – Federal	Section 304 of the Clean Water Act, updated by the National Toxics Rule, from National Recommended Water Quality Criteria (USEPA 2002), EPA-822-R-02-047 (USEPA 2002)	Criteria are based on protection of aquatic organisms (chronic marine criteria).

The comparison of groundwater analytical data is environmentally conservative for several reasons:

- The volume of groundwater seepage into the marine environment represents a very small fraction of ambient marine water conditions (see Section 7.3).
- The comparison does not consider the buffering effects of seawater on the relatively small contribution of submarine groundwater discharge. This may be particularly applicable to metals that tend to precipitate under the higher pH conditions of seawater.
- Some marine criteria are lower than freshwater criteria. It is possible that a pristine river could be out of compliance with marine water quality criteria.
- Groundwater is in intimate contact with aquifer material, which contains naturally occurring metals, including arsenic, chromium, copper, nickel, and mercury. This condition is not present in surface seawater.

In establishing cleanup levels, MTCA (WAC 173-34-700[6][d]) states that levels should not be set at concentrations less than the practical quantitation limit (PQL). The PQL is defined in MTCA as the lowest concentration that can be reliably measured within specified limits of precision, accuracy, representativeness, completeness, and comparability during routine laboratory operating conditions, using approved methods. For some chemicals, surface water cleanup levels derived using risk-based equations (WAC 173-340-730) or ambient water quality criteria are below the PQL, and in those

cases the cleanup level has been set at the PQL. Groundwater screening levels modified to reflect project-specific PQLs<sup>14</sup> are identified in Table 6-4 and 6-5.

The summary of the groundwater screening (Table 6-5) includes the number of samples analyzed for each chemical, the number of samples in which the chemical was detected, and the number of samples in which the chemical was detected above the minimum criteria (shown in bold). In a limited number of cases, a given chemical was not detected at an analytical detection limit that exceeded the criteria. Detection limits that were exceeded are shown in bold italics. In at least one onsite groundwater well, 117 of the 186 constituents tested were detected. Many of these chemicals occur naturally (e.g., metals) and would be detected in pristine locations. Screening criteria are available for 118 of the chemicals analyzed. The 27 COPCs listed below include 20 chemicals that were detected in at least one sample at a concentration above screening criteria, as well as seven chemicals with no detections, but with detection limits above the screening criteria in at least one sample.

Compound	Basis for Selection as a COPC in Groundwater	
	Detected Above Criteria	Non-Detect above Criteria
<b>SVOCs</b>		
2,4,6-Trichlorophenol	X	
Pentachlorophenol	X	
<b>PAHs</b>		
Benzo(a)anthracene	X	
Chrysene	X	
<b>Dissolved Metals</b>		
Arsenic	X	
Chromium	X	
Copper	X	
Lead (total only)	X	
Nickel	X	
Mercury	X	

Compound	Basis for Selection as a COPC in Groundwater	
	Detected Above Criteria	Non-Detect above Criteria
<b>Pesticides</b>		
4,4'-DDD	X	
4,4'-DDE	X	
4,4'-DDT	X	
Aldrin		X
Alpha-BHC		X
Alpha-Chlordane	X	
Dieldrin	X	
Endosulfan II		X
Endrin	X	
Heptachlor	X	
Heptachlor Epoxide		X
Toxaphene		X

<sup>14</sup> PQLs are from Houkal (2005, pers. comm.), and are provided in laboratory data packages in Appendix G.

Compound	Basis for Selection as a COPC in Groundwater	
	Detected Above Criteria	Non-Detect above Criteria
<b>PCBs</b>		
Aroclor 1016		X
Aroclor 1254		X
Aroclor 1260	X	
Total PCBs	X	
<b>Conventional Parameters</b>		
N-Ammonia (un-ionized)	X	

Chemicals identified as COPCs solely on the basis of one or more detection limits that exceed criteria are classified as COPCs to be environmentally conservative; there is no scientific evidence that they actually exceed criteria. There is simply no evidence that they do not exceed criteria at the location where the detection limit was elevated. For these chemicals, the analytical challenges discussed in Section 6.2.1 and the frequency of elevated detection limits must be carefully considered.

The COPCs and screening criteria discussed above differ somewhat from the screening performed on historical data in the RI Work Plan (Integral 2004). Individual VOCs, PCBs, and pesticides were not identified as COPCs from the historical data. Pesticides and PCBs are identified as COPCs for the 2003 sampling event due primarily to the lower detection limits achieved during the sampling event, the environmentally conservative decision to identify COPCs based on detection limits that exceed criteria, and updated screening criteria.

The number of non-detected analytes with detection limits above screening criteria was reduced from 48 in the RI Work Plan to nine for the June 2003 data, again primarily due to the lower detection limits achieved for the 2003 sampling event.

### 6.3 Nature and Extent of Groundwater COPCs

This section presents the nature and extent of the COPCs identified in Section 6.4 for groundwater at the Site. The following discussion addresses (by chemical class) the nature and extent for each of the COPCs. Graphical displays used in the discussions include plots of the relative concentrations of the COPCs measured in samples from each of the wells (Figures 6-20 through 6-28) and figures showing the spatial distribution of COPCs detected at concentrations exceeding screening criteria (Figures 6-29 through 6-46).

#### 6.3.1 Volatile Organic Compounds

VOC detections were sporadic in the June 2003 groundwater samples. VOCs detected at more than one location included acetone, ethylbenzene, xylenes, and toluene. No VOCs were detected above screening criteria.

Screening of historic groundwater data (Table 3-7) resulted in no detections above criteria.

### 6.3.2 Semivolatile Organic Compounds

SVOCs were only sporadically detected across the Site and nearly always at levels below screening criteria. The one exception was phthalates, which were detected at most locations, but at levels below screening criteria.

Concentrations of 2,4,6-trichlorophenol, PCP, benzo(a)anthracene, and chrysene (Figures 6-20 and 6-21) exceeded screening criteria at three wells, MW-23, MW-51, and MW-59, as summarized below:

- **2,4,6-Trichlorophenol**—MW-23
- **Pentachlorophenol** —MW-23
- **Benzo(a)anthracene**—MW-51
- **Chrysene**—MW-51 and MW-59.

The locations of the 2003 detections are shown on Figures 6-29 through 6-32. In all cases, the detections exceeded the screening criteria by less than a factor of 3. Detection limits exceeded screening criteria for 3,3'-dichlorobenzidine and hexachlorobenzene. These were the only SVOCs where detection limits exceeded screening criteria.

Screening of historic groundwater data (Table 3-7) shows that detected SVOCs exceeded criteria for pentachlorophenol (2 of 2 detections), bis(2-ethylhexyl)phthalate (4 of 12 detections), benzo(a)anthracene (3 of 3 detections), chrysene (2 of 2 detections), and benzo(a)pyrene (1 of 1 detection).

Benzo(a)pyrene and bis(2-ethylhexyl)phthalate were not identified as COPCs based on the 2003 groundwater monitoring data. Benzo(a)pyrene was detected above criteria at MW-55 in August 2001 and was not detected in following sampling events (December 2002 and June 2003). Bis(2-ethylhexyl)phthalate was detected above criteria at MW-55 in August 2001 and was not detected in following sampling events (December 2002 and June 2003). Bis(2-ethylhexyl)phthalate was also detected above criteria in December 2003 and not detected in June 2003. Because these concentrations were not replicated in subsequent sampling events, benzo(a)pyrene and bis(2-ethylhexyl)phthalate are not included as COPCs.

Diesel- and residual-range total petroleum hydrocarbons (TPH) were detected in MW-11 above criteria in August 2001. MW-11 was abandoned in 2002. Two wells are located downgradient of MW-11, MW-23 and MW-29, within 200 feet. Concentrations in these wells have never exceeded criteria. While there may be a local occurrence of TPH near former MW-11, it appears to be stable and not migrating toward marine surface water receptors. TPH is not included as a COPC.

### 6.3.3 Metals

Dissolved (filtered) metals concentrations were used to identify COPCs. As noted in Section 6.2.2, both state and federal ambient surface water quality standards were selected as screening criteria that are protective of 1) aquatic marine organisms and 2) human health associated with consumption of the aquatic marine organisms. Both state and federal criteria use dissolved concentrations to establish criteria.

The primary mechanism for toxicity to organisms that live in the water column is by adsorption across the gills, which requires the metal to be in a dissolved form. The bioavailable fraction of metal in the water column is better represented by the dissolved concentration than by the total recoverable concentration (USEPA 1992b). The federal and MTCA equations for fish consumption (MTCA Equations 730-1 and 730-2) use a bioconcentration factor (BCF), which represents the ratio of the metal concentration in the fish to the freely dissolved metal concentration in the water column.

The following summarizes the nature and extent of metals COPCs:

- **Arsenic**—Dissolved arsenic exceeded screening criteria (0.005 ppm) in four wells (MW-51, MW-56, MW-59, and PZ-9, Figure 6-22). Concentrations at PZ-9 and MW-59 (located near the former SSL lagoon) had concentrations of 0.0146 and 0.0633 ppm, respectively. Samples from, MW-51, and MW-56, located in the northeastern portion of the main process area, had concentrations of 0.0063 and 0.0085 ppm, respectively. Arsenic was not detected in PZ-6 and MW-55.
- **Chromium**—Dissolved chromium exceeded screening criteria (0.05 ppm) at two wells, MW-51 and MW-59 (Figure 6-22 and 6-34). The maximum concentration was 0.17 ppm in well MW-59.
- **Copper**—Dissolved copper exceeded screening criteria (0.0024 ppm) at 11 of the 20 wells sampled (Figure 6-23 and 6-35). The maximum concentration was at MW-56 (0.0345 ppm). Other than MW-56, concentrations greater than 0.01 ppm were limited to the main process area (MW-57, PZ-4, and PZ-3) and the SSL lagoon area (PZ-9 and MW-59). The distribution of the dissolved copper concentrations does not indicate discernable sources or identifiable plumes (Figure 6-36).
- **Nickel**—Dissolved nickel slightly exceeded the screening criteria (0.0082 ppm) at three shoreline wells (PZ-3, MW-56, and MW-59), with a maximum concentration of 0.0152 ppm (Figure 6-23).
- **Lead**—Total lead exceeded screening criteria in one sample (MW-55). Dissolved lead did not exceed screening criteria in any of the samples.
- **Mercury**—Dissolved mercury slightly exceeded the screening criteria (0.000025 ppm) at wells MW-56 and MW-57, with a maximum concentration of 0.0000385 ppm (Figure 6-24). Wells downgradient of MW-57 (PZ-3 and MW-55, and MW-51) did not exceed screening criteria (Figure 6-37). Well MW-56 is a shoreline well, and thus, no wells are located downgradient.

Screening of historical groundwater data collected by Rayonier is shown in Table 3-7. Dissolved metals exceeding screening criteria are nearly the same for both the historical and 2003 data, except that mercury was not an historic analyte. All the historic detections of arsenic were greater than criteria, nine of the 28 detections of chromium, 19 of the 38 detections of copper, none of three detections of lead, eight of the 37 detections of nickel, and two of the 27 detections of selenium exceeded criteria.

Selenium was not identified as a COPC based on 2003 data, but historically exceeded criteria at two locations. A concentration of 0.3 ppm was detected at PZ-9 in August 1997. This concentration was not replicated in the duplicate sample taken on the same date or in subsequent groundwater monitoring events (February 2001, August 2001, December 2002 and June 2003). Selenium was also detected at 0.1 ppm at MW-54 in February 2001 and not detected above criteria in subsequent monitoring events (August 2001, December 2002 and June 2003). Because these concentrations have not been replicated, selenium is not included as a COPC.

#### 6.3.4 Pesticides and PCBs

Pesticides and PCBs that exceeded screening criteria include those COPCs with detected concentrations above screening criteria and COPCs with no detections, but with detection limits above screening criteria.

Aldrin, heptachlor epoxide, and toxaphene were identified as COPCs due to non-detections greater than screening criteria. None of these pesticides were detected above the screening level in any samples collected, but all of the samples for these COPCs had detection limits above the screening level, indicating analytical constraints.

The pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, endrin, and heptachlor had at least one detection above screening criteria. However, many of the samples also had non-detections above screening criteria as summarized below:

COPC	No. of Values > Criteria <sup>1</sup>	No. of Detections > Criteria	No. of Non-Detection > Criteria
4,4'-DDD	18	9	9
4,4'-DDE	16	2	14
4,4'-DDT	13	5	8
Alpha-chlordane	7	3	4
Dieldrin	14	1	13
Endrin	2	1	1
Heptachlor	13	2	11

<sup>1</sup> 19 samples were analyzed

Alpha-BHC and endosulfan II each had only one non-detection result that exceeded screening criteria. This sample, collected from MW-56, required a 50x dilution for these analyses, substantially increasing the detection limit. All other non-detections for alpha-

BHC and endosulfan II were below screening criteria. These results indicate that the modified sample collection and laboratory methods were adequate to achieve the project DQOs, but that interferences resulted in elevated detection limits on a sample-specific basis.

Detected pesticides and PCBs that exceeded screening criteria were found at the following locations:

- **4,4'-DDD**—4,4'-DDD exceeded screening criteria (0.00031 ppb) at all nine locations in which it was detected (Figure 6-25). These detections occurred in the upper process area (PZ-12, PZ-11, and PZ-6), at the eastern portion of the Site (PZ-10 and MW-59), and in the main process area (MW-52, MW-53, MW-57 and MW-58) (Figure 6-38). The maximum detected concentration was 0.0098 ppb at MW-59.
- **4,4'-DDE**—Detected concentrations of 4,4'-DDE exceeded screening criteria (0.0005 ppb) at two locations in the main process area (MW-57 and PZ-4), with a maximum detected concentration of 0.0029 ppb at MW-57 (Figures 6-25 and 6-39).
- **4,4'-DDT**—Detected concentrations of 4,4'-DDT exceeded screening criteria (0.0005 ppb) at five locations (Figures 6-26). These detections occurred in the upper process area (PZ-6) in the eastern portion of the Site (MW-59), and in the main process area (MW-57, MW-29, and MW-53, Figure 6-40). The maximum detected concentration was 0.0079 ppb at MW-59.
- **Alpha Chlordane**—Detected concentrations of alpha chlordane exceeded screening criteria (0.00059 ppb) at three locations, PZ-12, MW54, and PZ-3, (Figures 6-26 and 6-41), with a maximum detected concentration of 0.00059 ppb at MW-54.
- **Dieldrin**—Detected concentrations of dieldrin exceeded screening criteria (0.0005 ppb) at one location (MW-58, Figures 6-27 and 6-42), with a maximum concentration of 0.0011 ppb at MW-58.
- **Endrin**—Detected concentrations of endrin exceeded screening criteria (0.0023 ppb) at PZ-3 at a concentration of 0.0046 ppb (Figures 6-27 and 6-43).
- **Heptachlor**—Detected concentrations of heptachlor exceeded screening criteria (0.0005 ppb) at MW-23, and MW-53, with a maximum detection of 0.0018 ppb at MW-23 (Figures 6-28 and 6-44).
- **PCB**—Aroclor 1260 was identified as a COPC based on a detected concentration in a single sample collected from MW-59. At this location, the Aroclor 1260 concentration of 0.045 ppb exceeded the criteria of 0.03 ppb (Figures 6-28 and 6-45). In addition, the total PCB concentration at MW-59 (0.045 ppb) was above the screening value of 0.005 ppb.

Historic analyses of pesticides resulted in no detections above screening levels; however, most of the pesticide detection limits were above criteria (Table 3-7).

PCBs (Aroclor 1260) were detected at MW-59 in December 2002 (0.13 ppb) and in June 2003 (0.045 ppb).

### 6.3.5 Conventionals

Ammonia was identified as a COPC. The total ammonia concentration was converted to NH<sub>3</sub> (USEPA 1989) and compared to the Washington promulgated criterion of 0.035 ppm (which is also the criterion listed in USEPA 1989). Seven locations exceeded the criterion, including PZ-3, PZ-9, MW-23, MW-29, MW-51, MW-56, and MW-57. All of these wells are located in the main process area, with the exception of PZ-9 (Figure 6-46). The maximum NH<sub>3</sub> concentration was 4.6 ppm at MW-57.

Historic concentrations of NH<sub>3</sub> exceeded criteria in 19 of 81 samples (Table 3-7). The maximum historic concentration was 11.9 at MW-56 in February 2001.

### 6.3.6 Summary

Groundwater samples collected in June 2003 were analyzed for 186 chemicals. Analytical methods were modified to achieve the project DQOs. The laboratory typically extracted 2 times the volume normally used for the method and concentrated the final extract volume by a factor of 2.

June 2003 analytical data were compared to conservative state and federal screening criteria protective of 1) aquatic marine organism, and 2) human health associated with consumption of aquatic marine organisms. Screening criteria are available for 118 of the chemicals analyzed. Twenty-nine constituents were detected above screening criteria, including 20 chemicals that were detected in at least one sample at a concentration above screening criteria, as well as nine chemicals with no detections, but with detection limits above the screening criteria in at least one sample. The improved analytical methods resulted in a reduction of non-detections exceeding screening criteria from 48 in the RI Work Plan analysis of historical groundwater data to nine for the June 2003 data.

June 2003 analytes exceeding screening criteria (COPCs) are summarized below:

- **VOCs.** No VOCs were detected above screening criteria.
- **SVOCs.** Four SVOCs exceeded screening criteria, two of which were due to non-detections exceeding criteria. Exceedences were limited to one or two sampling locations per analyte.
- **Metals.** Of the 20 wells samples, detections of dissolved constituents above screening levels included arsenic (4 exceedences), copper (11), nickel (3), chromium (2), and mercury (2).
- **Pesticides.** Twelve pesticides were identified as COPCs including five constituents identified as COPCs on the basis of non-detections exceeding criteria. Of the seven pesticides identified on the basis of detections, exceedences were found at seven

locations for 4,4'-DDD, five locations for 4,4'-DDT ,and three or less locations for the other pesticides.

- **PCBs.** PCBs exceeded screening criteria for a single Aroclor by a factor of 1.5 at a single location. Total PCBs exceeded screening criteria at the same location.
- **Conventionals.** Screening criteria was exceeded for ammonia (as NH<sub>3</sub>) at seven locations.

In addition to those COPCs identified with the 2003 data, three constituents [benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and selenium] had historical groundwater concentrations that exceeded screening levels. An examination of historical data indicates that these constituent concentrations were isolated occurrences and that the concentrations were not replicated with subsequent analyses. These chemicals are not included as groundwater COPCs. TPH was also detected above screening levels in 2002, but is not included as a COPC because in 2003 it was not detected downgradient of the 2002 exceedence.