



American Plating Post-Interim-Action Groundwater Monitoring Results February and August 2004

Abstract

Groundwater samples for select dissolved metals (cadmium, chromium, copper, and nickel), weak acid dissociable cyanide, and volatile organic compounds were collected from five monitoring wells in February and August 2004 at the former American Plating site in Tacoma, Washington. Samples were collected to provide the Department of Ecology's Toxics Cleanup Program with post-interim-action groundwater monitoring data.

Dissolved chromium, copper, and nickel were detected in groundwater at the site in both February and August.

- Nickel was detected in all five wells, with concentrations ranging from 4.4 to 62.2 ug/L. Nickel concentrations exceeded the groundwater cleanup level of 8.2 ug/L in wells MW-3, MW-5, and MW-10.
- Copper concentrations were below the cleanup level of 3.1 ug/L in all five wells.
- In February, chromium concentrations ranged from 8.2 to 30.9 ug/L. In August, chromium concentrations increased in all five wells, ranging from 24 to 71 ug/L. No groundwater cleanup level has been established for chromium at this site; however, concentrations reported in wells MW-4 (55 ug/L) and MW-5 (71 ug/L) in August exceeded the state surface water quality standards for protection of aquatic organisms in marine waters for acute exposure to hexavalent chromium of 50 ug/L. It is not possible to determine with the available data which form of chromium is present or to establish the reason for the increase in concentrations.

Because dissolved nickel exceeded the established groundwater cleanup standard during both monitoring rounds, some level of monitoring should continue. Future monitoring should be modified to determine which form of chromium, trivalent or hexavalent, is present in the groundwater.

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Background

American Plating, a metal electroplating company formerly operating on the Thea Foss waterway in Tacoma (Figure 1), ceased production in 1986 when it was discovered that facility operations potentially violated state dangerous waste regulations. The Washington State Department of Ecology (Ecology) conducted several site inspections from 1980 to 1985. These inspections determined that discharges, leaks, and spills of plating materials had occurred at the site. The site had been occupied by plating companies since 1955. All companies performed metal electroplating, including brass, cadmium, chromium, copper, nickel, and zinc plating.

A preliminary site assessment conducted by EPA in 1986 concluded that high levels of plating waste and contaminated materials were present on the site. Removal of waste material and site cleanup began in June 1987. A series of site investigations, which included the installation of 12 monitoring wells, were conducted from 1988 to 1994. In 1997 the site was ranked as a “2” under the Washington Ranking Method and placed on Ecology’s Hazardous Site List.

An interim action was initiated by Ecology in the summer of 2003, with the primary objective of reducing the human health risk from contact with contaminated soil. The interim action included the removal of site buildings, along with a concrete pad, sumps, and an underground storage tank. Soil was excavated and removed from the site from depths of three to eight feet or to the water table. Clean fill and top soil were added to the excavated areas. It is anticipated that additional soil cleanup will be performed by the new site owner under the provisions of a Prospective Purchaser Consent Decree.

Contaminants of concern in groundwater include cadmium, chromium, copper, nickel, cyanide, and volatile organic compounds (VOCs), specifically vinyl chloride. Elevated metal concentrations were detected throughout the site soils. Elevated metal concentrations in groundwater are probably associated with the leaching from the contaminated soils. Cyanide solutions are very common components of electroplating processes, and were widely used at the site. Elevated levels of cyanide have been detected in the site soils and are the likely source of the cyanide observed in the groundwater. A 1,000-gallon degreasing tank had been located in building 1 (Figure 2). Chlorinated solvents stored in the tank were used to degrease parts prior to plating. The source of the vinyl chloride is most likely from leaks or spills of degreasing solvents and their subsequent degradation in the environment. Historical data for the wells sampled during this monitoring are presented in Appendix A.

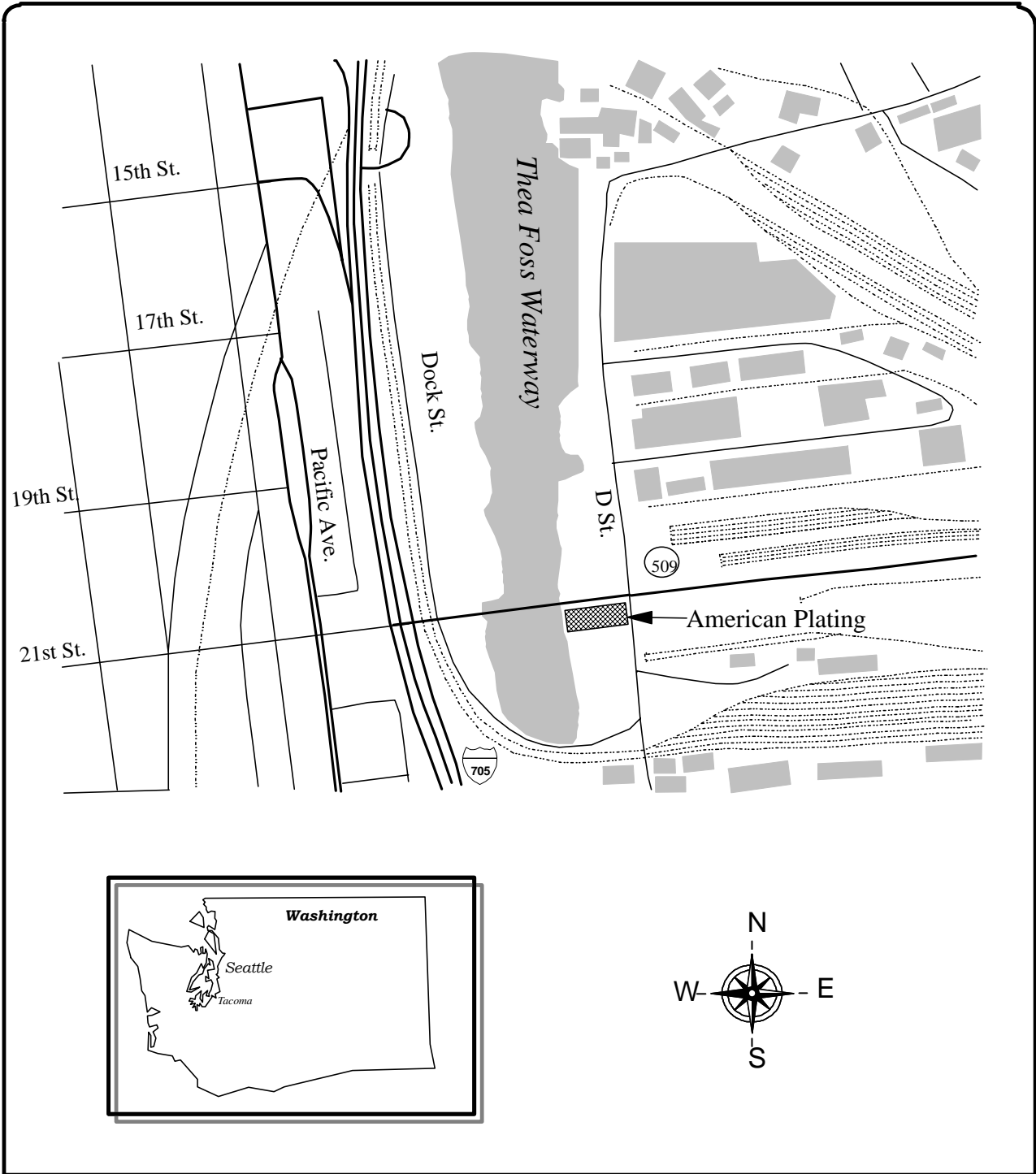
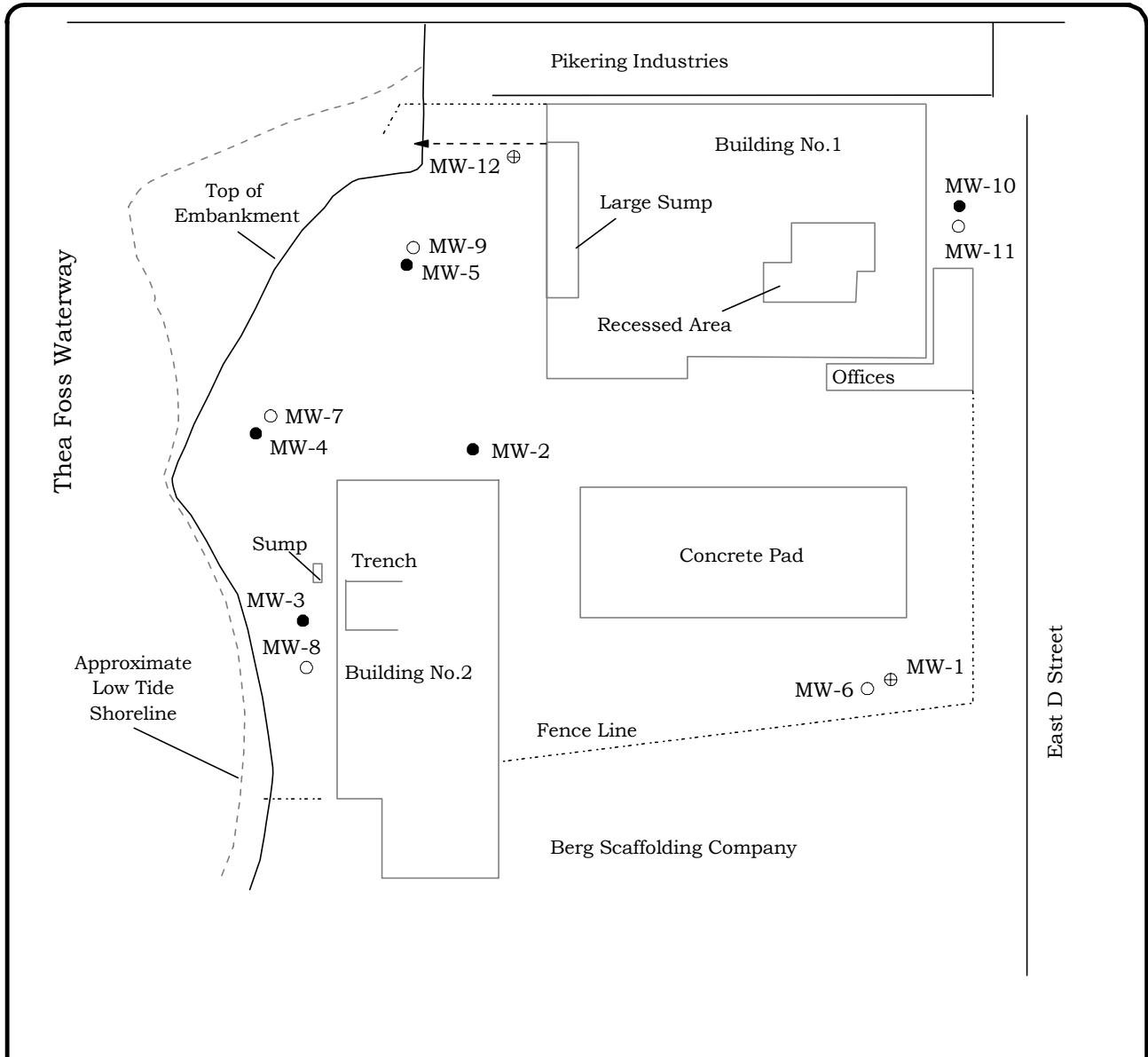


Figure 1: American Plating Site Location



Legend

- Monitoring Wells* Sampled (MW-2, MW-3, MW-4, MW-5, MW-10)
 - ⊕ Monitoring Wells*
 - Decommissioned Monitoring Wells*
- *Sample locations are approximate



Former location of Site Buildings

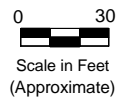


Figure 2: American Plating Sample Locations

Site geology has been described in several documents (SAIC, 1994 and PRC, 1995) and is summarized as follows. Geology of the site consists of sedimentary deposits including, from the surface down, fill materials, undifferentiated fill and marsh deposits, deltaic deposits, and glacial till. Prior to the interim action, the fill materials were heterogeneous, consisting of gravels, silty sand, and wood debris to a depth of 5 to 18 feet below surface. The fill and marsh deposits are undifferentiated, consisting of very soft sandy silts to clayey silts that are generally encountered at depths of about 3 to 12 feet below surface and range up to 15 feet thick. The wells sampled in February and August 2004 are screened in the fill and marsh aquifer that is encountered in these deposits. The deltaic deposits are medium dense silty sand and silty gravel, encountered at a depth of about 18 feet, and are about 5 feet thick. These deposits appear to be relatively continuous beneath the site and seem to thicken to the northwest across the site. The sand aquifer is encountered in this unit. The till is generally encountered at depths of about 23 to 29 feet with an unknown thickness, and consists of slightly consolidated very dense silty sand to silty gravel.

Groundwater in the fill/marsh aquifer and the sand aquifer occurs under unconfined and semi-confined conditions, respectively; the two aquifers are interconnected and tidally influenced. The unconfined water table ranges from approximately 5 to 9 feet below ground surface. Variations in groundwater elevations reflect tidal phases in both aquifers. Groundwater flow is interpreted to be in a general northwesterly direction towards the Thea Foss Waterway. However, the hydraulic gradient in the unconfined aquifer may reverse at high tide phases at least beneath the western portion of the site.

Methods

Groundwater Sampling

Groundwater samples were collected in February and August 2004 from five monitoring wells to determine post-interim-action groundwater concentrations of dissolved metals and weak acid dissociable (WAD) cyanide. Samples for VOCs were collected from well MW-10 (Figure 2).

The five wells that were sampled (MW-2, MW-3, MW-4, MW-5, and MW-10) are screened in the upper fill/marsh deposits aquifer. The monitoring wells were completed to a depth of about 10 to 17 feet, with 5-foot screened intervals at the base of the completion depth. Well MW-12 was scheduled to be sampled during this monitoring but could not be located. Consequently well MW-5 was selected as a replacement for sampling.

Static water levels were measured in all wells using a Solinst water level meter prior to well purging and sampling. Measurements were recorded to 0.01 foot and are accurate to 0.03 foot. The probe was rinsed with deionized water between measurements.

The monitoring wells were purged and sampled using a Grundfos Redi-Flo2 stainless steel submersible pump with dedicated tubing for each well. The pump intake was placed at the middle of the screened interval in each monitoring well and purged at a pump rate of 0.5-liter/minute or less. Wells were purged through a continuous flow cell until pH, specific conductivity, and temperature readings stabilized or the well was purged dry. Purge water from the wells was collected and stored on-site in a 55-gallon drum. The purge water waste was transported and disposed of in accordance with State of Washington regulations (Chapter 173-340-400 WAC). At the completion of purging, samples were collected from the monitoring wells directly from the dedicated pump discharge tubing into laboratory supplied containers. The pump was decontaminated between each well by circulating laboratory grade detergent/water through the pump followed by a clean water rinse, with each cycle lasting five minutes.

All metal samples were field filtered using a clean 0.45 micron membrane filter into a 1/2-liter high density polyethylene container and acidified with nitric acid to a pH <2. In February, standard capacity filters were used and clogged rapidly due to the high particulate levels in the groundwater. In August, high capacity filters were used. WAD cyanide samples were collected in a 250-milliliter amber polyethylene bottle with sodium hydroxide preservative. VOC samples were collected free of headspace in three 40-mL glass vials with Teflon-lined septa lids and preserved with 1:1 hydrochloric acid. Upon sample collection and proper labeling, all samples were stored in an ice-filled cooler. Samples were transported to Ecology's Operation Center in Lacey. Samples were kept in the walk-in cooler until picked up by the courier to the Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Environmental Laboratory protocol (Ecology, 2003).

Analysis

Analytes, analytical methods, and reporting limits for both field and laboratory parameters are listed in Table 1. Groundwater samples were analyzed for select dissolved metals (cadmium, chromium, copper, nickel), weak acid dissociable (WAD) cyanide, and VOCs.

Table 1: Field and Laboratory Methods

Analytes	Method	Reference	Accuracy
<i>Field</i>			
Water Level	Solinst Water Level Meter	NA	±0.03 feet
pH	Orion 25A Field Meter	NA	±0.1 std. units
Temperature	YSI 3510 Temperature Probe	NA	±0.1 C
Specific Conductance	YSI 3520 Conductivity Cell	NA	±10 umhos/cm
<i>Laboratory</i>			<u>Reporting Limit</u>
Dissolved Metals	EPA Method 200.8	U.S. EPA 1996	0.1-0.5 ug/L
WAD Cyanide	SM4500CN-I	SM 1998	5 ug/L
VOCs	EPA SW-846 Method 8260B	U.S. EPA 1996	1-5 ug/L

In general, the quality of the data is acceptable. Quality control samples collected in the field consisted of blind field duplicate samples, which were obtained from well MW-3 during both rounds of sampling. The numeric comparison of duplicate results is expressed as the relative percent difference (RPD). The RPD for the dissolved metals in February were 14% for copper, 43% for nickel, and 47% for chromium. Due to the high RPD for the February results, average concentrations of the duplicate samples will be used in the remainder of this report. In August, the RPD could only be calculated for chromium, which was 16%.

A high reporting limit prevented a comparison of duplicate results for copper and nickel. The quality assurance case narrative from MEL stated that due to matrix interferences, several samples required dilution for analysis. The reporting limits for non-detected diluted samples were raised correspondingly to the degree of dilution. The reporting limits for the February VOC analysis were also high.

In addition to field quality control samples, duplicate matrix spikes and surrogate compound recoveries were performed in the laboratory. Overall, matrix spikes and surrogate recoveries were within acceptable limits; appropriate qualifiers have been noted where they are not. Quality assurance case narratives and laboratory reporting sheets, with the complete list of VOCs analyzed, are available upon request.

Results

Field Observations

Total depth and depth-to-water of each monitoring well were determined before sampling began. pH, specific conductivity, and turbidity readings measured at the time of sampling, as well as the total purge volume, are listed in Table 2.

Table 2: Summary of Field Parameter Results for February and August 2004

Monitoring Well	Total Depth (feet) ¹	Depth to Water (feet) ¹ February		Depth to Water (feet) ¹ August		pH (standard units)		Specific Conductivity (umhos/cm)		Turbidity (NTU)		Purge Volume (gallons)	
		Time	2/04	Time	8/04	2/04	8/04	2/04	8/04	2/04	8/04	2/04	8/04
MW-2	16.65	14:10	5.60	16:20	6.90	--	6.4	3,080	2,800	11	7	5.5	5
MW-3	14.67	11:30	2.92	10:40	4.39	6.9	6.5	19,700	21,200	8	1.7	6	4
MW-4	16.89	12:50	5.16	13:15	6.35	--	7.2	14,500	20,200	1	1.2	6	3.5
MW-5	16.84	11:12	8.77	14:30	6.93	6.7	6.9	17,800	18,490	39	22	4	2.5
MW-10	10.15	15:31	4.57	10:00	6.53	--	--	--	--	--	--	--	--

¹ Measured from top of PVC casing.

-- Not Measured

Completion depths for the five monitoring wells ranged from 10.15 to 16.89 feet. Depth-to-water was measured prior to purging each well. Figure 3 shows the tidal phase when water levels were measured and samples collected. In February, the monitoring was conducted during a rising tide and in August during a falling tide. Depth-to-water ranged from 2.92 to 8.77 feet below the measuring point in February and 4.39 to 6.93 feet in August.

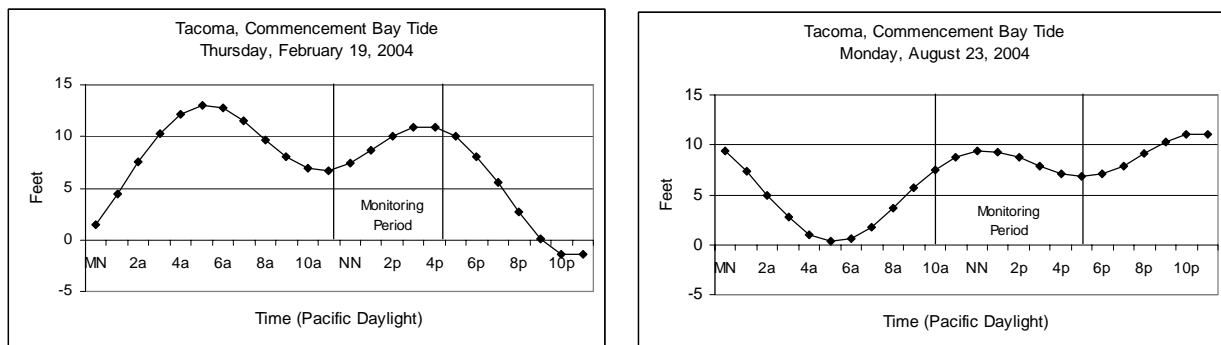


Figure 3: Tide Phase for Monitoring Period in February and August, 2004

The shallow wells sampled are screened in the soft sandy silt, silt, and clayey silt of the fill/marsh deposits. All the wells are slow yielding. While purging at the lowest flow possible, water levels dropped in wells MW-2, MW-3, and MW-4. Wells MW-5 and MW-10 were purged dry.

During the monitoring period, the pH of groundwater ranged from 6.4 to 7.2. Groundwater temperatures measured in the flow cell in February ranged from 11.6 to 13.8°C, increasing to 16.1 to 18.0°C in August. The higher temperatures in August are partly caused by the combination of purging at a low flow rate through a flow cell. Specific conductivity measurements were high, ranging from 2,800 to 21,200 umhos/cm. Specific conductivity values were higher for those wells closer to the waterway. The high conductivity is consistent to the close proximity to the salt water. Specific conductivity of the waterway has been reported between 15,000 to 35,000 umhos/cm. Turbidity measurements ranged from 1 to 39 NTUs, with well MW-5 representing the higher end. Field parameters were not measured in well MW-10 due to the low volume of water produced by this well.

Analytical Results

Analytical results for dissolved metals and WAD cyanide are summarized in Table 3. Dissolved metals results are also presented in Figure 4. A summary of historical data for this project is presented in the Appendix.

Table 3: Summary of Analytical Results (ug/L) for February and August 2004

Well	Dissolved Cadmium		Dissolved Chromium		Dissolved Copper		Dissolved Nickel		WAD Cyanide	
	2/04	8/04	2/04	8/04	2/04	8/04	2/04	8/04	2/04	8/04
MW-2	0.2 U	0.2 U	8.2	30.2	1 U	1 U	4.3	4.4	0.01 U	0.01 U
MW-3*	0.2 U	0.2 U	12.2 J	24	1.4	2.7	8.6 J	5.8	0.01 U	0.01 U
MW-4	0.2 U	0.2 U	20	54.9	1 U	2.1	4.9	4.9	0.01 U	0.01 U
MW-5	0.2 U	0.2 U	30.9	71	1 U	1.5	14.8	11.8	0.01 U	0.01 U
MW-10	--	0.2 U	--	25.5	--	1 U	--	62.2	0.01 U	0.01 U

* - Average concentration of duplicate samples.

U - Analyte was not detected at or above the reported value.

J - Result is qualified as an estimate due to the high relative percent difference of duplicate samples

Bold - Analyte was detected.

Dissolved chromium and nickel were detected in all the sampled wells. In February, chromium concentrations ranged from 8.2 to 30.9 ug/L. In August, chromium concentrations increased in all the wells ranging from 24 to 71 ug/L. The reason for the apparent increase in chromium concentrations could not be determined with the available data. Nickel was detected in all five wells, with average concentrations ranging from 4.4 to 13.3 ug/L. Metals data are not available for MW-10 in February due to insufficient sample amount. In August, the dissolved nickel concentration in this well was 62.2 ug/L. Dissolved copper was also detected in three of the wells at concentrations near the practical quantitation limit of 1 ug/L. Dissolved cadmium and WAD cyanide were not detected in any of the wells during this monitoring.

Well MW-10 was also sampled for VOCs. In February, 1,1-dichloroethane and 1,1,1-trichloroethane were detected at concentrations of 27 ug/L and 10 ug/L, respectively. Due to the low volume of water in this well, the sample was collected before the well was completely purged. Sampling prior to fully purging may result in under reporting VOC concentrations. In August, MW-10 was purged dry and allowed five hours to recover. 1,1-dichloroethane was detected at an estimated concentration of 0.49 ug/L, while 1,1,1-trichloroethane was not detected. Several other VOCs were detected, but at concentrations near or below the reporting limits. A summary of VOC data is presented in the Appendix.

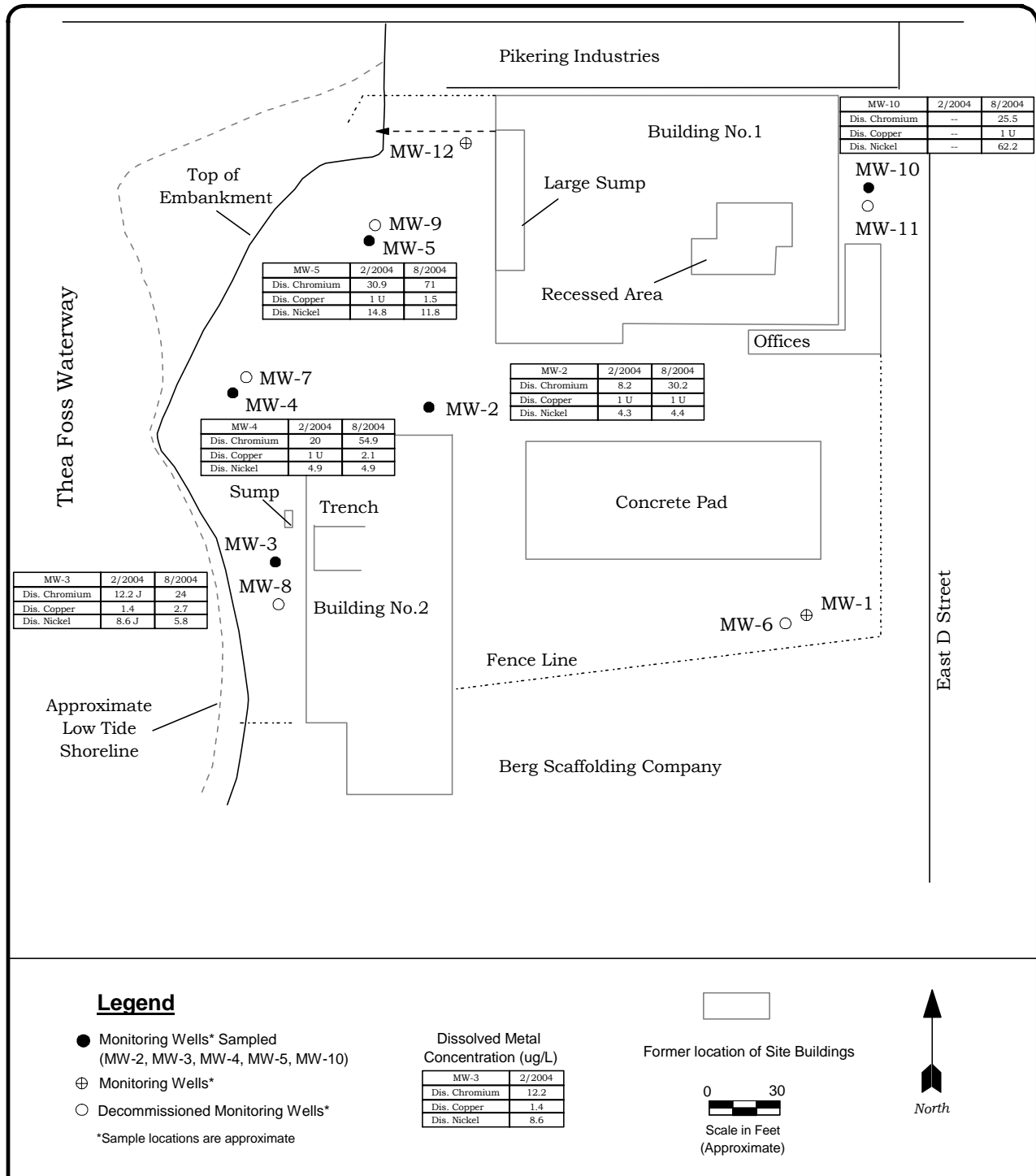


Figure 4: American Plating Dissolved Metal Concentrations

Discussion and Recommendations

Dissolved chromium, copper, and nickel were detected in groundwater at the site in February and August 2004. Table 4 is a comparison of the 2004 results to cleanup levels established for this site. Due to the proximity of the site to the waterway, the groundwater cleanup levels were developed based on protection of human contact with surface water (MTCA Method B surface water levels) and on protection of marine organisms (WAC 173-201A). The surface water criterion for cyanide (1 ug/L for acute exposure) is based on the weak acid dissociable (WAD) cyanide.

Table 4: Comparison of 2004 Groundwater Results to Surface-Water Based Cleanup Levels

Parameter	Cleanup Level (ug/L)	MW-2	MW-3*	MW-4	MW-5	MW-10
<i>Dissolved Metals</i>						
Cadmium	9.3	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chromium	--	8.2-30.2	12.2-24	20-54.9	30.9-71	25.5
Copper	3.1	1 U	1.4-2.7	1 U-2.1	1 U-1.5	1 U
Nickel	8.2	4.3-4.4	8.6-5.8	4.9-4.9	14.8-11.8	62.2
Cyanide	1 (WAD)	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vinyl Chloride	3.7	--	--	--	--	20 U-0.94 NJ

* – Average concentration of duplicate samples.

U – Analyte was not detected at or above the reported value.

Bold – Concentration exceeded established cleanup level.

Dissolved nickel concentrations exceeded the cleanup criterion of 8.2 ug/L in wells MW-3, MW-5, and MW-10. Nickel concentrations in MW-5 were 14.8 ug/L and 11.8 ug/L in February and August, respectively. The criterion was slightly exceeded in MW-3 with an average concentration of 8.6 in February. In August, the concentration of dissolved nickel in well MW-10 was 62.2 ug/L.

Dissolved copper concentrations were below the established groundwater criterion of 3.1 ug/L.

Although no groundwater cleanup level was established for chromium, concentrations reported in wells MW-4 and MW-5 in August exceeded the state surface water quality standards for protection of aquatic organisms in marine waters for acute exposure to hexavalent chromium of 50 ug/L (WAC 173-201A). Dissolved chromium concentrations were 55 ug/L (MW-4) and 71 ug/L (MW-5). With the available data, it is not possible to determine which form of chromium, trivalent or hexavalent, is present.

WAD cyanide was not detected in any of the wells during this monitoring. Previous results were for total cyanide which was detected at 10 of the 12 monitoring wells at the site, with concentrations ranging from 3 ug/L to 40 ug/L. The highest concentrations occurred in wells MW-4, MW-10, and MW-11. Well MW-11 has been decommissioned.

Because dissolved nickel exceeded the established groundwater cleanup standard during both monitoring rounds, some level of monitoring should continue. Future monitoring should be modified to determine which form of chromium, trivalent or hexavalent, is present in the groundwater.

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Appendix. Historical Data

Table A-1. Dissolved Metals Results (ug/L) from May 1988 to August 2004

Well ID	LRJones				EPA	LRJones		PRC	Ecology	
	5/88	8/88	11/88	2/89	2/89	3/89	12/93	9/94	2/04	8/04
MW-2										
Cadmium	4 U	--	--	--	5 U	--	0.5 U	2 U	0.2 U	0.2 U
Chromium	10 U	--	--	--	10 U	--	10 U	5 U	8.2	30.2
Copper	20 U	--	--	--	25 U	--	10 U	3 U	1 U	1 U
Nickel	20 U	--	--	--	17 U	--	10 U	19 P	4.3	4.4
Cyanide	10 U	20	20	20	5 U	10	9	13	0.01 U	0.01 U
MW-3										
Cadmium	4 U	--	--	--	5 U	--	0.2 U	--	0.2 U	0.2 U
Chromium	10 U	--	--	--	10 U	--	10 U	--	12.2*	24*
Copper	20 U	--	--	--	25 U	--	10 U	--	1.4*	2.7
Nickel	20	--	--	--	17 U	--	10 U	--	8.6*	5.8
Cyanide	10 U	10 U	10	10 U	5 U	10	27	--	0.01 U	0.01 U
MW-4										
Cadmium	4 U	--	--	--	5 U	--	0.5 U	10 U	0.2 U	0.2 U
Chromium	10 U	--	--	--	10 U	--	10 U	25 U	20	54.9
Copper	20 U	--	--	--	25 U	--	10 U	15 U	1 U	2.1
Nickel	20 U	--	--	--	17 U	--	10 U	50 U	4.9	4.9
Cyanide	10 U	30	30	20	5 U	10	9	15	0.01 U	0.01 U
MW-5										
Cadmium	4 U	--	--	--	5 U	--	0.4 U	--	0.2 U	0.2 U
Chromium	10 U	--	--	--	10 U	--	10 U	--	30.9	71
Copper	20 U	--	--	--	41.9	--	10 U	--	1 U	1.5
Nickel	20 U	--	--	--	17 U	--	28	--	14.8	11.8
Cyanide	10 U	10 U	10	10 U	5 U	10 U	5 U	--	0.01 U	0.01 U
MW-10										
Cadmium	--	--	--	--	--	--	0.5 U	--	--	0.2 U
Chromium	--	--	--	--	--	--	10 U	--	--	25.5
Copper	--	--	--	--	--	--	10 U	--	--	1 U
Nickel	--	--	--	--	--	--	110	--	--	62.2
Cyanide	--	--	--	--	--	40	24	--	0.01 U	0.01 U

-- = not sampled

U = Analyte was not detected at or above the reported value.

P = Analyte was detected, but at a concentration between the instrument detection limit and the quantitation limit.

* = Average concentration of duplicate samples.

Bold = Analyte was detected.

Table A-2. VOC Results (ug/L) from well MW-10 from May 1989 to August 2004

MW-10	LRJones		PRC	Ecology	
	3/89	1/94	9/94	2/04	8/04
Benzene	---	1.5	1.8	10 U	0.33 J
2-Butanone	---	---	1 U	20 U	1.8 NJ
Chloroethane	18	150 D6	178	12 U	15
Chloroform	3	0.2 U	1 U	10 U	1 U
Chloromethane	2.1	2 U	0.13 J	20 U	2 U
1,1-Dichloroethane	170 D4	140 D6	10	27	0.49 J
1,2-Dichloroethane	1.6	0.2	1 U	10 U	0.3 NJ
1,1-Dichloroethene	4	1	1 U	10 U	1 U
Cis-1,2-Dichloroethene	430 D4	8.2	2.3	10 U	0.93 J
Trans-1,2-Dichloroethene	1.3	0.2 U	1 U	10 U	1 U
1,2-Dichloropropane	0.2 U	1.3	0.34 J	10 U	1 U
Ethylbenzene	---	0.5	0.56 J	10 U	1 UJ
Propylbenzene	---	---	0.19 J	10 UJ	1 UJ
Tetrahydrofuran	---	---	---	20 U	1.4
Toluene	---	0.5 U	0.29 J	10 U	1 UJ
1,1,1-Trichloroethane	41 D4	0.2 U	1 U	10	1 UJ
Trichloroethene	8.6	0.7	0.89 J	10 U	0.46 NJ
1,2,4-Trimethylbenzene	---	---	2.5	10 UJ	1 UJ
1,3,5-Trimethylbenzene	---	---	0.42 J	10 UJ	1 UJ
Vinyl chloride	190 D4	6.1	1	20 U	0.94 NJ
Xylene	---	0.6	2 J	20 U	2 UJ

--- = not analyzed

U = Analyte was not detected at or above the reported value.

D = The detection limit was elevated due to matrix interference.

J = The analyte was positively identified. The associated numerical result is an estimate.

UJ = The analyte was not detected at or above the reported estimated result.

NJ = There is evidence that the analyte is present. The associated numerical result is an estimate.

Bold = Analyte was detected.