Supplemental Remedial Investigation Report
Tidal Portion of Wappinger Creek
Three Star Anodizing Site OU2
Wappingers Falls, New York

Prepared for

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1. INTRODUCTION

The New York State Department of Environmental Conservation (NYSDEC) tasked EA Engineering, P.C. and its affiliate EA Science and Technology (EA) to collect sediment samples from Wappinger Creek in the vicinity of the Three Star Anodizing Site (3-14-058), Wappinger Falls, New York (Figure 1-1) for analysis of inorganic constituents of concern.

The Work Assignment was conducted under the NYSDEC State Superfund Standby Contract (Work Assignment No. D004438-40).

The objectives of this Work Assignment were to:

- Collect sediment samples from the tidal portion of Wappinger Creek
- Analyze sediment samples for total inorganic constituents, including mercury and cyanide
- Analyze selected sediment samples for organic methylmercury
- Analyze grain size distribution for selected sediment samples
- Prepare a Supplemental Remedial Investigation Report for Wappinger Creek tidal reach (Three Star Anodizing Site Operating Unit 2 [OU2])
- Prepare a Feasibility Study Report, if necessary, for OU2.

This document constitutes the focused Supplemental Remedial Investigation deliverable for this contract, integrating the findings from two previous studies prepared for NYSDEC, included as appendixes to this Supplemental Remedial Investigation Report:

1. Three Star Anodizing Site, Wappingers Falls, New York Remedial Investigation of Wappingers Creek, NYSDEC Site 314058, Final Report (O'Brien and Gere Engineers, Inc. 2007a) (Appendix A)
2. Three Star Anodizing Site, Wappingers Falls, New York, Biota Sampling Report for Wappinger Creek (EA 2008) (Appendix B).

1.1 SITE HISTORY AND CONTAMINANTS

The Three Star Anodizing Site is comprised of an 8.5-acre industrial facility located on the south bank of Wappinger Creek. Several buildings, paved parking areas, and access roadways are present on the site. The site is located within the 100-year flood plain along an oxbow of Wappinger Creek. The creek discharges to the lower Hudson River approximately 1.5 mi downstream from the site.

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The Three Star Anodizing Site has been the location of industrial activities for over 150 years. Primary past uses of the site included dye operations, manufactured gas plant operations, and metal plating (O'Brien & Gere Engineers, Inc. 2001). A number of other smaller industrial activities also took place at the Three Star Anodizing Site. Dye operations, known as the Dutchess Bleachery, operated at the site between 1832 and 1955. The Dutchess Bleachery and Wappinger Water, Gas, and Electric Companies operated a coal-fired manufactured gas plant that included activities from the late 1800s to approximately 1913. Three Star and later Watson Metals Products Corporation operated a metal plating facility at the site from 1958 to approximately 1995.

Operations in the Market Street Industrial Park located on the north side of Wappinger Creek also included the Dutchess Bleachery, among others. This area also represents a potential source of hazardous waste constituents to the creek. Most of the upland area along the creek downstream of the Market Street Industrial Park consists of residential properties and wooded land.

Several buildings at the Three Star Anodizing Site had floor drains that discharged directly to the creek. Most of the buildings at one time had sanitary facilities that also discharged directly to the creek. The Axton-Cross (bulk chemical sales) building at the Three Star Anodizing Site had floor drains that discharged to the Three Star lagoon adjacent to the building (Dutchess County Department of Health 1971).

Rinse water from plating tanks in the Three Star facility was reportedly discharged to the back of the plant and subsequently flowed to the Three Star lagoon. Paint stripping caustics were discharged to the floor drains of the plant and to the ground behind the facility. In that area, the ground slopes toward the southeast in the direction of a raceway and Three Star lagoon. Page Print Systems occupied one of the buildings at the site (EA 1986) and reportedly discharged water from photographic development rinse sinks.

1.2 TIDAL WAPPINGER CREEK (OU2)

The tidal creek (OU2) is the portion of the creek that extends downstream from Wappingers Falls to the confluence of Wappinger Creek and the Hudson River. The tidal creek begins at the hydroelectric facility discharge at the upstream portion of the Market Street Industrial Park. The tidal creek is approximately 2 mi in length. Water levels can typically fluctuate up to 4 feet (ft) in the creek over the tidal cycle of the Hudson River.

In the vicinity of the Market Street Industrial Park, the creek is narrow (approximately 90 ft wide) relative to downstream sections; retaining walls border both sides of the creek in this reach. Two bridges (referred to as the east and west bridges) span the creek connecting the Three Star Anodizing Site to the Market Street Industrial Park. The retaining walls end at the west bridge. Downstream of the retaining walls along this section of the creek, the land on the north side of the tidal creek is undeveloped, containing a steep bank with exposed bedrock. The Market Street Industrial Park has been inundated by flood water at least twice, during floods in 1902 and 1938 (Popper 1991). It appears that the area floods when stage heights exceed

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approximately 13 ft. In this reach, the creek is shallowest on the south side nearest the Three Star Anodizing Site with water depths less than 5.5 ft and deepens to approximately 12 ft along the north bank. The relative narrowness of the creek at this location may cause higher water velocities and bed scouring than in wider sections located downstream. The creek bed is composed primarily of rocks and cobble with little sediment accumulation.

The creek bends toward the south as it passes the manufactured gas plant site associated with the Three Star Anodizing Site. Approximately 1,000 ft downstream of the west bridge, the creek widens to approximately 250 ft. A shoal composed primarily of rock and cobble overlain by silt and sand is located along the inside bend. The water velocity decreases as the creek widens and the cross-sectional area increases, facilitating sediment deposition and accumulation in this area. The shoal created by sediment deposition continues along the eastern bank past an unnamed tributary that drains into the creek approximately 1,500 ft downstream of the site. The proportion of fine sediment (sand and silt) comprising the shoal increases downstream. Dense growth of invasive water chestnut (*Trapa natans*) covers most of the shoal; during the growing season, only the main channel has open water. In this section of the creek, most flow and the open channel run along the west side of the creek.

A shallow embayment is located along the northern shore of the creek approximately 0.75 mi downstream of the site. This embayment is approximately 5.5 acres (approximately 800 ft by 300 ft) comprised of freshwater tidal wetland. Sediment in this embayment is primarily of silt and organic matter and supports aquatic emergent and submerged plant growth throughout. The main currents of the tidal creek bypass the embayment.

Downstream of the embayment, the tidal creek widens to approximately 600-800 ft. Surficial sediment in this section of the creek is primarily silt and sand; deeper sediments contain more rock and cobble. The main flow in this section occurs along the approximate center of the channel with water depths up to approximately 15 ft. Both shores are shallow throughout this section; approximately half of the surface area in this section of the tidal creek has water depths less than 5 ft. An island is located in the western half of the creek; a depositional area is located west of the island. During the growing season, most of the shallow area is chocked with dense stands of water chestnut.

Upstream of the confluence of Wappinger Creek with the Hudson River, a bridge carrying County Route 28 (CR 28) and a railroad bridge constrict the lower section of the creek to approximately 140 ft and 250 ft wide, respectively. The railroad bridge is located approximately at the confluence of the tidal creek and the river, and the CR 28 Bridge is located approximately 1,200 ft upstream of the river. The tidal creek reaches its greatest depth of approximately 25 ft beneath the CR 28 Bridge. The creek widens to approximately 800 ft between bridges and silt and sand overlay rock and cobble throughout this area.

1.3 FINDINGS OF REMEDIAL INVESTIGATION (O'BRIEN AND GERE ENGINEERS, INC. 2007a)

The remedial investigation (RI) (Appendix A) prepared by O'Brien and Gere Engineers, Inc. (2007a), provides a detailed description of the physical features of the Three Star Anodizing Site,

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industrial and commercial history, and the associated contaminant sources and pathways. This information is summarized briefly in the following sections.

1.3.1 Remedial Investigation Objectives

The RI (O'Brien and Gere 2007a) identified the following objectives of the study:

- Observe current conditions of Wappinger Creek and evaluate potential migration pathways of constituents
- Perform screening level assessment of potential site impacts to fish and wildlife in a Fish and Wildlife Impact Assessment (FWIA) through Step IIC
- Complete a pathway analysis for qualitative evaluation of potential human exposure
- Evaluate surface water in Wappinger Creek for potential impacts from Three Star Anodizing Site activities and other potential sources
- Identify spatial patterns of constituents in sediment
- Evaluate composition of polycyclic aromatic hydrocarbons in sediment compared to Three Star Anodizing Site sources
- Following a thorough delineation of the creek, a feasibility study will be completed, if necessary and appropriate.

The sampling plan for the Wappinger Creek RI included reconnaissance to identify areas of sediment deposition and scour, substrate type, and analysis of surface water and sediment in the tidal creek and at upstream reference locations. Based on this information, the tidal creek was stratified into four areas (Figure 1-2):

1. ***Site Area*—**The narrow upper reach adjacent to the upland Three Star Anodizing Site extending approximately 2,700 ft from the foot of Wappingers Falls ending at the shoal area.
2. ***Shoal Area*—**The shallow depositional area beginning approximately 1,000 ft downstream from the site and the west bridge and extending approximately 1,500 ft to downstream of an unnamed tributary entering the creek on the east shore.
3. ***Embayment*—**A 5.5-acre shallow freshwater tidal wetland embayment off the main creek channel approximately 0.75 mi downstream of the site
4. ***Downstream Area*—**The tidal reach downstream of the embayment to the confluence with the Hudson River.

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To evaluate potential wildlife exposures, an FWIA (NYSDEC 1994) was completed that included identification of constituents of potential ecological concern (COPECs) for representative species consisting of mink and great blue heron. To evaluate potential human exposure to constituents in the creek, a qualitative exposure pathway analysis was completed in accordance with NYSDEC (2002) guidance.

1.3.2 Source and Pathway Assessment

Constituents in surface water were generally below screening values for low flow. During storm event sampling, several inorganic constituents were detected above screening levels upstream in Wappingers Lake as well as the tidal creek. In general, the concentrations of constituents in the water column upstream of the site were similar to those observed at the site and downstream indicating that their presence is not related to the Three Star Anodizing Site.

Sediment at the background locations and in the tidal creek contained inorganic constituents above screening levels. Background sediment concentrations of inorganic constituents were frequently above lowest effect level (LEL) screening levels, while inorganic constituents often exceeded the higher severe effect level (SEL) screening levels. Background concentrations of 8 of 12 inorganic constituents analyzed exceeded LEL values. The concentrations in the tidal creek sediments were much higher than detected background levels. Highest concentrations were generally detected in deeper (deeper than 6 in.) sediment in the shoal and embayment areas. In decreasing order of magnitude above SEL screening values, the primary inorganic constituents detected in surface sediment (of greater ecological significance) consisted of mercury, lead, zinc, and chromium. Mercury was detected at the highest concentrations above SEL screening values (25 times the SEL screening value) in surface (0-6 in.) and deeper (deeper than 6 in.) sediments.

The following table from the RI summarizes the relative concentrations of inorganic constituents compared to SEL screening values:

Area	Oder of Magnitude above SEL Screening Values			
	50+	20+ to 50	10+ to 20	1 to 10
Shoal	Mercury	Zinc, Total chromium	Total cyanide	Lead, cadmium, arsenic, copper, antimony, iron
Embayment	Mercury	Total chromium	Total cyanide	Zinc, lead, arsenic, copper, cadmium
Downstream		Mercury		Total chromium, zinc, lead, antimony, cadmium, total cyanide, arsenic/copper, iron/nickel

1.3.3 Fish and Wildlife Impact Assessment Steps I and II

The FWIA evaluated the physical and biological characteristics, potential ecological exposure pathways, and potential risks to selected receptors of Wappinger Creek. The FWIA Step IIC report (O'Brien and Gere Engineers, Inc. 2007b) provides a streamlined screening level assessment incorporating maximum concentrations of constituents detected in surface water

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and sediment to conservatively estimate potential exposure of selected receptors. The report identified two assumed exposure pathways: direct exposure to constituents in the water column and sediment and via the food chain for wildlife foraging in the area. Potential receptors identified included benthic invertebrates, fish, predatory birds, small mammals, songbirds, reptiles, and amphibians. Concentrations of constituents in the water column and sediment were compared to ecologically-based criteria or screening levels (LEL; NYSDEC 1999).

The primary findings of the FWIA were:

- Wappinger Creek provides aquatic and wetland habitats.

- Maximum concentrations of chemical constituents in surface water and sediment were detected above conservative, ecologically-based screening values.

- Benthic macroinvertebrates and water column organisms may be exposed to COPECs in areas where maximum concentrations of constituents occur in sediment.

- Higher trophic level organisms may also be exposed to COPECs by indirect accumulation of constituents via the food chain.

- The exposure concentrations for sediment were generally much higher than those for surface water indicating that sediment constituents were primarily responsible for elevated hazard quotient estimates calculated from the food chain model.

- Sediment COPECs with hazard quotients greater than one included semivolatile orgranic compounds and inorganic constituents. Specifically, semivolatile organic compounds consisted of 2-dimethylphenol, phenol, and polycyclic aromatic hydrocarbons; the inorganic constituents primarily consisted of antimony, chromium, mercury, and zinc.

The range of estimated hazard quotient estimates calculated from the food chain model for Wappinger Creek for selected higher trophic level receptors (mink and great blue heron) associated with inorganic constituents in sediment are summarized in the following table adapted from the FWIA Step IIC Report (O'Brien and Gere Engineers, Inc. 2007b):

Hazard Quotient	Mink	Great Blue Heron
1 to 10	Chromium, thallium, zinc	Cadmium, chromium, cyanide, zinc
10-100	Aluminum, antimony, arsenic, cadmium, selenium	Mercury
> 100	Mercury	Antimony

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1.3.4 Qualitative Human Health Risk

An exposure pathway analysis was completed according to state guidance (NYSDEC 2002) which identified potential receptor populations for the tidal creek consisting of recreational users, swimmers, or fish consumers. Exposure to creek sediments and consumption of contaminated fish tissue were the primary exposure pathways for inorganic constituents to human receptors. The fish and invertebrate tissue study (Section 1.4) was designed to verify that fish consumption was a complete pathway.

1.4 FINDINGS OF FISH AND INVERTEBRATE TISSUE STUDY (EA 2008)

The FWIA (O'Brien and Gere Engineers, Inc. 2007b) makes the assumption of a complete exposure pathway from direct exposure to sediment inorganic constituents and via accumulation through the food chain to higher trophic level receptors. To confirm these pathways and document the potential food chain exposure, EA (2008) sampled benthic macroinvertebrates and forage and top predator fish to determine tissue concentrations of inorganic COPECs. The tissue study (Appendix B) provided the following findings:

- The benthic macroinvertebrate community was depauperate with few species or individuals. Two small isolated populations of zebra mussel and snail were sampled in the downstream area between the CR 28 Bridge and the embayment.

- Forage community was represented by spottail shiner, tessellated darter, and banded killifish; robust specimens of smallmouth and largemouth bass represented top predators.

- Detected concentrations of COPECs in fish were low and well below triggers for issuance of a consumption advisory.

- Statistical comparisons indicated no significant difference between sampling stations.

- Statistical comparison among species indicated considerable variability among taxon. The invertebrates generally had higher metal tissue concentrations than fish for arsenic, cadmium, copper, lead, and nickel. Forage fish generally had higher concentrations of zinc and bass had higher concentrations of mercury. The invertebrates grouped statistically with similar concentrations of cadmium, nickel, and lead; the two bass species grouped statistically for copper and lead. All the fish species grouped statistically for nickel and the three forage fish species grouped statistically for copper, lead, and zinc.

- Given the high concentrations of COPECs in sediment, the negligible accumulation of COPECs in tissue of aquatic organisms could be related to: lack of a benthic invertebrate forage base, minimal direct exposure of fish to sediments, movement of fish between the Hudson River and tidal creek with relatively short interrupted residence time in the creek, or a change in the inorganic constituent characteristics of the sediment.

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Before developing remedial alternatives for Wappinger Creek sediment, NYSDEC determined that additional sediment sampling should be conducted to provide insight into the apparent disconnect between COPEC concentrations in sediment and tissue. That is, had sediment conditions changed; had contaminated sediment been scoured by high flows, or been buried by relatively clean sediment during the interim period between the 2001-2003 sediment sampling (O'Brien and Gere Engineers, Inc. 2007a) and the 2007 tissue sampling (EA 2008), thus disrupting the assumed exposure pathway? To provide this information, EA performed additional sediment sampling in 2009 which are described in Sections 2 and 3.

1.5 SUPPLEMENTAL WAPPINGER CREEK REMEDIAL INVESTIGATION OBJECTIVES

The objectives of the supplemental RI studies conducted by EA under Work Assignment No. D004438-40 include the following:

- Determine if existing concentrations of COPECs are comparable to conditions at the time of the 2001-2003 study

- Evaluate whether the spatial and depth distribution of COPECs changed from that characterized by the RI studies in 2001-2003

- Evaluate validity of exposure pathway assumptions in the RI (2007) FWIA risk study

- Evaluate validity exposure pathway assumptions of qualitative human health (2007) risk evaluation

- Identify remedial action objectives for Wappinger Creek OU2.

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2. METHODS – SEDIMENT SAMPLING AND ANALYSIS

2.1 STUDY AREAS AND SAMPLE LOCATIONS

2.1.1 Sample Collection and Processing

Methods for collection, processing, and analysis of sediment samples were detailed in the project Field Sampling Plan. Sediment samples were collected using two methods: hand coring was utilized for water depths less than 5-6 ft, and gravity coring was used for water depths greater than 5-6 ft. Fifteen approximate sampling locations were allocated to the following areas (Figure 2-1):

1. Site area—one station
2. Shoal area—three stations
3. Embayment—three stations
4. Shoal area adjacent to the embayment—three stations
5. Downstream at the wide transect near the island—three stations
6. Downstream near the CR 28 Bridge—two samples.

The target core length was 2 ft or to refusal whichever was less. The actual station locations were determined in the field to optimize chances of obtaining the target core length. The location of each station was documented in the field using a Trimble ProXR differential Global Positioning System. The ProXRS uses the U.S. Coast Guard Differential Beacon System to obtain differential accuracy of 1-3 meters. Station coordinates were recorded in the field log along with approximate water depth and general observations of site conditions (Appendix C).

The 3-in. core casing was fitted with a clean stainless steel core cutter, retainer, and clean section of cellulose acetate butyrate plastic liner. When sufficient penetration was achieved at a location, the liner containing the sample was removed, capped, labeled, and placed on ice for storage until later processing. In order to provide sufficient sediment material to meet the laboratory volume requirements, two cores were collected at each location and labeled appropriately. The second core was typically taken within a few feet of the first core at each station.

Processing and shipping of samples was completed in compliance with the Quality Assurance Project Plan. Sediment cores were divided into the following depth intervals: 0-6 in., 6-12 in., and 12-24 in. (or refusal). Sediment was removed by cutting the plastic core liner length-wise and removing sediment with a clean, decontaminated stainless-steel spoon. Field characterization of the sediment cores was recorded in a core log (Appendix D). Sediments from each interval will be placed in separate stainless-steel bowls, composited, and transferred directly into clean containers (16-oz glass jars) provided by the laboratory for analysis of total Target Analyte List metals including mercury and cyanide. Duplicate field samples were preserved for analysis at a rate of 1 for every 20 samples. Additional sample material was provided to the laboratory for matrix spike/matrix spike duplicate analyses at the rate of 1 per 20 samples.

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Additional subsamples were placed in clean 4-oz glass jars and frozen; a subset of these frozen samples was later selected based on total mercury results for analysis of methylmercury. Samples were listed on standard chain-of-custody forms and shipped on ice to the appropriate analytical laboratory subcontractor.

2.1.2 Analysis of Inorganic Constituents and Grain Size

Sediment samples were analyzed for Target Analyte List metals, including cyanide and mercury by Life Science Laboratories, Inc., East Syracuse, New York. One sample from each of the six samplings area was also analyzed for grain size distribution using sieve and hydrometric methods. Analytical methods for inorganic constituents are summarized in the following table:

Life Science Laboratories, Inc. Analytical Methods			
Analyte	Matrix	Method	Sample Container
Target Analyte List Metals	Soil/water	SW846 6010B	16-oz jar
Mercury	Soil/water	SW846 M7471A	
Cyanide	Soil/water	SW846 9012A	
Moisture	Soil		
Grain Size	Soil	D4222	16-oz jar

Analytical results were provided by Life Science Laboratories, Inc. in hard copy and electronic data deliverable format (Appendix E).

2.1.3 Analysis of Organic Mercury

Selected samples with elevated total mercury concentrations were analyzed for methylmercury by Brooks Rand Labs, Seattle, Washington. Methods for analysis of methylmercury are summarized in the following table:

Brooks Rand Labs Analytical Methods			
Analyte	Matrix	Method	Sample Container
Methylmercury	Sediment	EPA 1630, modified	4-oz jar
Moisture	Sediment	SM 2540G	

Analytical results were provided by Brooks Rand Labs in hard copy and electronic data deliverable format (Appendix F).

2.2 DATA QUALITY REVIEW AND VALIDATION

Environmental Data Services performed a quality assurance review of the analytical procedures, laboratory calibration and quality control, and results (Appendix G) and provided a report summarizing their findings. Environmental Data Services did not recommend any restrictions on use of the data, but did recommend several modifications to the laboratory data qualifiers applied by the laboratories.

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2.3 HEALTH AND SAFETY

A site Health and Safety Plan was modified from the Health and Safety Plan prepared for the fish and invertebrate tissue study (Section 1.3). Field sediment sampling and processing was conducted in Level D protection, as appropriate.

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3. DISTRIBUTION AND CONCENTRATION OF SEDIMENT CONSTITUENTS OF POTENTIAL ENVIRONMENTAL CONCERN

3.1 FIELD WATER QUALITY DATA

Supplemental sediment sampling was performed on 7-8 October 2009. Water temperature, conductivity, salinity, dissolved oxygen, pH, and turbidity were recorded 1 ft below the water surface at each location during sediment sampling (Table 3-1). Water temperature ranged from 14.4 to 17.7 °C and dissolved oxygen ranged from 8.2 to 10.6 milligrams per liter. Conductivity was 0.316-0.486 milli-Siemens/centimeter and salinity was 0.18-0.29 parts per thousand. Turbidity ranged from 2 to 34 nephelometric turbidity unit. Observed pH ranged from 7.56 to 8.22. These conditions are within the typical range that might be expected in a tidal freshwater tributary to the mid-Hudson River during early fall.

3.2 PHYSICAL CHARACTERIZATION OF SEDIMENT SAMPLES

The recovered length of sediment cores exceeded 12 in. at the five downstream stations and the four stations in the embayment and mouth of the embayment (WC-1-SED to WC-9-SED). Each of these locations, therefore, yielded three depth strata samples (Appendix D): A, 0-6 in.; B, 6-12 in.; and C, 12+ in. The remaining six stations (WC-10-SED to WC-15-SED) produced only two depth strata (A and B) before refusal.

Grain size was analyzed using standard sieve and hydrometer for one station from each of the 2009 sampling areas to describe the physical characteristics of the sediment for subsequent use in evaluating remediation alternatives. The sediment samples exhibited a clear progression from coarser material upstream in the site area to finer material downstream near the CR 28 Bridge (Table 3-2). Sediment from the site area (WC-15) and the upstream end of the shoal (WC-14) was composed of greater than 63-69 percent gravel; less than 1-2 percent of the material was classified as silt-clay. Sediment from the embayment (WC-7) and the wide downstream shoal (WC-3) had less than 2 percent of the material classified as gravel and 51-54 percent classified as silt-clay. Sediment downstream near the CR 28 Bridge also had less than 3 percent gravel material; the silt-clay component at this location accounted for approximately 70 percent of the sample material.

3.3 COMPARISON OF CONSTITUENT OF POTENTIAL ENVIRONMENTAL CONCERN TO SEDIMENT SCREENING VALUES

3.3.1 NYSDEC Sediment Screening Guidelines—Lowest Effect Level and Severe Effect Level

To evaluate the potential for ecological effects associated with sediment inorganic constituents, sediment concentrations were compared with LEL and SEL screening values (Table 3-3) established by NYSDEC (1999). These screening values have not been established as sediment cleanup criteria, but as guidance for site evaluation and to identify areas that could require remediation. Concentrations below the LEL screening value are generally expected to have no

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associated ecological risk; concentrations greater than the SEL screening value have the potential for severe ecological impacts. Between the LEL and SEL, there is a potential for moderate impacts to aquatic resources. For constituents with no established screening values, background sediment concentrations can be used as a benchmark for evaluating sediment impacts associated with a particular site.

3.3.2 Background Constituent Concentrations

The RI (O'Brien and Gere Engineers, Inc. 2007a) reported background concentrations (Table 3-3) for inorganic constituents based on sediment samples collected in Wappinger Lake upstream of the site and Wappingers Falls. Lead and zinc were detected in Wappingers Lake sediment at background concentrations that ranged from levels similar to LEL screening values to infrequent detections that were above SEL screening values. In addition, copper, mercury, and nickel were detected at concentrations above LEL screening values in all background samples. Arsenic, cadmium, and chromium were detected at concentrations ranging from below their respective LEL screening values to slightly above them. Total cyanide was detected in 1 of 8 background samples. Iron and manganese are common minerals, and the detection of concentrations above the LEL screening values may be associated with local mineral levels. Silver and thallium were not detected in background samples; antimony and cyanide were detected in only one sample and are listed in Table 3-3 as maximum. Methylmercury was not analyzed by O'Brien and Gere Engineers, Inc. (2007a) in background samples.

3.3.3 2009 Sediment Data

3.3.3.1 Inorganic Constituents of Potential Environmental Concern

Based on ecological exposure risk and concentration relative to NYSDEC screening values, antimony, arsenic, cadmium, chromium, lead, mercury, zinc, and cyanide were identified as COPECs in the RI (O'Brien and Gere Engineers, Inc. 2007a). Data from the 2009 sediment study are consistent with those findings (Table 3-4) except that cyanide was generally below detection and no longer appears to be a constituent of concern.

Cyanide was detected in only 4 of 39 samples (Table 3-4); although these 4 samples exceeded the screening value, 3 were less than background. The single sample exceeding sediment background cyanide was a deep sample (12+ in.) at the mouth of the embayment (WC-9-SED-C). The other three samples (WC-5, WC-7, and WC-11) with detected cyanide were mid-depth samples (6-12 in.).

Lead (20), mercury (19), zinc (18), chromium (17), and copper (12) had the most samples that exceeded their respective SEL screening values (Tables 3-4 and 3-5, Figure 3-1). The largest relative (measured concentration divided by the SEL screening value) exceedances were observed for mercury and chromium (Table 3-6). The highest exceedance ratios were generally observed in samples from the embayment and the shallow stations at the wide transect at the island downstream of the embayment. These highest ratios generally occurred for sediment samples deeper than 6 in.; although surface samples (0-6 in.) often exceeded the SEL screening value.

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Sediment mercury ranged from not detected to 81 milligrams per kilogram dry weight. The most samples exceeding the SEL screening value for mercury were collected in the embayment area where concentrations ranged from one sample below the LEL screening value at 0.11 milligrams per kilogram (WC-8-SED-C) to 81 milligrams per kilogram (WC-9-SED-C). Ten of 12 samples exceeded the SEL screening value. The SEL exceedance ratios for mercury in embayment samples ranged from 1.5 to 62.3 (Table 3-6). Methylmercury was analyzed in 11 samples from the embayment with reported concentrations from not detected in one sample (WC-8-SED-B) to 2.31 micrograms per kilograms (WC-6-SED-B).

The NYSDEC screening values apply to total mercury; however, the concentrations of methylmercury were less than the LEL value for total mercury in all tested samples (Table 3-4). Many of the samples downstream in the vicinity of the island at the wide transect also exceeded the SEL screening value. Sediment mercury at station WC-4 in the open water, deeper channel near the upstream end of the island was less than the LEL, but samples from the shallow shoal on the north and south side of the main channel all exceeded the SEL level. The exceedance ratios ranged from 1.2 to 26.2 (Table 3-6). It appears that scour in the main channel where most of the flow is concentrated has prevented deposition of contaminated sediment within the main channel. Similar patterns were observed at WC-10 located on the edge of the main channel near the embayment and WS-12 at the edge of the main channel adjacent to the upstream shoal area. Copper slightly exceeded the LEL screening level at both of these locations and arsenic slightly exceeded the LEL value in WC-12-SED-B; none of the other COPECs exceeded their respective LEL value at either of these locations. Sediment mercury in the downstream area near the CR 28 Bridge was less than the LEL screening value in 5 of 6 samples. The surface sediment sample (WC-2-SED-A) was the only sample from this area that exceeded screening values; mercury (2.6 milligrams per kilogram) in this sample was twice the SEL screening value (Tables 3-4 and 3-6). Mercury in sediment from the shoal area upstream between the site and the embayment was below the LEL screening value in 7 of 10 samples. One sample (WC-11-SED-B) was twice the SEL value; two samples (WC-11-SED-A and WC-14-SED-A) were above the LEL, but less than the SEL value (Table 3-4). Adjacent to the site (WC-15), mercury in the surface sample was nearly twice the SEL and in the 6+in. sample was 4.5 times greater than the LEL level (Table 3-6).

The distribution and frequency of samples that exceeded the LEL and SEL screening levels for chromium, lead, and zinc were similar to that described above for mercury (Figure 3-1) except that the SEL exceedance ratios were typically lower than calculated for mercury (Tables 3-4, 3-5, and 3-6). Copper concentrations throughout the tidal creek more frequently exceeded the LEL value (34 of 39 samples) than observed for mercury chromium, lead, and zinc; however, fewer samples exceeded the SEL value (12 of 39).

Concentrations of antimony, arsenic, and cadmium each exceeded their respective SEL value in four different samples; all of these except WC-9-SED-C were less than twice the SEL value (Table 3-6). All three of these COPECs exceeded the SEL value in sample WC-5-SED-C, on the shoal north of the island downstream of the embayment. Other samples exceeding the SEL value for these three COPECs were collected from the embayment.

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3.3.3.2 Other Inorganic Constituents

Nickel and iron exceeded the LEL screening value in every sample; however, both constituents were within the typical range of background reported by O'Brien and Gere (2007a) (Table 3-5). Silver was below detection except in one sample near the embayment which was below the LEL screening value. Thallium was not detected in any samples. Aluminum is a common inorganic component of mineral soils and was within the range of background in all samples. Barium, beryllium, cobalt, selenium, and vanadium have no established screening values, but were generally within the background range in all samples. The common minerals calcium, magnesium, potassium, and sodium were within the range of background except the 6-12 in. sample adjacent to the site (WC-15-SED-B); sodium and potassium were greater than background in this sample. Another common mineral, manganese, exceeded the LEL screening level in 5 samples, but was within the range of background in all samples.

3.4 SPATIAL DISTRIBUTION OF INORGANIC CONSTITUENTS IN SEDIMENT

3.4.1 Statistical Comparison of 2001-2003 and 2009 Sediment Data

Using the area designations in the 2001/2003 database (Site, Shoal, Embayment, Downstream; Figure 1-2) the 2009 data (Figure 3-1) were compared to the 2001-2003 data (Figure 3-2) using a t-test. The t-statistic was calculated for each constituent by area and depth (0-6 in., 6-12 in., 12+ in., and combined depths (Table 3-7). No consistent statistical difference was observed for the primary COPECs (mercury, chromium, zinc, and lead) or other secondary COPECs (antimony, arsenic, cadmium, copper or nickel). The mean concentrations across all sampling depths for copper and lead in the shoal were significantly lower in 2009 compared to 2001-2003; copper was significantly higher in the site area. While there were no significant differences by depth strata between years for mercury and zinc, both mercury and zinc were significantly higher in the site area and lower in the shoal in 2009 when averaged across all sample depths. Given that few of the statistical comparisons demonstrated significant differences between the two sampling periods, the two data sets were combined to evaluate spatial and depth distribution of COPECs in tidal Wappinger Creek.

3.4.2 Depth and Spatial Distribution of Inorganic Constituents within Tidal Creek Sediments

Analysis of Variance (ANOVA) was used to evaluate the significance of variation of COPECs with depth and area within tidal Wappinger Creek for all 2001-2003 and 2009 samples combined. The statistical analyses were performed for constituents where concentrations were greater than the method detection limit in at least 50 percent of the 2001-2003 and 2009 samples. Also, excluding common nutrients, minerals, and constituents that were within the range of background (calcium, iron, manganese, magnesium, potassium, sodium, barium, beryllium, and cobalt), 8 inorganic constituents were statistically tested: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc.

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Arsenic, chromium, lead, and mercury demonstrated significant differences with depth; mean concentrations of the shallow 0-6 in. samples were significantly less than deeper samples (Table 3-8). This pattern was reversed for nickel; that is, the highest mean concentration was in the 0-6 in. depth. Although the mean concentrations for cadmium, copper, and zinc were less in the surface sample the differences compared to deeper samples were not statistically significant. Although the 0-6 in. surface sediment may have significantly lower concentrations of some COPECs than deeper sediment, the surface concentrations still frequently exceed both the LEL and SEL sediment criteria particularly in the embayment and downstream shoal near the island. These data do not indicate burial of contaminated sediments by clean material during the period between 2003 and 2006. Sediments in the deeper, open water, main channel of tidal Wappinger Creek have relatively low concentrations of inorganic COPECs compared to sediment in the shallows adjacent to the channel which have dense growth of invasive water chestnut. It appears that accumulation of contaminated sediments in the channel is minimal, whereas, the densely vegetated shallows have served as a depositional area for inorganic COPECs in sediment.

ANOVA grouped areas (site, shoal, embayment, and downstream; Figure 3-3) were comparable based on statistically significant differences among mean concentrations using the t-statistic. For each constituent, this test generally identified two area groupings with considerable overlap among groups; the areas included in each group were not consistent across constituents (Table 3-9). Only one group was identified for arsenic; that is, there was no significant difference in mean concentration associated with location within tidal Wappinger Creek. The mean concentrations of lead formed one group consisting of the site, shoal, and embayment, versus a second group with significantly lower mean concentration in the downstream area. For other constituents, ANOVA typically discriminated areas into high and low mean concentration groups; generally, two areas were common to both the high and low concentration groups and the other two areas distinguishing the two groups. For example, the higher concentration group for mercury consisted of samples from the shoal, embayment, and the site while the lower concentration group was comprised of samples from downstream, the site, and embayment. The highest mean concentration of mercury occurred in the shoal, the lowest downstream, while the embayment and site were intermediate. Similar patterns were identified for other constituents; however, the relative sequence of the areas from highest to lowest concentration varied among constituents (Table 3-9). The embayment had the highest mean concentration (4 of 8 constituents [arsenic, chromium, copper, nickel]) or second highest mean concentration (4 of 8 constituents [cadmium, lead, mercury, and zinc]). The shoal had the highest mean concentration for three constituents (zinc, mercury, and cadmium). The area adjacent to the site was highest for lead. Thus, the embayment and adjacent shoal accounted for the highest mean concentrations of all constituents except lead.

3.4.3 Co-Location of Metal Contaminants

It is apparent from review of Tables 3-4 and 3-6 that the COPECs are generally co-located in tidal Wappinger Creek. The most severe sediment impacts occur in the embayment and the shallow shoals adjacent to the embayment and downstream to the vicinity of the island. These

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data indicate that a remedial action objective spatially focused on the primary COPECs (e.g., mercury and chromium) will effectively remediate all of the inorganic COPECs including arsenic, cadmium, lead, and zinc.

3.5 METHYLMERCURY COMPONENT OF TOTAL MERCURY

Selected samples collected in the embayment and adjacent shoal were analyzed for methylmercury as well as total mercury to provide information about relative availability and toxicity of sediment mercury to aquatic organisms. Methylmercury is generally more toxic and more readily available for uptake by aquatic organisms than inorganic mercury. In the samples analyzed, methylmercury, as a percent of total mercury, ranged from 0.002 percent to 0.053 percent and averaged approximately 0.018 percent (Table 3-10). Thus, virtually all of the sediment mercury is in the inorganic form and not readily available for uptake by aquatic organisms. This could be a factor contributing to the low concentrations of mercury observed in fish tissue collected from the tidal portion of Wappinger Creek (EA 2008).

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4. FINDINGS AND REMEDIAL ACTION OBJECTIVES

The results and findings of the supplemental sediment sampling performed in 2009 generally confirm and reinforce the findings of the RI (O'Brien and Gere Engineers, Inc. 2007a) for the Three Star Anodizing site OU2, tidal Wappinger Creek. The concentration and distribution of inorganic constituents of concern in sediments from the 2009 study are similar to observations from the 2001-2003 sediment sampling, including samples in excess of NYSDEC sediment guidelines for many inorganic constituents (Figures 3-1 and 3-2). The sources of these inorganic contaminants and pathways to aquatic biota and human receptors are unchanged from those identified by O'Brien and Gere Engineers, Inc. (2007a). Statistical comparison of COPECs from the 2001-2003 and the 2009 sediment samples demonstrated no significant changes during the 6-8 intervening years. The COPECs identified by O'Brien and Gere Engineers, Inc. (2007a) are consistent with the results of the supplemental 2009 sediment sampling. Given these conditions, the FWIA and qualitative human health risk findings by O'Brien and Gere Engineers, Inc. (2007b) are considered to still be appropriate and applicable. Thus, concentrations of inorganic constituents in sediments of tidal Wappinger Creek have the potential to adversely affect aquatic biota and recreational users of this reach of the creek. Furthermore, resuspension of Wappinger Creek sediments is a potential source of inorganic constituents to the Hudson River. Sediments in the main channel of the creek are likely more at risk of resuspension than sediments within the embayment which are protected from higher flows in the creek.

The objective of any remedial action undertaken on tidal Wappinger Creek would be to reduce or eliminate the risk to aquatic biota and human users from sediment as a source of inorganic COPECs. A selected remedial action would be designed to eliminate or minimize the pathway of COPECs from sources at the Three Star Anodizing site via creek sediments to target aquatic and human receptors. This could be accomplished by removal (e.g., dredging) of contaminated sediment, capping contaminated sediment in place, physical or chemical stabilization, or a combination of these methods.

Downstream of the site, sediments in the open main channel of the creek have relatively low concentrations of any inorganic COPECs; however, high concentrations of COPECs have been observed in many shallow depositional areas. These shallow depositional areas are characterized by lower water velocities and dense vegetation which appear to have facilitated the stabilization of the deposits of inorganic constituents in these more quiescent areas. While some minor variation in distribution and concentration of inorganic sediment constituents was observed, overall sediment conditions have changed little between 2001 and 2009. The highest concentrations above the SEL sediment guidelines occur throughout the embayment, on the shallows to the north and south side of the channel downstream of the embayment to the island, and upstream adjacent to the Three Star Anodizing Site.

Any remedial action objective evaluated would need to consider rare or state-listed animals and plants, significant natural communities, and other significant habitat that could be affected. The New York Natural Heritage Program (NYNHP 2009) provided information on sensitive species, communities, and habitat that could potentially exist in the vicinity of tidal Wappinger Creek

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(29 December 2009). Included on the list were freshwater tidal marsh and mudflats at the mouth of Wappinger Creek; the entire tidal reach of Wappinger Creek is identified as an anadromous fish concentration area. Although not specifically listed, the embayment consists of freshwater tidal marsh and mud flats with a narrow upland buffer similar to that described by NYNHP at the mouth of the creek. The area is also adjacent to a designated Significant Coastal Fish and Wildlife Habitat that is subject to the Coastal Management Program administered by the New York State Department of State. Evaluation of remedial action options should also consider the extensive growth of invasive water chestnut throughout the shallow portions of most of the tidal creek. Consequently, remedial actions considered would require review by the following state agencies: NYNHP, NYSDEC Region 3 Wildlife Manager, NYSDEC Hudson River Fisheries Unit, and New York State Department of State. In addition, any sediment dredging or capping action would require a Joint Permit Application to NYSDEC and U.S. Army Corps of Engineers.

Based on the integrated results from studies of sediment and aquatic biota tissue from Wappinger Creek conducted between 2001 and 2009, it is appropriate to proceed with a Focused Feasibility Study for OU2. The following remedial action objectives are proposed to be evaluated for tidal Wappinger Creek with particular emphasis on appropriate actions for the embayment and shallow vegetated shoals:

- No action
- Capping/physical stabilization of sediment in place
- Chemical stabilization of sediment in place
- Dredge sediments and restore freshwater tidal marsh or intertidal habitat.

The no action alternative uses existing conditions as a baseline for comparison and evaluation of beneficial and adverse effects of proposed remedial actions at a given location. Any remedial action evaluated should also consider the status of remediation and removal of sources of inorganic constituents at the Three Star Anodizing site and the status of potential sources associated with the Market Street Industrial Park on the opposite side of Wappinger Creek from Three Star Anodizing. If upland soils and groundwater associated with this site are still active sources of inorganic COPECs to Wappinger Creek sediments, then the benefits of proposed remedial actions in OU2 could be negated over time.

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Appendix A

O’Brien and Gere Engineers, Inc. (2007)
Final Remedial Investigation of Wappinger Creek

Appendix B

Biota Sampling Report for Wappinger Creek (EA 2008)

Appendix C

Field Notes

Appendix D

Sediment Core Logs

Appendix E

Life Science Laboratories, Inc.
Electronic Data Deliverable

Appendix F

Brooks Rand Labs
Electronic Data Deliverable

Appendix G

Environmental Data Services Data Validation Report— Data Usability Summary Report

Figure 1-1. Vicinity Map

Three Star Anodizing Site, Wappinger Creek, NY

0 1 2 Miles

N W E S

EA Engineering, Science, and Technology, Inc.

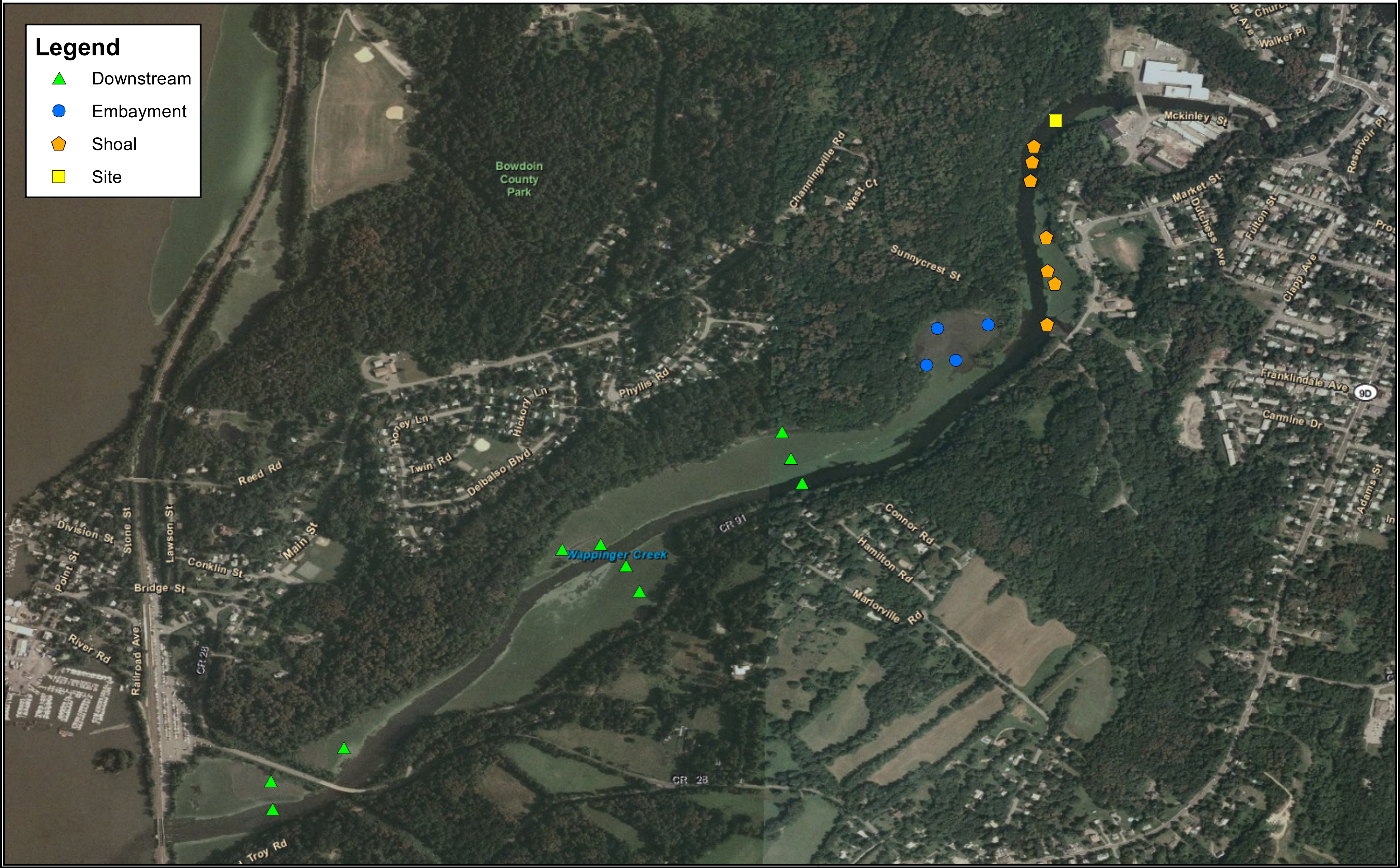

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Figure 1-2. Selected 2001/03 Sample Locations

Three Star Anodizing Site, Wappinger Creek, NY

0 0.125 0.25 Miles

N W E S

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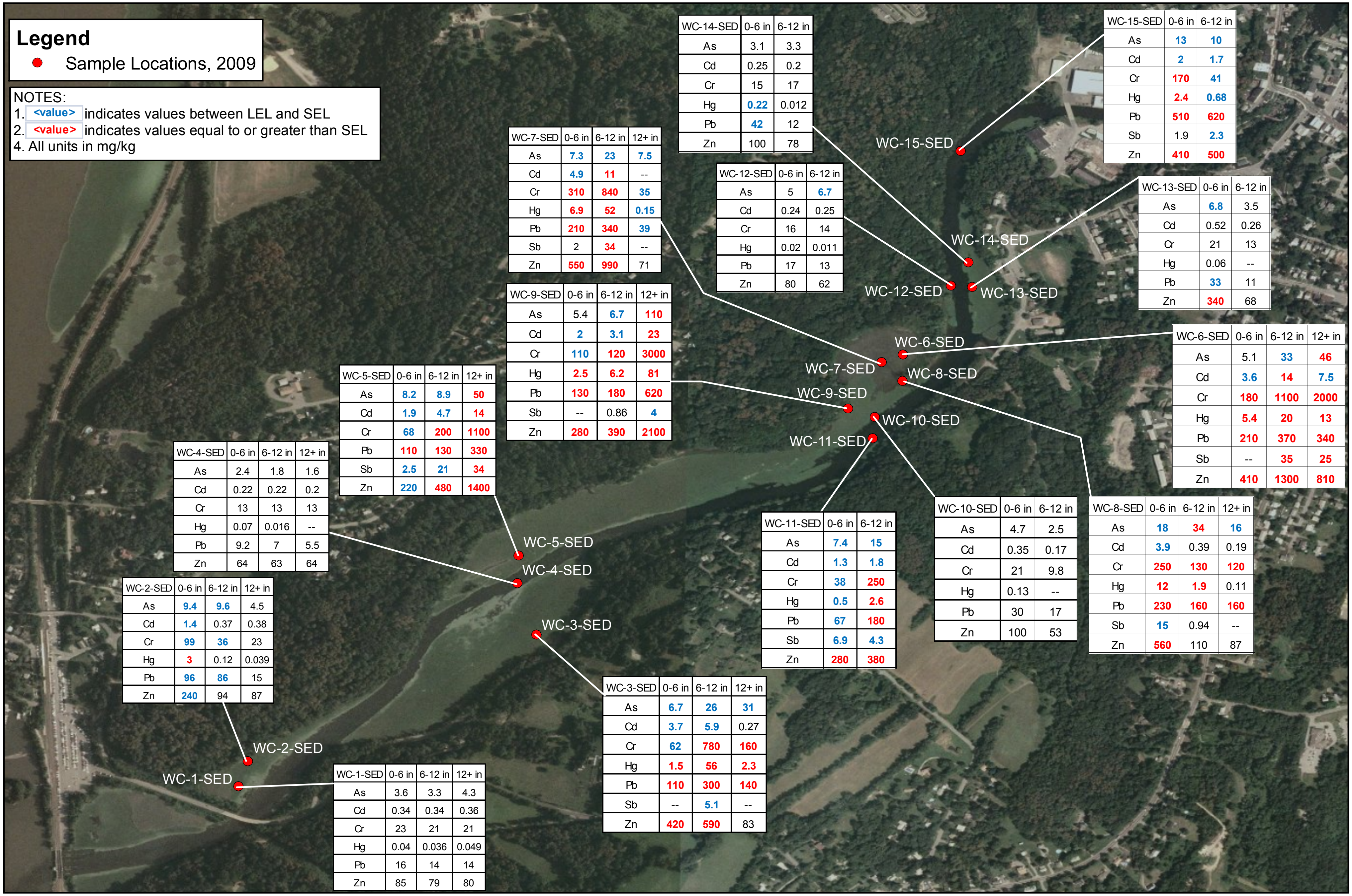
Figure 2-1. 2009 Sample Locations
Three Star Anodizing Site, Wappinger Creek, NY

0 0.1 0.2 Miles

N W E S



Legend

● Sample Locations, 2009

NOTES:
1. <value> indicates values between LEL and SEL
2. <value> indicates values equal to or greater than SEL
4. All units in mg/kg

WC-14-SED	0-6 in	6-12 in
As	3.1	3.3
Cd	0.25	0.2
Cr	15	17
Hg	0.22	0.012
Pb	42	12
Zn	100	78

WC-15-SED	0-6 in	6-12 in
As	13	10
Cd	2	1.7
Cr	170	41
Hg	2.4	0.68
Pb	510	620
Sb	1.9	2.3
Zn	410	500

WC-7-SED	0-6 in	6-12 in	12+ in
As	7.3	23	7.5
Cd	4.9	11	--
Cr	310	840	35
Hg	6.9	52	0.15
Pb	210	340	39
Sb	2	34	--
Zn	550	990	71

WC-12-SED	0-6 in	6-12 in
As	5	6.7
Cd	0.24	0.25
Cr	16	14
Hg	0.02	0.011
Pb	17	13
Zn	80	62

WC-13-SED	0-6 in	6-12 in
As	6.8	3.5
Cd	0.52	0.26
Cr	21	13
Hg	0.06	--
Pb	33	11
Zn	340	68

WC-9-SED	0-6 in	6-12 in	12+ in
As	5.4	6.7	110
Cd	2	3.1	23
Cr	110	120	3000
Hg	2.5	6.2	81
Pb	130	180	620
Sb	--	0.86	4
Zn	280	390	2100

WC-6-SED	0-6 in	6-12 in	12+ in
As	5.1	33	46
Cd	3.6	14	7.5
Cr	180	1100	2000
Hg	5.4	20	13
Pb	210	370	340
Sb	--	35	25
Zn	410	1300	810

WC-5-SED	0-6 in	6-12 in	12+ in
As	8.2	8.9	50
Cd	1.9	4.7	14
Cr	68	200	1100
Pb	110	130	330
Sb	2.5	21	34
Zn	220	480	1400

WC-4-SED	0-6 in	6-12 in	12+ in
As	2.4	1.8	1.6
Cd	0.22	0.22	0.2
Cr	13	13	13
Hg	0.07	0.016	--
Pb	9.2	7	5.5
Zn	64	63	64

WC-10-SED	0-6 in	6-12 in
As	4.7	2.5
Cd	0.35	0.17
Cr	21	9.8
Hg	0.13	--
Pb	30	17
Zn	100	53

WC-11-SED	0-6 in	6-12 in
As	7.4	15
Cd	1.3	1.8
Cr	38	250
Hg	0.5	2.6
Pb	67	180
Sb	6.9	4.3
Zn	280	380

WC-8-SED	0-6 in	6-12 in	12+ in
As	18	34	16
Cd	3.9	0.39	0.19
Cr	250	130	120
Hg	12	1.9	0.11
Pb	230	160	160
Sb	15	0.94	--
Zn	560	110	87

WC-2-SED	0-6 in	6-12 in	12+ in
As	9.4	9.6	4.5
Cd	1.4	0.37	0.38
Cr	99	36	23
Hg	3	0.12	0.039
Pb	96	86	15
Zn	240	94	87

WC-3-SED	0-6 in	6-12 in	12+ in
As	6.7	26	31
Cd	3.7	5.9	0.27
Cr	62	780	160
Hg	1.5	56	2.3
Pb	110	300	140
Sb	--	5.1	--
Zn	420	590	83

WC-1-SED	0-6 in	6-12 in	12+ in
As	3.6	3.3	4.3
Cd	0.34	0.34	0.36
Cr	23	21	21
Hg	0.04	0.036	0.049
Pb	16	14	14
Zn	85	79	80

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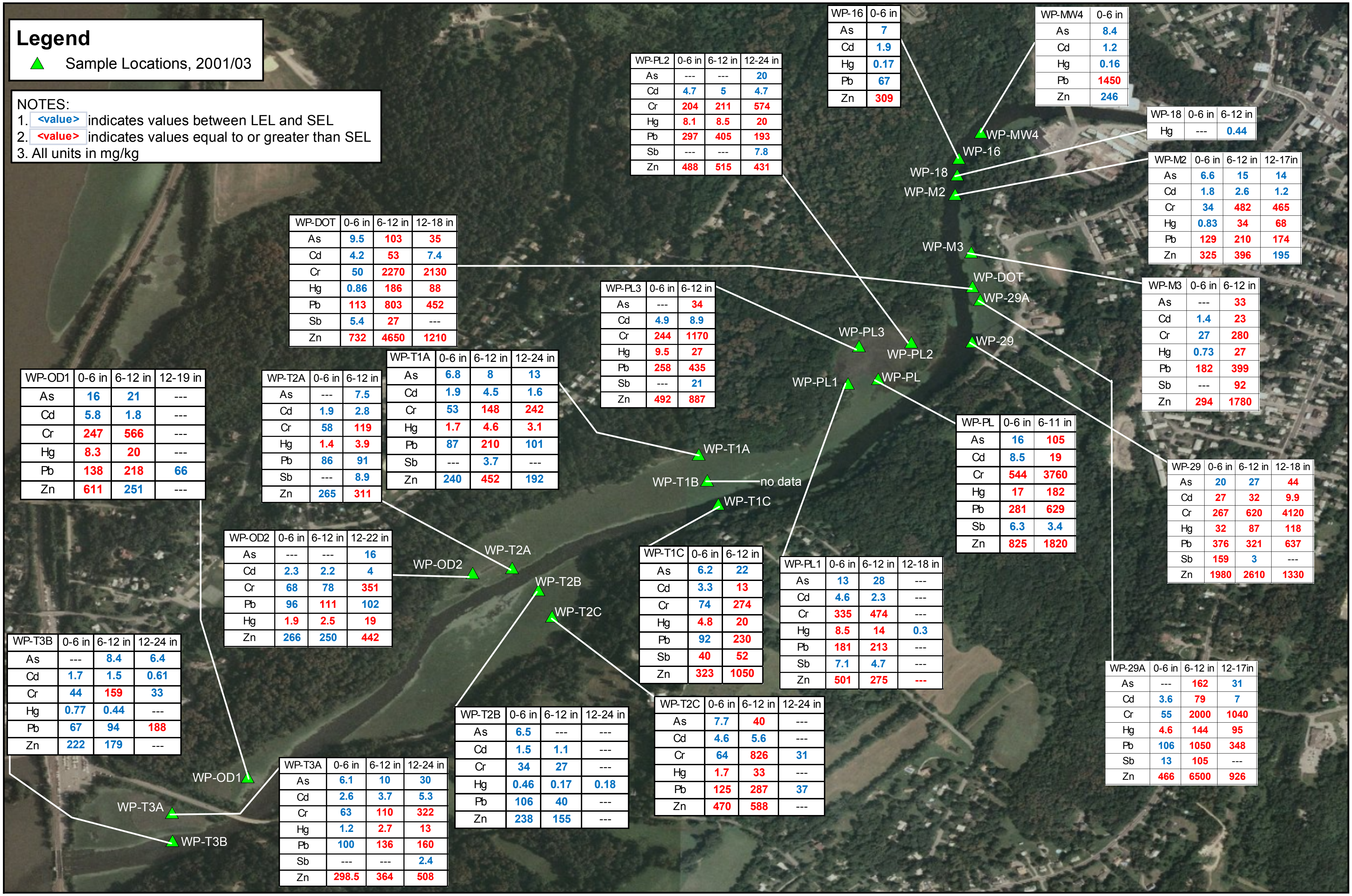
Figure 3-1. Concentrations of Selected Metals in Sediment Samples, 2009

Three Star Anodizing Site, Wappinger Creek, NY

0 0.125 0.25 Miles

N W E S



WP-16	0-6 in
As	7
Cd	1.9
Hg	0.17
Pb	67
Zn	309

WP-MW4	0-6 in
As	8.4
Cd	1.2
Hg	0.16
Pb	1450
Zn	246

WP-18	0-6 in	6-12 in
Hg	---	0.44

WP-PL2	0-6 in	6-12 in	12-24 in
As	---	---	20
Cd	4.7	5	4.7
Cr	204	211	574
Hg	8.1	8.5	20
Pb	297	405	193
Sb	---	---	7.8
Zn	488	515	431

WP-M2	0-6 in	6-12 in	12-17in
As	6.6	15	14
Cd	1.8	2.6	1.2
Cr	34	482	465
Hg	0.83	34	68
Pb	129	210	174
Zn	325	396	195

WP-DOT	0-6 in	6-12 in	12-18 in
As	9.5	103	35
Cd	4.2	53	7.4
Cr	50	2270	2130
Hg	0.86	186	88
Pb	113	803	452
Sb	5.4	27	---
Zn	732	4650	1210

WP-PL3	0-6 in	6-12 in
As	---	34
Cd	4.9	8.9
Cr	244	1170
Hg	9.5	27
Pb	258	435
Sb	---	21
Zn	492	887

WP-M3	0-6 in	6-12 in
As	---	33
Cd	1.4	23
Cr	27	280
Hg	0.73	27
Pb	182	399
Sb	---	92
Zn	294	1780

WP-OD1	0-6 in	6-12 in	12-19 in
As	16	21	---
Cd	5.8	1.8	---
Cr	247	566	---
Hg	8.3	20	---
Pb	138	218	66
Zn	611	251	---

WP-T2A	0-6 in	6-12 in
As	---	7.5
Cd	1.9	2.8
Cr	58	119
Hg	1.4	3.9
Pb	86	91
Sb	---	8.9
Zn	265	311

WP-T1A	0-6 in	6-12 in	12-24 in
As	6.8	8	13
Cd	1.9	4.5	1.6
Cr	53	148	242
Hg	1.7	4.6	3.1
Pb	87	210	101
Sb	---	3.7	---
Zn	240	452	192

WP-PL	0-6 in	6-11 in
As	16	105
Cd	8.5	19
Cr	544	3760
Hg	17	182
Pb	281	629
Sb	6.3	3.4
Zn	825	1820

WP-29	0-6 in	6-12 in	12-18 in
As	20	27	44
Cd	27	32	9.9
Cr	267	620	4120
Hg	32	87	118
Pb	376	321	637
Sb	159	3	---
Zn	1980	2610	1330

WP-OD2	0-6 in	6-12 in	12-22 in
As	---	---	16
Cd	2.3	2.2	4
Cr	68	78	351
Pb	96	111	102
Hg	1.9	2.5	19
Zn	266	250	442

WP-T1C	0-6 in	6-12 in
As	6.2	22
Cd	3.3	13
Cr	74	274
Hg	4.8	20
Pb	92	230
Sb	40	52
Zn	323	1050

WP-PL1	0-6 in	6-12 in	12-18 in
As	13	28	---
Cd	4.6	2.3	---
Cr	335	474	---
Hg	8.5	14	0.3
Pb	181	213	---
Sb	7.1	4.7	---
Zn	501	275	---

WP-T3B	0-6 in	6-12 in	12-24 in
As	---	8.4	6.4
Cd	1.7	1.5	0.61
Cr	44	159	33
Hg	0.77	0.44	---
Pb	67	94	188
Zn	222	179	---

WP-29A	0-6 in	6-12 in	12-17in
As	---	162	31
Cd	3.6	79	7
Cr	55	2000	1040
Hg	4.6	144	95
Pb	106	1050	348
Sb	13	105	---
Zn	466	6500	926

WP-T2C	0-6 in	6-12 in	12-24 in
As	7.7	40	---
Cd	4.6	5.6	---
Cr	64	826	31
Hg	1.7	33	---
Pb	125	287	37
Zn	470	588	---

WP-T2B	0-6 in	6-12 in	12-24 in
As	6.5	---	---
Cd	1.5	1.1	---
Cr	34	27	---
Hg	0.46	0.17	0.18
Pb	106	40	---
Zn	238	155	---

WP-T3A	0-6 in	6-12 in	12-24 in
As	6.1	10	30
Cd	2.6	3.7	5.3
Cr	63	110	322
Hg	1.2	2.7	13
Pb	100	136	160
Sb	---	---	2.4
Zn	298.5	364	508

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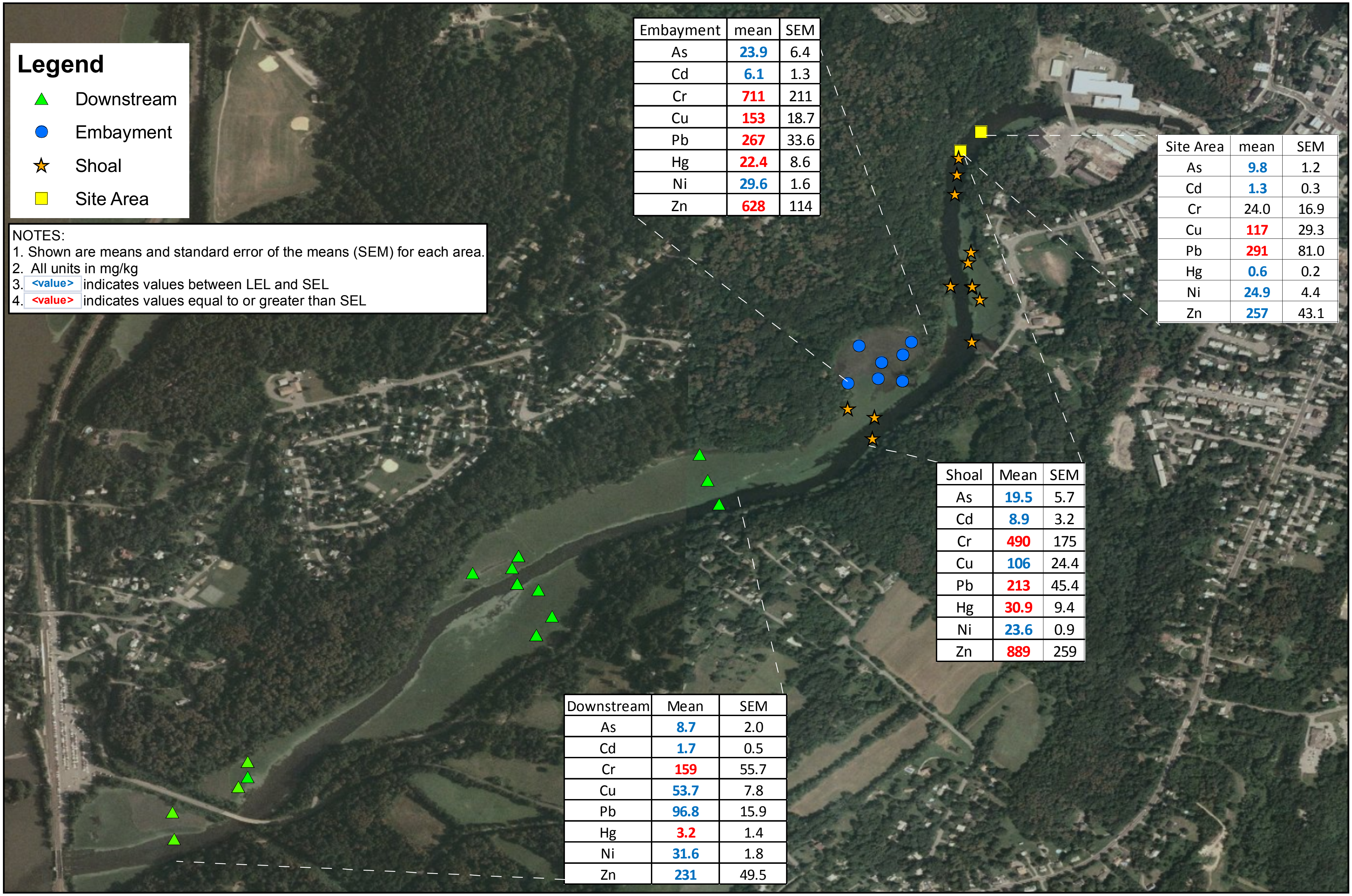
Figure 3-2. Concentrations of Selected Metals in Sediment Samples, 2001/03

Three Star Anodizing Site, Wappinger Creek, NY



Embayment	mean	SEM
As	23.9	6.4
Cd	6.1	1.3
Cr	711	211
Cu	153	18.7
Pb	267	33.6
Hg	22.4	8.6
Ni	29.6	1.6
Zn	628	114

Site Area	mean	SEM
As	9.8	1.2
Cd	1.3	0.3
Cr	24.0	16.9
Cu	117	29.3
Pb	291	81.0
Hg	0.6	0.2
Ni	24.9	4.4
Zn	257	43.1

Shoal	Mean	SEM
As	19.5	5.7
Cd	8.9	3.2
Cr	490	175
Cu	106	24.4
Pb	213	45.4
Hg	30.9	9.4
Ni	23.6	0.9
Zn	889	259

Downstream	Mean	SEM
As	8.7	2.0
Cd	1.7	0.5
Cr	159	55.7
Cu	53.7	7.8
Pb	96.8	15.9
Hg	3.2	1.4
Ni	31.6	1.8
Zn	231	49.5

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Figure 3-3. Comparison of Mean Metal Concentrations by Area

Three Star Anodizing Site, Wappinger Creek, NY

TABLE 3-1 FIELD WATER QUALITY DATA RECORDED DURING SEDIMENT COLLECTIONS ON TIDAL WAPPINGER CREEK, OCTOBER 2009

Station	Date	Time	Temperature (°C)	Conductivity (mS/cm)	Salinity (ppt)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)
WC-1	10/7/2009	1014	16.59	0.363	0.21	8.16	7.92	22.3
WC-2	10/7/2009	1035	17.7	0.316	0.18	8.29	7.83	34
WC-3	10/7/2009	1118	16.24	0.364	0.21	9.41	7.56	19.1
WC-4	10/8/2009	1035	14.26	0.437	0.27	8.24	7.8	3
WC-5	10/8/2009	1118	14.85	0.473	0.28	8.92	7.91	3.3
WC-6	10/7/2009	1601	16.07	0.413	0.24	9.92	7.91	18.8
WC-7	10/7/2009	1638	16.04	0.408	0.24	9.5	7.96	17.2
WC-8	10/8/2009	1336	14.85	0.474	0.29	9.44	7.63	2.3
WC-9	10/8/2009	1405	15.3	0.483	0.29	9.72	7.92	2
WC-10	10/8/2009	955	14.63	0.461	0.28	10.14	8.18	15.6
WC-11	10/8/2009	1225	14.5	0.469	0.29	9.28	7.9	2.6
WC-12	10/8/2009	1525	14.7	0.486	0.29	9.97	8.01	2.6
WC-13	10/8/2009	913	14.95	0.46	0.28	9.6	8.22	3.4
WC-14	10/8/2009	846	14.45	0.453	0.28	9.56	8.04	13.7
WC-15	10/8/2009	814	14.67	0.456	0.28	10.65	8.16	3.9

TABLE 3-2 RESULTS OF SEDIMENT GRAIN SIZE ANALYSIS (STANDARD SIEVE/HYDROMETER) FOR SELECTED SAMPLES FROM WAPPINGER CREEK, OCTOBER 2009

	Sieve Size – Percent Passing Sieve													Hydrometer	
Metric	38.1 mm	25.4 mm	19 mm	12.7 mm	9.5 mm	6.3 mm	4.8 mm	2 mm	0.59 mm	0.425 mm	0.25 mm	0.15 mm	0.074 mm	0.01 mm	0.001 mm
English	1 ½ in.	1 in.	¾ in.	½ in.	3/8 in.	¼ in.	#4	#10	#30	#40	#60	#100	#200		
Sample	Gravel							Sand						Silt-Clay	
WC-1-SED-AB		100	98.6	97.8	97.7	97.5	97.3	95.2	88.2	84.9	79.6	74.6	69.4	47	10
WC-3-SED-AB				100	98.5	98.2	98.1	97.1	89.6	86.3	80.8	72.7	54.2	12	5
WC-7-SED-AB			100	99.8	99.5	99.3	98.9	96.9	86.7	82.2	74.7	66.3	51.4	13	4
WC-14-SED-AB	100	94.6	78.8	58.7	52.2	43.2	37.3	23.7	9	5.7	3.2	2.5	1.9	<1	<1
WC-15-SED-AB	100	96.8	89.3	59.3	49	36.8	31.3	18.7	7.3	5.6	4.2	3.5	2.9	2	<1

TABLE 3-3 NYSDEC SEDIMENT SCREENING VALUES AND WAPPINGER CREEK BACKGROUND SEDIMENT CONCENTRATIONS FOR INORGANIC CONSTITUENTS

Constituent	LEL	SEL	Background	
			Minimum	Maximum
Aluminum (Al)	--	--	11,400	19,200
Antimony (Sb)	2	25	--	3.2J
Arsenic (As)	6	33	4.0BJ	6.3BL
Barium (Ba)	--	--	73J	120BJ
Beryllium (Be)	--	--	0.42J	0.86BJ
Cadmium (Cd)	0.6	9	0.16J	1.4BJ
Calcium (Ca)	--	--	5,350J	18,800J
Chromium (Cr)	26	110	15J	27J
Cobalt (Co)	--	--	6.5J	14.0J
Copper (Cu)	16	110	30J	90J
Iron (Fe)	2%	4%	2.4%J	3.3%J
Lead (Pb)	31	110	41J	187J
Magnesium (Mg)	--	--	5,540J	8,700J
Manganese (Mn)	460	1,100	460J	1,000J
Mercury (Hg)	0.15	1.3	0.21J	0.57J
Nickel (Ni)	16	50	22J	33J
Potassium (K)	--	--	852J	1,740BJ
Selenium (Se)	--	--	1.2J	2.5J
Silver (Ag)	1	2.2	--	--
Sodium (Na)	--	--	62J	386BJ
Thallium (Tl)	--	--	--	--
Vanadium (Vn)	--	--	18J	38BJ
Zinc (Zn)	120	270	132J	359J
Cyanide (CN)	0.1	--	--	3.2J

Yellow indicates background greater than the LEL screening value.
Tan indicates background greater than the SEL screening value.

NOTE: Dashes (--) indicate no data.
SEL = Severe effect level.
LEL = Lowest effect level.

TABLE 3-4 ANALYTICAL RESULTS FOR TARGET ANALYTE LIST METALS, CYANIDE, TOTAL MERCURY, AND METHYLMERCURY (µg/Kg) FOR SAMPLES COLLECTED FROM TIDAL WAPPINGER CREEK, OCTOBER 2009

Screening Value	Parameter (mg/Kg)																											
	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe (%)	Pb	Mg	Mn	Hg	Hg (E)	MeHg (µg/Kg)	Ni	K	Se	Ag	Na	Tl	Vn	Zn	Zn (E)	CN	Moisture (%)
LEL	--	2	6	--	--	0.6	--	26	--	16	2%	31	--	460	0.15	0.15	--	16	--	--	1	--	--	--	120	120	0.1	--
SEL	--	25	33	--	--	9	--	110	--	110	4%	110	--	1100	1.3	1.3	--	50	--	--	2.2	--	--	--	270	270	--	--
Background Min	11400	--	4	73	0.42	0.16	5350	15	6.5	30	2.4%	41	5540	460	0.21	0.21	--	22	852	1.2	--	62	--	18	132	132	--	--
Background Max	19200	3.2	6.3	120	0.86	1.4	18800	27	14	90	3.3%	187	8700	1000	0.57	0.57	--	33	1740	2.5	--	386	--	38	359	359	3.2	--
Sample																												
WC-1-SED-A	16000	--	3.6	69	0.73	0.34	3000	23	12	18	2.6	16	6000	290	0.04	NA	NA	27	1500	0.48	--	160	--	22	85	NA	--	45.7
WC-1-SED-B	14000	--	3.3	61	0.71	0.34	3100	21	11	18	2.3	14	5500	260	0.036	NA	NA	25	1500	0.53	--	190	--	22	79	NA	--	50.5
WC-1-SED-C	14000	--	4.3	51	0.71	0.36	3200	21	13	18	2.4	14	5600	260	0.049	NA	NA	26	1500	--	--	200	--	21	80	NA	--	50.6
WC-2-SED-A	14000	--	8.8	81	0.63	1.4	6300	84	16	69	2.7	86	6600	500	2.6	NA	NA	30	1400	--	--	150	--	23	210	NA	--	72.9
WC-2-SED-B	18000	--	9.6	88	0.84	0.37	3600	36	14	31	2.9	86	6600	420	0.12	NA	NA	29	1600	0.58	--	150	--	24	94	NA	--	51.9
WC-2-SED-C	15000	--	4.5	59	0.73	0.38	3000	23	13	19	3.1	15	6100	380	0.039	NA	NA	29	1800	--	--	160	--	22	87	NA	--	54.4
WC-3-SED-A	12000	--	6.7	67	0.55	3.7	6400	62	18	88	2.5	110	6400	430	1.5	NA	NA	38	1100	--	--	150	--	26	420	NA	--	69.1
WC-3-SED-B	12000	5.1	26	63	0.55	5.9	4500	780	13	140	2.3	300	5400	320	16	56	NA	27	1100	0.83	--	130	--	20	590	NA	--	51.9
WC-3-SED-C	15000	--	31	65	0.59	0.27	3100	160	11	77	2.4	140	5800	310	2.3	NA	NA	23	1100	0.64	--	150	--	17	83	NA	--	49.1
WC-4-SED-A	9500	--	2.4	24	0.26	0.22	1600	13	8.9	9.4	2.2	9.2	5000	250	0.066	NA	NA	18	710	--	--	51	--	10	64	NA	--	22.1
WC-4-SED-B	11000	--	1.8	30	0.34	0.22	1500	13	9.9	9	2.4	7	5800	260	0.016	NA	NA	20	900	0.4	--	82	--	12	63	NA	--	35.2
WC-4-SED-C	11000	--	1.6	28	--	0.2	1100	13	9.9	7.9	2.5	5.5	6000	260	--	NA	NA	21	870	--	--	91	--	12	64	NA	--	28.1
WC-5-SED-A	13000	2.5	8.2	50	0.39	1.9	1700	68	11	30	2.7	110	6200	300	1.6	NA	NA	23	900	0.5	--	62	--	14	220	NA	--	37.8
WC-5-SED-B	14000	21	8.9	67	0.54	4.7	2900	200	11	65	2.7	130	5800	330	5.3	6.8	NA	23	1100	0.55	--	85	--	16	480	NA	--	42.6
WC-5-SED-C	15000	34	50	86	0.68	14	4000	1100	12	200	2.8	330	5800	410	16	47	NA	25	1300	1.5	--	110	--	19	1300	1400	0.46	53.5
WC-6-SED-A	15000	--	5	76	0.63	3.6	6300	180	12	120	2.5	210	6300	350	4.8	NA	1.19	35	1400	1.4	--	180	--	20	410	NA	--	74.2
WC-6-SED-B	18000	35	33	170	0.83	14	4400	1100	13	230	3.1	370	6000	350	13	20	2.31	28	1400	2.5	--	170	--	22	1300	NA	--	66.2
WC-6-SED-C	16000	25	46	100	0.68	7.5	4100	2000	11	200	2.5	340	5400	320	13	9.1	0.333	24	1100	1.4	--	140	--	18	810	NA	--	57.9
WC-7-SED-A	14000	2	7.3	71	0.61	4.9	6300	310	13	140	2.6	210	6200	390	6.9	NA	1.55	34	1200	1.5	--	180	--	17	550	NA	--	76.2
WC-7-SED-B	17000	34	23	87	0.76	11	6000	840	15	230	3	340	6800	410	25	52	1.29	43	1400	1.7	--	190	--	27	990	NA	2.9	73.9

Screening Value	Parameter (mg/Kg)																										
	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe (%)	Pb	Mg	Mn	Hg	Hg (E)	MeHg (µg/Kg)	Ni	K	Se	Ag	Na	Tl	Vn	Zn	Zn (E)	CN	Moisture (%)
WC-7-SED-C	14000	--	7.5	84	0.62	--	4300	35	8.8	22	2.1	39	4800	370	0.15	NA	NA	21	890	1.1	--	110	--	15	71	NA	--	59.5
WC-8-SED-A	15000	15	18	91	0.57	3.9	2900	250	11	150	2.4	230	5900	300	12	8.4	2.25	25	950	0.93	--	97	--	17	560	NA	--	50.1
WC-8-SED-B	13000	0.94	34	64	0.54	0.39	2300	130	11	81	2.2	160	5600	200	1.9	NA	--	22	820	0.49	--	71	--	15	110	NA	--	39.5
WC-8-SED-C	15000	--	16	69	0.59	0.19	2100	120	11	46	2.4	160	6200	230	0.11	NA	0.058	24	840	0.67	--	74	--	17	87	NA	--	39.1
WC-9-SED-A	13000	--	5.4	73	0.57	2	6200	110	12	69	2.5	130	6600	520	2.5	NA	0.471	28	1100	1.2	--	150	--	20	280	NA	--	68.7
WC-9-SED-B	12000	0.86	6.7	69	0.55	3.1	4800	120	13	130	2.6	180	6000	500	5.3	6.2	0.719	27	810	0.63	0.46	87	--	20	390	NA	--	54.6
WC-9-SED-C	14000	4	110	91	0.62	23	4400	3000	11	350	2.8	620	5500	430	17	81	1.63	22	1100	1.3	--	85	--	17	1900	2100	9	52.3
WC-10-SED-A	14000	--	4.7	62	0.48	0.35	4000	21	10	22	3.1	30	7700	610	0.13	NA	NA	24	910	--	--	89	--	16	100	NA	--	44.7
WC-10-SED-B	9700	--	2.5	23	0.33	0.17	930	9.8	7.9	10	2.5	17	6000	180	--	NA	NA	17	480	--	--	30	--	12	53	NA	--	13.1
WC-11-SED-A	11000	6.9	7.4	27	0.37	1.3	5900	38	10	33	2.7	67	6200	310	0.5	NA	NA	23	630	--	--	42	--	14	280	NA	--	15.7
WC-11-SED-B	16000	4.3	15	46	0.52	1.8	2300	250	14	47	3.6	180	8100	330	2.6	NA	NA	28	1100	--	--	73	--	20	380	NA	0.72	44.7
WC-12-SED-A	13000	--	5	46	0.54	0.24	2400	16	9.1	18	2.7	17	6200	330	0.018	NA	NA	23	920	0.43	--	68	--	14	80	NA	--	34
WC-12-SED-B	12000	--	6.7	37	0.45	0.25	1400	14	11	17	2.8	13	5900	170	0.011	NA	NA	23	940	--	--	51	--	15	62	NA	--	23.5
WC-13-SED-A	14000	--	6.8	33	0.45	0.52	2300	21	12	16	4.1	33	7700	590	0.057	NA	NA	27	760	--	--	56	--	15	340	NA	--	18.4
WC-13-SED-B	11000	--	3.5	27	0.4	0.26	1100	13	9.8	11	2.8	11	6100	330	--	NA	NA	21	740	--	--	58	--	12	68	NA	--	18.4
WC-14-SED-A	9100	--	3.1	21	0.32	0.25	1700	15	7.5	19	2.4	42	4800	250	0.22	NA	NA	16	640	--	--	50	--	11	100	NA	--	21.5
WC-14-SED-B	12000	--	3.3	25	0.41	0.2	1300	17	10	18	3	12	7100	290	0.012	NA	NA	23	680	--	--	44	--	15	78	NA	--	13.9
WC-15-SED-A	9100	1.9	13	38	0.39	2	3800	170	13	240	4.6	510	4400	420	2.3	2.4	NA	24	640	0.94	--	62	--	13	410	NA	--	22.5
WC-15-SED-B	15000	--	10	93	0.64	1.7	11000	41	9.4	310	3	620	4500	340	0.68	NA	NA	21	2000	1.2	--	1700	--	22	500	NA	--	35.3

Dashes indicate "U" data qualifier--not detected.

E = Result from analysis of diluted sample.
SEL = Severe effect level.
LEL = Lowest effect level.

Yellow indicates result greater than or equal to LEL.

Tan indicates result greater than or equal to SEL.

TABLE 3-5 NUMBER OF SAMPLES WITH CONSTITUENT CONCENTRATIONS AT SELECTED SCREENING LEVELS AND RELATIVE TO BACKGROUND CONCENTRATIONS FOR WAPPINGER CREEK, OCTOBER 2009

	NYSDEC Screening Values			Background		
Constituent	<LEL	LEL-SEL	>SEL	<Min	<Max	>Max
Aluminum (Al)	--	--	--	8	39	0
Antimony (Sb)	27	8	4	0	29	10
Arsenic (As)	16	19	4	9	15	24
Barium (Ba)	--	--	--	27	38	1
Beryllium (Be)	--	--	--	9	39	0
Cadmium (Cd)	20	15	4	0	22	17
Calcium (Ca)	--	--	--	31	39	0
Chromium (Cr)	15	7	17	7	15	24
Cobalt (Co)	--	--	--	0	36	3
Copper (Cu)	5	22	12	18	27	12
Iron (Fe)	0	37	2	11	36	3
Lead (Pb)	13	6	20	15	28	11
Magnesium (Mg)	--	--	--	9	39	0
Manganese (Mn)	34	5	0	34	39	0
Mercury (Hg)	16	3	19	17	19	20
Nickel (Ni)	0	39	0	10	35	4
Potassium (K)	--	--	--	11	37	2
Selenium (Se)	--	--	--	33	39	0
Silver (Ag)	39	0	0	38	0	1
Sodium (Na)	--	--	--	10	38	1
Thallium (Tl)	--	--	--	39	0	0
Vanadium (Vn)	--	--	--	23	39	0
Zinc (Zn)	19	2	18	19	24	15
Cyanide (CN)	35	4	--		38	1

NOTE: LEL = Lowest effect level.
SEL = Severe effect level.

TABLE 3-6 RATIO OF THE CONSTITUENT CONCENTRATION TO THE LOWEST EFFECT LEVEL OR SEVERE EFFECT LEVEL SCREENING LEVEL FOR WAPPINGER CREEK, OCTOBER 2009

	Screening Value	Sb	As	Cd	Cr	Cu	Pb	Hg	Zn
	LEL	2	6	0.6	26	16	31	0.15	120
	SEL	25	33	9	110	110	110	1.3	270
Area	Sample								
Downstream (CR 28 Bridge)	WC-1-SED-A					1.1			
	WC-1-SED-B					1.1			
	WC-1-SED-C					1.1			
	WC-2-SED-A		1.5	2.3	3.2	4.3	2.8	2.0	1.8
	WC-2-SED-B		1.6		1.4	1.9	2.8		
	WC-2-SED-C					1.2			
Downstream (island transect)	WC-3-SED-A		1.1	6.2	2.4	5.5	1.0	1.2	1.6
	WC-3-SED-B	2.6	4.3	9.8	7.1	1.3	2.7	12.3	2.2
	WC-3-SED-C		5.2		1.5	4.8	1.3	1.8	
	WC-4-SED-A								
	WC-4-SED-B								
	WC-4-SED-C								
	WC-5-SED-A	1.3	1.4	3.2	2.6	1.9	1.0	1.2	1.8
	WC-5-SED-B	10.5	1.5	7.8	1.8	4.1	1.2	5.2	1.8
	WC-5-SED-C	1.4	1.5	1.6	10.0	1.8	3.0	36.2	5.2
Embayment	WC-6-SED-A			6.0	1.6	1.1	1.9	3.7	1.5
	WC-6-SED-B	1.4	1.0	1.6	10.0	2.1	3.4	15.4	4.8
	WC-6-SED-C	1.0	1.4	12.5	18.2	1.8	3.1	7.0	3.0
	WC-7-SED-A	1.0	1.2	8.2	2.8	1.3	1.9	5.3	2.0
	WC-7-SED-B	1.4	3.8	1.2	7.6	2.1	3.1	40.0	3.7
	WC-7-SED-C		1.3		1.3	1.4	1.3	1.0	
	WC-8-SED-A	7.5	3.0	6.5	2.3	1.4	2.1	6.5	2.1
	WC-8-SED-B		1.0		1.2	5.1	1.5	1.5	
	WC-8-SED-C		2.7		1.1	2.9	1.5		
	WC-9-SED-A			3.3	1.0	4.3	1.2	1.9	1.0
	WC-9-SED-B		1.1	5.2	1.1	1.2	1.6	4.8	1.4
	WC-9-SED-C	2.0		2.6	27.3	3.2	5.6	62.3	7.8

Area	Screening Value	Sb	As	Cd	Cr	Cu	Pb	Hg	Zn
	LEL	2	6	0.6	26	16	31	0.15	120
	SEL	25	33	9	110	110	110	1.3	270
	Sample								
Shoal	WC-10-SED-A					1.4			
	WC-10-SED-B								
	WC-11-SED-A	3.5	1.2	2.2	1.5	2.1	2.2	3.3	1.0
	WC-11-SED-B	2.2	2.5	3.0	2.3	2.9	1.6	2.0	1.4
	WC-12-SED-A					1.1			
	WC-12-SED-B		1.1			1.1			
	WC-13-SED-A		1.1			1.0	1.1		1.3
	WC-13-SED-B								
	WC-14-SED-A					1.2	1.4	1.5	
	WC-14-SED-B					1.1			
Site	WC-15-SED-A		2.2	3.3	1.5	2.2	4.6	1.8	1.5
	WC-15-SED-B		1.7	2.8		2.8	5.6	4.5	1.9

Yellow indicates concentration between LEL and SEL screening level.
Tan indicates concentration greater than SEL screening level.

NOTE: LEL = Lowest effect level.
SEL = Severe effect level.

TABLE 3-7 STATISTICAL COMPARISON OF SEDIMENT INORGANIC CONSTITUENTS FROM 2001-2003 AND 2009 SAMPLING PROGRAMS, WAPPINGER CREEK

				2001-2003 Data				2009 Data				t-Test			
Parameter	Area	Depth (in.)	Units	n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value	
Antimony	Downstream	0-6	mg/kg	11	1	3.64	12.1	5	1	0.5	1.12	0.57	14	0.58	
	Downstream	6-12	mg/kg	11	3	5.87	15.5	5	2	5.22	9.09	0.0864	14	0.93	
	Downstream	12 +	mg/kg	8	1	0.3	0.849	5	1	6.8	15.2	1.24	11	0.24	
	Downstream	Composite	mg/kg	30	5	3.57	11.8	15	4	4.17	9.89	0.171	43	0.86	
	Embayment	0-6	mg/kg	4	2	3.13	3.67	4	2	4.25	7.23	0.277	6	0.79	
	Embayment	6-12	mg/kg	4	3	7.28	9.36	4	4	17.7	19.4	0.968	6	0.37	
	Embayment	12 +	mg/kg	2	1	3.9	5.52	4	2	7.25	12	0.36	4	0.74	
	Embayment	Composite	mg/kg	10	6	4.94	6.42	12	8	9.73	13.9	1	20	0.33	
	Shoal	0-6	mg/kg	8	3	22.2	55.5	5	1	1.38	3.09	0.823	11	0.43	
	Shoal	6-12	mg/kg	7	5	31.8	44.2	5	1	0.86	1.92	1.54	10	0.15	
	Shoal	12 +	mg/kg	4	0	NA	NA	0				NA	NA	NA	
	Shoal	Composite	mg/kg	19	8	21.1	44.6	10	2	1.12	2.44	1.4	27	0.17	
	Site area	0-6	mg/kg	8	1	0.29	0.813	1	1	1.9		NA	NA	NA	
	Site area	6-12	mg/kg	0				1	1	2.3		NA	NA	NA	
	Site area	Composite	mg/kg	8	1	0.29	0.813	2	2	2.1	0.283	2.99	8	0.02	*
Arsenic	Downstream	0-6	mg/kg	11	6	4.48	5.08	5	5	6.06	2.98	0.638	14	0.53	
	Downstream	6-12	mg/kg	11	8	11.5	12.1	5	5	9.92	9.61	0.252	14	0.80	
	Downstream	12 +	mg/kg	8	4	8.18	10.9	5	5	18.3	21.4	1.14	11	0.28	
	Downstream	Composite	mg/kg	30	18	8.03	9.85	15	15	11.4	13.7	0.953	43	0.35	
	Embayment	0-6	mg/kg	4	2	6.45	7.45	4	4	8.95	6.11	0.519	6	0.62	
	Embayment	6-12	mg/kg	4	3	41.8	44.7	4	4	24.2	12.7	0.757	6	0.48	
	Embayment	12 +	mg/kg	2	1	10	14.1	4	4	44.9	46.5	0.986	4	0.38	
	Embayment	Composite	mg/kg	10	6	21.3	31.9	12	12	26	29.6	0.359	20	0.72	
	Shoal	0-6	mg/kg	8	5	7.56	7.94	5	5	5.4	1.72	0.591	11	0.57	
	Shoal	6-12	mg/kg	7	6	46.1	53	5	5	6.2	5.17	1.66	10	0.13	
	Shoal	12 +	mg/kg	4	4	31	12.6	0				NA	NA	NA	
	Shoal	Composite	mg/kg	19	15	26.7	36.1	10	10	5.8	3.66	1.81	27	0.08	
	Site area	0-6	mg/kg	8	8	9.41	4.13	1	1	13		NA	NA	NA	
	Site area	6-12	mg/kg	0				1	1	10		NA	NA	NA	
	Site area	Composite	mg/kg	8	8	9.41	4.13	2	2	11.5	2.12	0.673	8	0.52	

Parameter	Area	Depth (in.)	Units	2001-2003 Data				2009 Data				t-Test		
				n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value
Cadmium	Downstream	0-6	mg/kg	11	10	2.56	1.57	5	5	1.51	1.41	1.28	14	0.22
	Downstream	6-12	mg/kg	11	10	3.6	3.5	5	5	2.31	2.77	0.725	14	0.48
	Downstream	12 +	mg/kg	8	4	1.44	2.09	5	5	3.04	6.13	0.694	11	0.50
	Downstream	Composite	mg/kg	30	24	2.64	2.62	15	15	2.29	3.73	0.373	43	0.71
	Embayment	0-6	mg/kg	4	4	5.41	1.36	4	4	3.6	1.2	1.99	6	0.09
	Embayment	6-12	mg/kg	4	4	8.8	7.32	4	4	7.12	6.43	0.344	6	0.74
	Embayment	12 +	mg/kg	2	1	2.35	3.32	4	3	7.67	10.8	0.647	4	0.55
	Embayment	Composite	mg/kg	10	9	6.16	5.13	12	11	6.13	6.86	0.00888	20	0.99
	Shoal	0-6	mg/kg	8	7	5.19	8.91	5	5	0.532	0.444	1.15	11	0.28
	Shoal	6-12	mg/kg	7	6	26.6	28.3	5	5	0.536	0.708	2.03	10	0.07
	Shoal	12 +	mg/kg	4	4	6.38	3.68	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	17	13.3	20.2	10	10	0.534	0.557	1.98	27	0.06
	Site area	0-6	mg/kg	8	6	1.19	0.854	1	1	2		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	1.7		NA	NA	NA
	Site area	Composite	mg/kg	8	6	1.19	0.854	2	2	1.85	0.212	1.04	8	0.33
Chromium	Downstream	0-6	mg/kg	11	10	69.5	62.3	5	5	53	35.1	0.549	14	0.59
	Downstream	6-12	mg/kg	11	10	220	253	5	5	210	328	0.0684	14	0.95
	Downstream	12 +	mg/kg	8	5	122	155	5	5	263	472	0.798	11	0.44
	Downstream	Composite	mg/kg	30	25	139	183	15	15	175	321	0.488	43	0.63
	Embayment	0-6	mg/kg	4	4	315	122	4	4	213	86.6	1.38	6	0.22
	Embayment	6-12	mg/kg	4	4	1400	1620	4	4	548	499	1.01	6	0.35
	Embayment	12 +	mg/kg	2	1	287	406	4	4	1290	1460	0.905	4	0.42
	Embayment	Composite	mg/kg	10	9	745	1110	12	12	683	933	0.143	20	0.89
	Shoal	0-6	mg/kg	8	7	68.1	82.8	5	5	22.2	9.26	1.22	11	0.25
	Shoal	6-12	mg/kg	7	6	784	876	5	5	60.8	106	1.81	10	0.10
	Shoal	12 +	mg/kg	4	4	1940	1610	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	17	726	1100	10	10	41.5	73.7	1.95	27	0.06
	Site area	0-6	mg/kg	8	1	3.63	10.3	1	1	170		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	41		NA	NA	NA
	Site area	Composite	mg/kg	8	1	3.63	10.3	2	2	106	91.2	3.83	8	0.01 *

Parameter	Area	Depth (in.)	Units	2001-2003 Data				2009 Data				t-Test		
				n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value
Copper	Downstream	0-6	mg/kg	11	10	64.7	24.9	5	5	42.9	34	1.45	14	0.17
	Downstream	6-12	mg/kg	11	10	75.3	43.1	5	5	52.6	53.3	0.909	14	0.38
	Downstream	12 +	mg/kg	8	6	31.8	28.1	5	5	64.4	80.5	1.07	11	0.31
	Downstream	Composite	mg/kg	30	26	59.8	36.9	15	15	53.3	55.5	0.469	43	0.64
	Embayment	0-6	mg/kg	4	4	147	27.2	4	4	122	36.4	1.08	6	0.32
	Embayment	6-12	mg/kg	4	4	217	99.5	4	4	168	74.6	0.796	6	0.46
	Embayment	12 +	mg/kg	2	2	68	62.2	4	4	155	152	0.737	4	0.50
	Embayment	Composite	mg/kg	10	10	159	86	12	12	148	92.8	0.288	20	0.78
	Shoal	0-6	mg/kg	8	7	76.4	53.1	5	5	21.6	6.73	2.26	11	0.05 *
	Shoal	6-12	mg/kg	7	6	193	176	5	5	20.6	15.2	2.16	10	0.06
	Shoal	12 +	mg/kg	4	4	225	173	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	17	151	144	10	10	21.1	11.1	2.82	27	0.01 *
	Site area	0-6	mg/kg	8	8	77.7	41.9	1	1	240		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	310		NA	NA	NA
	Site area	Composite	mg/kg	8	8	77.7	41.9	2	2	275	49.5	5.81	8	0.00 *
Iron	Downstream	0-6	percent	11	10	2.54	0.887	5	5	2.58	0.259	0.0951	14	0.93
	Downstream	6-12	percent	11	10	2.55	0.944	5	5	2.52	0.268	0.079	14	0.94
	Downstream	12 +	percent	8	7	2.35	0.971	5	5	2.64	0.305	0.639	11	0.54
	Downstream	Composite	percent	30	27	2.5	0.902	15	15	2.58	0.262	0.356	43	0.72
	Embayment	0-6	percent	4	4	2.78	0.171	4	4	2.53	0.0957	2.55	6	0.04 *
	Embayment	6-12	percent	4	4	2.73	0.0957	4	4	2.73	0.411	2.1E-15	6	1.00
	Embayment	12 +	percent	2	2	2.35	0.0707	4	4	2.45	0.289	0.457	4	0.67
	Embayment	Composite	percent	10	10	2.67	0.206	12	12	2.57	0.293	0.937	20	0.36
	Shoal	0-6	percent	8	8	2.83	0.539	5	5	3	0.663	0.523	11	0.61
	Shoal	6-12	percent	7	7	2.56	0.138	5	5	2.94	0.41	2.29	10	0.05 *
	Shoal	12 +	percent	4	4	3.18	0.695	0						
	Shoal	Composite	percent	19	19	2.8	0.503	10	10	2.97	0.521	0.842	27	0.41
	Site area	0-6	percent	8	7	3.02	1.3	1	1	4.6				
	Site area	6-12	percent	0				1	1	3				
	Site area	Composite	percent	8	7	3.02	1.3	2	2	3.8	1.13	0.771	8	0.46

Parameter	Area	Depth (in.)	Units	2001-2003 Data				2009 Data				t-Test		
				n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value
Lead	Downstream	0-6	mg/kg	11	10	90.1	35.5	5	5	68.2	51.2	0.998	14	0.34
	Downstream	6-12	mg/kg	11	10	140	87.1	5	5	107	119	0.624	14	0.54
	Downstream	12 +	mg/kg	8	6	81.8	69.5	5	5	101	140	0.333	11	0.75
	Downstream	Composite	mg/kg	30	26	106	70.1	15	15	92.2	103	0.539	43	0.59
	Embayment	0-6	mg/kg	4	4	254	51.2	4	4	195	44.3	1.74	6	0.13
	Embayment	6-12	mg/kg	4	4	421	170	4	4	263	108	1.57	6	0.17
	Embayment	12 +	mg/kg	2	1	96.5	136	4	4	290	253	0.974	4	0.39
	Embayment	Composite	mg/kg	10	9	289	171	12	12	249	151	0.584	20	0.57
	Shoal	0-6	mg/kg	8	7	152	107	5	5	37.8	18.6	2.34	11	0.04 *
	Shoal	6-12	mg/kg	7	6	419	340	5	5	46.6	74.6	2.37	10	0.04 *
	Shoal	12 +	mg/kg	4	4	403	194	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	17	303	258	10	10	42.2	51.5	3.13	27	0.00 *
	Site area	0-6	mg/kg	8	8	222	238	1	1	510		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	620		NA	NA	NA
	Site area	Composite	mg/kg	8	8	222	238	2	2	565	77.8	1.93	8	0.09
Manganese	Downstream	0-6	mg/kg	11	6	283	293	5	5	364	124	0.587	14	0.57
	Downstream	6-12	mg/kg	11	3	132	226	5	5	318	65.7	1.77	14	0.10
	Downstream	12 +	mg/kg	8	0	NA	NA	5	5	324	68.8	NA	NA	NA
	Downstream	Composite	mg/kg	30	9	152	246	15	15	335	86.2	2.79	43	0.01 *
	Embayment	0-6	mg/kg	4	0	NA	NA	4	4	393	92.9	NA	NA	NA
	Embayment	6-12	mg/kg	4	0	NA	NA	4	4	365	126	NA	NA	NA
	Embayment	12 +	mg/kg	2	0	NA	NA	4	4	338	84.6	NA	NA	NA
	Embayment	Composite	mg/kg	10	0	NA	NA	12	12	365	95.9	NA	NA	NA
	Shoal	0-6	mg/kg	8	4	560	821	5	5	418	169	0.376	11	0.71
	Shoal	6-12	mg/kg	7	0	NA	NA	5	5	260	79.4	NA	NA	NA
	Shoal	12 +	mg/kg	4	0	NA	NA	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	4	236	586	10	10	339	150	0.543	27	0.59
	Site area	0-6	mg/kg	8	6	652	575	1	1	420		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	340		NA	NA	NA
	Site area	Composite	mg/kg	8	6	652	575	2	2	380	56.6	0.64	8	0.54

Parameter	Area	Depth (in.)	Units	2001-2003 Data n	2001-2003 Data No. of Detects	2001-2003 Data Mean	2001-2003 Data Std. Dev.	2009 Data n	2009 Data No. of Detects	2009 Data Mean	2009 Data Std. Dev.	t-Test t-Statistic	t-Test DF	t-Test Two-Tailed P-Value
Mercury	Downstream	0-6	mg/kg	11	10	2.1	2.41	5	4	0.921	1.32	1.01	14	0.33
	Downstream	6-12	mg/kg	11	10	8.38	10.9	5	4	11.2	25	0.325	14	0.75
	Downstream	12 +	mg/kg	8	4	4.41	7.41	5	3	0.478	1.02	1.16	11	0.27
	Downstream	Composite	mg/kg	30	24	5.02	7.99	15	11	4.21	14.4	0.243	43	0.81
	Embayment	0-6	mg/kg	4	4	9.78	2.23	4	4	6.7	3.98	1.35	6	0.23
	Embayment	6-12	mg/kg	4	4	57.9	83.1	4	4	20	22.7	0.879	6	0.41
	Embayment	12 +	mg/kg	2	2	10.2	13.9	4	4	23.6	38.8	0.452	4	0.67
	Embayment	Composite	mg/kg	10	10	29.1	54.2	12	12	16.8	24.7	0.707	20	0.49
	Shoal	0-6	mg/kg	8	7	6.23	10.9	5	5	0.185	0.192	1.22	11	0.25
	Shoal	6-12	mg/kg	7	7	67.7	71.6	5	3	0.525	1.16	2.07	10	0.07
	Shoal	12 +	mg/kg	4	4	92.3	20.6	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	18	47	56.4	10	8	0.355	0.804	2.59	27	0.02 *
	Site area	0-6	mg/kg	8	7	0.35	0.35	1	1	2.4		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	0.68		NA	NA	NA
	Site area	Composite	mg/kg	8	7	0.35	0.35	2	2	1.54	1.22	2.78	8	0.02 *
Nickel	Downstream	0-6	mg/kg	11	10	32.4	12.5	5	5	27.6	7.77	0.78	14	0.45
	Downstream	6-12	mg/kg	11	10	28	11.8	5	5	24.8	3.49	0.584	14	0.57
	Downstream	12 +	mg/kg	8	7	21.5	9.12	5	5	24.8	3.03	0.772	11	0.46
	Downstream	Composite	mg/kg	30	27	27.9	11.9	15	15	25.7	5.02	0.665	43	0.51
	Embayment	0-6	mg/kg	4	4	40	2.58	4	4	30.5	4.8	3.49	6	0.01 *
	Embayment	6-12	mg/kg	4	4	28.3	5.74	4	4	30	9.06	0.326	6	0.76
	Embayment	12 +	mg/kg	2	2	22.5	2.12	4	4	22.8	1.5	0.172	4	0.87
	Embayment	Composite	mg/kg	10	10	31.8	8.27	12	12	27.8	6.55	1.28	20	0.21
	Shoal	0-6	mg/kg	8	8	25.8	4.86	5	5	22.6	4.04	1.21	11	0.25
	Shoal	6-12	mg/kg	7	7	21.5	1.98	5	5	22.4	3.97	0.522	10	0.61
	Shoal	12 +	mg/kg	4	4	25.5	7.68	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	19	24.1	4.96	10	10	22.5	3.78	0.908	27	0.37
	Site area	0-6	mg/kg	8	7	25.4	15.8	1	1	24		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	21		NA	NA	NA
	Site area	Composite	mg/kg	8	7	25.4	15.8	2	2	22.5	2.12	0.251	8	0.81

Parameter	Area	Depth (in.)	Units	2001-2003 Data				2009 Data				t-Test		
				n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value
Selenium	Downstream	0-6	mg/kg	11	0	NA	NA	5	3	0.416	0.454	NA	NA	NA
	Downstream	6-12	mg/kg	11	0	NA	NA	5	5	0.578	0.157	NA	NA	NA
	Downstream	12 +	mg/kg	8	0	NA	NA	5	2	0.428	0.66	NA	NA	NA
	Downstream	Composite	mg/kg	30	0	NA	NA	15	10	0.474	0.443	NA	NA	NA
	Embayment	0-6	mg/kg	4	1	0.41	0.825	4	4	1.26	0.251	1.96	6	0.10
	Embayment	6-12	mg/kg	4	1	0.88	1.75	4	4	1.33	0.949	0.457	6	0.66
	Embayment	12 +	mg/kg	2	0	NA	NA	4	4	1.12	0.323	NA	NA	NA
	Embayment	Composite	mg/kg	10	2	0.52	1.17	12	12	1.24	0.548	1.9	20	0.07
	Shoal	0-6	mg/kg	8	0	NA	NA	5	1	0.086	0.192	NA	NA	NA
	Shoal	6-12	mg/kg	7	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Shoal	12 +	mg/kg	4	0	NA	NA	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	0	NA	NA	10	1	0.043	0.136	NA	NA	NA
	Site area	0-6	mg/kg	8	0	NA	NA	1	1	0.94		NA	NA	NA
	Site area	6-12	mg/kg	0				1	1	1.2		NA	NA	NA
	Site area	Composite	mg/kg	8	0	NA	NA	2	2	1.07	0.184	NA	NA	NA
Silver	Downstream	0-6	mg/kg	11	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Downstream	6-12	mg/kg	11	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Downstream	12 +	mg/kg	8	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Downstream	Composite	mg/kg	30	0	NA	NA	15	0	NA	NA	NA	NA	NA
	Embayment	0-6	mg/kg	4	1	0.29	0.575	4	0	NA	NA	NA	NA	NA
	Embayment	6-12	mg/kg	4	0	NA	NA	4	1	0.115	0.23	NA	NA	NA
	Embayment	12 +	mg/kg	2	0	NA	NA	4	0	NA	NA	NA	NA	NA
	Embayment	Composite	mg/kg	10	1	0.12	0.364	12	1	0.0383	0.133	0.681	20	0.50
	Shoal	0-6	mg/kg	8	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Shoal	6-12	mg/kg	7	0	NA	NA	5	0	NA	NA	NA	NA	NA
	Shoal	12 +	mg/kg	4	0	NA	NA	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	0	NA	NA	10	0	NA	NA	NA	NA	NA
	Site area	0-6	mg/kg	8	0	NA	NA	1	0	NA	NA	NA	NA	NA
	Site area	6-12	mg/kg	0				1	0	NA	NA	NA	NA	NA
	Site area	Composite	mg/kg	8	0	NA	NA	2	0	NA	NA	NA	NA	NA

Parameter	Area	Depth (in.)	Units	2001-2003 Data				2009 Data				t-Test		
				n	No. of Detects	Mean	Std. Dev.	n	No. of Detects	Mean	Std. Dev.	t-Statistic	DF	Two-Tailed P-Value
Thallium	Downstream	0-6	mg/kg	11	5	1.1	1.39	5	0	NA	NA	NA	NA	NA
	Downstream	6-12	mg/kg	11	5	0.87	1.13	5	0	NA	NA	NA	NA	NA
	Downstream	12 +	mg/kg	8	5	1.05	0.929	5	0	NA	NA	NA	NA	NA
	Downstream	Composite	mg/kg	30	15	1	1.15	15	0	NA	NA	NA	NA	NA
	Embayment	0-6	mg/kg	4	1	0.75	1.5	4	0	NA	NA	NA	NA	NA
	Embayment	6-12	mg/kg	4	0	NA	NA	4	0	NA	NA	NA	NA	NA
	Embayment	12 +	mg/kg	2	0	NA	NA	4	0	NA	NA	NA	NA	NA
	Embayment	Composite	mg/kg	10	1	0.3	0.949	12	0	NA	NA	NA	NA	NA
	Shoal	0-6	mg/kg	8	4	0.73	0.848	5	0	NA	NA	NA	NA	NA
	Shoal	6-12	mg/kg	7	4	0.64	0.645	5	0	NA	NA	NA	NA	NA
	Shoal	12 +	mg/kg	4	1	0.21	0.425	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	9	0.59	0.7	10	0	NA	NA	NA	NA	NA
	Site area	0-6	mg/kg	8	0	NA	NA	1	0	NA	NA	NA	NA	NA
	Site area	6-12	mg/kg	0				1	0	NA	NA	NA	NA	NA
	Site area	Composite	mg/kg	8	0	NA	NA	2	0	NA	NA	NA	NA	NA
Total Cyanide	Downstream	0-6	mg/kg	11	2	0.41	1.17	5	0	NA	NA	NA	NA	NA
	Downstream	6-12	mg/kg	11	7	0.76	1.26	5	0	NA	NA	NA	NA	NA
	Downstream	12 +	mg/kg	8	3	0.41	0.934	5	0	NA	NA	NA	NA	NA
	Downstream	Composite	mg/kg	30	12	0.54	1.12	15	0	NA	NA	NA	NA	NA
	Embayment	0-6	mg/kg	4	3	1.3	1.61	4	0	NA	NA	NA	NA	NA
	Embayment	6-12	mg/kg	4	3	13.4	19.7	4	1	0.725	1.45	1.28	6	0.25
	Embayment	12 +	mg/kg	2	2	4.33	5.2	4	1	2.25	4.5	0.512	4	0.64
	Embayment	Composite	mg/kg	10	8	6.74	13	12	2	0.992	2.66	1.51	20	0.15
	Shoal	0-6	mg/kg	8	5	3.8	9.79	5	0	NA	NA	NA	NA	NA
	Shoal	6-12	mg/kg	7	6	12.5	13.3	5	0	NA	NA	NA	NA	NA
	Shoal	12 +	mg/kg	4	4	4.18	2.32	0				NA	NA	NA
	Shoal	Composite	mg/kg	19	15	7.08	10.7	10	0	NA	NA	NA	NA	NA
	Site area	0-6	mg/kg	8	3	0.22	0.386	1	0	NA	NA	NA	NA	NA
	Site area	6-12	mg/kg	0				1	0	NA	NA	NA	NA	NA
	Site area	Composite	mg/kg	8	3	0.22	0.386	2	0	NA	NA	NA	NA	NA

Parameter	Area	Depth (in.)	Units	2001-2003 Data n	2001-2003 Data No. of Detects	2001-2003 Data Mean	2001-2003 Data Std. Dev.	2009 Data n	2009 Data No. of Detects	2009 Data Mean	2009 Data Std. Dev.	t-Test t-Statistic	t-Test DF	t-Test Two-Tailed P-Value	
Vanadium	Downstream	0-6	mg/kg	11	1	3.82	12.7	5	5	19.2	6.87	2.52	14	0.02	*
	Downstream	6-12	mg/kg	11	1	4.64	15.4	5	5	18.8	4.82	1.98	14	0.07	
	Downstream	12 +	mg/kg	8	0	NA	NA	5	5	18.2	3.96	NA	NA	NA	
	Downstream	Composite	mg/kg	30	2	3.1	11.9	15	15	18.7	4.98	4.87	43	0.00	*
	Embayment	0-6	mg/kg	4	0	NA	NA	4	4	18.5	1.73	NA	NA	NA	
	Embayment	6-12	mg/kg	4	0	NA	NA	4	4	21	4.97	NA	NA	NA	
	Embayment	12 +	mg/kg	2	0	NA	NA	4	4	16.8	1.26	NA	NA	NA	
	Embayment	Composite	mg/kg	10	0	NA	NA	12	12	18.8	3.36	NA	NA	NA	
	Shoal	0-6	mg/kg	8	0	NA	NA	5	5	14	1.87	NA	NA	NA	
	Shoal	6-12	mg/kg	7	0	NA	NA	5	5	14.8	3.27	NA	NA	NA	
	Shoal	12 +	mg/kg	4	0	NA	NA	0				NA	NA	NA	
	Shoal	Composite	mg/kg	19	0	NA	NA	10	10	14.4	2.55	NA	NA	NA	
	Site area	0-6	mg/kg	8	0	NA	NA	1	1	13		NA	NA	NA	
	Site area	6-12	mg/kg	0				1	1	22		NA	NA	NA	
	Site area	Composite	mg/kg	8	0	NA	NA	2	2	17.5	6.36	NA	NA	NA	
Zinc	Downstream	0-6	mg/kg	11	10	291	152	5	5	206	143	1.06	14	0.31	
	Downstream	6-12	mg/kg	11	10	359	277	5	5	261	253	0.673	14	0.51	
	Downstream	12 +	mg/kg	8	3	143	216	5	5	343	591	0.886	11	0.39	
	Downstream	Composite	mg/kg	30	23	277	231	15	15	270	357	0.0756	43	0.94	
	Embayment	0-6	mg/kg	4	4	555	123	4	4	450	132	1.16	6	0.29	
	Embayment	6-12	mg/kg	4	4	874	679	4	4	698	544	0.406	6	0.70	
	Embayment	12 +	mg/kg	2	1	216	305	4	4	767	953	0.759	4	0.49	
	Embayment	Composite	mg/kg	10	9	615	486	12	12	638	595	0.0993	20	0.92	
	Shoal	0-6	mg/kg	8	7	610	615	5	5	180	121	1.52	11	0.16	
	Shoal	6-12	mg/kg	7	6	2240	2310	5	5	128	141	2.01	10	0.07	
	Shoal	12 +	mg/kg	4	4	915	509	0				NA	NA	NA	
	Shoal	Composite	mg/kg	19	17	1280	1600	10	10	154	127	2.19	27	0.04	*
	Site area	0-6	mg/kg	8	7	208	96.7	1	1	410		NA	NA	NA	
	Site area	6-12	mg/kg	0				1	1	500		NA	NA	NA	
	Site area	Composite	mg/kg	8	7	208	96.7	2	2	455	63.6	3.35	8	0.01	*

* The t-test indicates difference between the 2001-2003 and 2009 means at the 95% significance level.

TABLE 3-8 GROUPING RESULTS FROM ANOVA FOR MEAN CONSTITUENT CONCENTRATION BY SAMPLE DEPTH 2001/2003 AND 2009 SEDIMENT DATA COMBINED

Depth	Mean	SEM	t Grouping	
Arsenic				
>12 in.	23.9	4.9		b
6-12 in.	23.4	3.9		b
0-6 in.	8.1	3.2	a	
Cadmium				
6-12 in.	8.0	1.7	a	
>12 in.	4.4	2.2	a	
0-6 in.	2.9	1.4	a	
Chromium				
>12 in.	747	150		b
6-12 in.	483	119		b
0-6 in.	124	98	a	
Copper				
6-12 in.	136	16.0	a	
>12 in.	120	20.1	a	
0-6 in.	87.9	13.1	a	
Lead				
6-12 in.	283	30.8		b
>12 in.	246	38.8	a	b
0-6 in.	170	25.3	a	
Mercury				
>12 in.	26.6	7.3		b
6-12 in.	25.6	5.8		b
0-6 in.	4.1	4.7	a	
Nickel				
0-6 in.	28.8	1.3	a	
6-12 in.	24.8	1.6	a	b
>12 in.	21.5	2.0		b
Zinc				
6-12 in.	762	143	a	
>12 in.	510	180	a	
0-6 in.	364	117	a	

1. Data were screened for frequency of detection; two-way ANOVA results are presented only if number of detects >50% of samples.
2. "t Grouping" letters only apply within a particular constituent.
3. Within each constituent, means are sorted from highest to lowest.
4. SEM = Standard error of mean.

TABLE 3-9 GROUPING RESULTS FROM ANOVA FOR MEAN CONSTITUENT CONCENTRATION BY SAMPLING AREA 2001-2003 AND 2009 SEDIMENT DATA COMBINED

Location	Mean	SEM	t Grouping	
Arsenic				
Embayment	24.3	4.6	a	
Shoal	21.4	4.1	a	
Site Area	18.6	7.2	a	
Downstream	9.5	3.2	a	
Cadmium				
Shoal	8.8	1.8	a	
Embayment	6.1	2.0	a	b
Site Area	3.0	3.2	a	b
Downstream	2.5	1.4		b
Chromium				
Embayment	738	139		b
Shoal	583	124	a	b
Downstream	171	97	a	
Copper				
Embayment	154	18.6		b
Site Area	139	29.5	a	b
Shoal	108	16.7	a	b
Downstream	58.0	13.0	a	
Lead				
Site Area	342.3	57.0	a	
Embayment	268.5	35.9	a	
Shoal	219.0	32.2	a	
Downstream	102.4	25.1		b
Mercury				
Shoal	33.6	6.0	a	
Embayment	23.1	6.7	a	b
Site Area	13.1	10.7	a	b
Downstream	5.3	4.7		b
Nickel				
Embayment	29.3	1.8	a	
Downstream	26.9	1.3	a	b
Shoal	22.5	1.6		b
Site Area	21.5	2.9	a	b
Zinc				
Shoal	885	150	a	
Embayment	624	167	a	b
Site Area	399	265	a	b
Downstream	272	117		b

1. Data were screened for frequency of detection; two-way ANOVA results are presented only if number of detects >50% of samples.
2. '"t Grouping" letters only apply within a particular analyte.
3. Within each analyte, means are sorted from highest to lowest.
4. SEM = Standard error of mean.

TABLE 3-10 METHYLMERCURY AS A PERCENT OF TOTAL MERCURY IN SEDIMENT SAMPLES FROM THE EMBAYMENT AND ADJACENT SHOAL

Sample ID	Mercury (µg/Kg dry wt)		Percent Methylmercury
	Methyl	Total	
WC-6-SED-A	1.19	4,800	0.025%
WC-6-SED-B	2.31	20,000	0.012%
WC-6-SED-C	0.333	9,100	0.004%
WC-7-SED-A	1.55	6,900	0.022%
WC-7-SED-B	1.29	52,000	0.002%
WC-8-SED-A	2.25	8,400	0.027%
WC-8-SED-C	0.058	111	0.052%
WC-9-SED-A	0.471	2,500	0.019%
WC-9-SED-B	0.719	6,200	0.012%
WC-9-SED-C	1.63	81,000	0.002%

Appendix A

O'Brien & Gere Engineers (2007)
Final Remedial Investigation
For Wappinger Creek

Appendix B

EA Engineering, P.C. (2008)
Biota Tissue Sampling Report
For Wappinger Creek

Appendix C

Field Sampling Information

Appendix C. Field Sampling Information Recorded During Supplemental Sediment Collections at Wappinger Creek, October 2009.

Location	Coring Date	Northing *	Easting*	Water Depth (ft)	Core Recoveries (inches)	Sample ID	Sample Date	Sample Time	Sample Interval (inches)	Analyses
WC-1-SED	10/7/2009	1002441.9	644411.2	3	23, 21	WC-1-SED-A	10/12/2009	1230	0-6	1
						WC-1-SED-B	10/12/2009	1235	6-12	1
						WC-1-SED-C	10/12/2009	1240	12-22	1
						WC-1-SED-AB	10/12/2009	1230	0-12	2
WC-2-SED	10/7/2009	1002645.3	644466.3	3.5	18, 23	WC-2-SED-A	10/12/2009	1325	0-6	1
						WC-2-SED-B	10/12/2009	1330	6-12	1
						WC-2-SED-C	10/12/2009	1335	12-24	1
WC-3-SED	10/7/2009	1003672.5	646201.3	3.6	31, 37	WC-3-SED-A	10/12/2009	1345	0-6	1
						WC-3-SED-B	10/12/2009	1350	6-12	1
						WC-3-SED-C	10/12/2009	1355	12-24	1
						WC-3-SED-AB	10/12/2009	1345	0-12	2
WC-4-SED	10/8/2009	1004086.9	646081.8	6.3	30, 30	WC-4-SED-A	10/12/2009	1410	0-6	1
						WC-4-SED-B	10/12/2009	1415	6-12	1
						WC-4-SED-C	10/12/2009	1420	12-24	1
WC-5-SED	10/8/2009	1004308.2	646088.5	0.8	29, 19	WC-5-SED-A	10/12/2009	1425	0-6	1
						WC-5-SED-B	10/12/2009	1430	6-12	1
						WC-5-SED-C	10/12/2009	1435	12-24	1
WC-6-SED	10/7/2009	1005938.8	648395.81	3.3	21, 24	WC-6-SED-A	10/12/2009	1445	0-6	1, 3
						WC-6-SED-B	10/12/2009	1450	6-12	1, 3
						WC-6-SED-C	10/12/2009	1455	12-24	1, 3
WC-7-SED	10/7/2009	1005874.7	648268	3.2	28, 21	WC-7-SED-A	10/12/2009	1520	0-6	1, 3
						WC-7-SED-B	10/12/2009	1525	6-12	1, 3
						WC-7-SED-C	10/12/2009	1530	12-24	1, 3
						WC-7-SED-AB	10/12/2009	1520	0-12	2
WC-8-SED	10/8/2009	1005727.1	648395.3	1	16, 13	WC-8-SED-A	10/12/2009	1555	0-6	1, 3
						WC-8-SED-B	10/12/2009	1600	6-12	1, 3
						WC-8-SED-C	10/12/2009	1605	12-16	1, 3
WC-9-SED	10/8/2009	1005503.1	648068.1	3	31, 31	WC-9-SED-A	10/12/2009	1625	0-6	1, 3
						WC-9-SED-B	10/12/2009	1630	6-12	1, 3
						WC-9-SED-C	10/12/2009	1635	12-24	1, 3
WC-10-SED	10/8/2009	1005435.6	648231.6	3.3	14, 10	WC-10-SED-A	10/12/2009	1700	0-6	1, 3
						WC-10-SED-B	10/12/2009	1705	6-12	1, 3
WC-11-SED	10/8/2009	1005265.4	648218.8	9	14, 12	WC-11-SED-A	10/12/2009	1720	0-6	1, 3
						WC-11-SED-B	10/12/2009	1725	6-12	1, 3
WC-12-SED	10/8/2009	1006495	648683.2	7.05	10, 8	WC-12-SED-A	10/12/2009	1740	0-6	1
						WC-12-SED-B	10/12/2009	1745	6-10	1
WC-13-SED	10/8/2009	1006485.7	648811.3	1.7	12, 7	WC-13-SED-A	10/12/2009	1800	0-6	1
						WC-13-SED-B	10/12/2009	1805	6-12	1
WC-14-SED	10/8/2009	1006681.6	648786.9	1.7	12, 10	WC-14-SED-A	10/12/2009	1815	0-6	1
						WC-14-SED-B	10/12/2009	1820	6-12	1
						WC-14-SED-AB	10/12/2009	1815	0-12	2
WC-15-SED	10/8/2009	1007576	648734.6	1.8	14, 12.5	WC-15-SED-A	10/12/2009	1830	0-6	1
						WC-15-SED-B	10/12/2009	1835	6-12	1
						WC-15-SED-AB	10/12/2009	1830	0-14	2

* - coordinates in New York East State Plane, NAD 83, U.S. Survey Feet
1 - TAL metals, Hg, CN, moisture
2 - Grain size
3 - Methyl mercury

Duplicate samples:
WC-2-SED-A
WC-3-SED-A
WC-6-SED-A

MS/MSD Samples
WC-1-SED-A
WC-4-SED-B
WC-8-SED-A

Appendix D

Core Logs for 2009 Sediment Samples From Tidal Wappinger Creek

CORING LOG	LOCATION ID: WC-1-SED	SHEET: 1 OF 1	
1. COMPANY NAME: EA Engineering	2. PROJECT NAME AND NUMBER: Wappinger Creek, 14368.40	3. DATE: 10/12/2009	4. NAME OF PERSON DESCRIBING CORE: Todd Ward
5. CORE RECOVERY (IN): 22		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION: 3 ft., 10/7/09, 1000	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 22 inches: Dark brown clayey silt with fine sand and root material. Organics.	WC-1-SED-A: 0-6 in., 10/12/09, 1230			
10		WC-1-SED-B: 6-12 in., 10/12/09, 1235			
15		WC-1-SED-C: 12-22 in., 10/12/09, 1240			
20		WC-1-SED-AB: 0-12 in., 10/12/09, 1230 Grain size			
				22	
25					
30					
35					
40					
45					
50					

CORING LOG

LOCATION ID	SHEET
WC-2-SED	1 OF 1

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
24	3.5 ft., 10/7/09, 1035

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 5 inches: dark brown silt with organics, high water content	WC-2-SED-A: 0-6 in., 10/12/09, 1325			
10	5 - 10 inches: dark gray clayey silt with fine sand	WC-2-SED-B: 6-12 in., 10/12/09, 1330			
15	10 - 24 inches: dark gray silty clay, small pieces of root mass, very fine sand	WC-1-SED-C: 12-24 in., 10/12/09, 1335			
20					
25				24	
30					
35					
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID	SHEET	
	WC-3-SED	1 OF 1	

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
36	3.6 ft., 10/7/09, 1118

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 8 inches: dark brown silt with very fine sand, organics, high moisture content	WC-3-SED-A: 0-6 in., 10/12/09, 1345			
10		WC-3-SED-B: 6-12 in., 10/12/09, 1350			
15	8 - 22 inches: dark gray clayey silt with very fine sand	WC-3-SED-C: 12-24 in., 10/12/09, 1355			
20		WC-3-SED-AB: 0-12 in., 10/12/09, 1345 Grain size			
25	22 - 36 inches: dark gray-black, fine-to-medium sand with silt, organics				
30					
35					
				36	
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID	SHEET
	WC-4-SED	1 OF 1

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
32	6.3 ft., 10/8/09, 1035

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 3 inches: med. gray med.-grained sand, gravel and cobble	WC-4-SED-A: 0-6 in., 10/12/09, 1410			
10	3 - 13 inches: med. gray silty sand, gravel, wood fragment at 9 inches	WC-4-SED-B: 6-12 in., 10/12/09, 1415			
15		WC-4-SED-C: 12-24 in., 10/12/09, 1420			
20	13 - 23 inches: dark gray med.-grained silty sand, dark brown color in sand at 16, 18, and 20 inches				
25					
30	23 - 32 inches: dark gray coarse sand, gravel				
35				32	
40					
45					
50					

CORING LOG

LOCATION ID	SHEET
WC-5-SED	1 OF 1

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
29	0.8 ft., 10/8/09, 1118

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 3 inches: dark gray coarse sand, gravel	WC-5-SED-A: 0-6 in., 10/12/09, 1425			
10	3 - 12 inches: dark gray silty clay with very fine sand	WC-5-SED-B: 6-12 in., 10/12/09, 1430			
15		WC-5-SED-C: 12-24 in., 10/12/09, 1435			
20	12 - 24 inches: dark gray silty clay, few pieces of organics throughout interval				
25					
30	24 - 29 inches: dark brown silty clay, roots, very fine sand			29	
35					
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID WC-6-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 24		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 3.3, 10/7/09, 1601	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 9 inches: dark brown silt with very fine sand, roots	WC-6-SED-A: 0-6 in., 10/12/09, 1445			
10		WC-6-SED-B: 6-12 in., 10/12/09, 1450			
15	9 - 24 inches: dark brown silty clay, roots, organics, few small pieces of gravel	WC-6-SED-C: 12-24 in., 10/12/09, 1455			
20					
25				24	
30					
35					
40					
45					
50					

CORING LOG

LOCATION ID	SHEET
WC-7-SED	1 OF 1

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
32	3.2, 10/7/09, 1638

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 10 inches: dark brown wet silt with very fine sand, small roots	WC-7-SED-A: 0-6 in., 10/12/09, 1520			
10		WC-7-SED-B: 6-12 in., 10/12/09, 1525			
15	10 - 32 inches: brown silty clay with very fine sand, small roots	WC-7-SED-C: 12-24 in., 10/12/09, 1530			
20		WC-7-SED-AB: 0-12 in., 10/12/09, 1520 Grain size			
25					
30					
35				32	
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID WC-8-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 16		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 1.0, 10/8/09, 1336	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 2 inches: gravel, cobble, dark gray coarse sand with silt, organics 2 - 5 inches: brown root mass with silt and fine-to-medium sand	WC-8-SED-A: 0-6 in., 10/12/09, 1555			
10	5 - 8 inches: brown silty clay with very fine sand, roots	WC-8-SED-B: 6-12 in., 10/12/09, 1600			
15	8 - 13 inches: dark brown silty clay with fine-to-medium sand, roots 13 - 16 inches: dark gray/black silty clay with fine-to-coarse sand, small pieces of gravel, small amount of roots	WC-8-SED-C: 12-16 in., 10/12/09, 1605		16	
20					
25					
30					
35					
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID	SHEET	
	WC-9-SED	1 OF 1	

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
28	3.0, 10/8/09, 1405

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 8 inches: medium gray wet silt, very fine sand, organics	WC-9-SED-A: 0-6 in., 10/12/09, 1625			
10		WC-9-SED-B: 6-12 in., 10/12/09, 1630			
15	8 - 20 inches: dark gray silt with very fine sand (14 - 15 inches: large piece of wood, one large piece of gravel)	WC-9-SED-C: 12-24 in., 10/12/09, 1635			
20					
25	20 - 28 inches: dark gray silty coarse sand, gravel, organics				
30				28	
35					
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID WC-10-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 14		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 3.3, 10/8/09, 0955	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 3 inches: brown silty clay with very fine sand, roots	WC-10-SED-A: 0-6 in., 10/12/09, 1700			
10	3 - 14 inches: black coarse sand, gravel, cobble at 13-14 inches	WC-10-SED-B: 6-12 in., 10/12/09, 1705			
15				14	
20					
25					
30					
35					
40					
45					
50					

CORING LOG

CORING LOG	LOCATION ID WC-11-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 14		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 9.0, 10/8/09, 1225	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 9 inches: black coarse sand, gravel, cobble	WC-11-SED-A: 0-6 in., 10/12/09, 1720			
10		WC-11-SED-B: 6-12 in., 10/12/09, 1725			
15	9 - 14 inches: black silty clay with very fine sand, roots			14	
20					
25					
30					
35					
40					
45					
50					

CORING LOG

LOCATION ID	SHEET
WC-12-SED	1 OF 1

1. COMPANY NAME	2. PROJECT NAME AND NUMBER	3. DATE	4. NAME OF PERSON DESCRIBING CORE
EA Engineering	Wappinger Creek, 14368.40	10/12/2009	Todd Ward

5. CORE RECOVERY (IN)	6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION
10	7.05, 10/8/09, 1525

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 2 inches: cobble, gravel, coarse sand 2 - 5 inches: brown clayey coarse sand, gravel, cobble	WC-12-SED-A: 0-6 in., 10/12/09, 1740			
10	5 - 10 inches: black clayey coarse sand, gravel, cobble	WC-12-SED-B: 6-10 in., 10/12/09, 1745		10	
15					
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35					
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45					
50					

CORING LOG	LOCATION ID: WC-13-SED	SHEET 1 OF 1	
1. COMPANY NAME: EA Engineering	2. PROJECT NAME AND NUMBER: Wappinger Creek, 14368.40	3. DATE: 10/12/2009	4. NAME OF PERSON DESCRIBING CORE: Todd Ward
5. CORE RECOVERY (IN): 12		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION: 1.7, 10/8/09, 0913	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 12 inches: gray fine-to-coarse sand, gravel, cobble	WC-13-SED-A: 0-6 in., 10/12/09, 1800			
10		WC-13-SED-B: 6-12 in., 10/12/09, 1805			
15				12	
20					
25					
30					
35					
40					
45					
50					

CORING LOG	LOCATION ID WC-14-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 12		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 1.7, 10/8/09, 0846	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 12 inches: gray coarse sand, gravel, cobble	WC-14-SED-A: 0-6 in., 10/12/09, 1815			
10		WC-14-SED-B: 6-12 in., 10/12/09, 1820			
				12	
15					
20		WC-14-SED-AB: 0-12 in., 10/12/09, 1815 Grain size			
25					
30					
35					
40					
45					
50					

CORING LOG	LOCATION ID WC-15-SED	SHEET 1 OF 1	
1. COMPANY NAME EA Engineering	2. PROJECT NAME AND NUMBER Wappinger Creek, 14368.40	3. DATE 10/12/2009	4. NAME OF PERSON DESCRIBING CORE Todd Ward
5. CORE RECOVERY (IN) 12		6. LOCATION WATER DEPTH AND TIME OF CORE COLLECTION 1.8, 10/8/09, 0814	

DEPTH (1 inch)	DESCRIPTION OF MATERIALS	ANALYTICAL SAMPLE NOs. AND TIMES	DEPTH (inches)	RECOVERY (inches)	REMARKS
5	0 - 14 inches: black coarse sand, cobble, gravel, pieces of brick	WC-15-SED-A: 0-6 in., 10/12/09, 1830			
10		WC-15-SED-B: 6-12 in., 10/12/09, 1835			
15				14	
20		WC-15-SED-AB: 0-14 in., 10/12/09, 1830 Grain size			
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45					
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Appendix E

Life Science Laboratories
Electronic Data Deliverable

Appendix F

Brooks Rand Laboratory
Electronic Data Deliverable

Appendix G

Environmental Data Services
Data Validation Report
Data Usability Summary Report