TECHNICAL MEMORANDUM CH2MHILL

Final Desktop Evaluation for Site 8 – Mercury Contamination at Building 766, and Site 56 – Lead Contamination at Industrial Wastewater Outfall 87, NSF-IH, Indian Head, Maryland

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DATE: September 29, 2006

This technical memorandum presents a Desktop Evaluation (DE) of Installation Restoration (IR) Site 8, Mercury Contamination at Building 766, and Site 56, Lead Contamination at Industrial Wastewater (IW) Outfall 87. Both sites are located at Naval Support Facility, Indian Head (NSF-IH) in Indian Head, Maryland. The DE describes the current and past uses of Sites 8 and 56, summarizes key findings from a review of available documents, and recommends a site management decision based on the document review findings.

This DE was prepared by CH2M HILL under the Comprehensive Long-Term Environmental Action Navy III (CLEAN III) Contract N62470-02-D-3052, Contract Task Order 050.

Site 8 was designated in Section 9.3A of the Federal Facility Agreement (FFA) for NSF-IH (December 9, 2000) as a Site-Screening Area (SSA). Site 56 was listed in Section 9.2A of the FFA as requiring a Remedial Investigation (RI); however, the site was designated as a SSA in January 2004. Based upon review of the existing site information, a DE, documented in this technical memorandum, was performed in accordance with Section 9.3D(3) of the FFA for an SSA.

Site Description and Operational History

Site 8 is cited as Building 766, Mercury Deposits in the FFA (2000) and Site 56 is named IW-87 Lead Contamination. As shown in Figure 1, Sites 8 and 56 are located in the central portion of the Indian Head peninsula, in the main area of NSF-IH. The sites are approximately 500 yards from the Mattawoman Creek to the southeast and the Potomac River to the northwest.

Sites 8 and 56 are linked by their common drainage along an intermittent stream that is approximately 1,300 feet in length along its main channel. The stream extends from a culvert located near Building 766 and flows into a marshy area and subsequently a tidal pond.

Outflow from the tidal pond discharges to the south through a weir near Noble Road and ultimately into Mattawoman Creek.

For discussion purposes in this DE, Sites 8 and 56 and locations downstream have been divided into areas extending from the Site 8 and Site 56 source areas to the water body south of Noble Road. The areas are summarized in Table 1 and are shown in Figure 2.

TABLE 1
Naming Protocol for Sites 8 and 56 Areas
Sites 8 and 56 Desktop Evaluation

Site	Name	Description
Site 8	Building 766 Area	Area surrounding Building 766 and manhole, some drainage from Site 47 enters the manhole.
Site 8	Upper Section of Stream	Stream section that extends from Building 766 Area downgradient (east) to the Mid Section of Stream; represents the area of the second RA at Site 8 (1994).
Site 8	Mid Section of Stream	Stream segment that extends between the Upper and Lower Sections of Stream.
Site 56	IW-87 Outfall Area	Area surrounding the Site 56, IW-87 Outfall, and extends from the outfall located within the drainage ditch/tributary north to the main stream channel at the transition between the Mid and Lower Sections of the Stream; represents the area of the RA at Site 56 (1996).
Sites 8 and 56	Lower Section of Stream	Stream section that extends from the Mid Section of Stream downgradient (east) to the Marsh/Tidal Pond Area, and incorporates the flat, marshy segment of the stream adjacent to the pond.
Sites 8 and 56	Marsh / Tidal Pond Area	The tidal pond and marsh wetland area located downgradient of the stream and upgradient of the weir near Noble Road.
Sites 8 and 56	Area Downstream of Noble Road	The tidal Mattawoman Creek bank area located downgradient of the weir near Noble Road.

Sites 8 and 56 are discussed together in this DE because of their common drainage area and because investigative work performed downgradient from these sites, along the stream and in the tidal pond, includes an assessment of contaminants that may have originated from Site 8 and Site 56.

In addition to the intermittent stream and tidal pond, investigation data from nearby NSF-IH sites that pertain to Sites 8 and 56 were considered in this DE. Site 47, Mercuric Nitrate Disposal Area, is located upgradient of Site 8, and some drainage from Site 47 discharges into the Upper Section of the Site 8 stream. Additionally, IR Site 12, Town Gut Landfill, overlaps Site 8 in the marsh/tidal pond area.

The following subsections provide descriptions and historical information related to the areas defined above in Table 1.

Site 8 Operational History / Building 766 Area

Building 766, which was constructed in 1953, was the former location of the Nitroglycerin Plant Office and Laboratory, Biazzi Plant. Nitrometers, which contained mercury, were used in testing in the laboratory of Building 766. Spills of mercury occurred between 1958 and 1981, when spent mercury was rinsed and transferred in the laboratory sinks. Estimates of the quantity of contamination released are between 23 and 500 pounds of elemental mercury. In 1981, the sink drains were rerouted, floor drains were sealed shut, and mercury traps were placed on the drains.

The sink and floor drains, prior to 1981, were connected to a 3-inch drain line that enters a manhole located approximately 30 feet east of Building 766. The original drain line and manhole were replaced following a RA at the site in 1984. The current manhole or drainage outfall consists of a 36-inch diameter concrete pipe that terminates with gabion walls at the top of the Upper Section of Stream. This 36-inch drainage pipe serves as a discharge point for surface water runoff and drainage from areas to the northwest of Site 8 and from the upgradient Site 47.

Upper Section of Stream

The Upper Section of Stream (Upper Stream) conveys drainage from the manhole, including any from Site 47, along a stretch of intermittent stream extending roughly 300 feet.

The Upper Stream segment represents the approximate extent of a Removal Action (RA) that occurred at Site 8. Following the excavation during the 1994 RA, the area was backfilled with clean soil between 18 and 30 inches deep and graded throughout the stream segment. The upper 120 feet of the stream channel is lined with riprap, approximately 12 feet wide. The remaining section of the Upper Stream is characterized by natural vegetation and trees, with some debris and soil blocking the channel in locations.

Two drainage ditches enter the Upper Stream from the west and south. The first drainage ditch, joins the stream from the west approximately 200 feet downgradient of the manhole. The second, is located approximately 300 feet from the manhole along the path of the stream, at the end of the Upper Stream segment. During the April 2004 site visit, a small volume of water was observed draining from this ditch into the Upper Stream. Existing monitoring well, MW-14, is located approximately 70 feet to the south of the stream, adjacent (west) of the second drainage ditch. IW-86, a concrete outfall / sampling point, is located just upstream of the second drainage ditch. Historically, IW-86 was located further downstream (east) but was moved in 1996 to facilitate sampling.

Mid Section of Stream

The Mid Section of Stream (Mid Stream) flows predominantly northeast between the upper and lower stream segments and is approximately 400 feet in length. The channel widens along the Mid Stream segment, but is blocked by soil and debris in several places, leading to underground or interstitial flow. A drainage ditch enters the Mid Stream from the northwest, slightly increasing the flow volume. Downstream of this drainage ditch the stream gradient decreases and a wider floodplain has developed.

Site 56 Operational History / IW-87 Outfall Area

Site 56 consists primarily of the area surrounding the National Pollutant Discharge Elimination System (NPDES) IW Outfall 87 (IW-87). Lead contamination at Site 56 derived from Building 790, which was constructed in 1953, and comprises part of the Biazzi Plant. Building 790 was used for the storage of spent nitric and sulfuric acids. The floor of the building was previously lined with lead to provide a conductive surface. Fumes from the concentrated acids deposited on the walls and floor inside the building and were washed down periodically; the acid dissolved the lead from the flooring and the rinsate from the washdown was discharged from the building to IW-87. An unknown quantity of lead was discharged via IW-87 between approximately 1953 and 1992.

An underground water discharge pit is located adjacent to Building 790 that previously collected wastewater from the building together with stormwater from the surface. The pit subsequently drained through a 24-inch terra cotta pipe, which conveyed the water approximately 700 feet and discharged at IW-87 into the main channel of the intermittent stream. In October 1992, the drain leading from inside Building 790 was sealed shut after elevated concentrations of lead in the discharge at IW-87 were initially observed. Prior to sealing the drains at Building 790, the acids released in wastewater through IW-87 may have solubilized metals that were contacted, potentially increasing mobilization.

IW-87 continues to receive discharges from surface water runoff in the vicinity around Building 790. Outfall IW-87 is located near the end of the Building 790 Drainage Pipe, as shown on Figure 2. It is approximately 100 feet to the southwest of the stream. The 3-foot square concrete outfall of IW-87 was observed during the April 2004 site visit to be approximately 90 percent full with sediments.

The IW-87 outfall area represents the approximate extent of the 1996 RA that occurred at Site 56. Following the excavation during the RA, the area was backfilled with clean soil about 18 to 30 inches deep and graded to restore the area to original elevations. As part of the RA, the pipe leading from Building 790 was cleaned of sediment and relined to prevent any infiltration of potentially lead-contaminated groundwater from getting into the pipe and recontaminating the sediment at the outfall.

Lower Section of Stream

The Lower Section of Stream extends approximately 800 feet between the mid stream section to the marsh/tidal pond area. This stream section is characterized primarily by natural vegetation including wooded areas. The stream widens, with shallow banks, a forested wetland floodplain, and a transition to emergent wetland, where it discharges to the pond.

Marsh / Tidal Pond Area

The Marsh/Tidal Pond Area is the southern pond of two ponds that drain in series into Mattawoman Creek. It is located north of Noble Road and west of the Atkins Road Extension. The area of the pond is approximately 900 feet in length and varies in width between 50 and 200 feet. The pond discharges into Mattawoman Creek to the south, through a 72-inch diameter pipe/culvert located under Noble Road. The intermittent stream from Site 8 drains into the northwestern end of the pond. A second pond is located north of and

drains into the aforementioned southern pond through a culvert located under the Atkins Road Extension. Site 12 is located along the eastern bank of both ponds.

The Marsh/Tidal Pond Area was originally a tidal creek, but after Noble Road was built, the outward flow from the creek was constricted, resulting in creation of the tidal impoundment. Prior to 1992, a beaver dam existed at the upstream end of the pipe under Noble Road, slowing drainage from the pond into Mattawoman Creek. After the dam was removed, the pond decreased in depth by approximately 4 feet. In April 1993, a weir was installed upstream of the Noble Road culvert to act as a sediment trap, preventing potentially contaminated sediments from entering Mattawoman Creek. At present, water levels in the pond are generally between 1 foot and 2 feet deep. The banks of the Marsh/Tidal Pond Area are steep and heavily wooded in some places; but for the most part, it is surrounded by vegetation.

Area Downstream of Noble Road

The Area Downstream of Noble Road is a tidal area along the bank of the Mattawoman Creek. It is located south of the Noble Road culvert where the marsh/pond drains. During low tide, a channel can be observed extending from the culvert into the creek. The area is characterized by natural vegetation.

Investigation History

Site 8 was initially identified in the Initial Assessment Study (IAS) (Fred C. Hart Associates, 1983), which was conducted as part of the Naval Assessment for the Control of Industrial Pollutants (NACIP) Program. NACIP is the former name of the Navy IR Program, and the IAS is equivalent to a Preliminary Assessment in the IR program. Following the IAS, Site 8 has undergone numerous studies including a Confirmation Study (CH2M HILL, 1985), two Site Characterization studies (ABB Environmental, 1991; Halliburton, 1993a), and an Engineering Evaluation/Cost Analysis (EE/CA) (Halliburton, 1993b). Two removal actions were performed in 1984 and 1994 in the upper section of the stream (Halliburton, 1995a).

Site 56 was identified in approximately 1993 as an IR site after lead levels in wastewater at the IW-87 outfall were found to exceed the newly established limit under the NPDES program. Lead contamination near the IW-87 outfall was investigated for the EE/CA (NSWC, 1995) and a subsequent removal action was performed between 1996 and 1997 (OHM, 1997).

The overlapping sections of Site 8 and 56, the lower section of the stream, the marsh and tidal pond areas, were evaluated in several studies to assess the extent of contamination and thirteen rounds of biomonitoring to assess any potential ecological impacts (Halliburton, 1994; Brown & Root Environmental, 1995a and 1996a). Sampling of surface water and sediments has also occurred in the marsh/tidal pond area as part of the Site 12 RI (TtNUS, 1999).

Document Review

The following documents were reviewed as part of this DE for Sites 8 and 56:

- *Initial Assessment Study of Naval Ordnance Station, Indian Head, Maryland.* May 1983. Prepared by Fred C. Hart Associates Inc. for Navy Assessment and Control of Installation Pollutants (NACIP) Department and Naval Energy and Environmental Support Activity under Contract Number: N62474-81-C-A526.
- *NACIP Confirmation Study, Naval Ordnance Station, Indian Head, Maryland.* September 1985. Prepared by CH2M HILL for Chesapeake Division, Naval Facilities Engineering Command, Washington, D.C. under Contract Number: N62477-83-C-0238.
- *Draft Final Technical Memoranda, Site 8 – Nitroglycerin Plan Office, Indian Head Naval Ordnance Station, Indian Head, Maryland.* May 1991. Prepared by ABB Environmental Services, Inc. for Environmental Engineering Branch, Chesapeake Division, Naval Facilities Engineering Command, Washington D.C. [Memo is compilation of data from four draft reports by E.C. Jordan, Inc. including (1) Supplemental Site Characterization, 1987; (2) Remedial Alternatives Evaluation Report, 1988; (3) Review of Monitoring Data, 1989; and (4) Mercury Speciation Study, 1990.]
- *Site Characterization Report for Site 8 – Nitroglycerin Plant Office, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* January 1993. Prepared by Halliburton NUS Environmental Corporation for the Chesapeake Division, Environmental Branch, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Engineering Evaluation / Cost Analysis (EE/CA) Report for Site 8 – Nitroglycerin Plant Office, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* January 1993. Prepared by Halliburton NUS Environmental Corporation for the Chesapeake Division, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Placement and Treatability Study Report for Removal of Mercury-Contaminated Soil for Site 8 – Nitroglycerin Plant Office, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* August 1993. Prepared by Halliburton NUS Corporation for Chesapeake Division, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Post Removal Action Report for Site 8 – Nitroglycerin Plant Office at Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* April 1995. Prepared by Halliburton NUS Corporation for the Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Engineering Evaluation and Cost Analysis (EE/CA) Report for IR Site 56, Lead Contamination at NPDES Outfall IW-87.* August 1995. Prepared for Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland and the Department of the Navy.

- Various: *Report(s) on Biomonitoring for Site 8 and/or Site 56, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* October 1992 – July 1995. Quarterly Reports including some Summary Reports. Prepared by Halliburton NUS Corporation or Brown & Root Environmental for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Proposed Plan for Site 8 – Nitroglycerin Plant Office, Indian Head Division Naval Surface Warfare Center, Indian Head, Maryland.* May 1996. Prepared by Brown & Root Environmental for Engineering Field Activity Chesapeake, Naval Facility Engineering Command, Washington Navy Yard, Washington, D.C. under Contract Number: N62472-90-D-1298.
- *Action Memorandum, Re: Non-Time Critical Removal Action at IR Site 56, Lead Contamination at NPDES IW87.* June 5, 1996. From: Frank Peters, Engineering Field Activity Chesapeake, to: Commander, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.
- *Draft Final Summary Report for Removal of Lead-Contaminated Soil at Site 56, Naval Surface Warfare Center, Indian Head, Maryland.* February 28, 1997. Prepared by OHM Remediation Services Corp. for the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia.
- *Remedial Investigation Report for Sites 12, 39/41, 42, and 44, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* July 1999. Prepared by Tetra Tech NUS for the Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, under Contract Number: N62472-90-D-1298.
- *Feasibility Study Report for Site 12 – Town Gut Landfill and Site 41 – Scrap Yard, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* January 2001. Prepared by Tetra Tech NUS for the Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, under Contract Number: N62472-90-D-1298.
- *Final Remedial Action Design Submittal for Site 12 – Town Gut Landfill, Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland.* February 2002. Prepared by Tetra Tech NUS for the Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, under Contract Number: N62472-90-D-1298.
- *Final Remedial Investigation Report, Site 47 – Mercuric Nitrate Disposal Area, Indian Head Division Naval Surface Warfare Center, Indian Head, Maryland.* December 2003. Prepared by CH2M HILL for the Department of the Navy, Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, under Contract Number: N62470-95-D-6007.

Findings of the document review are summarized in the following paragraphs.

IAS, 1983

The IAS (Fred C. Hart Associates, Inc., 1983) was conducted to summarize the known history of mercury contamination at Site 8. Hart estimated that 900 gallons of wastewater from the laboratory in Building 766 was discharged to the Upper Stream per week, which resulted in approximately 23 pounds of mercury discharged over the 23 year history of

discharges to the creek. Later estimates of the mass of mercury discharged were greater (CH2M HILL, 1985). The wastewater was known to contain oil and grease, suspended solids, and, potentially, nitrate esters in addition to mercury. In 1981, 10 pounds of mercury were recovered from the manhole by Naval Ordnance Station personnel, and subsequently an Erlenmeyer flask was connected to the drains in Building 766 to serve as a mercury trap.

The IAS concluded that Site 8 warranted further investigation and recommended a Confirmation Study.

Removal Action, 1984 (Site 8)

In August 1984, an excavation contractor (working on a project unrelated to Site 8) inadvertently broke the 3-inch drain pipe leading from Building 766 to the manhole, and mercury was observed leaking into the soil. The drain pipe, manhole, and approximately 200 55-gallon drums of mercury-contaminated soil were excavated and removed from the site. In July 1985, soil samples were collected from the excavated area and analyzed for mercury. The results indicated that mercury concentrations in remaining soil were consistent with background concentrations. With regulatory concurrence from the State of Maryland (Brown & Root Environmental, 1996b), the drain pipe and manhole were replaced, and the area was backfilled with clean soil. (This statement was obtained from the Proposed Plan (Brown & Root Environmental, 1996b) and cites the following reference, which was not obtained for review as part of this DE: Maryland Department of the Environment, August 13, 1985, *Technical letter on Post-Removal Sampling and Analysis Results*. Ref. No. 225-5700.)

NACIP Confirmation Study, 1985

The NACIP Confirmation Study (CH2M HILL, 1985) was conducted to further evaluate Sites 5, 8, and 12, based on recommendations in the IAS. Two rounds of sampling were conducted at Site 8 in January 1984 and January 1985 for the confirmation study. In total, 6 surface water and 34 sediment samples were collected from all areas encompassing Site 8. These include the area upgradient of Building 766, all sections of the stream, marsh/tidal pond area and downgradient of Noble Road. The samples collected in relation to Site 8 were analyzed only for mercury. In addition, four surface water and four sediment samples were collected for Site 12 in January 1984; two of these sample stations are the same as those used for Site 8, located within the marsh/tidal pond area. All samples collected from Site 12 were analyzed for arsenic, cadmium, lead, mercury, silver, and zinc.

The results of the sediment sampling are presented in Table 2. The surface water sampling generally indicated concentrations of mercury less than 0.001 parts per million (ppm) in samples collected upgradient of Building 766 and the marsh/tidal pond areas; whereas, concentrations range between 0.019 and 0.17 ppm in the area extending from Building 766 to the lower section of the stream. Lead was detected at a maximum concentration of 0.02 ppm in the marsh/tidal pond area surface water.

TABLE 2
Analytical Summary of Mercury and Lead Contamination in Sediment, 1985 NACIP Confirmation Study
Sites 8 and 56 Desktop Evaluation

Name	**Mercury (mg/kg)**				**Lead (mg/kg)**	
	# Samples	Mean	Median	Range	# Samples	Range
Upgradient of Building 766	2	0.57	0.54	0.45 to 1.5		
Building 766 Area	4	381.4	146.9	131.7 to 1,100		
Mid Section of Stream	3	6.86	8.5	0.98 to 11.1		
IW-87 Outfall Area	1	ND	ND	ND		
Lower Section of Stream	20	42.6	21.8	0.98 to 223		
Marsh / Tidal Pond Area	2	5.3	5.3	4.6 to 6.0	2	98 - 163
Area Downstream of Noble Road	1	3.5	3.5	3.5		
East Drainage Ditch from Site 12 (Upstream of Atkins Road Extension)	2	0.78	0.78	0.6 to 0.95	2	37.2 - 114
Other Tributaries to Stream and Marsh/Pond	1	ND	ND	ND		

Notes:
ND – Value is non-detect as reported by the laboratory
Many samples noted are collected at the same sample station but differing depths. To view results with this distinction, refer to the NACIP Confirmation Study (CH2M HILL, 1985).
Mean is calculated as average of all normal samples, non-detect values were included in the mean as ½ the non-detect (U-flagged) analytical result.

The study estimated the mass of mercury contamination in sediments in the stream and marsh/tidal pond areas based on the concentrations of mercury detected in the samples. Estimates of mercury present in sediments at Site 8 were between 190 and 490 pounds, with the majority of contamination present in the lower stream section of Site 8.

The confirmation study found that distribution of mercury at Site 8 was consistent with Building 766 wastewater discharges as the source of contamination. Deposition of mercury had occurred primarily in areas where natural sediment traps existed, specifically in the slower moving (lower energy) section of the lower stream and the marsh/tidal pond area. With respect to lead, the study concluded that contamination was insignificant.

The study concluded that sediments and surface water at Site 8 were "extensively contaminated with mercury" and contamination may be sufficient at some locations to pose potential threats both to human health and to the environment. The study recommended the restriction of access to contaminated areas, the removal of sediments in highly contaminated areas, continued monitoring to detect any offsite migration of contaminants, and, if necessary, further corrective measures. Site 12 was recommended only for long-term monitoring.

NOS Monitoring, 1985-1988

Naval Ordnance Station personnel collected surface water and sediment samples from segments of the Site 8 stream and marsh/tidal pond area, primarily on a quarterly basis, between November 1985 and December 1988 (ABB Environmental, 1991). Because the sampling and analyses were not conducted under a Quality Assurance/Quality Control Plan, the results will not be discussed in this DE.

Characterization Study, 1987

A Supplemental Site Characterization Study was performed by E. C. Jordan Inc. (ABB Environmental, 1991) to provide data to support a Feasibility Study for Site 8. The fieldwork was conducted in October 1987 and included a survey of the stream, surface water hydrology measurements, a Ground Penetrating Radar (GPR) survey to measure depth of sediments, and collection of surface water, sediment, and surface soil samples to gauge mercury contamination at the site.

Six surface water samples (both filtered and unfiltered) were collected from two locations in the lower stream and four locations in the marsh/tidal pond area, and were analyzed for mercury. Mercury was only detected in the unfiltered samples at concentrations greater than the detection limit, at concentrations of 1.45 and 0.22 micrograms per liter (µg/L), in the two surface water samples collected from the lower stream. Mercury results in all filtered surface water samples were below the analytical detection limit. Based on the mercury results, the study concluded that mercury transport is related to sediment transport rather than migration in solution in surface water.

Droplets of elemental mercury were observed in stream sediments near Building 766, though samples from this location were not analyzed. It was determined that a new concrete base to the manhole would be poured and would contain any remaining contamination. Confirmation that this work was completed was not found for this DE. This area was further investigated in 1992 and remediated with a RA in 1994.

Seventy-seven sediment and 12 surface soil samples were collected, from depths up to 5 feet, from areas throughout all stream segments and the marsh/tidal pond area. Sediment samples ranged in concentration from below the analytical detection limit to 21 mg/kg, with the highest concentrations observed in the lower stream. Results of the mercury analysis on surface soil samples ranged from 0.12 to 25 mg/kg. These samples were all collected from areas within the lower stream, where prior flooding had occurred as a result of the beavers damming the Noble Road culvert.

The volume of sediment contained within the stream and marsh/tidal pond area was estimated, based upon the GPR survey, to be approximately 23,000 cubic yards ranging from two to seven feet in thickness and underlain by clay. A study of the hydrology of the area showed that flow discharging from the marsh/tidal pond through the culvert under Noble Road averaged 23 gallons per minute, but could increase to approximately 120 gallons per minute when industrial process water was released upgradient of the Atkins Road tributary (north pond).

Speciation Study, 1990

A Speciation Study was conducted by E. C. Jordan Inc. (ABB Environmental, 1991) to evaluate the forms of mercury present in the Site 8 sediments and soils. The study was completed in 1990.

Three sediment samples at each of four locations and three surface soil samples at one location in the flood plain of the lower stream were collected. Additionally, one background surface soil sample was collected from an area near the Site 8 lower stream, but approximately 250 feet south of the stream channel. All samples were analyzed for total mercury, ionic mercury, elemental mercury, methyl mercury, bound mercury (elemental, ionic or organic mercury bound to soil or sediment particles), and mercuric sulfide. The results of the speciation study are presented in Table 3.

TABLE 3
Analytical Results Summary and Calculated Percentages of Mercury Forms, 1989 Mercury Speciation and Treatability Study
Sites 8 and 56 Desktop Evaluation

	Elemental Mercury	Methyl Mercury	Ionic Mercury	Bound Mercury	Mercuric Sulfide	Total Mercury (Est.)[1]
Upper Section of Stream	123[2]	0.038	-	151	54	328
	37.50%	*0.01%*		*46.04%*	*16.46%*	
Lower Section of Stream	20	0.054	-	13	9.4	42.5
	47.06%	*0.13%*		*30.59%*	*22.12%*	
Marsh / Tidal Pond Area	3.6	-[3]	-	2.2	0.19	5.99
	60.10%			*36.73%*	*3.17%*	
Downstream of Noble Rd / Mattawoman Creek	0.1	-[3]	-	0.47	-	0.57
	17.54%			*82.46%*		
Floodplain Surface Soil (Lower Stream Area)	0.15	-	-	0.9	-	1.05
	14.29%			*85.71%*		
Background Surface Soil	0.03	-	-	0.15	-	0.18
	16.67%			*83.33%*		

Note:
[1] Estimated Total Mercury = Sum of the 5 forms of mercury. Total Mercury was analyzed, and results were similar to estimated results.
[2] All concentrations are in units of mg/kg dry weight. All results presented are the mean of the three replicate samples collected at each location, except for Background Surface Soil where only one sample was collected.
[3] Study noted methyl mercury may be present in these samples at concentrations similar to other samples, but was not detected due to a higher detection limit for these samples because of their moisture content. Detection limits averaged 0.053 and 0.025 mg/kg for the marsh/tidal pond and Mattawoman Creek respectively.

The speciation study concluded that mercury was migrating from the Building 766 area primarily in the elemental form, and that transformation to mercuric sulfide was occurring in the upper and lower stream, but not significantly in the pond.

Low concentrations of methyl mercury, less than 0.06 mg/kg or less than 0.2% of total mercury, were detected. This finding was important as the methylated forms of mercury are generally ten times more toxic than the inorganic forms due to their enhanced bioavailability. Consequently, methyl mercury can be readily taken up by aquatic organisms and bioaccumulated in tissues. Methylmercury can also pose a risk to upper trophic level receptors because it is retained in the tissues of prey organisms and biomagnifies with each trophic level (i.e., with each level in the aquatic foodchain from prey to consumer, the concentration in prey organisms significantly increases).

Site Characterization Report, 1993

The Site Characterization study (Halliburton, 1993a) was conducted in order to further define the extent of mercury contamination at Site 8. A total of 204 soil and sediment samples were collected from all areas that encompass Site 8, and also include samples from drainage ditches that lead into the Site 8 stream, samples from the marsh/tidal pond upgradient of the Site 8 stream confluence, and background samples. Soil and sediment samples were analyzed for mercury; three samples were additionally analyzed for a list of Target Analyte List metals including lead. Soil and sediment samples were collected up to depths of 24 inches below ground surface. Nine surface water samples were collected with analysis for total and dissolved mercury. Fieldwork for this study was conducted in August and September 1992.

The results of the soil and sediment sampling are presented in Table 4. The surface water sampling was conducted at two locations. Five surface water samples were collected at the outfall of the marsh/tidal pond area into Mattawoman Creek; each of these five samples, both filtered and unfiltered, were below the analytical detection limit for mercury. Four samples were collected in the Building 766 area from water draining from the manhole/36-inch concrete pipe. Two of these samples were collected without disturbance to the pipe and mercury results were found to be below the analytical detection limit. Two samples were collected after scraping and suspending sludge contained in the pipe, the unfiltered samples were found to contain mercury up to 0.11 ppm, and the filtered samples contained mercury up to 0.0017 ppm.

TABLE 4
Analytical Summary of Mercury and Lead Contamination in Sediment, 1993 Site Characterization Report
Sites 8 and 56 Desktop Evaluation

Name	**Mercury (mg/kg)**				**Lead (mg/kg)**	
	# Samples	Mean	Median	Range	# Samples	Range
Upgradient of Building 766	4	0.57	0.54	ND - 1.1		
Building 766 Area	19	71.7	4.6	ND - 671		
Upper Section of Stream	31	42.2	22.2	ND - 218	2	9.6 - 10.5
Mid Section of Stream	18	1.05	ND	ND - 0.48K(m)		
IW-87 Outfall Area	2	ND	ND	ND		
Lower Section of Stream	36	4.20	ND	ND - 7.4K(m)		
Marsh / Tidal Pond Area	57	2.75	0.80	ND - 13.4	1	442
Area Downstream of Noble Road	12	0.39	ND	ND - 1.6		
Marsh / Tidal Pond of Site 12 only (upgradient of Site 8 confluence)	4	0.55	0.55	0.16 - 0.92		
Other Tributaries to Stream and Marsh/Pond	16	0.08	0.07	ND - 0.27		
Background	5	0.13	ND	ND - 0.34		

Notes:
ND – Value is non- detect as reported by the laboratory
K(m) – Positive result is estimated and biased high due to high matrix spike recovery
Many samples noted are collected at the same sample station but differing depths. To view results with this distinction refer to the Site Characterization Report (Halliburton, 1993a).
Mean is calculated as average of all normal samples, non-detect values were included in the mean as ½ the non-detect (U-flagged) analytical result.

The Site Characterization study found that distribution of mercury at Site 8 was primarily located in the Building 766 area and the upper section of the stream. Specifically, the higher levels of mercury in the stream were to be found in the first 300-foot section of the upper stream, down from the location of the manhole. The analytical results from this study were interpreted in the Site 8 EE/CA (Halliburton, 1993b).

Sediments in the lower section of the stream were found to have significantly lower concentrations of mercury than were found in samples collected in 1984 (CH2M HILL, 1985). No soil or sediment samples collected in the lower stream exceeded 10 ppm in 1992, whereas seventy percent of samples collected in this segment in 1984 were found to be greater than 10 ppm. This is likely indicative of mercury bound to sediments in the stream bed being transported downstream during the 8 year period between the two studies.

EE/CA, 1993 (Site 8)

An EE/CA (Halliburton, 1993b), evaluated the results of the Site Characterization study and proposed a RA plan for the 300-foot section of the upper stream.

Human health and ecological impacts were assessed in the EE/CA. Direct human exposure to mercury at Site 8 was evaluated assuming an occasional trespasser scenario, as access to the site is controlled and extremely limited. Under the direct exposure pathway, mercury contamination at the site would generally fall below the action levels calculated. Indirect human exposure to mercury could occur through consumption of fish. The ecological impact of mercury contamination could potentially occur in both aquatic and terrestrial ecosystems. Aquatic organisms and terrestrial animals could be exposed to mercury through direct contact and/or ingestion. The EE/CA expected ecological impacts to terrestrial animals to be insignificant as the species are wide ranging. The human health impacts through an indirect pathway and ecological impacts to aquatic ecosystems were both further evaluated through the Biomonitoring Program.

Navy discussions with regulatory agency personnel had indicated that 10 ppm was an acceptable action level for the EE/CA RA, and this target action level was consequently utilized in formation of the remedial alternatives. Except for three locations in the marsh/tidal pond area, mercury contamination greater that 10 ppm was delineated in the Site Characterization study to be contained within the 300-foot section of the upper stream, immediately downgradient of the manhole (location of prior wastewater outlet from Building 766). The marsh/tidal pond area would be further evaluated through the Biomonitoring Program to determine if any impacts were present.

The EE/CA recommended a remedial alternative that would include the excavation of contaminated soils and sediments present greater the action level in the upper 300-foot section of the stream, backfilling, and site restoration. It was anticipated this alternative would eliminate any risks associated with direct contact to the soils or sediments, and additionally would prevent any transportation of contaminated sediments downgradient of this source area.

Placement and Treatability Study Report

A Placement and Treatability Study (Halliburton, 1993c) was conducted to identify and select the disposal method for soils that would be removed during the Site 8 RA recommended by the EE/CA. Following leaching tests, the soil was determined to be non-hazardous, and the recommended action during the RA was for contaminated sediment/soil to be placed in the soil cover of Magazine 606.

Post Removal Action Report (Site 8)

The Post RA Report (Halliburton, 1995a) provides a summary of the RA conducted between June 1994 and October 1994 at Site 8. During the RA, approximately 440 cubic yards of sediment/soil with mercury concentrations above the 10 ppm action level were removed from the upgradient 300-foot segment of the Site 8 upper stream.

Confirmation sampling of soils was performed during the RA activities, and following analytical results, which indicated mercury concentrations greater than 10 ppm at two locations, supplemental excavations were completed. Twenty four confirmation samples collected represented the mercury concentrations that remained in place following the RA. A summary of the confirmation sampling results is provided in Table 5, presented later in this DE.

During the clearing and grubbing stage, prior to the RA, trees located adjacent to and within the stream channel were removed. Composite samples of three tree stumps and three samples of soil attached to the root mass of each tree were collected and analyzed for mercury. The results of the six samples ranged from below the analytical detection limit to 1.73 ppm.

Approximately 440 cubic yards of sediment and soil from the stream channel were placed in an earthen berm west of Building 606, on NSF-IH property. The berm was later capped with clay and topsoil. Caution tape was placed between the topsoil and clay layers to identify the placement location and depth. Following completion of the RA, the stream bed was backfilled with 18 to 30 inches of clean soil and graded, the upgradient 120-feet of the stream channel was lined with geotextile fabric and riprap, and in the remaining portions of the construction area revegetative matting was placed or seeding occurred to restore site conditions. Additionally, the outlet of the 36-inch concrete pipe that terminated at the manhole (stormwater drain pipe) was reconstructed with gabion ends.

Engineering Evaluation / Cost Analysis, 1995 (Site 56)

The EE/CA report (NSWC, 1995) documents investigative work at Site 56 and the subsequent recommendation for a RA to eliminate lead-contaminated sediments at the site.

The Maryland Department of the Environment establishes contaminant limits in wastewater under the NPDES. IW-87 is sampled monthly in accordance with the NPDES. In June 1992, a new limit for lead in wastewater, 82 µg/L, was established. After concentrations of lead in wastewater at IW-87 were found to exceed this limit, the Navy conducted an investigation of lead contamination in the area. In January 1994, a video survey of the drainage pipe extending from the Building 790 pit to IW-87 was conducted. The pipe was found to be cracked in some locations and contained sediment.

Seventeen sediment samples were collected at Site 56 and analyzed for lead. Eight samples were collected in the vicinity of the IW-87 along approximately a 30-foot segment of the drainage ditch towards the Site 8 stream. The samples ranged in lead concentration from 291 to 2,690 mg/kg. Samples collected along the drainage ditch (in which IW-87 is located), and at IW-86 (upgradient of IW-87 in the Site 8 upper stream) were found to be below the analytical detection limit for lead. Lead contamination in sediments was thus concluded to extend between the Building 790 pit, along the drainage pipe, to the area near the IW-87 outfall. Additionally water samples were collected from locations including IW-87 and the Building 790 pit. The water analysis indicated the high lead content found at IW-87 was not the result of current operations at Building 790.

Potential risks to human health and the environment were evaluated in the EE/CA, with soil or sediment and surface water determined to be the only media of concern. The National Oceanic and Atmospheric Administration screening guidance of 35 mg/kg (as used by EPA Region 4) was adopted as a conservative action level for performing the RA at Site 56.

The EE/CA recommended a remedial alternative that would include the removal of sediment from the Building 790 pit, pipe and surrounding the IW-87 outfall, and either pipe relining or abandonment.

Action Memorandum, 1996 (Site 56)

The Action Memorandum (Frank Peters, 1996) reiterated the goals established for the RA at Site 56 as determined in the EE/CA, following regulatory approval. The report outlined the plan to remove soils and sediments in excess of 35 mg/kg, verify cleanup through the collection of confirmation samples, re-line the drainage pipe for future use, and perform site restoration activities.

Summary Report for Removal of Lead-Contaminated Soil, 1997 (Site 56)

The RA at Site 56 (OHM, 1997) was completed in September 1996 and involved the removal of approximately 191 tons of soil and sediment from the Building 790 pit, inside the terra cotta drainage pipe, and the segment of drainage ditch extending from the pipe outfall towards the Site 8 upper stream.

Confirmation sampling of soils was performed during the RA activities, at 14 locations in a grid pattern along the excavation. The three sample locations centrally located along the excavation/drainage ditch were initially found to exceed the lead cleanup level of 35 mg/kg. A supplemental excavation was performed in the area surrounding these locations, and a second round of confirmation samples was collected at one remaining location, centrally located within the excavation exceeding the cleanup level. A third excavation was performed in this area, and the final confirmation samples were below the cleanup criteria. Fourteen confirmation samples represented the lead concentrations that remained in place following the RA. The highest residual lead concentration measured in these samples was 20.5 mg/kg.

Following the RA, the excavation was backfilled with between 18 to 30 inches of clean soil and site restoration was performed. A stainless steel weir was installed at the IW-87 discharge point, the drainage channel was lined with riprap, original elevations were restored and the ditch was seeded and mulched. The 24-inch terra cotta drainage pipe was relined with a 20-inch high density polyethylene pipe to accommodate future use of the pipe without leakage.

Biomonitoring, 1987-1995

Biomonitoring was performed over at least thirteen (predominantly quarterly) sampling events in areas downgradient of the Site 8 stream, including approximately the last 200 ft of the stream where it discharges to the pond (Halliburton, 1994; Brown & Root Environmental, 1995 and 1996a). Preliminary biomonitoring was conducted by the U.S. Fish and Wildlife Service (USFWS) over three quarterly sampling events in July 1992, October 1992, and January 1993. Halliburton, and subsequently, Brown & Root Environmental conducted an additional ten rounds of biomonitoring between April 1993 and November 1995.

Between 1987 and 1992, biomonitoring in Mattawoman Creek (downstream of Site 8), conducted by the USFWS focused on studying uptake of mercury by recreationally and commercially important species. In one round of biomonitoring, significantly higher levels of mercury were found in channel catfish sampled near the Site 8 outlet in comparison to the control site located 4.5 miles upstream in Mattawoman Creek. However, this observation

was only found in the catfish species, not in other species sampled, and was not replicated in any other biomonitoring events by the USFWS.

The initial objective of the biomonitoring program conducted by Halliburton between April 1993 and November 1995 was to assess the impact of elevated levels of mercury in the Site 8 ecosystem, primarily in the marsh/tidal pond area. However, after elevated lead levels were found in the wastewater at IW-87, the biomonitoring program was expanded in April 1994 to additionally assess any potential impacts from lead contamination deriving from Site 56.

The April 1994 biomonitoring included supplemental sampling of sediments in the Mid and Lower Stream segments and the marsh/tidal pond area, with lead analyses performed. The analytical results clearly indicated the lead contamination was coming from IW-87. A summary of these analytical results is shown in Table 6, presented later in this DE.

The Halliburton biomonitoring program consisted of sampling water quality, periphyton, benthic macroinvertebrates, fish and turtles. The sampling generally occurred over several transects located in the lower section of the stream and the marsh/tidal pond area. (Figure 2 depicts the most upgradient sampling location in the Lower Stream.) Additionally, samples were collected during some sampling events at upgradient locations (for example in the north Site 12 pond, located north of the Atkins Road Extension), and at control locations (including the Stump Neck Beaver Pond and Mattawoman Creek).

Water Quality

Temperature, dissolved oxygen, salinity, pH, hardness and total organic carbon were measured on surface water samples to collect the water quality data needed for evaluation of biological and toxicity information during biomonitoring. Water quality results indicated normal, seasonally fluctuating levels of the parameters measured.

Periphyton

Periphyton samples were examined during biomonitoring for species composition and abundance. The periphyton community was found to include diatoms, green algae, blue-green algae, and golden-brown algae, with seasonal shifts observed in the community structure. These fluctuations are normal for periphyton, which are short-lived and very prolific. No anomalies were observed in the periphyton community during biomonitoring.

Benthic Macroinvertebrates

Macroinvertebrates were sampled during biomonitoring, both quantitatively and qualitatively, in order to assess measures of density, species richness and species diversity. The benthic macroinvertebrate community was found to be composed largely of herbivores and detritivores that feed on algae and organic detritus, respectively. The structure and diversity of the benthic community was found to be typical of similar freshwater marshes during biomonitoring, and no anomalies were observed.

Fish and Turtles

Fish were counted for occurrence and distribution and a species list was maintained throughout biomonitoring. Additionally fish and turtles were sampled and analyzed for lead and mercury residue in tissue samples, to evaluate food web biomagnification. Fish

species richness and abundance were observed to be low during biomonitoring but it was concluded that the values were not unusual for the type of community.

Mercury levels found in fish tissue samples during biomonitoring indicated no clear distinction between samples from the marsh/tidal pond area and the control sites. Additionally, little variation was noted between the fish species sampled. Fish tissue samples generally revealed low levels of mercury, with samples collected from the two control sites containing the maximum mercury body burdens detected (0.29 mg/kg) during the biomonitoring program. Liver tissue from painted turtles appeared to contain elevated mercury concentrations in one sampling event, but concentrations were significantly lower in subsequent sampling rounds. The biomonitoring study concluded that fish had not been significantly affected by mercury contamination and did not pose a threat to animals that feed on them. This conclusion is consistent with expectations based on the results of the speciation study, which found that very little of the mercury in the system was present in the methymercury form and thus unlikely to be bioaccumulated and transferred through the foodchain.

Lead was detected at low concentrations in composite samples of fish from the marsh/tidal pond area during biomonitoring, but the levels found were similar to those found at the control sites. No clear differences were observed in lead levels between species. The biomonitoring study concluded that lead was not present at the site in a readily bioavailable form, lead was not found to be bioaccumulating significantly, and lead levels observed were generally comparable to similar habitats in the eastern United States.

Proposed Plan, 1996, (Site 8)

A draft Proposed Plan (Brown & Root Environmental, 1996b) was prepared which recommended No Further Action for Site 8. This recommendation was based on the two RAs, extensive sampling and analysis results, a site-specific risk assessment and the biomonitoring results.

Site risks to human health and the environment were discussed in the Proposed Plan. The report concluded that Site 8 does not present risks to human health and the 1994 RA was conducted in order to be conservative and mitigate the potential for downstream migration of mercury, and was not driven by risks to human health. Potential ecological risks to terrestrial wildlife were concluded to be low due to the limited areal extent and the low concentrations of mercury remaining at the site; and the aquatic ecology was not found to be impacted during the Biomonitoring Program.

Site 12 Studies, 1999-2002

The Site 12 studies (TtNUS, 1999, 2001, and 2002) detail sampling events that were conducted during the Site 12 RI, but include surface water and sediment samples that were collected from within the marsh/tidal pond area. Three sediment and three surface water samples were collected from locations along the eastern side of the marsh/pond area; numerous analyses, including lead and mercury, were performed on these samples.

Concentrations of mercury in the marsh/tidal pond range from 0.09 mg/kg to 0.16 mg/kg in sediment samples and were below the analytical detection limit in all surface water samples. Similarly, concentrations of lead range from 28.1 J mg/kg to 52.2 J mg/kg in

sediment samples and from below the analytical detection limit to 1.5 K mg/L in surface water samples. (Lab qualifier 'J' indicates that the analyte was positively identified but the quantitation is an estimate.) These results represent the most recent samples collected in the downgradient sections of sites 8 and 56, the only downgradient samples collected following both the Site 8 1994 RA and the Site 56 1996 RA. Concentrations of metals in these samples were low for both metals. Therefore, it appears that sediment and surface water concentrations in the marsh/tidal pond have decreased since the last comprehensive sampling in 1992.

Summary of Key Findings

Through numerous investigations, studies, and three RAs (1984 and 1994 RAs at Site 8, 1996 RA at Site 56), the contamination at Sites 8 and 56 has been clearly delineated and remediated to mitigate potential threats to human health and the environment. These prior studies are sufficient to determine the nature and extent of contamination at each site. The contaminant source areas at both Site 8 and Site 56 have been removed and confirmation samples have been collected to confirm that remedial objectives were met.

The following DE key findings are based on a review of the above-mentioned documents for Sites 8 and 56:

- Mercury contamination at Site 8 has been successfully remediated through the 1984 and 1994 RAs (Halliburton, 1995a) (Brown & Root Environmental, 1996b). Confirmation samples from the latest RA showed residual mercury at concentrations lower than the action level determined. In addition, the RA area has been covered by 18 to 30 inches of clean soil, is controlled by limited access to the site, and any residual contamination in the Site 8 source area is unlikely to be transported due to the soil cap.
- Lead contamination at Site 56 has been successfully remediated through the 1996 RA (OHM, 1997), and confirmation samples from the RA showed residual lead is lower than the conservative remedial action level utilized. Similar to Site 8, the Site 56 RA area has been covered by 18 to 30 inches of clean backfill, is controlled by limited access to the site, and any residual contamination is unlikely to be transported.
- Soil, sediment, and surface water in the lower stream and marsh/tidal pond area have been investigated through numerous studies and the Biomonitoring Program. These areas do not pose a threat to human health via direct human exposure. These areas do not pose an ecological risk or an indirect risk to humans through fish consumption. A variety of aquatic ecosystem components were evaluated during the Biomonitoring Program, none of which were found to be deleteriously affected.
- The speciation study (ABB Environmental, 1991) found that methyl mercury, one of the most toxic and readily bioavailable forms of mercury, was present at less than 0.2 percent of the total mercury at the site (i.e., mean value of 0.04 to 0.05 mg/kg methylmercury in the stream sediments).
- Lead and mercury concentrations have decreased over time, especially in the lower stream and marsh/tidal pond areas. This is likely the result of tidal flushing of the lower stream and pond, especially during periods when the weir and/or beaver dam were

absent, allowing higher-energy flow and a greater tidal influence to flush sediments in the area. The former source areas of both Sites 8 and 56 have been remediated and capped for eight years, and, as mercury transport has been shown to be primarily a result of sediment transport, it is likely that concentrations of lead and mercury will continue to naturally decrease with stream, stormwater, and tidal movement at the sites.

- Recent site visits by a CH2M HILL ecologist concluded that the area appears to be in good ecological health (i.e., no visual impact to the environment was observed, such as stressed vegetation), but provides limited quality habitat due to physical constraints. The stream conveys little flow (interstitial in places), has numerous channel obstructions, and is dominated by a sand substrate, thus providing aquatic habitat of limited value. Photographs from the site visit are provided in Appendix A.

Tables 5 and 6 summarize the most recent sediment sampling results for mercury and lead, respectively, throughout the sections of Sites 8 and 56, representing the known residual concentrations at the sites.

TABLE 5
Residual Mercury Concentrations at Site 8
Sites 8 and 56 Desktop Evaluation

Area Name	# Samples	Mean	Median	Range	Date Sampled	Source Report
Building 766 Area	3	0.19	0.03	ND - 0.518	Aug. 1994	Post RA Action Report
Upper Section of Stream	21	1.30	0.46	ND - 8.65	Aug. 1994	Post RA Action Report
Mid Section of Stream	18	1.05	ND	0.48 K(m)	Sept. 1992	Site Characterization
Lower Section of Stream	36	4.20	ND	7.3 K(m)	Sept. 1992	Site Characterization
Marsh / Tidal Pond Area	3	0.12	0.1	0.09 - 0.16	Oct. 1997	Site 12 RI
Area Downstream of Noble Road	12	0.39	ND	ND - 1.6	Sept. 1992	Site Characterization

Notes:
All results in mg/kg
ND – Value is non- detect as reported by the laboratory
K(m) – Positive result is estimated and biased high due to high matrix spike recovery
Mean is calculated as average of all normal samples, non-detect values were included in the mean as ½ the non-detect (U-flagged) analytical result.

TABLE 6
Residual Lead Concentrations at Site 56
Sites 8 and 56 Desktop Evaluation

Area Name	# Samples	Mean	Median	Range	Date Sampled	Source Report
Mid Section of Stream	1	8.73	8.73	8.73	May 1994	April 1994, Biomonitoring Report
IW-87 Outfall Area	14	10.2	8.65	2.6 - 20.5	Sept. 1996	Post RA Report
Lower Section of Stream	4	530	636	40.6 – 811	May 1994	April 1994, Biomonitoring Report
Marsh / Tidal Pond Area	3	40	39.6J	28.1J - 52.2J	Oct. 1997	Site 12 RI

Notes:
All results in mg/kg
ND – Value is non- detect as reported by the laboratory
K(m) – Positive result is estimated and biased high due to high matrix spike recovery
Mean is calculated as average of all normal samples, non-detect values were included in the mean as ½ the non-detect (U-flagged) analytical result.

As part of this DE, CH2M HILL evaluated the potential for residual mercury in sediments to migrate into groundwater. EPA Region III has not established Soil Screening Levels (SSLs) (USEPA, 2004) for any mercury forms for the migration to groundwater pathway. Consequently, residual mercury levels at Site 8 were compared with the generic US EPA SSLs. The generic mercury SSL (Dilution-Attenuation Factor [DAF] = 20) for the migration to groundwater pathway is 2 mg/kg (USEPA, 2001; USEPA, 1996); without accounting for dilution and attenuation processes (DAF=1) the SSL is 0.1 mg/kg.

The SSL developed by USEPA for mercury was based upon a reference dose for mercuric chloride, an inorganic form of mercury more soluble than elemental mercury. As was shown in the 1990 Speciation Study (ABB Environmental, 1991) performed on Site 8 soils and sediments, the majority of mercury present was in the form of elemental and bound mercury. Consequently, mercury in Site 8 soils is not likely to pose a threat to groundwater quality because it is not present in sediment at a significant percentage (Table 3) in a soluble form that will readily migrate into groundwater. Therefore, the SSL of 2 mg/kg should be considered a highly conservative number for evaluating the groundwater pathway for mercury at Site 8.

It should be noted that a few samples in the residual soil or sediment at Site 8 would exceed the SSL of 2 mg/kg:

- Three (out of 21) samples from the Building 766 and Upper Stream sections, sampled in August 1994 (Halliburton, 1995a). These samples are covered with between 18 and 30 inches of clean fill material.
- Six (out of thirty-six) samples in the Lower Stream segment, sampled in September 1992, (Halliburton, 1993a). These samples were collected prior to the 1994 Site 8 RA, and no subsequent sampling has been performed in the Lower Stream.

Although the stream is intermittent, groundwater flow patterns likely follow surface topography, providing convergent flow in the general vicinity of the stream valley subsequently discharging to the ponds. Therefore, any soluble mercury leaching into groundwater from the soil or sediment is still moving to the ponds, which are likely the regional discharge points for groundwater and for which biomonitoring, sediment and surface water data do not indicate any adverse effects.

Recommendations

Though the sources of contamination at Sites 8 and 56 have been remediated, and no adverse human health or ecological impacts have been observed through numerous investigations and studies at Sites 8 and 56, it should be noted that the data used in the evaluation are old (greater than 10 years). Consequently, new data are needed to make a recommendation for these sites.

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LEGEND

- Approximate Site Boundary
- Activity Boundary
- Buildings
- Roads and Paved Areas
- Water Bodies

N

0 2000 4000 Feet

Figure 1
Sites 8 and 56 Location map
Sites 8 and 56 Desktop Evaluation
NSF-IH, Indian Head, Maryland

CH2MHILL

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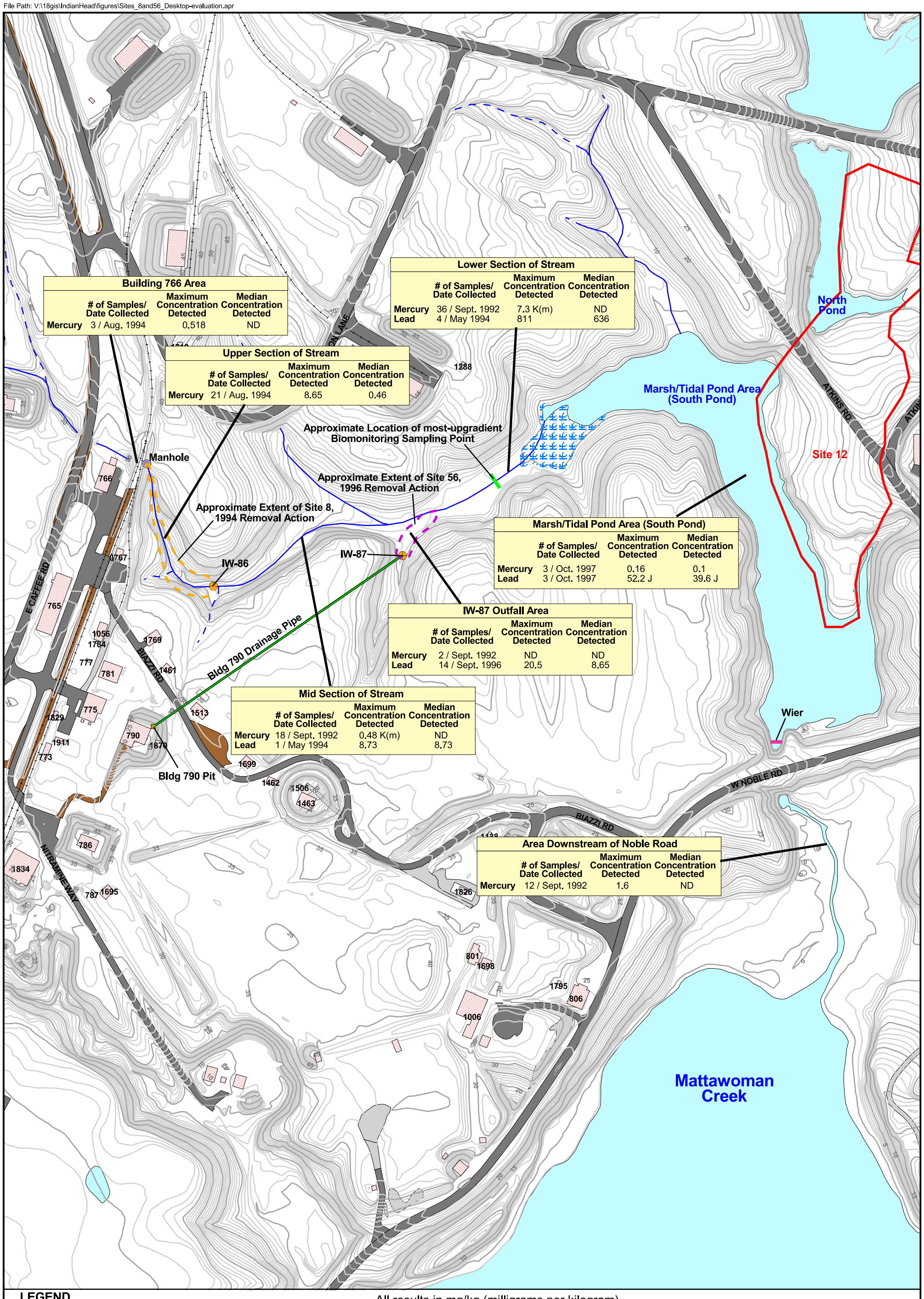

LEGEND

- Approximate Extent of Site 8, 1994 Removal Action
- Approximate Extent of Site 56, 1996 Removal Action
- Building 790 Drainage Pipe
- Perennial Swale
- Intermittent Swale
- 5 Foot Elevation Contours
- 1 Foot Elevation Contours
- Railroads
- Marsh
- Buildings
- Asphalt Road
- Dirt Road
- Gravel Road

ND - Non Detect
K(m) - Positive result is estimated and biased high due to high matrix spike recovery
J - Analyte was positively identified but the quantitation is an estimate

All results in mg/kg (milligrams per kilogram)

N

0 200 400 Feet

Figure 2
Site Features Map with Residual Mercury and Lead in Soil/Sediment Summary
Sites 8 and 56 Desktop Evaluation
NSF-IH, Indian Head, Maryland

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Appendix A
Photographs from Site Visit, April 4, 2004

Photograph 1: Site 8 Stream. View direction is from northwest to southeast at culvert on east side of Caffee Road. Area shown is the northern limit of the remediation and restoration at the site.

Photograph 2: Site 8 Stream. View direction is from northwest to southeast at culvert on east side of Caffee Road.

Photograph 3: Site 8 Stream. View direction is from southeast to northwest. Photo taken where drainage ditch enters stream near Building 767.

Photograph 4: Site 8 – Drainage Pipe near Building 767.

Photo of drainage pipe outfall (culvert on east side of Caffee Road), view direction is southeast to northwest. Area shown is the northern limit of the remediation and restoration at the site. (Note that this is the same as Photograph 3, only it is zoomed in.)

Photograph 5: Site 8 Stream. View is from west to east. Location near the downstream limit of the remediation/restoration area and near the NPDES monitoring location IW-86. (Upper Stream Area)

Photograph 6: Site 8 Stream channel before the confluence with Site 56 stream, shows limited nature of habitat value (narrow channel, little water flow, heavy sedimentation). (Middle Stream Area)

Photograph 7: Site 8 Stream channel before the confluence with Site 56 stream. View is from west to east, photo shows heavy sedimentation and natural debris blocking stream. (Middle Stream Area).

Photograph 8: Sites 8 stream channel downstream of confluence with Site 56 stream. View is from southwest to northeast, photo shows forested wetland near terminus of stream. (Lower Stream Area)

Photograph 9: Stream channel downstream of confluence with Site 56 stream. View is from southwest to northeast, photo shows forested wetland near terminus of stream, but closer to the pond than Photograph 8. (Lower Stream Area)

Photograph 10: View of the upper pond at the terminus of the Site 8 stream, view is from southwest to northeast. (Upper Pond Area)