Site 6 Additional Investigation Results NSF-IH, Indian Head, Maryland

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DATE: March 15, 2006

Introduction

This technical memorandum presents the results of the surface soil, sediment, and surface water sampling at Site 6—Radiographic Facility, Building 1349, at the Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland. The rationale for this investigation is presented in the technical memorandum entitled Final Work Plan for additional investigation at Site 6 NDWIH, Indian Head, MD (CH2M HILL, 2005) (herein referred to as Work Plan). To reduce duplication of material, background information and site history will not be repeated in this technical memorandum as they are presented in the report entitled *Final Remedial Investigation Report for Sites 6, 39, and 45, Naval District Washington, Indian Head, Indian Head, Maryland* (HydroGeologic, Inc., 2004). The objectives for this investigation were the following:

- Identify the lateral extent of silver contamination to support either a removal action or a finding of no further action inside the fenced area.
- Assess the need for a baseline ecological risk assessment or remediation outside the fenced area.

Field Activities

Sampling within the Fenced Area

On October 5, 2005, 44 surface soil (0–6 inches below ground surface) samples were collected from stations IS06SO14 through IS06SO57 (Figure 1). Sampling was conducted as outlined in the Work Plan. All samples were collected with either a stainless steel or disposable trowel. Table 1 summarizes the identification and analysis of the samples collected inside the fenced area.

As indicated in the Work Plan, the area within the fenced area was split into two segments, AB and BC, on the basis of the sampling approach. Segment AB was sampled using a grid approach. This area extends west and southeast of Building 1718 and includes the drainage ditch extending south of Building 1718 and the low area in the southwest corner of the site where water tends to pond (the ditch discharges into this low area). Segment BC was sampled using a transect approach. Segment BC extends from the low area northeast along the ditch to the fence line.

Fourteen surface soil samples (stations IS06SO14 through IS06SO27) were collected from segment AB. Thirty surface soil samples (IS06SO28 through IS06SO57) were collected from segment BC, six along each of five transects. The samples were collected from 1 foot, 3 feet, and 5 feet laterally on each side of the drainage ditch centerline. It had been assumed in the Work Plan that the water level in the drainage ditch has not been higher than 5 feet above the centerline elevation. These locations were selected to delineate the lateral extent of silver contamination to support a possible removal action to mitigate potential ecological risk.[1]

Sampling outside the Fenced Area

Thirty-five surface soil and sediment samples and four surface water samples were collected outside the fenced area (Figure 2). All samples were analyzed for silver; however, a subset of the samples was further analyzed for iron, manganese, total organic carbon (TOC), and cation exchange capacity (CEC). Table 2 summarizes the identification and analysis of the samples collected outside the fenced area.

On October 4, 2005, 17 surface soil samples were collected with a stainless steel or disposable trowel from stations IS06SO58 through IS06SO74. On October 4, 2005, 18 sediment samples were collected with disposable trowels (because the water depth was less than a foot) from stations IS06SO75 through IS06SO92. On October 3 and October 6, 2005, four surface water samples were collected with a peristaltic pump from stations IS06SW17, IS06SO84, IS06SO87, and IS06SO92.

A courier from GPL Laboratories of Frederick, Maryland, picked up all sample coolers from the site and took them to the laboratory under chain of custody.

The appropriate number of field quality assurance/quality control samples, including field blanks, equipment blanks, and duplicates, were collected and analyzed for each medium sampled.

Deviations from the Work Plan

The field investigation was conducted in accordance with the approved Work Plan with the following exceptions:

- Four surface water samples were collected instead of five owing to lack of water in the drainage ditch from the fence line to just beyond the transect for stations IS06SO71 through IS06SO74. It had been proposed that surface water samples would be collected from the five locations (IS06SO66, IS06SO73, IS06SO85, IS06SO88, and IS06SO92) shown

[1] The vertical extent of the removal action is assumed to be a maximum of 1 foot below grade, thereby eliminating the need for characterizing the vertical concentration profile.

in Figure 2 of the Work Plan. Because the ditch was dry at stations IS06SO66 and IS06SO73, a surface water sample was collected from station IS06SW17 (Figure 2 of this report).

- As noted in the Work Plan, station IS06SO92 was located at the mouth of the stream leading to Mattawoman Creek. Because this location was inaccessible by wading and a boat would have been required, the station was moved to the location shown in Figure 2 in this report.

Data Validation

The analytical data report was submitted to Environmental Data Services, Inc., of Concord, New Hampshire, for third-party validation. The hard copy laboratory data packages were validated for compliance with the applicable analytical method requirements following procedures established by the Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA, 1993). Following is a CH2M HILL chemist's summary of the review and evaluation of the data validator's report:

All samples for surface water, sediment, and soil were collected with the correct number of field quality control samples (field and equipment blanks) required for compliance with Navy and CERCLA guidance.

There were minor problems with the ICP Serial Dilutions; all of the detected results were affected, and the silver results for one sediment sample and 18 surface soil samples were "J" qualified (estimated concentration). Minor problems were also identified with matrix spikes and matrix spike duplicates; all of the detected results were affected, and manganese results for one sediment sample and three surface soil samples were "K" qualified (estimated concentration, biased high).

Silver was identified in seven field samples at concentrations similar to those in blank samples and were "B" qualified (attributable to blank contamination). The results cannot be directly attributable to the site and should be considered as not detected.

All of the validated results should be considered usable as qualified.

Results

Physico-Chemical Properties

Table 3 presents the physico-chemical parameters (pH, specific conductivity, temperature, dissolved oxygen, oxidation reduction potential [ORP], and turbidity) for surface water measured in the field prior to sampling.

The pH ranged from 6.47 (IS06SW17) to 6.97 (IS06SW20); specific conductivity ranged from 0.400 (IS06SW18) to 0.481 milliSiemens per centimeter (mS/cm) (IS06SW17); temperature ranged from 9.6°C (IS06SW18) to 9.9°C (IS06SW17); dissolved oxygen ranged from 4.03 (IS06SW17) to 6.01 mg/L (IS06SW20); and ORP ranged from 36 (IS06SW18) to -96 millivolts (mV) (IS06SW20); turbidity ranged from 0 (IS06SW19 and IS06SW20) to 329 nephelometric turbidity units (NTUs) (IS06SW18).

Data Evaluation

Analytical results for all media were evaluated as defined in Step 5 (Develop a Decision Rule) of the data quality objectives in the Work Plan:

1. Silver concentrations in surface soil and sediment within the fenced area will be compared to the average surface soil background concentration of 0.6 mg/kg (Tetra Tech NUS Inc., 2002)
    a. If concentrations are lower than background, they will be eliminated from further consideration.
    b. If concentrations are higher than background, they will be compared with the minimum ecologically based screening criterion of 2 mg/kg
        i. If concentrations are lower than 2 mg/kg, they will be eliminated from further consideration.
        ii. If concentrations are higher than 2 mg/kg, the area will be evaluated for removal action.
2. Identify and recommend the lateral extent of the removal action within the fenced area.
3. Silver concentrations in sediment and surface water outside the fenced area will be compared to risk-based screening criteria to assess the nature and extent of contamination. If the results exhibit elevated concentrations of silver, recommend a BERA or remediation outside the fenced area.

Inside the Fenced Area

Forty-four surface soil samples were collected from stations IS06SO14 through IS06SO57, shown in Figure 1, and analyzed for silver. Figure 1 also shows the eight surface soil sample locations (IS06SS01 and IS06SS06 through IS06SS12) and four sediment sample locations (IS06SD02 through IS06SD05) from which samples were collected during the 2001 Remedial Investigation (RI) (HGL, 2004). The figure shows the concentrations of silver detected during the 2001 RI and this sampling event.

Table 4 presents the raw data for this sampling event. A shaded cell indicates that silver was detected. Silver concentrations exceeding the ecological risk–based criterion of 2 mg/kg are shown in red in Figure 1. The discussion below is based on the soil analytical results for this sampling event.

Silver was detected in 35 samples at concentrations ranging from 0.59J mg/kg (IS06SO51) to 610 mg/kg (IS06SO15). All samples, except the sample from station IS06SO51, have silver concentrations higher than the background concentration of 0.6 mg/kg and the minimum ecologically based screening criterion of 2 mg/kg.

Figure 1 shows the spatial distribution of silver. Detected silver is present from the west side to the south side of Building 1718 and along the swale and west of the swale along segment AB. Silver concentrations east of the swale are “B” qualified. As noted above in the Data Validation section, these results should be considered as nondetect.

Segment BC shows a general decrease in average silver concentration from transect IS06SO28 through IS06SO32 (upgradient) to transect IS06SO52 through IS06SO57 (downgradient and close to the fence line).

In summary, the highest concentrations of silver are from Building 1718 to the first transect along segment BC. Silver in the soil reflects contamination from Building 1349 that is due to historical activities. The area just south of Building 1718 contains some of the highest concentrations of silver. Silver was also detected throughout the swale with concentrations gradually decreasing downgradient. The presence of silver is not reflective of current activities but is likely due to the construction of Building 1718 and associated excavation and spreading of soil.

Outside the Fenced Area

Thirty-five surface soil and sediment samples were collected from stations IS06SO58 through IS06SO74 shown in Figure 2. Also shown in Figure 2 are the locations and silver results from other investigations (Science Applications International Corporation, 2001; Tetra Tech NUS, 2003; and, HGL, 2004), results of which have been presented to the Indian Head partnering team). Silver concentrations exceeding the ecological risk–based criteria of 2 mg/kg for soil (samples IS06SO58 through IS06S74) and 1 mg/kg for sediment (samples IS06SO75 through IS06SO92) are shown in red in the figure.

Tables 5, 6, and 7 present the raw data for surface soil, sediment, and surface water, respectively, for this sampling event. A shaded cell indicates that the constituent was detected.

Surface Soil

Seventeen surface soil samples were collected from stations IS06SO58 through IS06SO74 (Figure 2). All samples were analyzed for silver. Samples from stations IS06SO61 and IS06SO66 were further analyzed for iron manganese, TOC, and CEC. Table 5 presents the raw data.

Silver was detected in each of the 17 surface soil samples at concentrations ranging from 0.91 mg/kg (station IS06SO64) to 456 mg/kg (station IS06SS68). All samples except those from stations IS06SO46 and IS06SO66 exceeded the ecological screening criterion of 2 mg/kg.

Total iron was detected at concentrations of 20,100 mg/kg and 19,500 mg/kg in samples from IS06SO61 and IS06SO66, respectively. Total manganese was detected at concentrations of 223J mg/kg and 319K mg/kg in samples from IS06SO61 and IS06SO66, respectively. Concentrations of TOC were 22,000 mg/kg and 27,000 mg/kg for samples from IS06SO61 and IS06SO66, respectively. The CEC is 25 meq/100 g and 22 meq/100 g in samples from IS06SO61 and IS06SO66, respectively.

Sediment

Eighteen sediment samples were collected from stations IS06SD75 through IS06SD92 (Figure 2). All samples were analyzed for silver. Samples collected from stations IS06S75 and IS06SD83 were further analyzed for iron, manganese, TOC, and CEC. These data will be

used in support of a baseline ecological risk assessment to be performed later. Table 6 presents the raw data.

Silver was detected above EPA Region III's ecological screening criterion of 1 mg/kg in all 18 sediment samples, with concentrations ranging from 3.5J mg/kg (station IS06SO89) to 234 mg/kg (IS06SD77).

Total iron was detected at concentrations of 38,900 mg/kg and 38,400 mg/kg in samples from IS06SO75 and IS06SO83, respectively. Total manganese was detected at concentrations of 1,270K mg/kg and 234 mg/kg in samples from IS06SO75 and IS06SO83, respectively. Total organic carbon was 100,000 mg/kg and 110,000 mg/kg for samples from IS06SO75 and IS06SO83, respectively. The CEC was 110 meq/100 g and 110,000 meq/100 g in samples from IS06SO75 and IS06SO83, respectively.

Surface Water

Four surface water samples were collected from stations IS06SW17, IS06SO84, IS06SO87, and IS06SO92, three of which were collocated with sediment sample locations (Figure 2). Samples were analyzed for total silver, iron, manganese, and dissolved silver. Additionally, sample IS06SO92 was analyzed for TOC and hardness. Table 7 presents the raw data.

The EPA Region III ecological screening value for silver is 3.2 µg/L (hardness of 100 mg/L). Total silver, however, was not detected in any of the four samples. Dissolved silver was analyzed in three of the four samples, and the results were nondetect in all three. Total iron ranged from 690 µg/L (IS06SO92) to 8,880 µg/L (IS06SW17). Total manganese ranged from 75.2 µg/L (IS06SO92) to 4,650 µg/L (IS06SW17). Total organic carbon and hardness were 6 mg/L and 150 mg/L, respectively, for the sample from station IS06SO92.

Cost Analyses

Soil Removal

During the December 2005 partnering meeting, IHIRT recommended that cost estimates be prepared for different removal volumes on the basis of ecological risk–based preliminary remediation goals (PRGs) of 2 mg/kg and 50 mg/kg.

Figure 1 shows the 2 mg/kg and 50 mg/kg isoconcentration lines. The areal extents are 8,091 square feet (ft^2) and 4,695 ft^2 for the 2 mg/kg and 50 mg/kg areas. Because excavation is assumed to be to a depth of 1 ft below ground surface, the estimated volumes for removal are 8,091 ft^3 (299.69 yd^3) and 4,695 ft^3 (173.90 yd^3) for 2 mg/kg and 50 mg/kg PRGs, respectively. The capital, annual operation and maintenance, and present-worth of the alternatives are summarized in Table 8. The cost breakdown for 2 mg/kg and 50 mg/kg are provided in Tables A-1 and A-2, respectively, in Appendix A.

The estimated cost range for implementation of soil excavation to silver cleanup of 2 mg/kg is $105,300 to $225,600, and the estimated cost range for soil excavation to silver cleanup of 50 mg/kg is $69,000 to $147,700. The cost estimates provided in this technical memorandum are preliminary and have not been checked by CH2M HILL's Construction Group for accuracy. These costs will be revised during preparation of the engineering evaluation/cost analysis for Site 6 (inside the fence).

Soil Bioassay

The following summarizes the estimated cost of conducting soil bioassays inside the fenced area to evaluate the bioavailability and toxicity of the silver in the soil. This toxicity information developed from this task would allow the determination of a site-specific silver threshold that might be higher than the literature-based values currently being considered to guide a potential removal action. A site-specific threshold would reduce the uncertainty inherent in using a literature-based toxicity value and could possibly reduce the volume of soil that would need to be removed. The cost of conducting soil bioassays inside the fence line is estimated at $16,900. The cost estimate breakdown is shown in Table 9.

The soil bioassay effort assumes the collection of site and reference soil by a two-person field team, submission of the samples to a bioassay laboratory, the chemical analysis of split soil samples by an analytical laboratory, data validation, and data analysis and reporting.

References

CH2M HILL, 2005. Work Plan for Additional Investigation at Site 6, NDWIH, Indian Head, Maryland.

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EPA, 1994. Region III Modifications to National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration (OLM01.0-OLM01.9).

HydroGeologic, Inc. (HGL), 2004. Final Remedial Investigation Report for Sites 6, 39, and 45, Naval District Washington, Indian Head, Indian Head, Maryland.

Tetra Tech NUS Inc., 2002. Background Soil Investigation Report for Indian Head and stump Neck Annex, Naval Surface Warfare Center, Indian Head, Maryland.

Tetra Tech NUS Inc., 2003. Final FS Report for Site 42, Olson Road Landfill, Indian Head Division, Naval Surface warfare Center, Indian Head, MD. Volume 2 of 2, Appendices.

Science Applications International Corporation, 2001. Sediment Toxicity Identification Evaluation Demonstration, Indian Head, Naval Surface Warfare Center.

Tables

Table 1
Nomenclature and Laboratory Analysis of Samples Inside the Fenced Area
Site 6 Additional Investigation Results
NSF-IH, Indian Head, Maryland

Station ID	Sample ID	Sample Media	Silver
Segment AB			
IS06SO14	IS06SS14-1005	Surface Soil	X
IS06SO15	IS06SS15-1005	Surface Soil	X
IS06SO16	IS06SS16-1005	Surface Soil	X
IS06SO17	IS06SS17-1005	Surface Soil	X
IS06SO18	IS06SS18-1005	Surface Soil	X
IS06SO19	IS06SS19-1005	Surface Soil	X
IS06SO20	IS06SS20-1005	Surface Soil	X
IS06SO21	IS06SS21-1005	Surface Soil	X
IS06SO22	IS06SS22-1005	Surface Soil	X
IS06SO23	IS06SS23-1005	Surface Soil	X
IS06SO24	IS06SS24-1005	Surface Soil	X
IS06SO25	IS06SS25-1005	Surface Soil	X
IS06SO26	IS06SS26-1005	Surface Soil	X
IS06SO27	IS06SS27-1005	Surface Soil	X
Segment BC			
IS06SO28	IS06SS28-1005	Surface Soil	X
IS06SO29	IS06SS29-1005	Surface Soil	X
IS06SO30	IS06SS30-1005	Surface Soil	X
IS06SO31	IS06SS31-1005	Surface Soil	X
IS06SO32	IS06SS32-1005	Surface Soil	X
IS06SO33	IS06SS33-1005	Surface Soil	X
IS06SO34	IS06SS34-1005	Surface Soil	X
IS06SO35	IS06SS35-1005	Surface Soil	X
IS06SO36	IS06SS36-1005	Surface Soil	X
IS06SO37	IS06SS37-1005	Surface Soil	X
IS06SO38	IS06SS38-1005	Surface Soil	X
IS06SO39	IS06SS39-1005	Surface Soil	X
IS06SO40	IS06SS40-1005	Surface Soil	X
IS06SO41	IS06SS41-1005	Surface Soil	X
IS06SO42	IS06SS42-1005	Surface Soil	X
IS06SO43	IS06SS43-1005	Surface Soil	X
IS06SO44	IS06SS44-1005	Surface Soil	X
IS06SO45	IS06SS45-1005	Surface Soil	X
IS06SO46	IS06SS46-1005	Surface Soil	X
IS06SO47	IS06SS47-1005	Surface Soil	X
IS06SO48	IS06SS48-1005	Surface Soil	X
IS06SO49	IS06SS49-1005	Surface Soil	X
IS06SO50	IS06SS50-1005	Surface Soil	X
IS06SO51	IS06SS51-1005	Surface Soil	X
IS06SO52	IS06SS52-1005	Surface Soil	X
IS06SO53	IS06SS53-1005	Surface Soil	X
IS06SO54	IS06SS54-1005	Surface Soil	X
IS06SO55	IS06SS55-1005	Surface Soil	X
IS06SO56	IS06SS56-1005	Surface Soil	X
IS06SO57	IS06SS57-1005	Surface Soil	X

Notes
All samples were collected from 0 to 6 inches below ground surface with a trowel.
All samples were collected on October 5, 2005.

Table 2
Nomenclature and Laboratory Analysis of Soil and sediment Samples Outside the Fenced Area
Site 6 Additional Investigation Results
NSF-IH, Indian Head, Maryland

Station ID	Sample ID	Sample Media	Silver	Iron	Manganese	Total Organic Carbon	Cation Exchange Capacity
IS06SO58	IS06SS58-1005	Surface Soil	X				
IS06SO59	IS06SS59-1005	Surface Soil	X				
IS06SO60	IS06SS60-1005	Surface Soil	X				
IS06SO61	IS06SS61-1005	Surface Soil	X	1	1	1	1
IS06SO62	IS06SS62-1005	Surface Soil	X				
IS06SO63	IS06SS63-1005	Surface Soil	X				
IS06SO64	IS06SS64-1005	Surface Soil	X				
IS06SO65	IS06SS65-1005	Surface Soil	X				
IS06SO66	IS06SD66-1005	Surface Soil	X	1	1	1	1
IS06SO67	IS06SS67-1005	Surface Soil	X				
IS06SO68	IS06SS68-1005	Surface Soil	X				
IS06SO69	IS06SS69-1005	Surface Soil	X				
IS06SO70	IS06SS70-1005	Surface Soil	X				
IS06SO71	IS06SS71-1005	Surface Soil	X				
IS06SO72	IS06SS72-1005	Surface Soil	X				
IS06SO73	IS06SD73-1005	Surface Soil	X				
IS06SO74	IS06SS74-1005	Surface Soil	X				
IS06SO75	IS06SS75-1005	Sediment	X	1	1	1	1
IS06SO76	IS06SS76-1005	Sediment	X				
IS06SO77	IS06SS77-1005	Sediment	X				
IS06SO78	IS06SS78-1005	Sediment	X				
IS06SO79	IS06SS79-1005	Sediment	X				
IS06SO80	IS06SS80-1005	Sediment	X				
IS06SO81	IS06SS81-1005	Sediment	X				
IS06SO82	IS06SS82-1005	Sediment	X				
IS06SO83	IS06SS83-1005	Sediment	X	1	1	1	1
IS06SO84	IS06SS84-1005	Sediment	X				
IS06SO85	IS06SD85-1005	Sediment	X				
IS06SO86	IS06SS86-1005	Sediment	X				
IS06SO87	IS06SS87-1005	Sediment	X				
IS06SO88	IS06SS88-1005	Sediment	X				
IS06SO89	IS06SD89-1005	Sediment	X				
IS06SO90	IS06SS90-1005	Sediment	X				
IS06SO91	IS06SS91-1005	Sediment	X				
IS06SO92	IS06SD92-1005	Sediment	X				

Station ID	Sample ID	Sample Media	Silver, Iron, Manganese	Silver (filtered)	Hardness	Total Organic Carbon
	IS06SW16-1005	Surface Water	1	1	1	1
	IS06SW17-1005	Surface Water	1	1		
IS06SO84	IS06SW18-1005	Surface Water	1	1	1	1
IS06SO87	IS06SW19-1005	Surface Water	1	1		
IS06SO92	IS06SW20-1005	Surface Water	1	1		

Notes:

Field Blanks are collected at a rate of 1 per sampling event per week.

Equipment Blanks are collected at a rate of 1 per day per matrix where equipment is decontaminated (i.e., if dedicated disposable equipment is not used). One per event if disposable equipment is used.

Table 3
Physio-Chemical Properties
2005 Sampling Event
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	Sample ID	pH	Specific Conductivity (mS/cm)	Temperature (^{o}C)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (NTUs)
IS06SW17	IS06SW17	6.47	0.481	9.8	4.03	4	205
IS06SO84	IS06SW18	6.67	0.4	9.6	4.76	36	329
IS06SO87	IS06SW19	6.9	0.412	9.9	5.78	-72	0
IS06SO92	IS06SW20	6.97	0.427	9.8	6.01	-96	0

Notes
mS/cm = milliSiemens per centimeter
NTUs = Nephelometric turbidity units
mg/L = milligram per liter
^{o}C = degrees celsius
mV = millivolts

Table 4
Surface Soil Analytical Results Inside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO14	IS06SO15	IS06SO16	IS06SO17		IS06SO18	IS06SO19	IS06SO20	IS06SO21	IS06SO22	IS06SO23	IS06SO24	IS06SO25	IS06SO26	IS06SO27	IS06SO28	IS06SO29	IS06SO30	IS06SO31
Sample ID	IS06SS14-1005	IS06SS15-1005	IS06SS16-1005	IS06SS17-1005	IS06SS17P-1005	IS06SS18-1005	IS06SS19-1005	IS06SS20-1005	IS06SS21-1005	IS06SS22-1005	IS06SS23-1005	IS06SS24-1005	IS06SS25-1005	IS06SS26-1005	IS06SS27-1005	IS06SS28-1005	IS06SS29-1005	IS06SS30-1005	IS06SS31-1005
Sample Date	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05
Chemical Name																			
Total Metals (MG/KG)																			
Silver	37.4	610	58.7	349	299	6.8 B	1.2 B	2.2 B	2.6 B	4.5 B	1.5 B	3.3 B	63.8	16.8	109	54.2	100	284	454
Wet Chemistry (MG/KG)																			
% Solids	96	92	96	77	93	95	96	96	97	95	95	96	93	93	80	78	80	65	69

Note
A shaded cell indicates constituent is detected.
NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
U - Analyte not detected

Table 4
Surface Soil Analytical Results Inside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO32	IS06SO33	IS06SO34	IS06SO35	IS06SO36	IS06SO37	IS06SO38	IS06SO39	IS06SO40		IS06SO41	IS06SO42	IS06SO43	IS06SO44	IS06SO45	IS06SO46		IS06SO47	IS06SO48
Sample ID	IS06SS32-1005	IS06SS33-1005	IS06SS34-1005	IS06SS35-1005	IS06SS36-1005	IS06SS37-1005	IS06SS38-1005	IS06SS39-1005	IS06SS40-1005	IS06SS40P-1005	IS06SS41-1005	IS06SS42-1005	IS06SS43-1005	IS06SS44-1005	IS06SS45-1005	IS06SS46P-1005	IS06SS46-1005	IS06SS47-1005	IS06SS48-1005
Sample Date	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05
Chemical Name																			
Total Metals (MG/KG)																			
Silver	440	319	2.9	43.7	66.5	262	258	16.3	26.4	23.2	17.4	54.9	129	33.2	12.3	27.2	27.6	195	205
Wet Chemistry (MG/KG)																			
% Solids	64	73	85	84	79	84	86	91	90	89	92	88	89	90	88	90	90	90	87

Note
A shaded cell indicates constitu
NA - Not analyzed
B - Analyte not detected above
J - Reported value is estimated
U - Analyte not detected

Table 4
Surface Soil Analytical Results Inside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO49	IS06SO50	IS06SO51	IS06SO52		IS06SO53	IS06SO54	IS06SO55	IS06SO56	IS06SO57
Sample ID	IS06SS49-1005	IS06SS50-1005	IS06SS51-1005	IS06SS52-1005	IS06SS52P-1005	IS06SS53-1005	IS06SS54-1005	IS06SS55-1005	IS06SS56-1005	IS06SS57-1005
Sample Date	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05	10/05/05
Chemical Name										
Total Metals (MG/KG)										
Silver	15.5	0.92 J	0.59 J	0.32 U	0.33 U	6.9	74.4	69.8	0.71 J	0.31 U
Wet Chemistry (MG/KG)										
% Solids	75	90	93	86	87	88	84	92	91	94

Note
A shaded cell indicates constitu
NA - Not analyzed
B - Analyte not detected above
J - Reported value is estimated
U - Analyte not detected

Table 5
Surface Soil Analytical Results Outside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO58	IS06SO59	IS06SO60	IS06SO61		IS06SO62	IS06SO63	IS06SO64	IS06SO65	IS06SO66	IS06SO67		IS06SO68	IS06SO69	IS06SO70	IS06SO71	IS06SO72	IS06SO73	IS06SO74
Sample ID	IS06SS58-1005	IS06SS59-1005	IS06SS60-1005	IS06SS61-1005	IS06SS61P-1005	IS06SS62-1005	IS06SS63-1005	IS06SS64-1005	IS06SS65-1005	IS06SS66-1005	IS06SS67-1005	IS06SS67P-1005	IS06SS68-1005	IS06SS69-1005	IS06SS70-1005	IS06SS71-1005	IS06SS72-1005	IS06SS73-1005	IS06SS74-1005
Sample Date	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/04/05	10/03/05	10/03/05	10/03/05	10/03/05
Chemical Name																			
Total Metals (MG/KG)																			
Iron	NA	NA	NA	20,100	16,600	NA	NA	NA	NA	19,500	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	198 K	184 K	NA	NA	NA	NA	319 K	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	2.2 J	145 J	208 J	213 J	223 J	63.5 J	231 J	0.91 J	36.6 J	1.3 J	22.1 J	23.3 J	456 J	274 J	23.4 J	48.1 J	28.1 J	48.7 J	19.5
Wet Chemistry (MG/KG)																			
% Solids	91	71	87	83	87	78	88	90	62	88	85	86	47	54	76	88	67	93	87
Total Organic Carbon	NA	NA	NA	22,000	9,400	NA	NA	NA	NA	27,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cation Exchange Capacity (MEQ/100G)	NS	NS	NS	25	24	NS	NS	NS	NS	22	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes
J - Reported value is estimated
K - Reported value may be biased high
NS - Not sampled
NA - Not analyzed

Table 6
Sediment Analytical Results Outside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO75		IS06SO76	IS06SO77	IS06SO78	IS06SO79	IS06SO80	IS06SO81	IS06SO82	IS06SO83	IS06SO84	IS06SO85	IS06SO86	IS06SO87	IS06SO88		IS06SO89	IS06SO90	IS06SO91
Sample ID	IS06SD75-1005	IS06SD75P-1005	IS06SD76-1005	IS06SD77-1005	IS06SD78-1005	IS06SD79-1005	IS06SD80-1005	IS06SD81-1005	IS06SD82-1005	IS06SD83-1005	IS06SD84-1005	IS06SD85-1005	IS06SD86-1005	IS06SD87-1005	IS06SD88-1005	IS06SD88P-1005	IS06SD89-1005	IS06SD90-1005	IS06SD91-1005
Sample Date	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05	10/03/05
Chemical Name																			
Total Metals (MG/KG)																			
Iron	37,300	38,900	NA	NA	NA	NA	NA	NA	NA	38,400	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	950	1,270 K	NA	NA	NA	NA	NA	NA	NA	743	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	104	101 J	28.1	234	18.4	6.5	73.5	47.2	38.7	74.3	24.9	27.9	30.2	24.3	8.9	8.8	3.5 J	6.3	4 J
Wet Chemistry (MG/KG)																			
% Solids	41	39	45	37	49	45	34	16	28	22	23	22	25	23	24	31	17	23	26
Total Organic Carbon	75,000	100,000	NA	NA	NA	NA	NA	NA	NA	110,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cation Exchange Capacity (MEQ/100G)	110	58	NS	NS	NS	NS	NS	NS	NS	83	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes
J - Reported value is estimated
K - Reported value may be biased high
NS - Not sampled
NA - Not analyzed

Table 6
Sediment Analytical Results Outside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO92
Sample ID	IS06SD92-1005
Sample Date	10/03/05
Chemical Name	
Total Metals (MG/KG)	
Iron	NA
Manganese	NA
Silver	4.8
Wet Chemistry (MG/KG)	
% Solids	28
Total Organic Carbon	NA
Cation Exchange Capacity (MEQ/100G)	NS

Notes
J - Reported value is estimated
K - Reported value may be biased high
NS - Not sampled
NA - Not analyzed

Table 7
Surface Water Analytical Results Outside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Station ID	IS06SO84	IS06SO87	IS06SO92	IS06SW17	
Sample ID	IS06SW18-1005	IS06SW19-1005	IS06SW20-1005	IS06SW17-1005	IS06SW17P-1005
Sample Date	10/03/05	10/02/05	10/02/05	10/06/05	10/06/05
Chemical Name					
Total Metals (UG/L)					
Iron	7,870	8,880	690	8,480	8,550
Manganese	996	778	75.2	4,650	4,640
Silver	10 U	10 U	10 U	1.8 U	1.8 U
Dissolved Metals (UG/L)					
Silver	10 U	10 U	10 U	1.8 U	NA
Wet Chemistry (MG/L)					
Total Organic Carbon	NA	NA	6	NA	NA
Hardness	NA	NA	150	NA	NA

Notes
U - Analyte not detected
NS - Not sampled
NA - Not analyzed

Table 8
Soil Removal Cost Summary
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Alternative	Capital Cost	Annual O&M Cost	Present-Worth Cost
Soil Excavation to 50 mg/kg of silver at Site 6 Inside the fenced area.	$69,000 - $ 147,700	$0	$69,000 - $ 147,700[1,2]
Soil Excavation to 2 mg/kg of silver at Site 6 Inside the fenced area.	$105,300 - $ 225,600	$0	$105,300 - $ 225,600[1,2]

Notes
[1]Cost assumes that the removal action will be completed within 1 year.
[2]In accordance with USEPA guidance, costs are considered to be accurate within -30% to +50%.

Table 9
Soil Bioassay Cost Summary
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Tasks	Capital Cost
Work Plan	$1,500
Field Work	$5,300
Soil Bioassays and Chemical Analyses/Data Validation	$7,800
Data Analysis and Reporting	$2,300
Total Cost	$16,900

Figures

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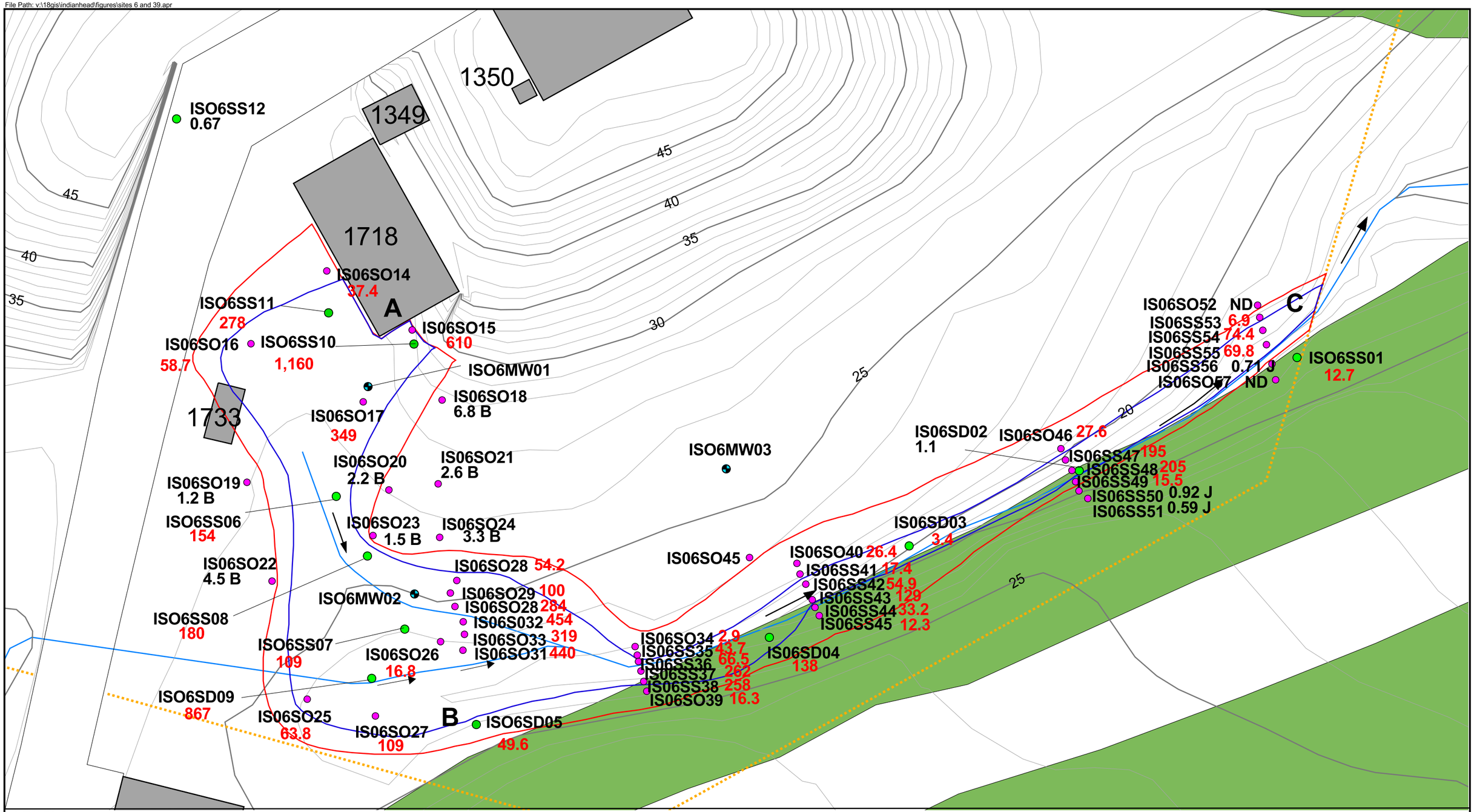


LEGEND

- Sample Location
- 2.2 Silver Concentration in mg/kg
- Previously Sampled Location (HGL, 2004)
- Monitoring Well Location
- Surface Water Drainage
- Fence
- Flow of Water in Ditch
- Isoconcentration Line - 2 mg/kg
- Isoconcentration Line - 50 mg/kg

ND - Not Detected
J - Estimated
B - Possible Blank Contamination

Notes: Concentrations in red indicate detection above the minimum ecologically based screening criteria of 2 mg/kg.
HGL, 2004. Final Remedial Investigation for Sites 6,39, and 45.
Isoconcentration lines are drawn using the October 2005 analytical data.

N

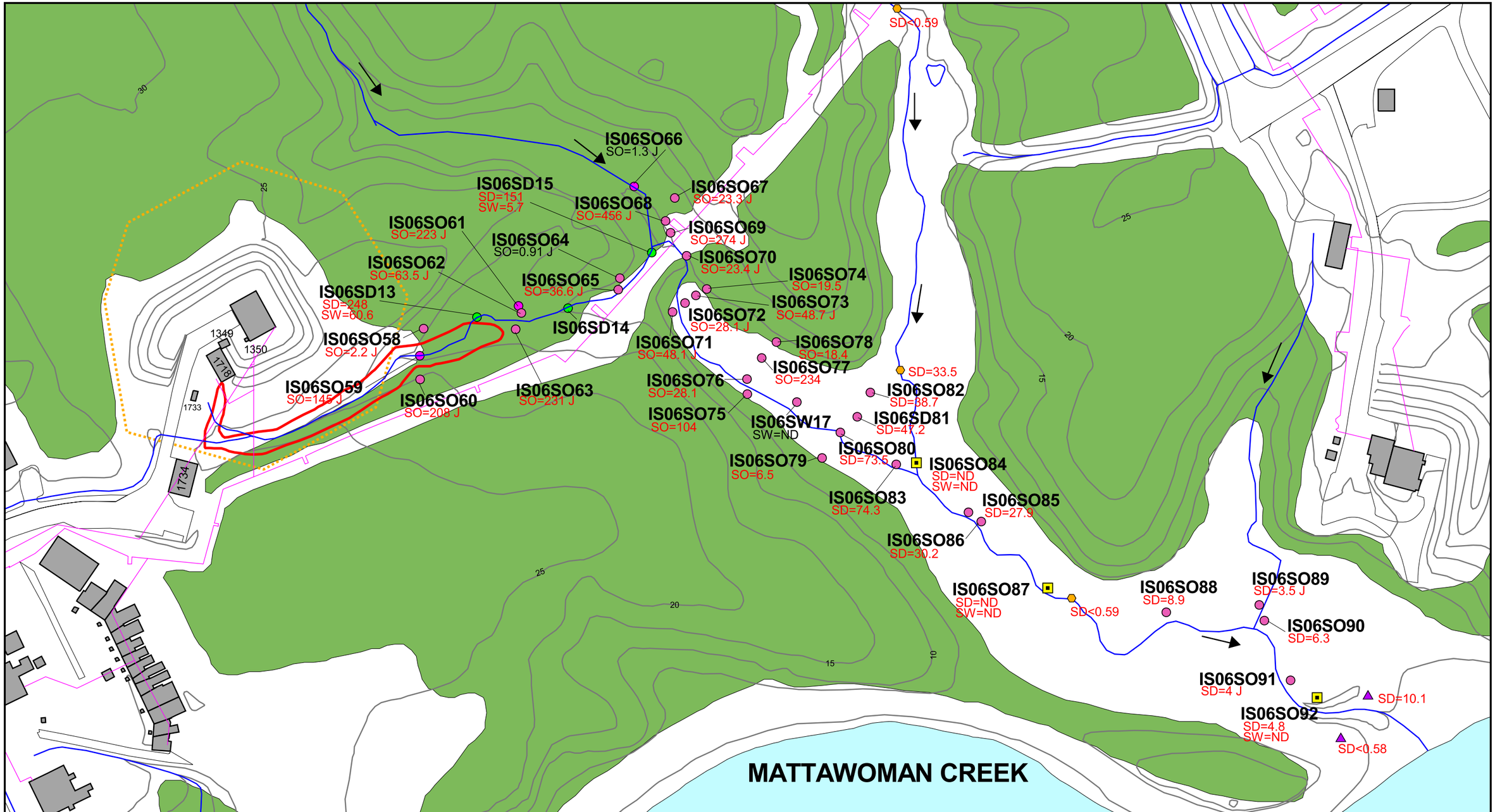
0 20 40 Feet

1 inch = 20 feet

Figure 1
Silver Detection Within the Fenced Area
Results for Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

CH2M HILL

File Path: v:\18gis\indianhead\figures\sites 6 and 39.apr



LEGEND

- Sample Location
- 2.2 Silver Concentration (unit for soil and sediment is mg/kg; unit for surface water is µg/L)
- Surface Water and Sediment Sample Location
- Previously Sampled Location (by SAIC in 2001)
- Previously Sampled Location (by TTNUS in 2003)
- Previously Sampled Location (by CH2M HILL in 2004)
- Surface Water Drainage
- Fence

SD - Sediment Analytical Result
SO - Surface Soil Analytical Result
SW - Surface Water Analytical Result
J - Estimated

N

0 60 120 180 Feet

1 inch = 120 feet

Note:
1. Concentrations in red indicate detection above the minimum ecologically based screening criteria of 2 mg/kg.
2. SAIC, 2001, Site Report for Sediment Toxicity Identification Evaluation Demonstration.

Figure 2
Silver Detection Outside the Fenced Area
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

CH2MHILL

Appendix A

Table A-1
Detailed Cost Estimate
Removal of Silver to 2 mg/kg
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Item	Quantity	Units	Unit Cost	Subtotal	Notes
1 PROJECT SETUP AND CONTROL					
1.1 Field Project Manager [1]	100	hr	$55.00	$5,500	Assuming 2 weeks, 10 hour days
1.2 Construction Superintendent [1]	100	hr	$55.00	$5,500	Assuming 2 weeks, 10 hour days
1.3 Health and Safety Officer [1]	100	hr	$40.00	$4,000	Assuming 2 weeks, 10 hour days
1.4 Field Technician for Sample Collection [1]	80	hr	$40.00	$3,200	Assuming 2 weeks, 8 hour days
2 MOBILIZATION					
2.1 Storage Trailer2	1	mo	$1,175.16	$1,175	
2.2 Construction Survey 3	2	day	$1,040.00	$2,080	1 day each for pre- and post-excavation surveys
2.3 Equipment Mobilization/Demobilization 2	3	ea	$843.22	$2,530	Backhoe, bull dozer, front end loader
2.4 Decontamination Trailer 2	1	mo	$1,175.16	$1,175	
3 DECONTAMINATION					
3.1 Equipment Decon Pad 3	1	ls	$500.00	$500	
3.2 Steam cleaner 2	1	mo	$1,658.44	$1,658	
3.3 3000 gal Decon Water Storage Tank [2]	4	wk	$201.33	$805	
3.4 Decon Water 2	3000	gal	$0.05	$150	
3.5 PPE 2	10	day	$32.30	$323	
3.6 Spent Decon Water Storage Tank 2	12	wk	$201.33	$2,416	Storage between sampling and removal from site
3.7 Decon water testing (Metals, Ignitability, Reactivity, Corrosivity) 3	1	ea	$294.00	$294	
3.8 Decon water disposal, Nonhazardous 3	3000	gal	$0.79	$2,370	
4 EXCAVATION					
4.1 Clear, Grub, Chip Brush & Trees (level D)	0.2	ac	$6,536.91	$1,307	
4.2 Backhoe Excavation, 1 cy (level D)	300	cy	$3.80	$1,140	Excavation to 12"
4.3 Confirmatory Sample Testing, 24 hour turn-around-time (Metals)	20	ea	$208.64	$4,173	
5 STOCKPILING AND SOIL DISPOSAL					
5.1 HDPE, 30 mil, sheeting for Liner and Cover 2	1500	sf	$0.88	$1,320	stockpile is 25' x 25' x 13'
5.2 Staked Hay Bales for Berm 2	36	ea	$2.65	$95	bails 3' long, 9 per side
5.3 Stockpile sample testing (Metals, Ignitability, Reactivity, Corrosivity) 3	2	ea	$248.82	$498	
5.4 Backhoe, 1 cy, for Loading Excavated Soil to Dump Truck 2	300	cy	$4.38	$1,314	
5.5 Haul Excavated Soil to landfill 11, 12 CY Dump 2	300	cy	$20.50	$6,150	
5.6 Landfill Soil, Nonhazardous 2	300	cy	$101.68	$30,504	
6 SITE RESTORATION					
6.1 Confirm imported material meets clean soil criteria 3	2	ea	$115.91	$232	
6.2 Standard Proctor Compaction Test for Backfill Soil 2	5	ea	$179.04	$895	
6.3 Purchase, Import, Place and Compact Clay Backfill from Off-Site Source to Backfill Excavation 2	150	cy	$18.29	$2,744	6" of clay
6.4 Purchase, Import, Place and Compact Topsoil Backfill from Off-Site Source for Plant Growth 2	150	cy	$32.14	$4,821	6" of topsoil
6.5 Finish Grading Slopes 2	900	sy	$0.16	$144	
6.6 Fertilizer/Push and Seeding (native grasses) 2	0.2	ac	$892.33	$178	
6.7 Straw Mulch, hand spread 1" deep 2	900	sy	$1.15	$1,035	
7 MISC. SITE WORK					
7.1 Silt Fence 2	50	lf	$2.72	$136	
7.2 Remove Silt Fence 3	50	lf	$1.92	$96	
Subtotal				**$90,459**	
Project Management	8%			$7,237	
Remedial Design	15%			$13,569	
Construction Management	10%			$9,046	
Contingency	25%			$30,078	
TOTAL COST					
Removal with Stockpiling				**$150,388**	
Upper Limit of Cost Accuracy	150%			**$225,582**	
Lower Limit of Cost Accuracy	70%			**$105,272**	

[1] Engineer's estimate
[2] R.S. Means Site Work and Landscape Cost Data, 2004
[3] Navy CLEAN BOA rates

Table A-2
Detailed Cost Estimate
Removal of Silver to 50 mg/kg
Site 6 Additional Investigation
NSF-IH, Indian Head, Maryland

Item	Quantity	Units	Unit Cost	Subtotal	Notes
1 PROJECT SETUP AND CONTROL					
1.1 Field Project Manager [1]	50	hr	$55.00	$2,750	Assuming 1 week, 10 hour days
1.2 Construction Superintendent [1]	50	hr	$55.00	$2,750	Assuming 1 week, 10 hour days
1.3 Health and Safety Officer [1]	50	hr	$40.00	$2,000	Assuming 1 week, 10 hour days
1.4 Field Technician for Sample Collection [1]	40	hr	$40.00	$1,600	Assuming 1 week, 8 hour days
2 MOBILIZATION					
2.1 Storage Trailer2	1	mo	$1,175.16	$1,175	
2.2 Construction Survey 3	2	day	$1,040.00	$2,080	1 day each for pre- and post-excavation surveys
2.3 Equipment Mobilization/Demobilization 2	3	ea	$843.22	$2,530	Backhoe, bull dozer, front end loader
2.4 Decontamination Trailer 2	1	mo	$1,175.16	$1,175	
3 DECONTAMINATION					
3.1 Equipment Decon Pad 3	1	ls	$500.00	$500	
3.2 Steam cleaner 2	1	mo	$1,658.44	$1,658	
3.3 3000 gal Decon Water Storage Tank [2]	1	wk	$201.33	$201	
3.4 Decon Water 2	1500	gal	$0.05	$75	
3.5 PPE 2	5	day	$32.30	$162	
3.6 Spent Decon Water Storage Tank 2	10	wk	$201.33	$2,013	Storage between sampling and removal from site
3.7 Decon water testing (Metals, Ignitability, Reactivity, Corrosivity) 3	1	ea	$294.00	$294	
3.8 Decon water disposal, Nonhazardous 3	1500	gal	$0.79	$1,185	
4 EXCAVATION					
4.1 Clear, Grub, Chip Brush & Trees (level D)	0.11	ac	$6,536.91	$719	
4.2 Backhoe Excavation, 1 cy (level D)	525	cy	$3.80	$1,995	Excavation to 12"
4.3 Confirmatory Sample Testing, 24 hour turn-around-time (Metals)	20	ea	$208.64	$4,173	
5 STOCKPILING AND SOIL DISPOSAL					
5.1 HDPE, 30 mil, sheeting for Liner and Cover 2	1500	sf	$0.88	$1,320	stockpile is 25' x 25' x 7.5'
5.2 Staked Hay Bales for Berm 2	36	ea	$2.65	$95	bails 3' long, 9 per side
5.3 Stockpile sample testing (Metals, Ignitability, Reactivity, Corrosivity) 3	2	ea	$248.82	$498	
5.4 Backhoe, 1 cy, for Loading Excavated Soil to Dump Truck 2	174	cy	$4.38	$762	
5.5 Haul Excavated Soil to landfill 11, 12 CY Dump 2	174	cy	$20.50	$3,567	
5.6 Landfill Soil, Nonhazardous 2	174	cy	$101.68	$17,692	
6 SITE RESTORATION					
6.1 Confirm imported material meets clean soil criteria 3	2	ea	$115.91	$232	
6.2 Standard Proctor Compaction Test for Backfill Soil 2	5	ea	$179.04	$895	
6.3 Purchase, Import, Place and Compact Clay Backfill from Off-Site Source to Backfill Excavation 2	84	cy	$18.29	$1,536	6" of clay
6.4 Purchase, Import, Place and Compact Topsoil Backfill from Off-Site Source for Plant Growth 2	80	cy	$32.14	$2,571	6" of topsoil
6.5 Finish Grading Slopes 2	525	sy	$0.16	$84	
6.6 Fertilizer/Push and Seeding (native grasses) 2	0.11	ac	$892.33	$98	
6.7 Straw Mulch, hand spread 1" deep 2	525	sy	$1.15	$604	
7 MISC. SITE WORK					
7.1 Silt Fence 2	50	lf	$2.72	$136	
7.2 Remove Silt Fence 3	50	lf	$1.92	$96	
Subtotal				**$59,222**	
Project Management	8%			$4,738	
Remedial Design	15%			$8,883	
Construction Management	10%			$5,922	
Contingency	25%			$19,691	
TOTAL COST					
Removal with Stockpiling				**$98,457**	
Upper Limit of Cost Accuracy	150%			**$147,686**	
Lower Limit of Cost Accuracy	70%			**$68,920**	

[1] Engineer's estimate
[2] R.S. Means Site Work and Landscape Cost Data, 2004
[3] Navy CLEAN BOA rates