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ENVIRONMENT

Mr. Anthony Karwiel, P.E.
New York State Department of Environmental Conservation
625 Broadway
Albany New York, 12233

Subject:
Feasibility Study for Operable Unit 2
Hudson (Water Street) Site
Hudson, New York
NYSDEC Site No. 4-11-005

Date:
April 29, 2011

Contact:
Doug Weeks

Phone:
518.452.7826 ext. 11

Email:
Doug.weeks@arcadis-us.com

Our ref:
B0036702.0001

Dear Mr. Karwiel:

Enclosed for your review are two copies (one hard copy and one electronic copy) of the Feasibility Study (FS) for Operable Unit 2 for the Hudson (Water Street) Site, located in Hudson, New York.

If you have any questions, please contact me at 518.452.7826 ext. 11 or Mr. William Jones of National Grid at 315.428.5690.

Sincerely,

ARCADIS of New York, Inc.

Doug Weeks
Project Manager

Copies:
William Jones, P.E., National Grid
Edward Neuhauser, National Grid
Maureen Schuck, New York State Department of Health
Mark Gravelding, P.E., ARCADIS

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Feasibility Study for Operable Unit 2

Hudson (Water Street) Site
Hudson, New York
NYSDEC Site No. 4-11-005

April 2011

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Certification Statement

I, Mark O. Gravelding, P.E. certify that I am currently a NYS registered professional engineer and that this *Feasibility Study Report* was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Date 4/29/11

Mark O. Gravelding, P.E.
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Feasibility Study for Operable Unit 2

Hudson (Water Street) Site

Prepared for:
National Grid

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Our Ref.:
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Date:
April 2011

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Figures

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Acronyms and Abbreviations

^{7}Be	Beryllium-7
^{137}Cs	Cesium-137
^{210}Pb	Lead-210
amsl	above mean sea level
ARC	Area for Remedial Consideration
ASTM	American Society for Testing and Materials
BBL	Blasland, Bouck & Lee
BMP	Best Management Practice
bmsl	below mean sea level
bss	below sediment surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAMP	Community Air Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO_2	carbon dioxide
CSIR	Comprehensive Sediment Investigation Report
CWA	Clean Water Act
cy	cubic yards
DAR	Division of Air Resources
ECL	Environmental Conservation Law
EPRI	Electric Power Research Institute
ERL	Effects Range Low
ERM	Effects Range Medium
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ft/sec	feet per second
GHG	greenhouse gas
GRA	general response action
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
LD_{20}	Lethal Dose 20 percent

LDR	Land Disposal Restriction
LOEL	Lowest Observed Effects Level
LTTD	Low Temperature Thermal Desorption
LWRP	Local Waterfront Revitalization Program
mg/kg	milligrams per kilogram
MGP	manufactured gas plant
MLLW	Mean Lower Low Water
MNR	Monitored Natural Recovery
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRIS	National Registry Information System
NWP	Nationwide Permit
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	pre-design investigation
PPE	personal protective equipment
PPPAH	priority pollutant polycyclic aromatic hydrocarbon
POTW	publicly owned treatment works
RAO	Remedial Action Objective
RCM	reactive core mat
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SCG	Standards, Criteria, and Guidance

SEQRA	State Environmental Quality Review Act
SIR	Site Investigation Summary Report
SMP	Site Management Plan
SOC	Soot Organic Carbon
SPDES	State Pollutant Discharge Elimination System
SPME	solid-phase microextraction
SQT	sediment quality triad
SSI	Supplemental Sediment Investigation
SVOC	semi-volatile organic compound
TAGM	Technical and Administrative Guidance Memorandum
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TPH	total petroleum hydrocarbon
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTS	Universal Treatment Standard
VOC	volatile organic compound

1 Introduction and Project Background

This Feasibility Study (FS) Report for Operable Unit 2 (OU2) has been prepared by ARCADIS on behalf of National Grid to present and evaluate potential remedial alternatives to address sediments containing site-related non-aqueous phase liquid (NAPL) and polycyclic aromatic hydrocarbons (PAHs) within the Hudson River adjacent to the former manufactured gas plant (MGP) site located on Water Street in Hudson, Columbia County, New York (the Site). This FS has been prepared in a manner consistent with applicable requirements of the following documents:

- New York State Department of Environmental Conservation (NYSDEC) DER-10 Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC 2010)
- United States Environmental Protection Agency (USEPA), Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Interim Final (USEPA 1988)
- Applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations contained in Title 40 of the Code of Federal Regulations (CFR) Part 300
- Applicable provisions of the New York State Environmental Conservation Law (ECL) and associated regulations, including Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6)

1.1 Purpose

This FS Report represents the next step in the regulatory progression of the Site. It has been prepared based on correspondence and discussions between National Grid and NYSDEC and in consideration of the data collected at the Site from 1995 to 2009, including the evaluation of the bioavailability and toxicity of PAHs in surface sediments as described in Section 2.1 of this FS Report.

The purpose of this FS Report is to identify and evaluate remedial alternatives for the OU2 sediments that are:

- Appropriate for Site-specific conditions
- Protective of public health and the environment

- Consistent with relevant sections of NYSDEC guidance, the NCP, and CERCLA

The overall objective of this FS is to recommend a reliable, cost-effective remedy that achieves the remedial action objectives (RAOs) established for the Site, which are presented in Section 4.

1.2 Site Description and History

This section presents a summary of the Site background and history, including the Site location and description, historical Site operations and land use, regulatory background, and the physical and environmental setting.

1.2.1 Site Location and Description

The Site is located in and along the east bank of the Hudson River. It includes property where the former MGP was located on Water Street in Hudson, Columbia County, New York, and sediments within a portion of the Hudson River. The Site consists of two operable units: OU1 and OU2. OU1 is defined as the upland area and Embayment #1 located on the Lockwood property (Lot 16.2), and the former MGP located on the SBD Warehouse property (Lot 15). OU2 is defined as a portion of the Hudson River adjacent to the Site extending approximately 1,700 feet along the shoreline from the west end of Ferry Street to Holcim Ltd's (formerly St. Lawrence Cement Company's) storage area, and approximately 300 feet offshore into the eastern edge of the shipping channel. OU2 includes Embayment #2, Embayment #3, and Embayment #4. A Site Location Map is presented as Figure 1-1. A Site Plan depicting the Site and pertinent features is presented as Figure 1-2.

1.2.2 Historical Site Operations and Land Use

The City of Hudson, New York was settled in the 1700s and became a center for whale oil processing and candle manufacturing. In the 1850s, whale oil street lamps were replaced with manufactured gas lamps (Bradbury 1908). For more than 100 years, the eastern upland area adjacent to the Site has been used for industrial and commercial purposes. Beginning in the late 1800s, iron and steel works, fuel storage, and metal manufacturing facilities operated near the shoreline (Beers 1873) of the Site, and the byproducts of these industries were used as fill material for the shoreline areas. The majority of the upland area along the shoreline in the vicinity of the Site was filled with several feet of ash, cinders, brick, clay, sand, and gravel. Railroad spurs were also constructed in the vicinity of the four embayments of the Hudson River for loading and

unloading materials manufactured in the vicinity of the Site. Coal yards and oil tanks were also located along the shoreline of the Site (Sanborn 1949). MGP operations in this area were active from 1853 until 1949, when natural gas replaced the need for manufactured gas. Subsequent to 1949, historical operations at or near the Site have included a motor freight building, an auto scrap yard, and a lumberyard storage area (Sanborn 1961).

Currently, the land immediately north of the Site is used by the public as a park (Henry Hudson Riverfront Park owned by the City of Hudson), and land to the south is used for industrial purposes by CSX Transportation and Holcim Ltd (Figure 1-2). A commuter rail station is located to the east of the Site, across Water Street. The northwestern portion of the City of Hudson contains several active industrial facilities, railroads, streets, and parking lots. A stormwater outfall that provides drainage for a majority of the northwestern portion of the City of Hudson discharges to the eastern end of Embayment #3 (Figure 1-2). The Hudson River in the vicinity of the Site is used as a navigable waterway and for recreational purposes. A large island called Middle Ground Flats divides the river off-shore from the Site. The shipping channel is located east of the island and is maintained by the United States Army Corps of Engineers (USACE). A barge docking area is located south of Embayment #4 adjacent to the Holcim property. Hudson Cruises, Inc. operates guided boat tours from a dock located just north of Embayment #1 (Spirit of Hudson Dock Area, Figure 1-2), and a private marina and public boat launch are located to the north of the City Park. As part of the Local Waterfront Revitalization Program (LWRP), the City of Hudson is in the process of installing a series of public docks in Embayments #1 and #2, and in the area north of Embayment #1, to encourage access to the City by boat. A fiber optic line owned by Mid-Hudson Cablevision Inc. (Mid-Hudson Cable) crosses the Hudson River within OU2 (Figure 1-2). A fish consumption advisory issued by the New York State Department of Health (NYSDOH 2011) is currently in effect for fish caught from the Hudson River in the vicinity of the Site due to non-Site-related contaminants.

1.2.3 Regulatory Background

In July 1986, NYSDEC identified an oil spill and sheens in Embayment #1. Oil sheens were observed again in Embayment #1 in September 1988. In response, NYSDEC installed absorbent booms at the mouth of Embayment #1 to prevent potential migration of oil sheens into the river. Analysis of soil, surface water, and groundwater samples collected at the Site by NYSDEC indicated the presence of PAHs and volatile organic compounds (VOCs).

In 1988, at the direction of NYSDEC, a contractor excavated approximately 2,000 cubic yards (cy) of impacted soil and sediments from the bank of and within Embayment #1, and from a former 20,000-cubic-foot, brick-lined gas holder foundation located east of Water Street that was part of the former MGP operations. The excavated material was stockpiled in an area between Embayment #1 and Water Street and covered with polyethylene sheeting. A groundwater containment trench equipped with a recovery pump and an oil separation and granular activated carbon treatment system were also installed along the northwestern portion of the location where the excavated materials were stockpiled. The recovery system failed during the summer of 1989, resulting in recurrence of oil sheens in the river. At that time, NYSDEC installed absorbent booms along the shoreline.

On July 9, 1993, NYSDEC requested that USEPA conduct a CERLCA Removal Action at the Site. USEPA completed a Removal Site Evaluation in August 1994, and determined that a CERCLA Removal Action was warranted to mitigate potential threats to human health and the environment.

Niagara Mohawk (now National Grid) entered into an Administrative Order on Consent (Consent Order) for Removal Action with USEPA in 1995. The Consent Order required Niagara Mohawk to prepare a Removal Action Work Plan, remove and properly dispose of the aforementioned stockpiled material, redeploy and maintain absorbent booms near the mouth of Embayment #1, conduct additional Site investigations, and if necessary, evaluate potential remedial actions.

The stockpiled material was removed and disposed off site in 1995. Subsequent to the stockpile removal, Blasland, Bouck & Lee, Inc. (BBL), under contract to Niagara Mohawk, conducted additional investigations to support the evaluation of potential remedial actions required by USEPA and NYSDEC for the Site.

The Site was listed on the Registry of Inactive Hazardous Waste Sites as the Hudson Coal Tar Site (Site Number 4-11-005) in 1998. In July 2000, a Site Investigation Summary Report (SIR; BBL 2000) was submitted to NYSDEC documenting the results of the Phase I, II, and III sediment investigations conducted in the embayments and the Hudson River near the Site (Section 2.1).

In March 2001, NYSDEC issued a Record of Decision (ROD) for the Hudson Coal Tar Site Operable Unit 1, which separated out a portion of the Site as a “second operable unit (OU2), to address potential Hudson River sediment…,” including Embayment #2 (NYSDEC 2001a). The ROD required remediation for OU1, including removal of an

estimated 10,000 cy of soil within the former gas holder area and former tar tank area on the SBD Warehouse Property, removal of up to 10 feet of sediment in Embayment # 1 and replacement of sediment with backfill material, implementation of institutional controls, and execution of a long-term monitoring program. A Final (100%) Remedial Design - Basis of Design Report (BBL 2002c) was subsequently submitted to NYSDEC in June 2002.

In a letter dated September 20, 2001 (NYSDEC 2001b), NYSDEC commented that the investigations presented in the SIR did not completely delineate the extent of PAHs and other MGP-related constituents in Hudson River sediments to the north and south of the Site and in the eastern side of the shipping channel. Consequently, NYSDEC recommended that additional sediment sampling be performed in those areas. NYSDEC also requested that sediment sampling be performed at the mouth of Embayment #3.

Niagara Mohawk agreed to the additional sediment sampling, as described in a September 28, 2001 letter to NYSDEC (Niagara Mohawk 2001). In addition to the sediment delineation sampling requested in NYSDEC's September 20, 2001 comment letter (NYSDEC 2001b), Niagara Mohawk proposed to conduct other characterization activities which would provide further understanding of conditions in OU2 and aid in evaluation of potential remedial alternatives for OU2 sediments. The activities proposed by Niagara Mohawk were described in the 2002 Sediment Sampling Program, Hudson River Sediment Sampling Work Plan (2002 Work Plan; BBL 2002b).

The additional sediment investigation activities were completed between April and June 2002, in accordance with the NYSDEC-approved 2002 Work Plan. The 2002 sediment investigation consisted of geophysical surveys (bathymetric and sub-bottom profiling), physical characterization of sediment, chemical characterization of sediment, geochronological sediment analysis (chronostratigraphic dating), and a habitat assessment and macroinvertebrate survey. The activities, results, and conclusions of the 2002 sediment investigation, including previous sediment investigations completed from 1995 to 2001, were presented in the Comprehensive Sediment Investigation Report for OU2 (CSIR; BBL 2003a).

Following submittal of the 2003 CSIR to the NYSDEC, remediation activities for OU1 were completed from April 2004 to September 2005 in accordance with the Final Remedial Design – Contract No. 1 – General (OU1 Contract Documents; BBL 2003b). The OU1 remediation activities included:

- Excavation and off-site disposal of approximately 8,800 cy of soil from the former gas holder area and former tar tank area on the SBD Warehouse Property;
- Excavation and off-site disposal of approximately 8,600 cy of sediment and soil from Embayment #1 and the surrounding shoreline; and
- Restoration of the Embayment #2 shoreline and the north wall of the warehouse on the SBD Warehouse Property (Figure 1-2).

As described in the Final Engineering Report (BBL 2007a), a permanent sheet pile wall was installed around the sediment removal area of Embayment #1. This steel sheet pile wall was left in place to provide additional protection against the potential lateral subsurface migration of impacted material from surrounding properties (e.g., the former oil terminal) into Embayment #1.

Following the OU1 remediation, Niagara Mohawk, a National Grid Company (National Grid acquired Niagara Mohawk in January 2002) and NYSDEC agreed that it would be appropriate to develop and implement a monitoring program to assess the progress of natural recovery of sediments containing Site-related PAHs. It was expected that the natural recovery of the OU2 sediments containing Site-related PAHs would be accelerated as a result of the OU1 remedial activities, with concentrations of PAHs in the surface sediments decreasing over time. Further, National Grid and NYSDEC agreed to delay the development of an FS for OU2 sediments until the monitoring and evaluation of natural recovery were complete.

In September 2005, National Grid submitted a Monitoring Plan for OU2 Sediments (OU2 Monitoring Plan; BBL 2005) to NYSDEC. Comments on the initial OU2 Monitoring Plan were received from NYSDEC through various correspondences from April 2006 to January 2007. To address the comments, a Revised Monitoring Plan for OU2 Sediments (Revised Monitoring Plan; BBL 2007b) was submitted to NYSDEC, and subsequently approved in July 2007. The first and second rounds of the OU2 sediment monitoring program were completed in October 2007 and October 2008. The results, which indicate that natural recovery of sediments within portions of OU2 is occurring, were presented in the letter reports titled First Year Results of the OU2 Sediment Monitoring Program (First Year Letter Report; ARCADIS 2008a) and Second Year Results of the OU2 Sediment Monitoring Program (Second Year Letter Report; ARCADIS 2009a), respectively.

In 2009, NYSDEC and National Grid discussed the use of sediment PAH bioavailability and toxicity data for remedial decision-making purposes. NYSDEC requested that

National Grid identify a site from their portfolio to demonstrate how such sediment PAH bioavailability data would be used. National Grid selected the Hudson (Water Street) Site for the demonstration program. In September 2009, National Grid submitted a Draft Supplemental Sediment Investigation Work Plan for OU2 (SSI Work Plan; ARCADIS 2009b) to describe the additional sediment investigation activities that would be used to help prepare the OU2 FS and define the area subject to remediation. The SSI Work Plan included three primary activities:

- Conducting the third (final) sampling event associated with the OU2 Sediment Monitoring Program
- Evaluating the bioavailability and toxicity of PAHs in surface sediments following a modified sediment quality triad (SQT) approach
- Further delineating the extent of NAPL in the Site sediments

The SSI was completed in October 2009.

A comprehensive summary of the results of the sediment investigations completed at the Site from 1995 to 2009 is presented in the Revised Comprehensive Sediment Investigation Report for OU2 (Revised CSIR; ARCADIS et al. 2010), which was submitted to NYSDEC in May 2010 and approved by NYSDEC in a letter to National Grid dated August 4, 2010.

This FS Report represents the next step in the regulatory progression of the Site. It has been prepared based on the data collected at the Site from 1995 to 2009, including the Site-specific evaluation of the bioavailability and toxicity of PAHs in surface sediments following the SQT approach described above, as well as subsequent discussions between National Grid and NYSDEC in 2010.

1.2.4 Physical and Environmental Setting

The physical and environmental setting for OU2 and the surrounding area is described below in terms of regional and Site geology and hydrology, including specific information about the Hudson River and sediments within OU2.

1.2.4.1Regional and Site Geology

OU2 and the surrounding vicinity are situated in an area of lacustrine deposits of sand, silt, and clay in the Hudson River Valley with underlying Normanskill gray to black shale bedrock of Ordovician age (Goldring 1943). The shale bedrock outcrops at the

surface at locations north of the Site (along the railroad near the public boat launch), and is more than 70 feet below mean sea level (bmsl) in the Hudson River. The lacustrine deposits come from the retreating Wisconsin ice sheet. A postglacial lake formed in the upper Hudson River Valley, known as Lake Albany, which accumulated thick deposits of fine sediment for up to 5,000 years (Isachsen et al. 1991).

As discussed in Section 1.2.2, the eastern shoreline of the Hudson River adjacent to the Site has supported significant industrial activity, including the placement of fill materials along the shoreline. This shoreline area, similar to many portions of the Hudson River, was filled to support the expansion of industrial facilities in this area, as well as to support the continued growth of the area in the vicinity of the City of Hudson. While historical accounts are limited, it is likely that the riverbank was initially filled to support the railroad infrastructure parallel to the shoreline of the Site. Over time, additional fill materials, consisting of slag, cinder, ash, bricks, and gravel, were also deposited along the river bank between the existing railroad and the waterway, further encroaching on the Hudson River. This filling continued until the riverbank extended approximately 50 to 100 feet into what was once the Hudson River tidal flats and riverbed. As the industries that used the embayments for transportation ceased operations approximately 100 years ago, the embayments have been slowly filling in. Based on a review of historical maps, it appears that a portion of the eastern end of Embayment #3 has been filled.

The current physical characteristics of the shoreline at the Site reflect the historical filling efforts described above. The shoreline is generally steeply sloped, with slopes between 15 and 90 degrees, consisting of the aforementioned various types of fill materials, rip-rap, or walled with concrete, piles, and sheet piling.

The river sediment characteristics within OU2 are described as follows:

- The sediment surface layer (0 to 0.5 foot below sediment surface [bss]) and near-surface layer (0.5 to 2 feet bss) in the eastern portion of the channel along the slope was found to generally consist of coarse sand, gravel, and cobbles, with fill and shells. Closer to and within the shipping channel, the sediments grade to finer sands with traces of coarser sands and gravels and fewer shells. In general, the sediment surface is stable due to the presence of a natural armoring layer consisting of cobbles, gravel, coarse sand, coarser fill (e.g., slag and bricks), and shells.

- Thicker layers (greater than 2 to 12 feet) of coarser-grained sediments (i.e., greater sand and gravel content) and more fill materials were observed closer to the eastern shoreline, especially near the floating dock north of Embayment #1.

- Between 0.5 and 12 feet bss, the sand and gravel proportion in the sediment diminishes and the sediment becomes almost entirely silt and fine sands grading to silty clay at depth. In general, the transition depth to the silty clay is shallower farther from the shoreline. The depth to bedrock under this portion of the river is unknown, but based on the result of the geophysical survey, is believed to be deeper than 30 feet bss.

1.2.4.2Regional and Site Hydrology

The Hudson River is approximately 315 miles long from its source at Lake Tear-of-the-Clouds in the Adirondack Mountains to the Battery in New York City. At the Federal Dam at Troy, New York, the total drainage area is approximately 8,000 square miles. At U.S. Geological Service (USGS) gauging station 01358000 in Green Island, New York, approximately 40 miles north of the Site, the river flow has an average daily discharge of 14,210 cubic feet per second (cfs) (USGS 2010). The highest Hudson River flow recorded at Green Island was 215,000 cfs on March 19, 1936, and the lowest was 882 cfs on September 2, 1936 (Stedfast 1982).

The Hudson River flows in a southerly direction across OU2. This portion of the Hudson River is fresh water and tidally influenced (tidal influence extends up to the Federal Dam at Troy, New York). According to NYCRR Title 6 Part 858.4 (NYCRR 1995), the Hudson River in the area of OU2 is classified as a NYSDEC Class A water body. According to the regulations (701.6), "[T]he best usages for Class A water bodies are: a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation and fishing. The waters shall also be suitable for fish propagation and survival" (NYCRR 1995).

In the vicinity of the Site, the Hudson River is a long, narrow estuary, approximately 0.5 mile wide, formed in a drowned-river valley. Because the river bottom is below sea level, it is not down-cut or eroded; rather, upland sediment is filling in the river channel. A large island called Middle Ground Flats divides the river off-shore from the Site. The shipping channel is located east of the island and is maintained by the USACE at a width of 400 feet and a depth of approximately 34 feet at mean lower low water (MLLW) (BBL 2000). In the stretch of river adjacent to the Site, a generalized cross-

section would be characterized by steep banks, descending to a flat bottom at approximately 45 feet bmsl (North American Vertical Datum [NAVD] 1988).

The tidal influence in the estuary can be observed by the variations in stage and discharge over a complete tidal cycle. Just south of the Federal Dam (approximately 36 miles upstream of the Site), the average range in tidal elevation is 4.7 feet, and at the Site, the elevation change is estimated at 4.1 feet (BBL 2002c). The direction of flow in the estuary reverses four times daily, except during high flows in the spring, which can overshadow the tidal influence. Also, strong north and south winds can significantly influence the river stage. The 100-year flood elevation is 12 feet above mean sea level (amsl), which is above most of the upland areas bordering OU2 (Federal Emergency Management Agency [FEMA] 1989).

1.3 Report Organization

The remainder of this FS Report is organized into the following sections:

- Section 2 - Summary of RI and Exposure Assessment – Discusses OU2 investigations, nature and extent of MGP-related constituents in OU2 sediments, and potential human and ecological exposure to OU2 sediments.
- Section 3 - Standards, Criteria, and Guidance – Identifies the standards, criteria, and guidance (SCGs) that have been identified as potentially applicable for OU2.
- Section 4 - Remedial Action Objectives – Presents the RAOs for OU2 sediments.
- Section 5 - Development of General Response Actions and Screening of Technologies – Identifies areas potentially subject to remediation, estimated material quantities, and general response actions (GRAs), and presents the screening of technologies and associated process options.
- Section 6 - Development and Evaluation of Remedial Alternatives – Presents the sediment remedial alternatives, criteria used to evaluate the alternatives, and detailed analysis of each alternative against the evaluation criteria.
- Section 7 - Comparative Analysis – Presents a comparative analysis of each alternative and identifies the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria.

- Section 8 - Recommended Remedy – Identifies the recommended remedial alternative for OU2 sediments.
- Section 9 - References – Provides a list of references cited throughout this FS Report.

2 Summary of RI and Exposure Assessment

The following subsections summarize the investigations that have been completed for OU2, summarize the nature and extent of MGP-related sediment impacts based on the Site data, and describe the potential human and ecological exposure to OU2 sediments.

2.1 RI Summary

Between 1995 and 2009, numerous sediment investigations were completed within OU2 to evaluate the nature and extent of MGP-related constituents, including the spatial distribution of PAHs and NAPL, in Site sediments. These investigations have also included an evaluation of the bioavailability and potential toxicity of PAHs in the OU2 sediments, assessments of the health of the macroinvertebrate community, and evaluations of the extent of natural recovery of sediments containing Site-related PAHs following completion of the OU1 remedial activities. A summary of the OU2 sediment investigations completed from 1995 to 2009 is presented below.

- **Phase I Investigation** – The Phase I Investigation was conducted by BBL in November 1995 and included the advancement of 18 sediment borings in the Hudson River upstream, adjacent to, and downstream of Embayment #1. Two background sediment borings were also advanced at locations approximately 1 mile upstream of the Site. Sediment samples were collected for analysis of geotechnical parameters, VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), inorganics, Resource Conservation and Recovery Act (RCRA) characteristics, diesel fuel, kerosene, presence of lube oil, presence of gasoline, total petroleum hydrocarbons (TPH), total organic carbon (TOC), heating value, and percent sulfur. The results of the Phase I sediment investigation activities were presented in the Site Investigation Data Report (Phase I Data Report; BBL 1996).

- **Phase II Investigation** – The Phase II Investigation was conducted by BBL during August and September 1996 and included the advancement of 12 sediment borings: three within Embayment #2 and nine in the Hudson River downstream of Embayment #2. During the investigation sediment samples were collected and analyzed for Lead-210 (^{210}Pb), Cesium-137 (^{137}Cs), and Beryllium-7 (^{7}Be), VOCs, SVOCs, inorganics, PCBs, RCRA characteristics, TOC, TPH, and geotechnical parameters. The results of the Phase II sediment investigation were presented in the Phase II Site Investigation Report (Phase II Report; BBL 1997).

- **Phase III Investigation** – The Phase III Sediment Investigation was conducted by BBL during March and April 1998 and included the advancement of 14 sediment borings in the Hudson River near the eastern shore south of the Site and across the shipping channel along the western shore of the Hudson River. Sediment samples were collected for laboratory analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX); PAHs; and inorganics. Data collected from the Phase III Sediment Investigation were presented in the SIR (BBL 2000).

- **2000 Sediment Investigation** – In August 2000, TAMS Consultants (TAMS) was retained by the NYSDEC to perform an assessment at the Conrail Site (now CSX Transportation property). As part of this assessment, nine sediment samples were collected from Embayment #3 and three samples were collected from Embayment #4. Sediment samples were collected and analyzed for VOCs, SVOCs, PCBs, pesticides, and inorganics. Data collected during the TAMS sediment investigation are presented in the Draft Site Assessment Report, Conrail Site, City of Hudson, New York. Site No. 4-11-013 (TAMS 2000).

- **Embayment #2 Investigation** – The Embayment #2 investigation activities were conducted by BBL in 2001 and included the advancement of eight sediment borings within Embayment #2. During the investigation, sediment samples were collected for laboratory analysis for BTEX, PAHs, PCBs, RCRA metals, and TOC. Data collected during the Embayment #2 investigation are presented in the Embayment #2 Investigation Report (BBL 2002a).

- **2002 Sediment Investigation** – The 2002 sediment investigation was conducted by BBL from April to June 2002 and included the advancement of 45 sediment borings (13 previously sampled locations, 22 new locations, and 10 background locations). The investigation included geophysical surveys, physical characterization of sediments, geotechnical analyses, chemical characterization of sediments (PAHs, TOC), in-situ vane shear testing, geochronological sampling (sediment dating), and a benthic macroinvertebrate survey. The results of the 2002 sediment investigation were presented in the 2003 CSIR (BBL 2003a).

- **2003-2006 PAH Bioavailability and Sediment Toxicity Investigation Activities-** Previous work characterizing the bioavailability and potential toxicity of PAHs in Site sediments was conducted by The RETEC Group, Inc. (RETEC) in 2003, 2005, and 2006 and included the collection of sediment samples from 26 locations within OU2. Surface sediment (0 to 6 inches) was collected from each location and analyzed for total extractable and pore water PAHs. Of the 26 locations

sampled, a total of 17 locations were selected for toxicity testing based on the total extractable and pore water PAH data. The results of the bioavailability and sediment toxicity investigation activities conducted from 2003 to 2006 are presented in the report titled Characterization of the Bioavailabilty and Toxicity of PAHs in Aquatic Sediments near the Hudson MGP Site, Hudson, New York (RETEC 2007).

- **2007 Supplemental Sediment Sampling Activities** – The 2007 Supplemental Sediment Sampling Activities were conducted by BBL (an ARCADIS Company) in October 2007, and included the advancement of seven sediment borings. As requested by the NYSDEC, sediment cores were collected from the "The Spirit of Hudson" dock area, outside the mouth of Embayment #1, and just offshore of the peninsula between Embayment #1 and Embayment #2. Laboratory analyses included PAHs, forensic PAHs, and TOC. The results of the 2007 supplemental sediment sampling activities are presented the 2007 Supplemental Sediment Sampling Letter Report, dated April 11, 2008 (Supplemental Sampling Letter Report; ARCADIS 2008b).

- **OU2 Sediment Monitoring Program** – The OU2 Sediment Monitoring Program consisted of three sampling events (2007, 2008, and 2009) to monitor the natural recovery of Site sediments containing MGP-related constituents following completion of the OU1 remedial activities in 2005. The sediment monitoring activities have included collecting surface sediment samples from 16 monitoring stations located upstream of, adjacent to, and downstream of Embayment #1 and from three locations within Embayment #2. The results of the 2007 and 2008 sediment monitoring activities are presented in the First and Second Year Letter Reports, respectively. The third and final round of sediment monitoring was performed in conjunction with the 2009 SSI Activities (described below), and the results were presented in the Revised CSIR.

- **2009 SSI Activities –** The 2009 SSI Activities were conducted by ARCADIS and GEI, on behalf of National Grid, in October 2009. The investigation consisted of three interrelated components including:

    - The third (and final) round of the OU2 Sediment Monitoring Program.
    - A program to further evaluate the bioavailability and potential toxicity of PAHs in surface sediments. As part of the evaluation, a total of 62 samples (53 locations within OU2 and nine reference locations) were collected. Surface sediment (0 to 6 inches) was collected from each

location and analyzed for total extractable and pore water PAHs. Of the 62 locations sampled, a total of 41 locations (nine reference locations and 32 Site locations) were selected for toxicity testing based on the total extractable and pore water PAH data. The results of the bioavailability and sediment toxicity investigation activities are presented in the report entitled Characterization of the Bioavailablity and Toxicity of PAHs in Aquatic Sediments at OU2 – Hudson (Water Street) Former MGP Site (GEI and Foth 2010), which is contained in Appendix A of the Revised CSIR.

- A program to delineate the horizontal and vertical extent of NAPL. A total of 22 TarGOST™ borings were advanced into the subsurface sediment within OU2. To verify and calibrate the information obtained from the TarGOST™ system, five confirmation borings were advanced at select TarGOST™ locations. Confirmation borings were advanced using direct-push techniques, and a 2-foot split-spoon sampler was used to extract sediment cores to the depth of the TarGOST™ boring. The recovered sediment cores were visually observed for sediment types/characteristics and the presence/absence of NAPL, sheens, staining, and odors. To complete the NAPL delineation activities, historical sediment sampling boring logs were reviewed for notations of visual indications of NAPL (e.g., sheen, staining, tar, free product, blebs).

The results of the 2009 SSI Activities, as well as a comprehensive summary of the previous sediment investigations completed at the Site from 1995 to 2008, are presented in the Revised CSIR.

2.2 Nature and Extent of COCs

As described above and in the Revised CSIR, many sediment samples have been collected at the Site to characterize the nature and extent of former MGP constituents and to assess the bioavailability and potential toxicity of MGP-related constituents. The primary constituents of concern in OU2 sediments are NAPL, PAHs, and (to a lesser extent) BTEX. The distributions of other constituents within the OU2 sediments are independent of PAH distribution; therefore, the other constituents are assumed to be the result of other urban/industrial sources and are not attributable to the former MGP operations at the Site.

NAPLs in OU2 sediments are primarily located along the slope adjacent to Embayment #1 and in a small portion of the shipping channel. NAPL and staining were also

observed near the mouth of Embayment #2. NAPL was not observed in the sediments in Embayment #3 or Embayment #4. Deeper NAPL impacts were observed along the shoreline; the depth to NAPL decreases to the west as the river bottom slopes steeply toward the shipping channel. The horizontal and vertical extent of NAPL and staining is depicted on Figure 2-1.

In general, higher PAH concentrations are associated with sediments containing NAPL and exhibiting staining near Embayment #1 (Figure 2-2). Total "priority pollutant" polycyclic aromatic hydrocarbon (PPPAH)[1] concentrations in both the surface and subsurface sediments are highest in the vicinity of Embayment #1, generally increasing from north to south toward Embayment #1, peaking near the mouth of Embayment #1, and then decreasing southward, downstream of Embayment #1. West of Embayment #1, the highest PPPAH concentrations were observed on the slope between the shore and the shipping channel. In general, total PPPAH concentrations decrease to the north, west, and south of the NAPL-impacted area. At several locations to the south and north of the NAPL-impacted area, and in Embayment #4, PPPAH concentrations approach background levels. Compositionally, PAH concentrations transition from Site-related to background just south and just north of the NAPL-containing sediment area. In Embayment #2, PAHs are characteristic of background (MPE2-1 and MPE2-3) and petroleum (MPE2-2). PAH compositional evaluation and the known presence of a storm water sewer outfall within Embayment #3 together indicate that PAHs in sediments within Embayment #3 are primarily the result of urban/industrial sources not related to the former MGP. With respect to BTEX, the occurrence of higher concentrations correlates to the locations with higher concentrations of PAHs.

As presented in the Revised CSIR, the characterization of the bioavailability and toxicity of PAHs in Site sediments indicates that the PAHs are not as toxic to benthic aquatic organisms as is currently assumed by the NYSDEC regulatory guidance for screening contaminated sediments (Effects Range Low [ERL]). The Lowest Observed Effects level (LOEL) total PAH_{16} concentration associated with a significant reduction in amphipod survival was 112 milligrams per kilogram (mg/kg; HD142). However, sediment samples with total PAH_{16} concentrations as high as 566 mg/kg (HD151) showed no significant reductions in *H. azteca* survival. The previous work indicates that

[1] PPPAH is used to distinguish the sum of the 16 priority pollutant PAHs (PAH_{16}) by standard USEPA Method 8270C from the measurement of these PAHs for the bioavailability evaluations by other methods.

solid-phase microextraction (SPME) pore water TU_{34} concentrations[2] were a more accurate predictor of *H. azteca* survival than total PAH_{16} concentrations. The Site-specific threshold value[3] for Hudson was approximately 5.4 SPME pore water TU_{34}. The relatively high fraction of Soot Organic Carbon (SOC)/TOC in the sediment samples (up to 90% in some Site sediment samples) provides an explanation for why the ERL/ERM screening values for total PAH_{16} concentrations do not predict biological effects. The PAHs are much more strongly bound to sediment organic carbon than is assumed by the standard equilibrium partitioning assumptions, because PAHs sorb to anthropogenic sources of "hard" organic carbon (e.g., charcoal, soot, coal or coke fines, or coal tar pitch) more strongly than to natural sources of "soft" organic carbon (e.g., natural organic matter). As a consequence, the total PAH_{16} concentration is not bioavailable. By contrast, the direct measurement of sediment pore water (SPME pore water TU_{34}) only measures the concentration of PAHs that partition from the solid phase (i.e., sediment) to the dissolved phase (i.e., pore water). It is this bioavailable fraction which drives exposure, and is therefore a better predictor of biological effects (e.g., *H. azteca* survival).

The weight-of-evidence assessment of sediment chemistry, toxicity testing, and benthic macroinvertebrate survey shows that only the seven Site sediment samples (HD-142, HD-143, HD-146, HD-147, HD-148, HD131 and HD138) with both SPME pore water TU_{34} concentrations greater than the Site-specific threshold of 5.4 and significant reduction in *H. azteca* survival pose a potential risk to benthic macroinvertebrates at the Site. Five of these sample locations correspond to a localized region adjacent to Embayment #1, and two sample locations correspond to an area slightly downriver (just outside the mouth of Embayment #2), as shown on Figure 2-3. These areas of potential sediment toxicity, together with the sediments containing NAPL, are referred to as the Area for Remedial Consideration (ARC) in this FS. Conversely, potential risks to the environment were not identified outside the ARC in the area referred to as the 4 mg/kg PAH Area (Note: NYSDEC requested for purposes of this FS that consideration be given to the area of sediments with total PAH

[2] Sediment pore water concentrations of the 34 National Oceanic and Atmospheric Administration (NOAA) PAHs measured using SPME and expressed as toxic units (SPME pore water TU_{34}), per USEPA (2003) and ASTM Method D7363-07.

[3] the Site-specific threshold of 5.4 is the 95 percent confidence interval for the Lethal Dose, 20 percent (LD_{20}), or the concentration required to kill 20 percent of the test organism population after 28 days)

concentrations greater than 4 mg/kg, which is the ERL concentration presented in the NYSDEC Technical Guidance for Screening Contaminated Sediments [1999]).

2.3 Exposure Assessment

The exposure assessment identifies potentially complete exposure pathways (both human health and ecological) for OU2. An exposure pathway is complete when all of the following five elements are documented: 1) contaminant source; 2) contaminant release and transport mechanisms; 3) point of exposure; 4) route of exposure; and 5) receptor population (NYSDOH 2009). If any one of these elements is missing, the exposure pathway is not complete and exposure cannot occur.

2.3.1 Human Health Exposure Assessment

The potential for human exposure associated with MGP constituents in OU2 is considered to be low due to the existing land use and the physical attributes that prohibit exposure. The rocky shoreline with steep (in some areas vertical due to the presence of concrete or steel bulk heads) banks and deep water with swift currents presents little or no potential for wading or swimming within the Site. Therefore, the potential for direct contact with MGP-impacted sediment by recreational users of the river is extremely low.

Potential exposure via ingestion of MGP constituents from consumption of fish is also expected to be unlikely given the existing NYSDOH-issued consumption advisory for fish for this area of the Hudson River.

Construction workers (e.g., dredging or marine contractors) could be potentially exposed to sediments containing MGP constituents via incidental direct contact with, ingestion of, and/or inhalation of organic vapors from, MGP-impacted sediments if the sediments are raised to the surface. The potential exposure of workers to sediments containing MGP constituents could be mitigated by the use of standard health and safety practices, including the use of appropriate personal protective equipment (PPE), as well as standard sediment management practices. These practices could be set forth in a Site Management Plan (SMP).

2.3.2 Fish and Wildlife Exposure Assessment

Potential ecological receptors include aquatic and semi-aquatic organisms. Potential exposure pathways include direct contact with sediment and indirect exposure to MGP constituents by consuming contaminated organisms. Aquatic organisms can

ingest PAHs from the water column and from PAH-impacted food, and to a lesser degree from sediment transfers. When PAHs are consumed from water, food, or sediments, the PAHs are rapidly metabolized and excreted by most fish and crustaceans, although biotransformation and excretion rates can vary among species (Brooks 1997; Meador 1995; Varanasi et al. 1989). These exposure pathways are potentially complete. The potential for exposure of ecological receptors may increase in the future should dredging or other activity disturb and mobilize impacted sediments or NAPL into the water column.

The similarity in benthic macroinvertebrate richness and diversity between Site and reference sample locations indicates, with the exception of two sample locations containing NAPL, that Site conditions have not significantly impacted the benthic organisms found in the Hudson River at the Site. Furthermore, of 32 Site samples selected for the bioavailability demonstration project in 2009, only seven samples have both: 1) SPME pore water TU_{34} concentrations greater than the Site-specific threshold of 5.4; and 2) significant reduction in *Hyalella azteca* survival. It is exposure to sediment represented by these samples (Figure 2-3) that poses a potential risk to benthic macroinvertebrates at the Site (ARCADIS et al. 2010). All of these sample locations lie within the NAPL-impacted portion of OU2).

The short-nose sturgeon (endangered) is known to occur in the Hudson River and is listed on the U.S. Fish and Wildlife Service (USFWS) list of Threatened, Endangered, Sensitive Species for Columbia County (USFWS 2011). However, given the relatively small area of MGP impacts in the Site sediments in comparison to the overall size of the available habitat area of the Hudson River, the area adjacent to the Site is not likely to provide significant habitat for sturgeon.

3 Standards, Criteria, and Guidance

This section identifies the SCGs that have been identified as potentially applicable for OU2.

3.1 Definition of Standards, Criteria, and Guidance

"Standards and criteria" are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance.

"Guidance" are non-promulgated criteria, advisories, and/or guidance that are not legal requirements and do not have the same status as "standards and criteria"; however, remedial programs should be designed with consideration given to guidance documents that, based on professional judgment, are determined to be applicable to the project (6 NYCRR 375-1.8[f][2][ii]).

SCGs will be applied so that the selected remedy will conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated; and that are either directly applicable, or that are not directly applicable but relevant and appropriate, unless there is good cause (as defined in 6 NYCRR 375-1.8 [f][2][i]) for deviation.

3.2 Types of SCGs

The SCGs considered for the potential remedial alternatives identified in this FS were categorized into the following classifications:

- *Chemical-Specific SCGs* – These SCGs are usually health- or risk-based numerical values or methodologies which, when applied to Site-specific conditions, result in the establishment of numerical values for each MGP-related constituent of interest. These values establish the acceptable amount or concentration of constituents that may be found in, or discharged to, the environment.

- *Action-Specific SCGs* – These SCGs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and Site cleanup.

- *Location-Specific SCGs* – These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

3.3 Identification of Applicable SCGs

The SCGs identified for the evaluation of remedial alternatives are presented below.

3.3.1 Chemical-Specific SCGs

The potential chemical-specific SCGs for the Site are summarized in Table 3-1. No cleanup standards, criteria, or limitations are currently promulgated under federal or state laws that specifically address concentrations of hazardous substances in sediment. However, technical guidance to be considered for Site sediment includes the NYSDEC Technical Guidance for Screening Contaminated Sediments (1999). The 1999 NYSDEC guidance is applicable to the Site in that it provides a methodology for establishing screening criteria to be used to identify sediment that may potentially result in harmful effects to marine and aquatic ecosystems. The document also provides guidance when evaluating risk management options for contaminated sediment and when determining final contaminant concentrations that will be achieved through remedial efforts. According to the 1999 guidance, sediments with concentrations of constituents that exceed the listed screening levels are considered potentially impacted, but the screening levels do not necessarily represent remediation clean-up levels.

As specifically stated, “Once it has been determined that a sediment criterion is exceeded, more information is required to determine if remediation is necessary and what actual risks to the environment are present. The volume and location of sediment exceeding a criterion, which levels of protection are exceeded, the persistence of the contaminant, the uncertainty about the criteria, and the results of more detailed, site-specific sediment tests all play a role in making decisions about how, and how much sediment to clean up in order to eliminate or minimize adverse effects.” Consistent with this guidance, and as requested by NYSDEC, Site-specific bioavailability and toxicity assessments (as discussed in Section 2.2) were completed by National Grid at the Site. As noted in Section 2.2, the results of this work to date indicate that the NYSDEC sediment screening value of 4 mg/kg Total PAHs (TPAHs; a sediment screening criteria for TPAHs presented in the 1999 NYSDEC guidance document that is commonly requested for consideration by the NYSDEC) is overly conservative. Further, sediment PAH bioavailability research conducted on MGP sites in New York State through funding and support by National Grid and the Northeast Gas Association

indicates that selecting a global number for TPAH remediation for all sites is not appropriate, but rather a Site-specific determination of the remedial scope based on toxicity to benthic organisms at each individual site is more appropriate. As such, based on the bioavailability study work performed in 2009, National Grid has established a Site-specific SPME pore water TU_{34} threshold of 5.4.

The Hudson River at the Site is classified by NYSDEC as Class A fresh water (NYSDEC 2008a) and, as such, the New York State Surface Water and Groundwater Quality Standards (6 NYCRR Parts 700-705) are potentially applicable to the Site. Specifically, 6 NYCRR Part 703.2 Narrative Water Quality Standards identifies the surface water quality standards that need to be met during in-water activities, such as turbidity and generation of sheens. In addition, guidance potentially applicable to determining ambient water quality at the Site includes the NYSDEC's Division of Water, TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NYSDEC, reissued June 1998 and addended April 2000 and June 2004).

Chemical-specific SCGs that potentially apply to the waste materials generated during remedial activities are the RCRA and New York State regulations regarding the identification and listing of hazardous wastes outlined in 40 CFR 261 and 6 NYCRR Part 371. Included in these regulations are the regulated levels for toxicity characteristic leaching procedure (TCLP) constituents. The TCLP constituent levels are a set of numerical criteria at which solid waste is considered a hazardous waste by the characteristic of toxicity. In addition, the hazardous characteristics of ignitability, reactivity, and corrosivity may also apply, depending upon the results of waste characterization activities.

Another set of chemical-specific SCGs that may apply to waste materials generated at the Site (e.g., sediment that is excavated and determined to be a hazardous waste) are the USEPA Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs), as listed in 40 CFR Part 268. These standards and restrictions identify hazardous wastes for which land disposal is restricted and define acceptable treatment technologies or concentration limits for those hazardous wastes on the basis of their waste code characteristics. The UTS/LDRs also provide a set of numerical criteria at which a hazardous waste is restricted from land disposal, based on the concentration of select constituents present. In addition, the UTS/LDRs define hazardous waste sediment and hazardous waste debris, and specify alternative treatment standards and treatment methods required to treat or destroy hazardous constituents on or in hazardous waste debris.

Because MGP wastes resulted from historical operations that ended before the passage of RCRA, MGP-impacted sediment is only considered a hazardous waste in New York if it is removed (generated) and exhibits a characteristic of a hazardous waste. However, if the MGP-impacted sediment only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste management requirements (6 NYCRR Parts 370-374 and 376) when destined for thermal treatment, in accordance with the requirements set forth in NYSDEC's DER-4 TAGM HWR-4061, Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants (NYSDEC 2002). If MGP-related hazardous wastes are destined for land disposal in New York, the state hazardous waste regulations apply, including LDRs and alternative LDR treatment standards for hazardous waste described above.

The USEPA's "Contained-in Policy" includes guidance potentially applicable to OU2 of the Site. Pursuant to this "Contained-in Policy," environmental media (including, but not limited to, sediment) and debris impacted by a hazardous waste are subject to RCRA hazardous waste management requirements until they no longer contain the hazardous waste. Specifically, environmental media/debris that has been impacted by a release of characteristic hazardous waste must be managed as hazardous waste until the media/debris no longer exhibits that characteristic (based on laboratory testing). UTS/LDR requirements will continue to apply for the waste in accordance with 40 CFR Part 268.

In addition, environmental media/debris containing a listed hazardous waste must be managed as hazardous waste until the media/debris no longer contains the listed hazardous waste at concentrations exceeding health-based levels. Under certain circumstances, the UTS/LDR requirements might continue to apply. Although USEPA has not established generic health-based "contained-in" levels for listed hazardous wastes, individual states have been authorized to establish their own levels. The NYSDEC has established "contained-in" criteria for environmental media and debris, which are presented in NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 3028 titled Contained-In Criteria for Environmental Media; Soil Action Levels (NYSDEC 1997a).

3.3.2 Action-Specific SCGs

The potential action-specific SCGs for the Site are summarized in Table 3-2. Action-specific SCGs include general health and safety requirements and general requirements regarding handling and disposing of waste materials generated during

implementation of the selected remedial alternative (including transportation and disposal, permitting, manifesting, and disposal and treatment facilities).

Guidance potentially applicable to the Site includes the NYSDEC Division of Air Resources (DAR) policy document DAR-1: Guidelines for the Control of Toxic Ambient Air Contaminants (formerly issued as Air Guide 1; NYSDEC 1997b). DAR-1 incorporates applicable federal and New York State regulations and requirements pertaining to air emissions, which may be applicable for sediment alternatives that result in certain air emissions. Community air monitoring may be required in accordance with the NYSDOH Generic Community Air Monitoring Plan (CAMP). New York Air Quality Standards provide quality requirements for air emissions (6 NYCRR Part 257). Emissions from remedial activities will meet the air quality standards based on the air quality class set forth in the Air Quality Classification System for New York State, or more specifically, for Columbia County (6 NYCRR Parts 256 and 269) and the permit requirements set forth in New York Permits and Certificates (6 NYCRR Part 201).

One set of potential action-specific standards for the Site consists of the LDRs, which regulate land disposal and established UTSs of hazardous wastes. The UTSs/LDRs are applicable to alternatives involving the off-site treatment and disposal of hazardous wastes (if any). Because MGP wastes resulted from historical operations that ended before the passage of RCRA, MGP-impacted sediment is only considered a hazardous waste in New York if it is removed (generated) and exhibits a characteristic of a hazardous waste. However, if the MGP-impacted sediment only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste management requirements (6 NYCRR Parts 370-374 and 376) when destined for thermal treatment, in accordance with the requirements set forth in NYSDEC's DER-4 TAGM HWR-4061, Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants (NYSDEC 2002). If MGP-related hazardous wastes are destined for land disposal in New York, the state hazardous waste regulations apply, including LDRs and alternative LDR treatment standards for hazardous waste.

Section 404 of the Clean Water Act (CWA) establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality, and Section 401 of the CWA requires a 401 Water Quality Certification permit be obtained for those activities that may result in a discharge to the Hudson River. The New York State Pollutant Discharge Elimination System (SPDES) administered under the National Pollutant Discharge Elimination System (NPDES) Program establishes permitting requirements for point source discharges that may occur during the

treatment and disposal of water generated during remedial activities along the Hudson River.

The NYSDEC will no longer allow amendment of sediment at MGP sites with lime kiln dust/quick lime containing greater than 50 percent calcium/magnesium oxide due to vapor issues associated with free oxides. A letter from the NYSDEC to the New York State utility companies, dated May 20, 2008, indicated that lime kiln dust/quick lime will not be permitted for use during future remedial activities (NYSDEC 2008b).

Additional standards potentially applicable to the Site include the United States Department of Transportation (USDOT) and New York State rules for the transport of hazardous materials, which are provided under 49 CFR Parts 107 and 171.1 through 172.558, and 6 NYCRR 372.3. These rules include procedures for packaging, labeling, manifesting, and transporting hazardous materials, and would be potentially applicable to the transport of hazardous materials under any remedial alternative. New York State requirements for waste transporter permits are included in 6 NYCRR Part 364, as well as standards for the collection, transport, and delivery of regulated wastes within New York. Contractors transporting waste materials off site during implementation of the selected remedial alternative would need to be properly permitted.

A remedial alternative conducted within the Site would need to comply with applicable requirements outlined under the Occupational Safety and Health Administration (OSHA). General industry standards are outlined under OSHA law (29 CFR 1910) that specify time-weighted average concentrations for worker exposure to various compounds and training requirements for workers involved with hazardous waste operations. The types of safety equipment and procedures to be followed during site remediation are specified under 29 CFR 1926, and recordkeeping and reporting-related regulations are outlined under 29 CFR 1904. Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations (29 CFR 1910.120) will also be followed during Site remediation.

In addition to the requirements outlined under OSHA, the preparedness and prevention procedures, contingency plan, and emergency procedures outlined under RCRA (40 CFR 264) are potentially applicable standards to those remedial alternatives that include the generation, treatment, or storage of hazardous wastes.

3.3.3 Location-Specific SCGs

The potential location-specific SCGs for the Site are summarized in Table 3-3. Examples of potential location-specific SCGs include regulations and federal acts

concerning activities conducted in floodplains, wetlands, and historical areas, as well as activities affecting navigable waters and endangered/threatened or rare species. Location-specific SCGs also include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any), and influent requirements of publicly owned treatment works (POTW) if water is treated within the Site and discharged to these facilities. These potential SCGs are discussed in further detail below.

The Site is located within an area included in the City of Hudson's LWRP, and as such, will require a Coastal Consistency Review through the New York Department of State. In addition, a site-specific review may be required under the State Environmental Quality Review Act (SEQRA).

Because the Site is located within the 100-year floodplain of the Hudson River, federal floodplain management laws and regulations are potential standards for remedial alternatives that would include staging of materials and dewatering of dredged sediments within the floodplain. Federal requirements for activities conducted within floodplains are provided in 40 CFR, Part 6, Appendix A.

The Hudson River is a navigable waterway, and as such, Section 10 of the Rivers and Harbors Act and Section 401 of the CWA are potential standards for sediment remediation activities. The following permits from the USACE and NYSDEC would likely be required:

- NWP #38 authorization, for "specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority"
- 401 Water Quality Certification

In addition, a Protection of Waters Permit under 6 NYCRR Part 608 would be required for remedial alternatives involving placing a cap in the navigable waters of the Hudson River below the mean high water level.

The Indiana bat (*Myotis sodalis*; endangered), the New England cottontail rabbit (*Sylvilagus transitionalis*; candidate), and the bog turtle (*Glyptemys muhlenbergii*; threatened) are included on the USFWS list of Threatened, Endangered, Sensitive Species for Columbia County, New York (USFWS 2011). Even though the presence of these species will likely not affect the timing and environmental controls associated with potential sediment remedial activities they will still be listed for consideration under

the location-specific SCGs. The short-nose sturgeon (*Acipenser brevirostrum*; endangered) is known to occur in the Hudson River near the Site and is listed on the USFWS list of Threatened, Endangered, and Sensitive Species for New York. The presence of this species may affect the timing of, and requirements for environmental controls associated with any potential sediment remedial activities. Specifically, activities that disturb habitat and are potentially dangerous to the short-nose sturgeon during the spawning migration require using containment/netting to protect the short-nose sturgeon by keeping them away from the potentially detrimental activities. The time frame established to protect the short-nose sturgeon during spawning migration is April 1 through September 30.

In addition, The National Register of Historic Places website was accessed (National Park Service 2011) and a location search for Hudson, New York was performed. No records were present for historical sites adjacent to the MGP site; however, the Athens Lighthouse is located approximately 0.5 mile downriver of the Site (south of Middle Ground Flats) and the Front St. – Parade Hill – Lower Warren St. Historic District is located approximately 0.2 mile to the north of the Site. Six sites were located within the National Registry Information System (NRIS) within 1.0 mile of the Site. The NRIS sites include:

- Front St. – Parade Hill – Lower Warren St. Historic District, Front St. and Warren St. – NRIS # 70000420
- Athens Lighthouse, South of Middle Ground Flats - NRIS # 79003796
- Cornelius H. Evans House, 414-416 Warren St. – NRIS # 74001226
- U.S. Post Office, 402 Union St. – NRIS # 88002508
- Hudson Historic District, roughly bounded by Warren St. and State St., Eighth St. and Seventh St., E. Allen St. and Allen St., and Penn Central Railroad –NRIS # 85003363
- Historic Houses, 37-47 N. Fifth St. –NRIS # 03001142

Location-specific SCGs also potentially include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any) and influent/pre-treatment requirements of the local POTW. If removal activities require a building permit, efforts will be coordinated with the City of Hudson Public Works Department. If treatment of water occurs at the Site, the City of Hudson's Code Part II Chapter 240 (codes and regulations for sewers) may also be applicable.

4 Remedial Action Objectives

This section presents the RAOs for OU2 sediments containing MGP-related constituents. The RAOs represent goals that, if met, would be protective of public health and the environment (NYSDEC 2010). These RAOs were developed, in consultation with the NYSDEC, by considering: 1) the results of the Site investigation activities, including the nature and extent of MGP-related constituents and MGP-related materials (e.g., MGP-related coal tar), exposure pathways, and receptors; 2) potential SCGs; 3) generic sediment RAOs included in DER-10; and 4) current and foreseeable future uses of the Site. The RAOs were presented to NYSDEC in a letter dated August 30, 2010 (Appendix A), and were subsequently approved by the NYSDEC on October 27, 2010 in a letter from Mr. Anthony Karwiel to Mr. William R. Jones of National Grid (also presented in Appendix A),

The RAOs for the Site are as follows:

- To eliminate or reduce, to the extent practicable, the potential for human contact with MGP-related coal tar (NAPL) and MGP-impacted sediments
- To eliminate or reduce, to the extent practicable, the release(s) of contaminant(s) from MGP tar and MGP-impacted sediments that would result in surface water concentrations in excess of surface water quality standards
- To eliminate or reduce, to the extent practicable, impacts to biota due to ingestion of/direct contact with MGP tar and MGP-impacted sediments that would cause toxicity or bioaccumulation through the marine or aquatic food chain

Potential remedial alternatives will be evaluated based on their ability to meet the RAOs and be protective of public health and the environment.

5 Development of General Response Actions and Screening of Technologies

This section uses the results of previous investigations to identify potential remediation areas and determine estimated material quantities in those areas. Following estimation of areas and volumes, this section identifies GRAs that may be utilized to meet the RAOs set forth in Section 4 of this FS for the sediment at the Site. For each GRA that is identified, a series of technology types and associated process options is identified and evaluated.

5.1 Estimate of Areas and Volumes of Contaminated Sediment

Results of the remedial investigations conducted at the Site between 1995 and 2009 were used to conservatively estimate the area of sediments where remediation may be warranted to address the RAOs. Specifically, the OU2 sediment ARC (Figure 5-1) was developed to encompass sediments containing NAPL (that could result in the generation of sheens on the water surface if disturbed) and sediments identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates. The extent of the ARC was defined using a combination of analytical results and field observations, as follows:

1. Plotting the locations where NAPLs and potentially toxic sediment were observed in surface and/or subsurface sediments

2. Determining the next closest sampling locations where NAPLs/potentially toxic sediments were not observed (considering also whether the sample extended deep enough to encounter potential NAPL impacts)

3. Drawing a conservative outermost extent of the NAPL/potentially toxic sediment area by connecting the sample locations described in Step 2 above

The sample locations used to determine the conservative outermost extent of the ARC are presented in Table 5-1 below.

Table 5-1 - Sample Locations used to Determine the Outermost Extent of the Area for Remedial Consideration

Sample Location (Depth)	Comments
T-18 (18.68), SD-16 (10)	No NAPLs/potential NAPLs (based on TarGOST) observed.
SD-12 (14)	No NAPLs observed.
T-16 (18.81)	No potential NAPLs (based on TarGOST) observed.
HD-149 (0.5)	No NAPLs observed. This surface sample used to delineate potential NAPL (based on TarGOST) at the surface (0.03 foot) of T-13
HD-144 (0.5)	No NAPLs observed. This surface sample used to delineate potential NAPL (based on TarGOST) at the surface (0.03 foot) of T-13
T-10 (16.61)	Slightly elevated TarGOST reading at 8 to 8.2 feet; however, no NAPL observed in adjacent boring. Concluded no NAPLs present.
CB-T10 (18)	No NAPLs observed.
T-6 (8.39)	No potential NAPLs (based on TarGOST) observed.
T-5 (16.6)	No potential NAPLs (based on TarGOST) observed.
T2 (19.51)/ CB-T2 (20)	Slightly elevated TarGOST reading at 6.5 to 6.6 feet; however, no NAPL observed in adjacent boring. Concluded no NAPLs present.
SD-01 (5.5)	Some staining observed at 2 to 4 feet; no NAPL observed; TPAHs= 56.1 mg/kg; 2-4 feet) Concluded no NAPLs present.
T-21 (18.1)	No potential NAPLs (based on TarGOST) observed.
SD-59 (20)	Some staining observed at 7.5 feet; no NAPL observed; TPAHs= 263 mg/kg (6- 8 feet). Concluded no NAPL present.

The limits of ARC comprise an approximate 1.1-acre area. The actual area subject to remediation is expected to be smaller than the conservatively estimated area and could be further refined during PDIs.

At an FS scoping meeting on July 26, 2010, NYSDEC stated that according to 6 NYCRR Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, sediments cannot generate sheens on the water surface; therefore, any sheen-generating sediments would need to be addressed by the remedial alternatives presented in the FS. In particular, NYSDEC raised concern about the four sediment cores located downstream of Embayment #4 (SD-34, SD-35, SD-36, and SD-82) where sheens were reported in the upper 2 feet of sediment. The sediment core logs for those four cores were reviewed to determine if there was any additional information regarding the nature of the observed sheens. The results of that review are presented in Table 1 of Appendix A. In summary, all sheens noted on the surface of the sediment cores were described as either trace or light oil sheens, which are not considered to be significant and therefore would not be expected to result in generation of sheens on the water surface. In addition, the field notes from the more recent investigation activities completed from 2007 through 2009 (i.e., the three rounds of sampling performed as part OU2 Sediment Monitoring Program and the 2009 Supplemental Sampling Activities) were reviewed to determine if any sheens were observed on the water surface during the investigation activities (e.g., when retrieving samples from the river bottom or pulling barge spuds). The results of that review are presented in Table 2 of Appendix A. In summary, all locations where sheens or other NAPL impacts were observed on the water surface are within the boundary of the ARC with the exception of MPE2-3, which is at the far eastern side of Embayment #2. As stated in the Revised CSIR, PAH concentrations in sediments in Embayment #2 are typical for industrial/urban river sediments (MPE2-1 and MPE2-3) and characteristic of petroleum (MPE2-2).

Based on a review of sediment boring logs, NAPL-impacted sediments have been observed at the Site at depths ranging from 0 to 14 feet bss. The volume of NAPL-containing and potentially toxic sediment subject to remediation within the ARC is approximately 9,000 cy.

For purposes of this FS, the GRAs and remedial alternative development focuses on the ARC. However, as requested by the NYSDEC, the area of sediment with total PAH concentrations greater than the NYSDEC sediment screening guidance value of 4 mg/kg (the “4 mg/kg PAH Area”) has also been identified on Figure 5-1 (this area includes the entire ARC area). The limits of the 4 mg/kg PAH Area were established

as half the distance between sample locations with concentrations greater than 4 mg/kg PAHs and the next closest sample with concentrations less than 4 mg/kg PAHs, with the exception of the northwestern limit of the area. In this area the extent of PAHs with concentrations greater than 4 mg/kg could not be fully delineated due to restrictions placed on previous investigation activities by Mid-Hudson Cable due to the presence of the fiber-optic bundle cable (i.e., uncertainty regarding the exact location of the fiber-optic bundle cable increases with increasing distance from the shoreline into the Hudson River). The limits of the 4 mg/kg PAH Area comprise an approximately 6.1-acre area. Based on the available PAH data, PAHs at concentrations greater than 4 mg/kg were detected at sample depths of up to 14 feet bss. The volume of sediment exceeding 4 mg/kg PAHs is approximately 41,000 cy.

5.2 General Response Actions

GRAs describe those actions that can potentially achieve the RAOs established in Section 4 for the estimated areas and volumes of sediment identified in the ARC and the 4 mg/kg PAH Area. The purposes of these actions are to: (1) mitigate potential exposure to; (2) control the release of; and/or (3) remediate constituents of interest identified in Section 2.2.

Eight GRAs have been identified for sediments at the Site, as described below.

- *No Further Action (NFA)* – Under this GRA, no further action would be taken at the Site to treat, contain, or remove MGP-impacted sediments (including potentially toxic sediments) within the Hudson River adjacent to the Site.

- *Institutional Controls* – This GRA consists of implementing non-intrusive controls to reduce the potential human exposure to MGP-impacted sediments, and to regulate actions that may jeopardize the effectiveness of other remedial alternatives such as those involving in-place containment. Institutional controls can be in the form of governmental controls, proprietary controls, enforcement and permit controls, and/or informational devices.

- *In-Situ Treatment* – This GRA involves addressing MGP-impacted sediment by in-place treatment to remove or otherwise alter the constituents of interest.

- *In-Situ Containment/Controls* – This GRA consists of containing/controlling MGP-impacted sediments without removing or otherwise treating the media.

- *Removal* – This GRA consists of removing MGP-impacted sediment from the river bottom via excavation/dredging.
- *Ex-situ On-Site Pre-Treatment, Treatment, and/or Disposal* – This GRA includes the on-Site treatment of MGP-impacted sediments following removal of those sediments from the river.
- *Off-Site Treatment and/or Disposal* – This GRA includes the off-site treatment/disposal of MGP-impacted sediments once they have been removed from the river.
- *Residual Management* – This GRA consists of managing residual wastes generated as a result of other remedial technologies, including, but not limited to managing water, remedial construction debris, and decontamination wastes.

The No Further Action GRA is carried forward through the FS to serve as a baseline against which other remedial alternatives are evaluated. This approach is consistent with the applicable state and federal guidance and is required by the NCP [§300.430(e)(6)]. The identification and screening of technologies within each of the GRAs is discussed below in Section 5.3.

5.3 Identification and Screening of Remedial Technologies and Process Options

For each GRA, potentially applicable remedial technology types and technology process options were identified and screened, as presented in the following subsections, to identify those that could be implemented and potentially effective at achieving the RAOs established for the Site.

5.3.1 Identification of Remedial Technologies and Process Options

For each GRA, potentially applicable remedial technology types and technology process options were identified based on a review of available literature, as well as consideration of professional judgment and experience at similar sites. The available literature search included the following documents:

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA 1988)
- Remediation Technologies Screening Matrix and Reference Guide (USEPA and USAF 1993)

- Evaluation of Technologies for In-Situ Cleanup of DNAPL Contaminated Sites (USEPA 1994a)
- Management of Manufactured Gas Plant Sites (Gas Research Institute 1996)
- Assessment and Remediation of Contaminated Sediments (ARCS) Program, Remediation Guidance Document (USEPA 1994b)
- Review of Sediment Removal and Remediation Technologies at MGP and Other Contaminated Sites (Electric Power Research Institute [EPRI] 1999)
- Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (USEPA 2005)

The remedial technology types and process options identified for each GRA are presented in Table 5-2.

5.3.2 Screening of Remedial Technologies and Process Options

Following identification of potential remedial technologies and associated process options, preliminary and secondary screening steps were performed to identify those technologies that could be implemented and potentially effective at achieving the RAOs established for the Site. The preliminary and secondary screening processes are described below.

Preliminary screening of the identified technologies was performed on the basis of technical implementability. Technical implementability was determined using Site characterization information collected during the remedial investigations, including the types and concentrations of impacts and physical characteristics of the Site, to screen out technology types and process options that could not reasonably or practicably be implemented at the Site.

To further reduce the potentially applicable technology types and process options to be assembled into remedial alternatives, process options were subjected to a secondary screening. The objective of the secondary screening was to choose, when possible, one process option to represent each technology type to simplify the subsequent development and evaluation of the remedial alternatives without limiting flexibility during the remedial design. The secondary screening criteria are described below:

- Effectiveness – This criterion is used to evaluate each technology process option with respect to other process options within the same technology type. This evaluation focused on the process options:
    - potential effectiveness of the process option in meeting the RAOs by reducing the toxicity, mobility and/or volume of chemical constituents in the impacted medium
    - potential impacts to human health and the environment during the construction and implementation phase
    - reliability of the technology with respect to the nature and extent of impacts and conditions at the Site
- Implementability – Implementability encompasses both the technical and administrative feasibility of implementing a process option. Because technical implementability was assessed during the preliminary screening step, this subsequent, more detailed evaluation places more emphasis on the administrative aspects of implementability. This criterion also evaluates the ability to construct the process option, and availability of specific equipment and technical specialists to design, implement, operate, and maintain the remedy.
- Relative Cost – This criterion evaluates the overall cost required to implement the remedial technology. As a screening tool, relative capital and operation and maintenance (O&M) costs are used rather than detailed cost estimates. For each remedial technology and associated technology process, relative costs are presented as low, moderate, or high and made on the basis of engineering judgment.

Per USEPA guidance (USEPA 1988), the secondary screening evaluation focuses more on the effectiveness criterion, with less emphasis on the implementability and cost criteria.

The results of the preliminary and secondary screening steps are presented in Table 5-2, and a summary of the retained technology process options for each GRA is presented in Table 5-3 below.

Table 5-3 Summary of Retained Technology Process Options

GRA	Technology Process Option(s)
No Further Action	No Further Action
Institutional Controls	Governmental controls, proprietary controls, enforcement and permit controls, and informational devices
In-situ Treatment	Monitored Natural Recovery (MNR)
In-situ Containment/Controls	Engineered cap
Removal	Mechanical dredging
Ex-Situ, On-Site Pre-Treatment, Treatment, and/or Disposal	Dewatering (Gravity Drainage), Solidification/stabilization
Off-Site Treatment and/or Disposal	Low Temperature Thermal Desorption, Solid waste landfill
Residual Management	On-site water treatment with discharge to Hudson River Off-site water treatment via discharge to local Publicly-Owned Treatment Works

6 Development and Evaluation of Remedial Alternatives

The retained technologies in Section 5 were used to assemble potential remedial alternatives for sediment within the ARC and the 4 mg/kg PAH Area. The assembled sediment remedial alternatives, which were reviewed and approved by NYSDEC in August 2010, include:

1. Alternative 1 – No Further Action

2. Alternative 2 – Monitored Natural Recovery of Sediments within the ARC with Institutional Controls

3. Alternative 3 – Capping Sediments within the ARC and Institutional Controls

4. Alternative 4 – Excavation of Sediments within the ARC to a Depth of 1 foot with Treatment/Disposal of the Excavated Sediments, Capping of the Excavated Area, and Institutional Controls

5. Alternative 5 – Excavation of Sediments within the ARC to a Depth of 2 feet with Treatment/Disposal of the Excavated Sediments, Capping of the Excavated Area, and Institutional Controls

6. Alternative 6 – Excavation of Sediments within the ARC to Variable Depths (up to 6 feet) with Treatment/Disposal of the Excavated Sediments, Backfill and Capping of the Excavated Area, and Institutional Controls

7. Alternative 7 – Excavation of Sediments within the ARC to Full Depth of NAPL (up to 15 feet) with Treatment/Disposal of the Excavated Sediments and Backfill of the Excavated Area

8. Alternative 8 – Sediment Excavation within the 4 mg/kg PAH Area (up to 15 feet) with Treatment/Disposal and Backfill of the Excavated Area

These eight remedial alternatives are described below in Section 6.1, while the criteria used to evaluate these alternatives are described in Section 6.2 and the detailed evaluation of alternatives against the evaluation criteria is presented in Section 6.3.

6.1 Description of Remedial Alternatives

6.1.1 Alternative 1 – No Further Action

The "No Further Action" alternative would not involve implementation of any remedial activities to treat, remove, contain, or monitor NAPL-containing and potentially toxic sediment within the ARC and PAH-containing sediments in the 4 mg/kg PAH Area at the Site. No effort would be made to change or monitor future Site conditions. The No Further Action alternative serves as the baseline against which other remedial alternatives may be compared in accordance with the NCP and NYSDEC DER-10 (NYSDEC 2010).

6.1.2 Alternative 2 –MNR of Sediments within the ARC and Institutional Controls

Alternative 2 involves allowing for natural recovery of sediments within the ARC through naturally occurring physical/chemical processes (e.g., advection, dispersion, burial, dissolution, sorption, photo-oxidation and biodegradation). A long-term monitoring program would be designed and implemented to document and measure the progress of these natural processes toward achieving the RAOs.

Sediment/surface water systems have considerable inherent capacity to recover from either natural or human disturbances. Physical and chemical processes combine to achieve reductions in constituent mass, mobility and bioavailability in sediment environments through mechanisms such as burial, sorption, dissolution, advection, and dispersion. Chemical transformation or biodegradation can also be important mechanisms for reducing the toxicity and mass of PAHs when site conditions are favorable (Pastorok et al. 2000; USEPA-OSWER 1999). In most cases, there is evidence that PAHs degrade to compounds that are less toxic to environmental or human receptors (USEPA-ORD 1999). Several of the more effective (and better understood) natural recovery processes are further described below.

Physical processes promote natural recovery in sediments through several mechanisms. Advection/dispersion and burial are purely physical processes that reduce potential risks by decreasing the concentration of PAHs at points of exposure, such as in the biologically active surficial sediment layer. Advection refers to the movement of dissolved PAHs in flowing water, while dispersion describes the spreading of the dissolved constituents along the direction of the flow as well as away from the flow. MGP-related PAHs sorbed to resuspended fine-grained sediments may also be removed by advection and dispersion. Burial through natural deposition of cleaner sediment is another purely physical process that occurs in areas of

sedimentation, where cleaner sediments depositing on impacted sediments mix with or overlie and effectively diminish constituent concentrations at the surface.

Physical-chemical weathering alters compositions and concentrations of MGP-related PAHs in surficial sediments through dissolution and sorption. In dissolution (diffusion), the MGP-related PAH constituents dissolve into interstitial and overlying water as a function of their solubility, depleting the concentrations of the more soluble MGP-related PAHs. The existence of a concentration gradient between pore-water and overlying surface water is sufficient to initiate transport by molecular diffusion. The magnitude of the chemical flux (i.e., the movement of chemicals over a cross-sectional area during a given time period) is quantified by Fick's first law governing diffusion of a dilute contaminant through a porous medium. If the compounds of interest are hydrophobic, as is the case for PAHs, the adsorption equilibrium established between the organic fraction of the sediment and the pore water will retard the apparent rate of diffusion.

This process can be modeled using Fick's second law of diffusion. Sorption refers to the physical and chemical binding of organic impacts to soil/sediment particles. As MGP NAPL weathers, the more persistent components, such as the 4-, 5- and 6-ringed PAHs, become sequestered in the sediment phase (Pastorok et al. 2000; Neff et al. 2001) through stronger, chemical sorption. Physical chemical weathering processes reduce risk through depletion of the more bioavailable components of MGP NAPL and sequestering of the less bioavailable components through sorption, reducing their bioavailability even further. For example, physical-chemical weathering rapidly depletes low-molecular-weight MGP-related PAHs such as naphthalene (a 2-ringed PAH). Physical-chemical weathering also depletes 3-ringed and higher-molecular-weight MGP-related PAHs, but over longer periods of time (Brenner et al. 2002). The results of the OU2 Sediment Monitoring Program conducted from 2007 to 2009 indicate that depletion of Site-related PAHs is occurring. PAH compositional changes in the sediments are evidenced by the loss of 2- and 3-ring PAHs by the first of the monitoring events 2007 (as compared to the Site-related source material), and generally a continued relative loss of PAHs from 2007 to 2009.

Biological degradation processes complement physical-chemical processes and are generally considered the primary mechanism degrading the weathering-resistant fraction of NAPL. Microbial degradation further depletes persistent MGP-related PAHs, with 2- and 3-ringed PAHs being more amenable to biodegradation than 4-, 5-, and 6-ringed structures. For microbial degradation to be viable, certain conditions must exist, including the presence of hydrocarbon utilizing microorganisms, electron acceptors (oxygen, nitrate, sulfate, iron), nutrients, suitable hydrocarbon substrate, and other

conditions favorable to microbial growth (Pastorok et al. 2000). Although rates of biodegradation are typically driven by nutrient availability, the mechanism of degradation is determined by the oxidation/reduction conditions of the sediment and the nature of the microbiological community (Atlas et al. 1981). Some mineralization of MGP-related PAHs to carbon dioxide (CO_2) results from microbial degradation, but typically to less than 50 percent (Atlas et al. 1981). Biological degradation is viewed favorably for its ability to reduce risk through the mineralization or transformation of hydrocarbons, including MGP-related PAHs, to non-toxic derivatives.

The combined effects of physical-chemical weathering, biodegradation, and natural sedimentation are predicted to reduce MGP-related PAH concentrations, as well as the bioavailability of remaining PAHs, in surficial sediments that would be left in place. The extent and timeframe for future reductions in MGP-related constituent concentrations under this remedial alternative are governed by several factors. As part of Alternative 2, periodic monitoring (i.e., sediment sampling and analysis) would be conducted to assess the progress of the natural recovery processes toward reducing the PAH bioavailability and toxicity.

The sampling proposed for Alternative 2 is based on the results from the previous demonstration projects that were conducted to assess the bioavailability and toxicity of PAHs in sediments at the Site. The previous work (which was summarized in Section 2) indicates that the concentrations of SPME pore water TU_{34} were a more accurate predictor of *H. azteca* survival than total PAH_{16} concentrations. The Site-specific threshold value for Hudson was determined to be 5.4 SPME pore water TU_{34}. During the most recent investigations in 2009, a total of seven locations (primarily adjacent to Embayment #1) had both SPME pore water TU_{34} values greater than 5.4 and significant reduction in amphipod survival (Figure 2-3).

The periodic monitoring to be performed as part of this remedial alternative would include the collection of sediment samples from up to 20 near-site locations spanning the previously identified areas of potential sediment toxicity. In each sample, visual inspection would be performed to check for the presence of NAPL and sediment pore water PAH_{34} concentrations would be measured in two replicate analyses using SPME and expressed as SPME pore water TU_{34}, per USEPA (2003) and ASTM Method D7363-07. The SPME pore water TU_{34} values would be compared to the Site-specific threshold value of 5.4 SPME pore water TU_{34} to measure the progress of natural recovery. For the purposes of this FS Report, it was assumed that sediment sampling/analysis would be performed every 2 years for the first five years (i.e., three monitoring events during the first 5-year period), and then every five years thereafter until year 30. The historic data would be used as a general baseline for the monitoring

program. Periodic reports would be prepared and submitted to NYSDEC to document the progress of the natural recovery processes.

This alternative would also include preparation of an SMP describing the following:

- Known locations of NAPL-containing and potentially toxic sediment within the ARC
- Protocols for sediment MNR monitoring
- Conditions for modifying/ceasing the sediment monitoring activities
- Protocols (including health and safety requirements) for conducting intrusive (i.e., subsurface) activities within the ARC and managing potentially impacted material encountered during these activities
- Restrictions on intrusive activities to mitigate potential exposures to impacted sediments

Because NAPL-containing and potentially toxic sediments would initially remain in the Hudson River for a period of time, this alternative would also include establishment of institutional controls. Institutional controls would be in the form of governmental, enforcement, or permit controls, and/or informational devices. For example, potential institutional controls could include, but not necessarily be limited to, designating "no anchor" zones in the ARC. Annual reports would be submitted to the NYSDEC to document that institutional controls are maintained and remain effective.

6.1.3 Alternative 3 – Capping Sediments within the ARC with Institutional Controls

The major components of Alternative 3 include the following:

- Removing debris and shore-line rip-rap within the ARC
- Off-site disposal of excavated debris
- Constructing and placing an above-grade engineered cap over sediments within the ARC
- Establishing and maintaining institutional controls
- Conducting long-term monitoring and maintenance of the cap

The engineered cap placed within the ARC (Figure 6-2) would provide a physical barrier effectively mitigating the mobilization of, and potential exposure to, NAPL-containing and potentially toxic sediments. The cap would be designed to limit upward

migration of NAPL from the underlying sediments to the bioavailable zone and to limit the potential for erosion of the cap materials. Based on the physical characteristics of the Hudson River in the vicinity of the Site (e.g., water depths up to 45 feet, water velocities exceeding 3 feet per second [ft/sec]), it is anticipated that the cap would be composed of a series of marine mattresses containing the following layers in order from top to bottom: 6-inch-thick layer of stone, a 0.25-inch-thick reactive core mat (RCM), which consists of permeable composites of geotextiles and a non-swelling granular organoclay compound designed to adsorb organics, and geogrid. A marine mattress is a system used to simplify construction of sediment caps. Marine mattresses are composed of a series of smaller individual mattresses that are built separately, joined together and then placed on the sediment. A marine mattress configured with RCM and rock provides a method to place RCM under more difficult conditions, such as high flow currents and/or deep waterways. The specific details of the cap design would be determined during the remedial design phase based on additional data collected during the pre-design investigation (PDI) and subsequent engineering analyses.

Based on experience at another site located on the Hudson River (North Water Street Site in Poughkeepsie, New York) with similar physical characteristics, the placement of the cap is not expected to result in significant adverse impacts to water quality, and the marine mattresses can be placed in high flow currents. Therefore, the installation of containment around the capping area (i.e., the ARC) to help contain any potential releases and support effective cap placement would not be necessary. Absorbent booms would be used as necessary to address any minor sheens generated during the cap placement activities. Because the cap installation work would not be performed within containment, it would need to be performed from October 1 to March 31 (i.e., outside the fish protection period which is from April 1 to September 30). To allow the in-river work to begin in early November, the cap segments would be constructed in advance at a nearby on-shore location to be identified during the remedial design phase.

Prior to sediment capping, debris and shore-line rip-rap would be removed (as necessary for cap placement) via a barge-mounted crane with a clamshell bucket. Debris would be disposed at a permitted non-hazardous waste landfill. Rip-rap would be temporarily staged on-Site in a designated area for subsequent replacement along the shoreline following cap installation. Once the debris and rip-rap are removed, the engineered cap would be placed into the river using a crane operating from a floating work platform. Divers would be used as necessary during cap installation to assist with cap placement and positioning activities.

Following completion of the cap installation, a cap monitoring and maintenance program would be implemented. For this evaluation, it has been assumed that this program would involve cap monitoring to be conducted annually for the first 5 years, and then once every 5 years until year 30. Inspections of the cap may also be conducted subsequent to episodic events (e.g., extreme high-flow events). Cap monitoring activities would consist of diver inspections of the cap to check for damage to the cap and/or NAPL breakthrough by checking for indications of NAPL in sediments accumulated on top of the cap. If the presence of NAPL is suspected, divers may collect samples of the sediments located on top of the cap for visual observation and/or analysis. Any disturbance or damage to the cap observed during the periodic cap inspections would be addressed appropriately to maintain the long-term effectiveness of the cap. The maintenance plan would include protocols to be followed should NAPL breakthrough be observed during the cap inspection activities. Periodic reports would be prepared and submitted to NYSDEC documenting the results of the monitoring activities and any maintenance activities performed.

Institutional controls would also be implemented to reduce the potential for disturbance of, or damage to, the cap, and thereby improve its long-term effectiveness. An example of the potential institutional controls could include placement of signs along the banks to prohibit anchoring within the capped area. This alternative would also include preparation of an SMP to document the following:

- Known locations of NAPL-containing and potentially toxic sediments remaining in the river below the cap
- Requirements for cap inspection and maintenance
- Protocols (including health and safety requirements) for conducting intrusive (i.e., subsurface) activities within the OU2 river area and managing potentially impacted material encountered during these activities
- Restrictions on invasive activities to mitigate potential damage to the sediment cap

Annual verification/certification would be filed with the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

6.1.4 Alternative 4 – Excavation of Sediments within the ARC to a Depth of 1 foot with Treatment/Disposal of Excavated Sediments, Capping of the Dredged Area, and Institutional Controls

The major components of Alternative 4 include the following:

- Installing temporary containment around the ARC (if possible given Site conditions as further discussed below)
- Removing debris and shoreline rip-rap within the ARC
- Off-site disposal of debris removed from within the ARC
- Mechanical dredging of the top 1 foot of sediment within the ARC
- On-site processing of sediment in preparation for off-site treatment of the sediment via Low Temperature Thermal Desorption (LTTD)
- Placing an engineered cap over the dredged area
- Establishing and maintaining institutional controls
- Conducting long-term monitoring and maintenance of the cap

For Alternative 4, approximately 2,000 cy of sediment would be removed from the river by the dredging activities (Figures 6-3 and 6-3a), including all of the sediments identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediment.

If technically feasible, sheet pile containment walls would be installed around the ARC to control and contain re-suspended sediments and mobile NAPL that would be generated as a result of the dredging activities. However, as described in more detail below, there is considerable uncertainty regarding the technical feasibility of installing containment sheeting around the dredging area due to the Site conditions, including water depths up to 45 feet at the western edge of the ARC (a portion of which extends into the Hudson River navigation channel), water velocities greater than 3 ft/sec, 4-foot tidal fluctuations, and an assumed (based on borings installed for the OU-1) depth to bedrock of 30 feet (or greater) bss.

ARCADIS evaluated two different options for the containment sheet pile enclosure due to the uncertainty of geotechnical data in the OU2 area (sediment properties, depth to bedrock, etc.). These options included:

- Using the containment sheeting to support dredging adjacent to it, and

- Using the sheeting solely for purposes of containing resuspended sediments and NAPL during dredging operations (i.e., without dredging immediately adjacent to the sheeting).

Based on our initial evaluation, we have concluded that containment sheeting immediately adjacent to the OU2 dredge area is likely not feasible due to the water depths at the Site, particularly near the limits of the shipping channel. Extraordinary engineering measures would be necessary to construct a stable containment wall in such conditions. Such measures could include a combination wall with steel H-piles drilled into rock and steel sheet piles acting as "lagging" driven into the sediment between the drilled piles; or a driven steel sheet pile wall with bracing. Such measures are considered impractical from a cost and constructability perspective for this type of work. The rationale for screening out containment sheeting around the current limits of the ARC (with dredging immediately adjacent to the sheeting) includes the following:

- The length of a sheet pile wall can be estimated for this exercise by taking the height of the wall above the mud line as 1/3 of the total length, where embedment is estimated as 2/3 of the total length of the sheetpiling. At the western limit of the ARC along the shipping channel, the mud line is approximately -40 ft amsl, or about 45 ft below mean water surface. Based on upland borings installed as part of the OU1 remediation, the bedrock below the river is estimated to be at an elevation of -60 ft to -70 ft amsl. The approximately 20 to 30 ft of sediment below the mud line would be insufficient to provide adequate embedment depth for structural sheet piles; required embedment depth is estimated to be a minimum of 80 ft due to physical characteristics of the sediments, tidal fluctuations, dredge depths of up to 6 ft immediately adjacent to the sheeting, wind loading, ice loading, and loading from vessel impacts. Hydrodynamic forces would also need to be considered, and those forces associated with water flow acting on sheet piling of this length alone would likely exceed the ability to maintain stable sheeting.

- The length of the sheet piles would likely be greater than 120 ft. Sheet piles of such length would not be able to be shipped by land, and would limit the source of supply to steel mills located in such proximity that would allow sheet piles to be shipped to the Site via barge up the Hudson River only.

- 120-foot-long sheet piles would create many challenges with respect to drivability and constructability. The sheets would have to be strong enough to prevent buckling during the picking operations, and the crane would have to be large enough to pick a 120 ft sheet. Additional bracing measures may be needed due to these issues, which would be limited by the circumstances and Site features (e.g. being located in-water). It would be likely that two rows of sheets connected with stone in-fill would need to be utilized to provide a stable containment wall.

Based on the information provided above, the most feasible option for a sheet pile containment enclosure around the OU2 area includes containment sheeting that does not function as structural dredge support (i.e., no dredging would be performed within 10 feet immediately adjacent to the sheeting). If containment can be installed under this scenario, the following assumptions would apply:

- Steel sheeting would be at least 70 feet long and set to -65 amsl (assumed minimum embedment depth of approximately 25 feet).
- Sheeting walls would be installed to minimize drag force impacts (e.g., the far wall would need to be parallel to the flow, and the side walls would likely be angled at approximately 45 degrees).
- The sheet pile walls would not be able to withstand vessel impacts (a potential risk due to the known boat traffic in this section of the river), nor would the sheet pile walls be able to withstand ice loading (as a result the work inside containment would have to be performed at a time of year when ice formation is not a concern).

If sheet pile containment can be installed at the Site, the sheeting would be installed in the river prior to the start of the fish protection period (i.e., prior to April 1) so that the dredging work could be performed during the summer construction season. Sorbent material such as oil booms would also be installed around the dredging area (i.e., outside the temporary containment sheeting) as secondary containment in the event any sheens escape from the containment area.

Debris and sediment removal would be performed via mechanical dredging in the wet from a barge positioned inside the containment area. The shoreline would be sloped back to a slope of approximately 3H:1V to provide adequate stability to the dredge operations. This slope would require the removal of existing rip-rap and soil along the shoreline. Rip-rap would be temporarily staged on-Site in a designated area for subsequent replacement along the shoreline following cap installation. The dredged sediment and debris would be loaded into scows in the containment area, which would be transported to a floating work platform for offloading by a long-reach excavator into haul trucks for subsequent transport to a designated sediment processing and staging area (further described below). Water that accumulates in the scows as a result of gravity drainage of the sediments would be allowed to drain back into the contained area. Water column turbidity monitoring would be conducted upstream and downstream of the dredging area during construction activities to monitor the effectiveness of the sheet pile containment wall system. Based on monitoring results, dredging activities may be modified (e.g., work temporarily halted and/or pace slowed)

until acceptable turbidity levels (to be determined during the remedial design phase) are achieved.

Following off-loading, the dredged sediment would be transferred to a designated staging and processing area located on an adjacent property. The construction of the staging area would be conducted to facilitate waste characterization sampling and material handling/stabilization. The location for the staging and processing area would be selected during the design stage of the project. The sediment staging and processing area would be constructed of a 6-inch gravel sub-base overlain by 6 inches of asphalt pavement. A 12-inch berm would be installed around the perimeter of the sediment processing area and the entire area would be sloped to drain to a sump. Temporary access roads would be constructed, as needed, to facilitate access to the staging area from the sediment offloading area. These access roads would be constructed by placing a layer of geotextile and placing, grading and compacting New York State Department of Transportation (NYSDOT) Type 2 Subbase or similar material. The temporary access roads and staging area materials would be removed at the completion of remedial activities and disposed off-site as appropriate.

Given the proximity of the Site to the City of Hudson Park, commuter rail lines, and other potential receptors, a temporary containment structure would be installed over the sediment staging/processing area. The structure would be equipped with an air handling and treatment system. Inside the temporary structure, the dredged material would be segregated to remove debris and material not suitable for treatment via LTTD (i.e., greater than 6-inch-diameter, timbers, boulders) and staged to facilitate dewatering, stabilization, sampling for waste characterization purposes, and subsequent loading for off-site treatment/disposal. Based on the previous data collected at the Site regarding NAPL distribution, it has been assumed that all of the dredged material (approximately 2,000 cy) would require off-site treatment via LTTD.

A temporary water treatment system would be constructed at the Site to treat water removed from the dredged sediment. The elements of the water treatment system may consist of pumps, holding tanks, carbon filters, sand filters and bag filters, the details of which would be determined during the remedial design phase. Treated water would be discharged to the Hudson River under the terms of a SPDES permit.

Following dredging, an engineered cap would be installed over the remaining NAPL- and PAH-containing sediments that were not removed via dredging. The cap would be installed in the wet and the work would be performed within the aforementioned containment sheeting (assuming it can be installed). The cap would be designed to

limit upward migration of NAPLs from the underlying sediments to the bioavailable zone and to limit the potential for erosion of the cap materials. For the purposes of this FS Report, the cap to be installed over the remaining NAPL- and PAH-containing sediments under this Alternative would consist of (from the bottom up): a 0.25-inch-thick RCM followed by a 6-inch-thick layer of D_{50}-3-inch stone. It has been assumed that natural re-deposition would occur following cap placement to restore the river bottom to the pre-remediation elevation. The actual cap configuration would be adjusted as necessary during the remedial design phase based on additional data collected during the PDI and appropriate engineering analyses. Cap placement would be conducted within the containment area using a barge-mounted dredge with a clamshell bucket for the stone and RCM. Divers would be used to confirm the correct placement of the RCM.

As was the case with Alternative 3, a cap monitoring and maintenance program would be implemented as part of this alternative. For cost-estimating purposes, it has been assumed that the cap would be inspected annually for the first 5 years, and then once every 5 years thereafter until year 30. Inspections of the cap may also be conducted subsequent to episodic events (e.g., high-flow events). Cap monitoring activities would consist of diver inspections of the cap to check for damage and/or NAPL breakthrough by checking for indications of NAPL in sediments accumulated on top of the cap. If the presence of NAPL is suspected, divers may collect samples of the sediments located on top of the cap for visual observation and/or analysis. Any disturbance or damage to the cap observed during the periodic cap inspections would be addressed appropriately to maintain the long-term effectiveness of the cap. The maintenance plan would include protocols to be followed should NAPL breakthrough be observed during the cap inspection activities. Periodic reports would be prepared and submitted to NYSDEC documenting the results of the cap monitoring activities and any maintenance activities performed.

Institutional controls would also be implemented to reduce the potential for disturbance of the cap and enhance its long-term effectiveness. An example of the potential institutional controls could include placement of signs along the banks to prohibit anchoring within the capped area. This alternative would also include preparation of an SMP to document the following:

- Known locations of NAPL-containing sediments remaining in the river below the cap
- Requirements for cap inspection and maintenance

- Protocols (including health and safety requirements) for conducting intrusive activities within the ARC and managing dredged material resulting from these activities
- Restrictions on intrusive activities to mitigate potential damage to the sediment cap

Annual verification/certification would be filed with the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

6.1.5 Alternative 5 – Excavation of Sediments within the ARC to a Depth of 2 feet with Treatment/Disposal of Excavated Sediments, Capping of Excavated Area, and Institutional Controls

Alternative 5 is almost identical to Alternative 4 except that the top 2 feet of sediment would be removed within the footprint of the ARC instead of the top foot. For Alternative 5, approximately 4,000 cy of sediment would be removed from the river by the dredging activities (Figures 6-4 and 6-4a), including all of the sediments identified during the 2009 bioavailability study as potentially being toxic, as well as a portion of the NAPL-containing sediment. Because this alternative is so similar to Alternative 4, the detailed description of this alternative is not repeated here.

6.1.6 Alternative 6 – Excavation of Sediments within the ARC to Variable Depths (up to 6 feet) with Disposal/Treatment of Excavated Sediments, Backfill and Capping of Excavated Area, and Institutional Controls

Alternative 6 is very similar to Alternatives 4 and 5, with the following exceptions:

- NAPL- and PAH-containing sediment would be dredged within the ARC to variable depths (up to 6 feet). A total of approximately 6,000 cy of sediment would be removed from the river by the dredging activities (Figures 6-5 and 6-5a), including all of the sediments identified during the 2009 bioavailability study as potentially being toxic, as well as a portion of the NAPL-containing sediment.
- Due to the removal depths associated with Alternative 6, shoreline bracing would be necessary. For dredge depths of 4 feet or greater along the shoreline, temporary sheet piling would be necessary to provide stable and safe support to the dredge operations and the existing shoreline. Due to the removal depths associated with Alternative 6, such shoreline bracing would be installed to a 20-foot depth over approximately 100 feet, encompassing the shoreline between Embayments 1 and 2.

- Following dredging, clean backfill would be placed within the dredged area to act as a leveling layer and restore the riverbed to 2 feet below the current bed elevation (i.e., 2 feet below the pre-dredge elevation) in preparation for placement of the cap materials (i.e., for constructability purposes). It has been assumed that natural re-deposition would occur following cap placement to restore the river bottom to the pre-remediation elevation.

Other than the differences noted above, this alternative is identical to Alternatives 4 and 5; therefore, the detailed description of this alternative is not repeated herein.

6.1.7 Alternative 7 – Excavation of Sediments within the ARC to Full Depth of NAPL with Treatment/Disposal of Excavated Sediments and Backfill of Excavated Area

The major components of Alternative 7 include the following:

- Installation of temporary containment around the ARC (if possible given Site conditions) as described above
- Removing debris and shore-line rip-rap within the ARC
- Off-site disposal of debris removed from within the ARC
- Mechanical dredging to full depth of NAPL-containing sediment within the ARC
- On-site pre-treatment of the sediment in preparation for off-site treatment via LTTD
- Placing clean backfill in the dredged area to 2 feet below the current bed elevation

Alternative 7 involves the removal of all NAPL-containing and potentially toxic sediment within the ARC to the full depth of NAPL (approximately 15 feet). Approximately 9,000 cy of sediment would be removed by the dredging activities (Figures 6-6 and 6-6a).

If technically feasible (refer to discussion presented above for Alternative 4), sheet pile containment walls would be installed around the ARC to control and contain re-suspended sediments and mobile NAPL that would be generated as a result of the dredging activities. If it can be installed, the sheeting would be installed in the river prior to the start of the fish protection period (i.e., prior to April 1) so that the dredging work could be performed during the typical construction season for water-based work (i.e., during the summer months). Sorbent material such as oil booms would also be installed around the dredging area (i.e., outside the temporary containment sheeting) as secondary containment in the event any sheens escape from the containment area.

Debris and sediment removal would be performed via mechanical dredging in the wet from a barge positioned inside the containment area. Due to the removal depths associated with Alternative 7, protection of the shoreline would be necessary. For dredge depths less than 4 feet along the shoreline (i.e., where sheeting is not currently assumed), the shoreline would be sloped back to a slope of approximately 3H:1V to provide adequate stability to the dredge operations. This slope would require the removal of existing rip-rap and soil along the shoreline. Rip-rap would be temporarily staged on-Site in a designated area for subsequent replacement along the shoreline following dredging and backfilling. The soil would be inspected for evidence of visual impacts (NAPL, staining, odors) and managed accordingly. At dredge depths of 4 feet or greater along the shoreline, temporary sheet piling would be necessary to support to the dredge operations and the existing shoreline. Therefore, shoreline bracing would be installed to an estimated 35-foot depth over approximately 100 feet including the shoreline area between Embayments #1 and #2. Side-sloping the excavation area would increase the sediment volume that would need to be managed; although the additional sediment is assumed not to be impacted, for the purposes of this FS it would be managed in the same manner as the impacted sediment.

The dredged material would be loaded into scows, which would be transported to a floating work platform for offloading by a long-reach excavator into haul trucks for subsequent transport to a designated sediment processing and staging area (further described below). Water that accumulates in the scows as a result of gravity drainage of the sediments would be allowed to drain back into the contained area. Water column turbidity monitoring would be conducted upstream and downstream of the dredging area during construction activities to monitor the effectiveness of the sheet pile containment wall system. Based on monitoring results, dredging activities may be modified (e.g., work temporarily halted and/or pace slowed) until acceptable turbidity levels (to be determined during the remedial design phase) are achieved.

Following off-loading, the dredged sediment would be transferred to a designated staging and processing area located on an adjacent property. The construction of the staging area would be conducted to facilitate waste characterization sampling and material handling/stabilization. The location for the staging and processing area would be selected during the design stage of the project. The sediment staging and processing area would be constructed of a 6-inch gravel sub-base overlain by 6 inches of asphalt pavement. A 12-inch berm would be installed around the perimeter of the sediment processing area and the entire area would be sloped to drain to a sump. Temporary access roads would be constructed, as needed, to facilitate access to the staging area from the sediment offloading area. These access roads would be

constructed by placing a layer of geotextile and placing, grading and compacting NYSDOT Type 2 Subbase or similar material. The temporary access roads and staging area materials would be removed at the completion of remedial activities and disposed off-site as appropriate.

Given the proximity of the Site to the City of Hudson Park, commuter rail lines, and other potential receptors, a temporary containment structure would be installed over the sediment staging/processing area. The fully-enclosed structure would be equipped with an air handling and treatment system. Inside the temporary structure, the dredged material would be segregated to remove debris and material not suitable for treatment via LTTD (i.e., greater than 6-inch-diameter, timbers, boulders) and staged to facilitate dewatering, stabilization, sampling for waste characterization purposes, and subsequent loading for off-site treatment/disposal. Based on the previous data collected at the Site regarding NAPL distribution, it has been assumed that all of the dredged material (approximately 9,000 cy) would require off-site treatment via LTTD.

A temporary water treatment system would be constructed at the Site to treat water removed from the dredged sediment. The elements of the water treatment system may consist of pumps, holding tanks, carbon filters, sand filters and bag filters, the details of which would be determined during the remedial design phase. Treated water would be discharged to the Hudson River under the terms of a SPDES permit.

Once the NAPL-impacted and potentially toxic sediments are removed, clean backfill would be placed back into the dredged area to restore the riverbed to 2 feet below the current bed elevation/configuration. It has been assumed that natural re-deposition would occur to restore the river bottom to the pre-remediation elevation.

No NAPL-containing or potentially toxic sediment would remain within the ARC after the completion of Alternative 7. Therefore, no institutional controls, engineering controls, or SMP would be required for OU2 as part of Alternative 7.

6.1.8 Alternative 8 – Excavation of Sediments within the ARC and the 4 mg/kg PAH Area (all depths) with Treatment/Disposal and Backfill of the Excavated Area

The major components of Alternative 8 include the following:

- Installing temporary containment around the ARC (if possible)
- Removing debris and shore-line rip-rap in the 4 mg/kg PAH area

- Off-site disposal of debris
- Mechanical dredging to all depths of sediment with Total PAH concentrations greater than 4 mg/kg within the Site, including the NAPL- and potentially toxic sediments located within the ARC
- On-site processing of the dredged sediment in preparation for off-site treatment/disposal
- Placing clean backfill in the dredged sediment area to 2 feet below the current bed elevation

Alternative 8 involves the removal of all sediment within the Site with PAH concentrations greater than 4 mg/kg to full depth (approximately 15 feet), including the NAPL-containing and potentially toxic sediment located within the ARC. The 4 mg/kg PAH Area measures approximately 6.1 acres. A significant portion of this area falls within the existing navigation channel (1.5 acres). Approximately 41,000 cy of 4 mg/kg PAH- and NAPL-containing sediment would be removed by the dredging activities (Figures 6-7a and 6-7b).

If technically feasible, sheet pile containment walls would be installed around the ARC to control and contain re-suspended sediments and mobile NAPL that would be generated as a result of the dredging activities within the ARC. If it can be installed, the sheeting would be installed in the river prior to the start of the fish protection period (i.e., prior to April 1) so that the dredging work within the ARC could be performed during the typical construction season for water-based work (i.e., during the summer months). Sorbent material such as oil booms would also be installed around the dredging area (i.e., outside the temporary containment sheeting) as secondary containment in the event any sheens escape from the containment sheeting area.

Sediment and debris removal within the ARC would be performed via mechanical dredging in the wet from a barge positioned within the ARC. The dredging conducted outside the ARC would be performed via a mobile mechanical dredge unit equipped with a turbidity skirt (i.e., partial depth silt curtain). Because the dredging outside of the ARC would be conducted without complete containment, it would need to be performed outside the fish protection period during the fall/winter months (i.e. from October to March 31). Due to the large sediment removal volume for the uncontained area, the decreased production rates anticipated during winter dredging, and the potential for ice formation/movement to further prolong the schedule, it is anticipated that two winter dredging seasons would be required to complete the dredging activities outside of the ARC. The dredged material would be loaded into scows, which would be

transported to a floating work platform for offloading by a long-reach excavator into haul trucks for subsequent transport to a designated sediment processing and staging area (further described below).

Due to the removal depths associated with Alternative 8, protection of the shoreline would be necessary. For dredge depths less than 4 feet where sheeting is not currently assumed, the shoreline would need to be sloped back to a slope of approximately 3H:1V to provide adequate stability to the dredge operations. This slope would require the removal of existing soil along the shoreline. The soil would be inspected for evidence of visual impacts (NAPL, staining, odors) and managed accordingly. At dredge depths of 4 feet or greater along the shoreline, temporary sheet piling would be necessary support to the dredge operations and the existing shoreline. Therefore, shoreline bracing would be installed to a 35-foot depth over approximately 1,000 feet, which would include the shoreline area around the perimeter of Embayment #2 and Embayment #4, the shoreline area between Embayments #1 and #2, and a portion of the shoreline area north of Embayment #1.

Water column turbidity monitoring would be conducted upstream and downstream of the dredging area during construction activities to monitor the effectiveness of the sheet pile containment wall system. Based on monitoring results, dredging activities may be modified (e.g., work temporarily halted and/or pace slowed) until acceptable turbidity levels (to be determined during the remedial design phase) are achieved.

Following off-loading, the dredged sediment would be transferred to a designated staging and processing area located on an adjacent property. The construction of the staging area would be conducted to facilitate waste characterization sampling and material handling/stabilization. The location for the staging and processing area would be selected during the design stage of the project. The sediment staging and processing area would be constructed of a 6-inch gravel sub-base overlain by 6 inches of asphalt pavement. A 12-inch berm would be installed around the perimeter of the sediment processing area and the entire area would be sloped to drain to a sump. Temporary access roads would be constructed, as needed, to facilitate access to the staging area from the sediment offloading area. These access roads would be constructed by placing a layer of geotextile and placing, grading and compacting NYSDOT Type 2 Subbase or similar material. The temporary access roads and staging area materials would be removed at the completion of remedial activities and disposed off-site as appropriate.

Given the proximity of the Site to the City of Hudson Park, commuter rail lines, and other potential receptors, a temporary containment structure would be installed over the sediment staging/processing area. The fully enclosed structure would be equipped with an air handling and treatment system. Inside the temporary structure, the dredged material would be segregated to remove debris and material not suitable for treatment via LTTD (i.e., greater than 6-inch-diameter, timbers, boulders) and staged to facilitate dewatering, stabilization, sampling for waste characterization purposes, and subsequent loading for off-site treatment/disposal. Based on the previous data collected at the Site regarding NAPL distribution, it has been assumed that all of the material dredged from within the ARC (approximately 9,000 cy) would require off-site treatment via LTTD. Sediments dredged from the area outside the ARC (32,000 cy) are assumed to be disposed off-site at a RCRA Subtitle D landfill.

A temporary water treatment system would be constructed at the Site to treat water removed from the dredged sediment. The elements of the water treatment system may consist of pumps, holding tanks, carbon filters, sand filters and bag filters, the details of which would be determined during the remedial design phase. Treated water would be discharged to the Hudson River under the terms of a SPDES permit.

Once the sediments with concentrations greater than 4 mg/kg PAHs are removed, clean backfill would be placed back into the dredged areas to restore the riverbed to 2 feet below the current bed elevation/configuration. It has been assumed that natural re-deposition would occur over the backfilled area.

No NAPL-containing sediment, potentially toxic sediment, or sediment with PAH concentrations greater than 4 mg/kg would remain within OU2 after the completion of Alternative 8. Therefore, no institutional controls, engineering controls, or SMP would be required for OU2 as part of Alternative 8.

6.2 Remedial Alternative Evaluation Criteria

The remedial alternatives presented in Section 6.1 have been evaluated against the following criteria as required by NYSDEC DER-10 (NYSDEC 2010):

- Compliance with SCGs
- Implementability
- Reduction of toxicity, mobility or volume of contamination through treatment
- Short-term impact and effectiveness

- Long-term effectiveness and permanence
- Land use
- Overall protectiveness of the public health and the environment
- Cost

These evaluation criteria encompass statutory requirements and include other gauges such as overall feasibility. Descriptions of the evaluation criteria are presented in the following subsections. Additional criteria, including community acceptance, will be addressed following submittal of this FS.

Per DER-10 (NYSDEC 2010), sustainability and green remediation will also be considered in the remedial evaluation with the goal of improving the sustainability of the selected remedy. This evaluation will include: minimizing energy use; reducing greenhouse gas and other emissions; maximizing reuse/recycling of materials; and preserving, enhancing, or creating natural habitats. Sustainability and green remediation will be discussed under the short-term impacts and effectiveness.

6.2.1 Compliance with SCGs

This criterion is used to evaluate whether the alternative or remedy complies with directly applicable or relevant and appropriate chemical-specific, action-specific, and location-specific SCGs. Conformance with standards and criteria is required, unless good cause exists why conformity should be dispensed with. Examples of such good cause are as follows:

- The proposed action is only part of a complete program or project that will, as a whole, conform to such standard or criterion upon completion;
- Conformity to such standard or criterion will result in greater risk to the public health and the environment than alternatives;
- Conformity to such standard or criterion is technically impracticable from an engineering or scientific perspective; or
- The program or project will attain a level of performance that is equivalent to that required by the standard or criterion through the use of another method or approach.

For those SCGs that will not be met, acceptable documentation of the basis must be submitted to DER for approval. In addition to standards and criteria, this criterion also

provides consideration to guidance which through the application of scientific and engineering judgment is determined to be applicable to the alternative evaluation.

6.2.2 Implementability

This criterion is used to evaluate the technical feasibility of implementing an alternative or remedy, including construction and operation, reliability, monitoring, and the ease of undertaking an additional remedial action if the remedy fails. It also considers the administrative feasibility of activities needed to coordinate with other offices and agencies, such as for obtaining permits for off-site actions, rights-of-way, and institutional controls, and the availability of services and materials necessary to the alternative, such as treatment, storage, and disposal facilities. This criterion also evaluates the reliability and viability of implementation of institutional controls necessary for a remedy.

6.2.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

This criterion refers to the evaluation of whether treatment processes can be used, the amount of hazardous material treated, including the principal threat that can be addressed, the degree of expected reductions, the degree to which the treatment is irreversible, and the type and quantity of treatment residuals. Preference should be given to remedies that permanently or significantly reduce the toxicity, mobility or volume of the contamination at the site.

6.2.4 Short-term Impact and Effectiveness

This criterion includes an evaluation of the effects of the alternative or remedy during the construction and implementation phase until remedial objectives are met. This criterion includes the identification of potential human exposures, adverse environmental impacts and nuisance conditions at the site resulting from implementation of the remedy or alternative. The potential short-term impacts to be evaluated include: nuisance conditions or potential exposures resulting from increased traffic, including truck trips, detours or loss of the used of access to property; potential for releases of NAPL and/or PAH-containing sediments to downstream/adjacent areas; odors; vapors; dust; habitat disturbance; run off from the site and noise. A discussion of engineering controls that would be used to mitigate the short-term impacts (i.e., dust control measures) is also included. The length of time needed to implement the remedy or alternative including time to achieve the remedial objectives is estimated.

6.2.5 Long-Term Effectiveness and Permanence

This criterion includes an evaluation of the impact on human exposures, ecological receptors and impacts to the environment from untreated contaminated materials or treatment residuals remaining after remedial action has been concluded (known as residual risk), and the adequacy and reliability of controls to manage that residual risk. It also includes an assessment of the potential need to replace technical components of the alternative, such as a cap or a treatment system, and the potential risk posed by that replacement.

6.2.6 Land use

This criterion is an evaluation of the current, intended and reasonably anticipated future use of the site and its surroundings, as it relates to and an alternative or remedy, when unrestricted levels would not be achieved. The evaluation considers the following 16 land use factors specified in DER-10 (NYSDEC 2010):

- Current use and historical and/or recent development patterns:
- Consistency of proposed use with applicable zoning laws and maps;
- Brownfield opportunity areas;
- Consistency of proposed use with applicable comprehensive community master plans, local waterfront revitalization plans as provided for in article 42 of the executive law or any other applicable land-use plan formally adopted by a municipality;
- Proximity to real property currently used for residential use and to urban, commercial, industrial, agricultural and recreational areas;
- Any written and oral comments submitted by members of the public on the proposed use as part of citizen participation activities;
- Environmental justice concerns, which for purposes of this evaluation, include the extent to which the proposed use may reasonably be expected to cause or increase a disproportionate burden on the community in which the site is located, including low-income minority communities, or to result in a disproportionate concentration of commercial or industrial uses in what has historically been a mixed use or residential community;
- Federal or state land-use designations relating to the property;
- Whether the population growth patterns and projections support the proposed use;

- Accessibility to existing infrastructure;
- Proximity of the site to important cultural resources, including federal or state historic or heritage sites or Native American religious sites;
- Natural resources, including proximity of the site to important federal, state or local natural resources, including waterways, wildlife refuges, wetlands, or critical habitats of endangered or threatened species;
- Potential vulnerability of groundwater to contamination that might migrate from the site, including proximity to wellhead protection and groundwater recharge areas and other areas identified by the state comprehensive groundwater remediation and protection program;
- Proximity to floodplains;
- Geography and geology; and
- Current institutional controls applicable to the site.

6.2.7 Overall Protection of Public Health and the Environment

This criterion is used to evaluate how each alternative or remedy achieves and maintains protection of human health and the environment. This criterion draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with SCGs.

6.2.7.1 Cost

This criterion includes an evaluation of overall costs of the remedial alternative. This criterion includes an evaluation of direct and indirect capital costs, including costs of treatment and disposal, annual costs of monitoring and maintenance of the alternative, and the total present worth of these costs.

6.3 Detailed Evaluation of Remedial Alternatives

6.3.1 Alternative 1 – No Further Action

Under Alternative 1, no remedial activities would be completed to treat, remove, contain, or monitor the NAPL-containing and potentially toxic sediment. The Site would be allowed to remain in its current condition, and no effort would be made to change or monitor future Site conditions. The natural physical/chemical processes (e.g.,

advection, dispersion, burial, dissolution, sorption, and biodegradation) that are known to occur at the Site are anticipated to continue, and over time, such processes would likely reduce the mass, mobility, and bioavailability of NAPLs and PAHs in sediments; however no effort would be taken to confirm or monitor the progress of such processes. Although this alternative does not readily achieve the RAOs established for the Site, it has been retained for use as a baseline against which other remedial alternatives may be compared.

6.3.1.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. Chemical-specific SCGs considered for Alternative 1 are the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999), the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}, and 6 NYCRR Part 703.2 Water Quality Standards (NYCRR 1995), which identifies the surface water quality standards, such as turbidity and generation of sheens. Because impacted sediments would remain in place without any active treatment or containment, this alternative is not expected to achieve the Site-specific threshold value for Hudson River sediment in the short-term. Over time, the Site-specific threshold value for Hudson River sediment could ultimately be achieved through the natural recovery processes known to be taking place; however, no actions would be conducted under Alternative 1 to verify this. Sediments containing NAPL would remain in place and would not be isolated in any way. The NAPL-containing sediments would have the potential to create sheens on the water surface if disturbed and thus violate the 6 NYCRR Part 703.2 Water Quality Standards (NYCRR 1995). However, this potential is considered low based on Site-specific characteristics, including the presence of a natural armoring layer consisting of cobbles, shells and other larger-grained materials.

Action-Specific SCGs

This alternative does not involve implementation of any remedial activities; therefore, the action-specific SCGs are not applicable.

Location-Specific SCGs

Because no remedial activities would be conducted under this alternative, the location-specific SCGs are not applicable.

6.3.1.2 Long-Term Effectiveness and Permanence

Under the No Further Action alternative, the NAPLs and PAHs in Site sediments would not be actively addressed through removal, treatment or engineering controls. Therefore, the long-term effectiveness and permanence would be solely based on the extent of any natural recovery processes. The results of the OU2 Sediment Monitoring Program conducted from 2007 to 2009 indicate that depletion of Site-related PAHs is occurring (ARCADIS 2008a, 2009a). PAH compositional changes in the sediments are evidenced by the loss of 2- and 3-ring PAHs by the first of the monitoring events in 2007 (as compared to the Site-related source material), and generally a continued relative loss of PAHs from 2007 to 2009. In addition, outside the ARC area, the PAHs are not bioavailable or toxic as documented in the Revised CSIR. Based on the OU2 Sediment Monitoring Program results, natural attenuation and recovery of PAHs are expected to continue in the future; however, no monitoring would be performed to document the effectiveness and progress of such processes in achieving the RAOs. Thus, the long-term effectiveness of the alterative is uncertain.

6.3.1.3 Reduction of Toxicity, Mobility, or Volume through Treatment

Because the OU2 sediments would not be actively removed, treated, or isolated, any reduction in the toxicity, mobility, and volume of the NAPL- and PAH-containing sediments would be solely based on the extent of natural recovery processes, which would not be monitored or otherwise documented.

6.3.1.4 Short-Term Impacts and Effectiveness

No remedial actions would be taken to address the impacted sediments. As a result, there would be no increased short-term environmental impacts or risks posed to workers or the community.

Although the amount of time required for natural recovery to achieve protective levels in sediments (i.e., the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}) is currently undefined, results from the OU2 Sediment Monitoring Program demonstrated that natural recovery of sediments at the Site has occurred and is expected to continue into the future.

6.3.1.5 Implementability

The No Further Action alternative does not require implementation of any remedial or monitoring activities, and therefore is both technically and administratively implementable.

6.3.1.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. There are no anticipated land use changes for the Site as a result of taking no further action to address the NAPL-containing and potentially toxic sediments within the ARC or the PAH-containing sediments within the 4 mg/kg PAH Area.

Although the potential for human exposure to MGP constituents in the OU2 sediments is low due to the existing land use and the physical attributes of the Site, taking no further action to address the NAPL- and PAH-containing sediments could discourage the use of the waterfront.

6.3.1.7 Overall Protection of Public Health and the Environment

The No Further Action alternative does not actively address the toxicity, mobility, or volume of NAPL- or PAH-containing sediments and therefore the RAOs would not be achieved in the short term. The mobility and toxicity of the sediments could be reduced over time through natural recovery processes such as weathering and burial through clean sediment deposition. However, no monitoring of the Site sediments would be conducted to verify that these natural recovery processes are occurring. Therefore, the overall protectiveness of the No Further Action alternative is considered low in short-term and uncertain in the long-term.

6.3.1.8 Cost

The No Further Action alternative does not involve implementation of any active remediation or monitoring activities; therefore, there are no costs associated with this alternative.

6.3.2 Alternative 2 – MNR of Sediments within the ARC and Institutional Controls

As described in Section 6.1.2, Alternative 2 involves allowing for recovery of sediments containing NAPL and PAHs through naturally occurring physical/chemical processes (e.g., advection, dispersion, burial, dissolution, sorption, and biodegradation). Over time, such processes would likely reduce the mass, mobility, and bioavailability of NAPL- and PAH-containing sediments. A sediment monitoring program would be designed and implemented to assess the progress of these processes.

Because NAPL- and PAH-containing sediments would remain in the Hudson River for a period of time, this alternative also includes establishment of institutional controls. Institutional controls would be in the form of governmental, enforcement, or permit controls, and/or informational devices.

6.3.2.1 Compliance with SCGs

This section summarizes the applicable chemical-, action-, and location-specific SCGs for this alternative.

Chemical Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. Chemical-specific SCGs considered for Alternative 2 are the are the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999), the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}, and 6 NYCRR Part 703.2 Water Quality Standards (NYCRR 1995), which identifies the surface water quality standards, such as turbidity and generation of sheens. Because NAPL- and PAH-containing sediments would remain in place without any active treatment or containment, this alternative is not expected to achieve the Site-specific threshold value for Hudson River sediment in the short-term. Over time, the Site-specific threshold value could be achieved through natural recovery processes. As noted previously, the potential for the NAPL-containing sediments at the Site to generate sheens on the water surface is already considered low under current Site conditions. As a result, the implementation of institutional controls associated with this alternative should serve to further reduce the potential for disturbance of NAPL-containing sediments and creation of sheens on the water surface.

Action-Specific SCGs

Because Alternative 2 would not include active remediation, action-specific SCGs identified in Table 3-2 are not applicable.

Location-Specific SCGs

Because Alternative 2 would not include active remediation, location-specific SCGs identified in Table 3-3 are not applicable.

6.3.2.2 Long-term Effectiveness and Permanence

Under Alternative 2, the NAPL- and PAH-containing sediments would not be actively addressed through removal, treatment or engineering controls. Therefore, the long-term effectiveness and permanence would be based on the extent of natural recovery processes and the effectiveness of the institutional controls.

The results of the OU2 Sediment Monitoring Program conducted from 2007 to 2009 indicate that depletion of Site-related PAHs is occurring. PAH compositional changes in the sediments are evidenced by the loss of 2- and 3-ring PAHs by the first of the monitoring events 2007 (as compared to the Site-related source material), and generally a continued relative loss of PAHs from 2007 to 2009. In addition, outside the ARC area, the PAHs are not bioavailable or toxic as documented in the Revised CSIR. Based on the OU2 Sediment Monitoring Program results, natural recovery of PAHs are expected to continue in the future (ARCADIS 2008a, 2009a). A sediment monitoring program would be designed and implemented to assess the progress of these processes toward achieving the RAOs.

The implementation of institutional controls should further reduce the potential for sediments containing NAPL to create sheens on the water surface when disturbed. Although periodic reports would be filed with the NYSDEC to demonstrate that the institutional controls are being maintained, the effectiveness and permanence of the institutional controls would largely be determined by the extent to which governmental or private entities adopt, comply with, and enforce them.

6.3.2.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

Because the OU2 sediments would not be actively removed, treated, or isolated, any reduction in the toxicity, mobility, and volume of the NAPL- and PAH-containing

sediments would be solely based on the extent of natural recovery processes, such as burial, sorption, dissolution, advection, dispersion, chemical transformation and biodegradation.

6.3.2.4 Short-term Impact and Effectiveness

With Alternative 2 there would be no increased short-term environmental impacts or human-health risks posed to Site workers or the community since no active remedial actions will be conducted; however, there would be potential for Site workers to be exposed to NAPL- and PAH-containing sediments during the implementation of the sediment monitoring program. A Site-specific Health and Safety Plan (HASP) would be developed to prescribe the appropriate PPE for workers to use to protect themselves during the sampling activities, thereby mitigating the potential for exposure. Although implementation of Alternative 2 would not include active construction at the Site, vessels/barges would be required for sampling operations, which would result in minor energy use, slight potential for impacts to surface water, generation of air pollutants, and greenhouse gas emissions. These potential impacts would be addressed by following, as appropriate, Best Management Practices (BMPs) related to vessel re-fueling, clean fuel and emissions (e.g., engine idle reduction practices, utilizing alternative fuels)

Although natural recovery of sediments has been documented to be occurring at the Site, estimation of the time frame for full recovery of the sediments is difficult to assess due to unknown variables and heterogeneity of the system. Based on the uncertainties associated with predictions about natural recovery process rates and the presence of NAPL in Site sediments, it is assumed for purposes of this FS that the natural recovery processes alone would require many years to meet the RAOs. The timeframe for implementation of the institutional controls would depend on the specific types of institutional controls selected, and the responsiveness and cooperation of the entities that National Grid would need to coordinate with to establish them. However, once the institutional controls have been implemented, the potential for human exposure to MGP-related constituents in sediments, albeit low now due to Site specific conditions, would be reduced. The implementation of institutional controls should also reduce the potential for sediments containing NAPL to be disturbed and potentially create sheens on the water surface.

6.3.2.5 Implementability

Implementation of Alternative 2 is technically feasible. Based on the successful implementation of previous investigation activities conducted at the Site, equipment and personnel that would be required to collect the sediment samples are known to be readily available and could be mobilized to the Site with relative ease. Further, based on the results of the OU2 Sediment Monitoring Program (ARCADIS 2008a and 2009a), natural recovery of sediments containing NAPL and PAHs has been demonstrated to be occurring since completion of the OU1 remediation, and recovery is expected to continue in the future.

Implementation of Alternative 2 is also considered to be administratively feasible. Selection of institutional controls would be performed in consultation with the appropriate parties, which could include New York State (owners of the river bottom), NYSDEC, USACE and the City of Hudson.

6.3.2.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. Although the potential for human exposure to MGP constituents in the OU2 sediments is low due to the existing land use and the physical attributes of the Site, taking no actions (i.e., active treatment, isolation, or removal) to address the NAPL- and PAH-containing sediments could discourage the use of the waterfront.

Any land use changes for the Site as a result of the implementation of Alternative 2 are expected to be minimal and limited to activity restrictions associated with the selected institutional controls. For example, although the potential for sediments within the ARC to generate sheens is considered low under current Site conditions, signs may be posted to prohibit anchoring in the ARC to further reduce the potential for disturbance of NAPL-containing sediments and generation of sheens on the water surface. In addition, an SMP would be prepared to document protocols to be followed in the event that intrusive activities (navigational dredging, construction of piers or docks, etc.) are required that could disturb NAPL- and PAH-containing sediment.

6.3.2.7 Overall Protectiveness of Public Health and the Environment

Alternative 2 does not include any removal, treatment, or containment actions to address potential human health and ecological risks. Though it is currently not high, the potential for human exposure to NAPL- and PAH-containing sediments would be reduced through establishment of institutional controls. Under this alternative, natural recovery processes (such as chemical weathering, degradation, and natural capping via deposition of clean sediments over the impacted sediments) would be relied upon in the long-term to isolate, or reduce the bioavailability and toxicity of MGP constituents in sediment and thereby reduce associated potential risks to human health and the environment. A monitoring program would be designed and implemented to document the progress of the natural recovery processes and allow for an assessment of progress toward achieving the RAOs and overall risk reduction.

6.3.2.8 Cost

The estimated costs associated with Alternative 2 are presented in Appendix B. The estimated 30-year present worth total cost for this alternative is approximately $1,430,000. The estimated capital cost for establishing institutional controls and preparing a Sediment Monitoring Work Plan is approximately $150,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting periodic sediment monitoring and annual verification of the status of institutional controls, is approximately $1,280,000.

6.3.3 Alternative 3 – Sediment Capping within the ARC and Institutional Controls

As detailed in Section 6.1.3, Alternative 3 involves placing an engineered cap over the sediments within the ARC, thus providing a physical barrier to mitigate potential mobility of, and human and biota exposure to, the NAPL-containing and potentially toxic sediments. A cap monitoring and maintenance program would be implemented to assess the long-term effectiveness of the cap, and appropriate institutional controls would be established to reduce the potential for disturbance of, and damage to, the cap as a result of human activities.

6.3.3.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. Chemical-specific SCGs considered for Alternative 3 are the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999), the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}, 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials, and 6 NYCRR Part 703.2 Water Quality Standards, which identifies the surface water quality standards, such as turbidity and generation of sheens (NYCRR 1995). In addition, the CWA criteria (33 USC 1341 through 1346) for discharges of fill into U.S. waters are potentially applicable for capping materials placed in the river.

Placement of an above-grade engineered cap over the NAPL- and PAH-containing sediments in the ARC would isolate and mitigate the potential migration of those sediments, resulting in achievement of the Site-specific threshold value. Debris removed from within the ARC would be characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 (NYCRR 1995) to determine appropriate off-site treatment/disposal requirements.

Potentially applicable chemical-specific SCGs for surface water include the NYSDEC Class A standards and guidance values. This alternative would meet these SCGs for surface water, as the NAPL-containing sediment would be isolated via an engineered cap that would be designed and maintained to mitigate the potential for the NAPL-containing sediments to result in the generation of sheens on the surface water. The implementation of institutional controls should reduce the potential for disturbance of the cap. Based on experience at a similar site on the Hudson River in Poughkeepsie, New York, sheen generation during cap placement is expected to be minimal. If any sheen should be generated on the water surface during cap placement, it would be addressed through the deployment of absorbent booms.

Action-Specific SCGs

Action-specific SCGs are presented in Table 3-2. Permits/approvals from the USACE and NYSDEC would be required for conducting construction activities within a navigable waterway of New York State. In particular, a Protection of Waters Permit under 6 NYCRR Part 608 (NYCRR 1995) would be required for placing a cap in the navigable waters of the Hudson River below the mean high water level. In accordance with Section 401 of the CWA, a Water Quality Certification would also be

required for placing an above-grade cap in a navigable waterway. It is anticipated that Alternative 3 would meet the substantive technical requirements of the Protection of Water Permit, which include that the alternative be reasonable and necessary; will not endanger the health, safety or welfare of the people of the State of New York; and will not cause unreasonable, uncontrolled or unnecessary damage to the natural resources of the state. However, securing the applicable permits for this activity could prove difficult and time-consuming.

Other potentially applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

Prior to cap installation, debris would be removed from the ARC and transported off site for disposal. The debris may be subject to USDOT and New York State regulation requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. If applicable, compliance with these requirements would be achieved by utilizing licensed waste transporters and permitted disposal facilities.

Additionally, the following activities under Alternative 3 are consistent with the core elements of USEPA's Green Cleanup Standard Initiative (USEPA 2009):

- Biodiesel fuels would be utilized (if available), resulting in the employment of a renewable energy source that is cleaner and will mitigate the generation of greenhouse gases.

- Field operations would be modified to reduce idling equipment (to the extent possible), thus mitigating total energy use and greenhouse gas emissions.

- BMPs would be employed to mitigate impacts to stormwater, thereby minimizing impacts to water resources.

- Shoreline rip-rap in the ARC would be removed, temporarily staged on Site, and re-used for slope protection along the shoreline. This beneficial re-use of Site material would reduce the consumption of virgin materials, the generation of

greenhouse gases through transportation of materials from off-Site sources, and the generation of waste.

Location-Specific SCGs

Location-specific SCGs are presented in Table 3-3. Potentially applicable location-specific SCGs generally include regulations re-grading construction activities (e.g., capping) in navigable waters. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit, and applicable local permits, prior to conducting Site activities. In accordance with the LWRP, a Coastal Consistency Review through the New York Department of State would also be required prior to conducting Site activities. Permits for remediation in regulated waters are issued by the USACE, usually under Nationwide Permit (NWP) 38: Cleanup of Hazardous and Toxic Waste, and jointly with the NYSDEC Water Quality Certification. Although securing the applicable permits for this activity could prove difficult and time-consuming, the above-grade engineered cap is anticipated to meet the substantive requirements of the NWP 38, which typically state:

- *No activity may cause more than minimal adverse effects on navigation.* The waters off-shore from the Site are deep, ranging up to 45 feet at the western edge of the ARC. The National Oceanic and Atmospheric Administration (NOAA) Navigational chart for this section of the Hudson River states that the USACE maintains an average depth of 34 ft for navigation. Thus, the addition of the engineered cap, estimated to be approximately 6-1/4 inches thick, would have no effect on navigation.

- *The activities for which the permit is issued will have minor adverse effects on normal patterns of water level fluctuations due to tides and flooding.* The placement of an engineered cap is not anticipated to have any significant effect on water levels. If necessary, this could be confirmed through modeling during the design phase.

- *The activities for which the permit is issued will have minimal adverse effects on current patterns and water circulation*. The addition of an engineered cap is not anticipated to have any effect on water currents or circulation. If necessary, this could be confirmed through modeling during the design phase.

- *The activities for which the permit is issued must withstand expected high flows and maintain the course, condition, capacity and location of open waters to the*

maximum extent possible. The cap would be designed to withstand reasonable worst case flow conditions and mitigate the potential for scour of the cap. As noted above, because the cap would only be 6-1/4 inches thick and the water depths are significant, the placement of the cap would not affect the open waters or navigation in the vicinity of the Site.

To minimize potential impacts to the shortnose sturgeon from the placement of the cap, the cap would be constructed at a time of year when this species would not be present at the Site (i.e., between October 1 and March 31).

6.3.3.2 Long-term Effectiveness and Permanence

The potential for future long-term impacts resulting from human and biota exposures to NAPL-containing and potentially toxic sediments would be reduced through the implementation of this alternative. NAPL-containing and potentially toxic sediment in the ARC would be isolated via an engineered cap that would reduce the mobility of, and potential human and biota exposure to, impacted sediments. The engineered cap would require monitoring and maintenance, along with potential activity restrictions within the capped area, for this alternative to remain effective and reliable over the long term. The cap would be inspected annually for the first 5 years, and every 5 years thereafter until year 30. Maintenance activities would be performed as necessary and could include replacing and repairing disturbed or damaged sections of the cap. Periodic reports would also be submitted to NYSDEC to describe any cap monitoring and maintenance activities. Institutional controls would be established to mitigate the potential for disturbance of or damage to the cap, thereby enhancing its long-term effectiveness and permanence. The effectiveness and permanence of the institutional controls would largely be determined by the extent to which governmental or private entities adopt, comply with, and enforce them. Annual reports would be submitted to the NYSDEC to document that the institutional controls are being maintained.

6.3.3.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

Installation of the engineered cap over the sediments within the ARC would reduce the mobility of the NAPL- and PAH-containing sediments. A properly-designed cap would mitigate the potential for the NAPL-containing sediments to result in the generation of sheens on the surface water, which would achieve the RAO to eliminate or reduce, to the extent practicable, the release(s) of contaminant(s) from MGP tar and MGP-impacted sediments that would result in exceedances/violations of surface water quality standards. The engineered cap would also isolate the NAPL-containing and

potentially toxic sediments, thereby providing a barrier to mitigate human and biota exposure to the sediments and achieving the RAOs related to human and biota exposure.

6.3.3.4 Short-term Impact and Effectiveness

The short-term impacts on the environment resulting from implementation of Alternative 3 could include potential minor impacts to the water column due to resuspension of sediments and slight sheen generation. However, based on experience installing a similar cap at a site on the Hudson River in Poughkeepsie, New York, sheen generation during cap placement is expected to be minimal and could be effectively addressed through the deployment of absorbent booms. Implementation of this alternative could also result in temporary impacts to biota in the Hudson River area during capping activities due to temporary alteration/destruction of existing habitat types in the area subject to capping. However, restoration of the previous benthic communities is expected to occur in relatively short timeframes as a result of re-colonization.

Additionally, impacts on the local community resulting from implementation of Alternative 3 would include short-term (i.e., limited duration) increased vehicular traffic associated with the delivery of cap materials to the Site. The number of truck trips estimated for the implementation of Alternative 3 (approximately 60 tri-axle trucks, each carrying a total of 14 cy of material) is considered to be minimal. The slight increased potential for total emissions and motor vehicle accidents on local roadways would be managed through the use of appropriate BMPs for clean fuel and emission (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels), and planned truck routes to minimize impacts on local community. Short-term impacts to Site workers would be controlled through the use of appropriate health and safety practices (29 CFR Part 1910) and compliance with the site-specific HASP.

Implementation of Alternative 3 would have short-term impacts on land use during the remedy implementation period. Recreational users of the river would not be able to access the portion of the river where remedial activities are being conducted. Buoys or other means of demarcation would be used to keep recreational boaters out of the work area in accordance with U.S. Coast Guard (USCG) requirements. Likewise, portions of the upland area adjacent to OU2, possibly including portions of the City of Hudson Park, would be restricted from public access during the remedy implementation as a result of the need for construction staging areas and debris

handling activities. The operations associated with Hudson Cruises, Inc. could need to be temporarily re-located during the remediation activities.

Based on the size of the area to be capped (i.e., the ARC) it is anticipated that cap construction and placement could be completed in approximately 4 months. The cap is anticipated to be effective at mitigating the potential mobility of, and human and biota exposure to, the NAPL-containing and potentially toxic sediment, and achieving the RAOs, immediately following placement.

6.3.3.5 Implementability

This remedial alternative would be technically implementable. Equipment, materials, and remedial contractors necessary to construct, install, monitor and maintain the engineered cap are readily available. Potential technical implementability issues for this alternative would be associated with placing the cap during the colder weather months (i.e., outside of the fish protection period of April 1 through September 30), the potential for severe weather conditions (conducting activities in water may be limited by conditions such as winds and storms [e.g., thunderstorms or hurricanes]), and the potential presence of underwater structures/obstructions. These implementation challenges could be mitigated with proper advance planning and coordination of the remedial activities, such as constructing the marine mattresses on land in advance such that placement of the cap in the river could begin in early fall as soon as possible after the fish protection period closes.

Alternative 3 would also be administratively implementable. Above-grade sediment caps have been designed and successfully implemented at other contaminated sediment sites in compliance with Section 401 of the CWA and USACE requirements. The ROD issued by NYSDEC for the Central Hudson Gas & Electric Corporation (Central Hudson) Newburgh, New York Site in December 2005 included an above-grade sediment cap (in certain areas pre-dredging was needed to maintain minimum water depths) (NYSDEC 2005). Although the above-grade sediment cap was ultimately not installed at the Newburgh site (based on post-ROD PDIs of sediment toxicity), NYSDEC selected above-grade sediment capping in the Newburgh ROD with the expectation that the cap would be able to meet the permit requirements for 6 NYCRR Part 608 (NYCRR 1995). In addition, on behalf of EPRI and Central Hudson, in 2009 ARCADIS performed a field demonstration pilot study of an above-grade sediment cap at the Central Hudson North Water Street Site in Poughkeepsie, New York. In addition to these sites within New York State, above-grade capping was the selected as the remedial alternative and implemented at the following sites:

- Asarco Sediments/Groundwater Operable Unit of the Commencement Bay Nearshore/Tideflats Superfund Site in Washington
- McCormick & Baxter Creosoting Superfund Site in California
- McCormick & Baxter Creosoting Superfund Site in Oregon
- Palos Verde Shelf OU of the Montrose Chemical Corp. Superfund Site in California
- Pacific Sound Resources Superfund Site in Washington
- Pine Street Canal Superfund Site in Vermont
- Puget Sound Naval Shipyard Complex Superfund Site in Washington
- Silver Lake portion of Housatonic River Superfund Site in Massachusetts
- Upriver Dam portion of the Spokane River in Washington
- Whatcom Waterway in Washington
- Zidell (ZRZ Realty Company) Waterfront Property in Oregon

In summary, an above-grade sediment cap installed at the Site would meet the administrative requirements of 6 NYCRR Part 608 (NYCRR 1995) and USACE NWP 38 and would be administratively feasible if it can be demonstrated that:

- The cap would not endanger the health, safety or welfare of the people of the State of New York (refer to descriptions under Short-term Impact and Effectiveness, Long-Term Effectiveness and Permanence, and Overall Protection of Public Health and the Environment criteria)
- The cap would not cause unreasonable, uncontrolled or unnecessary damage to the natural resources of the state including soil, forests, water, fish, shellfish, crustaceans, and aquatic and land-related environment (refer to descriptions under Short-term Impact and Effectiveness criteria).

Conducting sediment remediation activities adjacent to an active shipping channel that is maintained by the USACE and that falls within an area of the Hudson River that is

used for recreational and navigation purposes would present numerous logistical challenges. Coordination with the USACE and other river users (e.g., the Hudson Cruises, Inc.) would be necessary and river work areas would need to be secured from these river users. The operations associated with Hudson Cruises, Inc. may need to be temporarily re-located during remediation activities. Permits (or meeting the substantive requirements of any permits) associated with work within a waterway would be required for Alternative 3. Finally, based on previous experience sampling/monitoring sediment within OU2, there may be difficulties gaining permission from the Mid-Hudson Cable Company to conduct remedial activities adjacent to the fiber optic line located to the north of the ARC.

Implementation of Alternative 3 is also considered to be administratively feasible with respect to the institutional controls. Selection of institutional controls would be performed in consultation with the appropriate parties, which could include New York State (owners of the river bottom), NYSDEC, USACE, and the City of Hudson.

6.3.3.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. The rocky shoreline with steep banks (in some areas vertical due to the presence of concrete or steel bulkheads) and the deep water with swift currents present little or no potential for wading or swimming within the Site.

The implementation of Alternative 3 is not expected to significantly affect the use of the river for navigation or recreational purposes. The only land use changes that are expected to result from the implementation of Alternative 3 would be activity restrictions associated with the selected institutional controls. For example, signs may be posted prohibiting anchoring within the capped area to reduce the potential for future disturbance of or damage to the cap. An SMP would be prepared to document protocols to be followed in the event that intrusive activities (navigational dredging, construction of piers or docks, etc.) are required in the future that could disturb the cap and underlying sediments containing MGP constituents.

6.3.3.7 Overall Protectiveness of Public Health and the Environment

Alternative 3 would reduce the mobility of, and potential for human and biota exposure to, NAPL-containing sediment and sediment identified during the 2009 bioavailability study as potentially toxic to benthic macroinvertebrates through the installation and maintenance of an engineered cap over the sediments. Appropriate institutional controls would be established to limit the potential for disturbance of or damage to the cap. Although generation of sheens on the water surface is not a significant concern under existing Site conditions, Alternative 3 would further reduce the potential for disturbance of NAPL-containing sediments that could result in generation of sheens on the water surface.

Potential short-term impacts to the community from remedial construction activities are expected to be minimal and would be managed by following site plans, establishing appropriate engineering controls, and proper sequencing of the work. Potential short-term exposures of Site workers to MGP-related constituents during implementation of this alternative could be mitigated by following appropriate health and safety practices. A long-term cap monitoring and maintenance program would be implemented to enhance the long-term effectiveness of the cap.

Through capping and institutional controls, Alternative 3 would achieve the Site RAOs and be protective of public health and the environment.

6.3.3.8 Cost

The estimated costs associated with Alternative 3 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $8,890,000. The estimated capital cost for installing the cap and establishing institutional controls is approximately $7,170,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting cap monitoring and maintenance and verifying the status of institutional controls, is approximately $1,720,000.

6.3.4 Alternative 4 – Excavation of Sediments within the ARC to a Depth of 1 foot with Treatment/Disposal of Excavated Sediments, Capping of the Excavated Area, and Institutional Controls

As described in Section 6.1.4, Alternative 4 involves the removal of 1 foot of sediment from within the footprint of the ARC. Approximately 2,000 cy of sediment would be

removed by the dredging activities, including all of the sediments identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediments. An engineered cap would be installed over the remaining NAPL- and PAH-containing sediments (Figure 6-3). Institutional controls would be established to reduce the potential for future disturbances of, and damage to, the cap.

6.3.4.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. Chemical-specific SCGs considered for Alternative 4 are the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999), the Site-specific threshold value of approximately 5.4 SPME pore water TU_{34}, 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials, and 6 NYCRR Part 703.2 Water Quality Standards, which identifies the surface water quality standards, such as turbidity and generation of sheens (NYCRR 1995). In addition, the CWA criteria (33 USC 1341 through 1346) for discharges of fill into U.S. waters are potentially applicable for capping materials placed in the river.

Removal and off-Site treatment of the top foot of sediments within the ARC, and placement of a cap over the NAPL- and PAH- containing sediments remaining at depth within the ARC would isolate and mitigate the potential for migration of those sediments, resulting in achievement of the Site-specific threshold value and RAOs following remedy implementation. For purposes of this FS, the dredging and capping activities associated with this alternative are assumed to be carried out within containment (i.e., sheet pile walls), which would minimize potential surface water quality impacts (i.e., turbidity and generation of sheens) during dredging and cap placement if it can be successfully installed and maintained to be effective. However, as described previously, there is uncertainty regarding the technical feasibility of installing the sheet pile walls. If a containment system cannot be installed, this alternative would likely not meet the surface water quality SCGs (6 NYCRR Part 703.2 Water Quality Standards [NYCRR 1995]) during the remedy implementation period due to NAPL transport, sheen generation, and sediment re-suspension (i.e., exceedances of turbidity standards) as a result of the dredging activities.

Debris and sediment removed from within the ARC would be characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 (NYCRR 1995) to determine appropriate off-site treatment/disposal requirements.

With respect to the NAPL- and PAH-containing sediment that would remain at depth, the engineered cap would be designed and maintained to mitigate the potential for the NAPL-containing sediments to result in the generation of sheens on the water surface. The implementation of institutional controls should reduce the potential for disturbance of the cap. Thus, this alternative would meet the SCGs for surface water following cap placement.

Action-Specific SCGs

Action-specific SCGs are presented in Table 3-2. Permits/approvals from the USACE and NYSDEC would be required for conducting construction activities within a navigable waterway of New York State. Debris and sediment would be subject to USDOT and New York State regulations for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved remedial design and using licensed waste transporters and permitted treatment/ disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). For the purposes of this FS Report, all sediment excavated under this alternative is assumed to be treated via LTTD. Additionally, a SPDES permit would be required to discharge treated water to the Hudson River. The permit would establish maximum discharge limits and pre-treatment requirements that would need to be achieved prior to discharge.

Other applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

Additionally, the following activities under Alternative 4 are consistent with the core elements of USEPA's Green Cleanup Standard Initiative (USEPA 2009):

- Biodiesel fuels would be utilized (if available), resulting in the employment of a renewable energy source that is cleaner and would mitigate the generation of greenhouse gases.

- Field operations would be modified to reduce idling equipment (to the extent possible), thus mitigating total energy use and greenhouse gas emissions.

- Dredged sediments would be staged and processed within an enclosed structure equipped with an air handling and treatment system, thus addressing the generation and transport of airborne contaminants and dust through BMPs

- BMPs would be employed to mitigate impacts to stormwater, thereby minimizing impacts to water resources.

- Water generated during sediment processing would be treated and returned to the Hudson River under a SPDES permit, which in turn would minimize impacts to water resources.

- Shore-line rip-rap in the ARC would be removed, temporarily staged on Site, and re-used for slope protection along the shoreline. This beneficial re-use of Site material would reduce the consumption of virgin materials, the generation of greenhouse gases through transportation of materials from off-Site sources, and the generation of waste.

Location-Specific SCGs

Location-specific SCGs are presented in Table 3-3. Potentially applicable location-specific SCGs generally include regulations regarding construction activities (e.g., installing temporary containment sheeting, dredging and capping) in navigable waters. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit, and applicable local permits, prior to conducting Site activities. In accordance with the LWRP, a Coastal Consistency Review through the New York Department of State would also be required prior to conducting the Site activities associated with this alternative. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances, as applicable.

To minimize impacts to shortnose sturgeon from the dredging and placement of the cap, these activities would be conducted inside containment, which would be installed in the river prior to April 1 to allow the dredging and cap placement to occur during the

peak construction season (i.e., summer months). In the event that the containment sheeting cannot be successfully installed, the dredging and capping activities would need to be conducted between October 1 and March 31.

6.3.4.2 Long-term Effectiveness and Permanence

The potential for human and biota exposures to NAPL- and PAH-containing sediments, including the sediments identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, would be reduced through the implementation of this alternative. All of the sediments identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediments, would be permanently removed from the river and treated off-Site via LTTD. NAPL- and PAH-containing sediment remaining at depth within the ARC would be isolated via an engineered cap that would be reduce the mobility of, and potential human and biota exposure to, those impacted sediments. The engineered cap would require monitoring and maintenance, along with potential activity restrictions within the capped area, for this alternative to remain effective over the long-term. For purposes of this FS it is assumed that inspection of the cap would be conducted annually for the first 5 years and then every 5 years thereafter until year 30. Maintenance activities would include replacing and repairing disturbed or damaged areas of the cap. Periodic reports would be prepared and submitted to NYSDEC to describe any monitoring and maintenance activities. Reports would also be submitted to the NYSDEC annually to document that the institutional controls are being maintained. However, the effectiveness of the institutional controls would largely be determined by the extent to which governmental or private entities adopt, comply with, and enforce them.

As previously discussed, if effective containment cannot be installed around the ARC, there would likely be resuspension and release of PAH-impacted sediment and NAPL transport during dredging activities which could result in long-term impacts in adjacent/downriver areas of the river.

6.3.4.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

This alternative would include the removal and off-site treatment of the top foot of sediment within the ARC, including all of the sediment identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates. Approximately 2,000 cy of NAPL- and PAH-containing sediment would be dredged from the river and treated off-site via LTTD. These removal activities would result in

the reduction of the volume of NAPL-containing sediment and associated potential toxicity. Installation of the engineered cap over the sediments remaining within the ARC at depth would effectively mitigate the mobility of, and potential human and biota exposure to, those NAPL- and PAH-containing sediments. A properly-designed cap would mitigate the potential for the remaining NAPL-containing sediments at depth to result in the generation of sheens on the water surface.

6.3.4.4 Short-term Impact and Effectiveness

The short-term impacts on the environment resulting from implementation of Alternative 4 would include potential impacts to the water column, air, and biota in the Hudson River area during dredging and capping activities. These effects could be mitigated by the use of engineering controls. Potential impacts to the water column during dredging and cap placement could be addressed through installation of containment sheeting around the dredging and capping area. However, as noted previously, if the containment walls cannot be feasibly installed and maintained to be effective, there could be significantly increased negative short-term impacts due to resuspension of sediment and NAPL movement that would likely result from dredging activities. Potential air impacts during dredging and on-site sediment processing would be addressed through the use of engineering controls, including application of a surfactant such as Biosolve® to address odors and processing of sediments within an enclosed structure equipped with an air handling and treatment system. Implementation of this alternative could also result in temporary impacts to biota in the ARC during dredging and capping activities due to temporary alteration/destruction of habitat in the area subject to dredging and capping. However, restoration of the previous benthic communities is expected to occur in relatively short timeframes as a result of re-colonization.

Implementation of this alternative may result in short-term exposure of the Site workers surrounding community to MGP-related constituents as a result of dredging, material handling, capping, and off-site transportation activities. Potential exposure mechanisms would include incidental ingestion of, and dermal contact with, impacted sediment and/or surface water (workers only) and inhalation of organic vapors or dust containing MGP-related constituents. Potential exposure of remedial workers would be mitigated through the use of appropriately trained field personnel and the appropriate level of PPE, as specified in a site-specific HASP that would be developed as part of the remedial design, as well as by using an enclosed structure with air treatment for sediment processing. Air monitoring would be performed during dredging activities to evaluate the need for additional engineering controls (e.g., use of a surfactant such as

Biosolve® to suppress odors, modifying the rate of dredging). A site-specific CAMP would be prepared and community air monitoring would be performed during dredging activities to evaluate the need for additional engineering controls. Community access to the upland work areas (e.g., sediment staging/processing area) would be restricted by temporary fencing. River use in the remediation area would also be restricted using signs, buoys, lighting, and/or other controls consistent with USCG requirements, and communication with the USCG would be required regarding temporary obstruction in the river.

Additional worker safety concerns include working with and around large construction equipment, working on and around water, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of dredged sediment from the Site and delivery of cap materials. If the containment walls cannot be feasibly installed, worker safety would also potentially include working in cold temperatures due to the requirement for any uncontained in-water construction to be performed outside the fish protection period (i.e., work would be conducted between October 1 and March 31).

Additionally, short-term impacts on the local community resulting from implementation of Alternative 4 would include short-term or limited duration increased vehicular traffic associated with the off-site transportation of dredged material and importation of clean materials for cap construction. The number of truck trips estimated for the implementation of Alternative 4 is approximately 200 tri-axle trucks, each carrying approximately 14 cy of material. The increased vehicle emissions and increased potential for motor vehicle accidents on local roadways would be managed through the use of appropriate BMPs for clean fuel and emissions (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels) and by carefully planning truck routes to minimize impacts on the local community . In this alternative, energy would also be used for construction and treatment operations primarily through fuel consumption. Dredging of sediments, transportation of dredged sediments, treatment of sediments via LTTD, and cap installation would result in the emission of GHGs from remediation equipment, transportation vehicles, and the sediment treatment process itself. BMPs that would be utilized to minimize impacts and improve sustainability would include modifying field operations to reduce idling equipment (to the extent possible), and using biodiesel fuels (if available).

Implementation of Alternative 4 would have short-term impacts on land use during the remedy implementation period. Recreational users of the river would not be able to access the portion of the river where remedial activities are being conducted.

Buoys or other means of demarcation would be used to keep recreational boaters out of the work area in accordance with USCG requirements. Likewise, portions of the upland area adjacent to OU2, likely including portions of the public park, would be restricted from public access during the remedy implementation as a result of the need to slope back shoreline areas for stability purposes, sediment off-loading and handling, and water treatment activities. The operations associated with Hudson Cruises, Inc. would likely need to be temporarily re-located during the remediation activities.

Based on the volume of sediment that would be dredged and the size of the cap that would be installed, it is anticipated that the in-river construction activities associated with Alternative 4 would require approximately 3 months. The cap is anticipated to be effective at isolating and reducing the mobility of the NAPL- and PAH-containing sediment remaining at depth within the ARC, and therefore achieving the RAOs, immediately following placement.

6.3.4.5 Implementability

Equipment, materials, and remedial contractors necessary to dredge, transport, and treat sediments, and construct, install, monitor and maintain an engineered cap are readily available. Technical implementability issues for this alternative would be associated with the ability to install containment sheeting, the potential for severe weather conditions (conducting activities in water may be limited by conditions such as winds and storms [e.g., thunderstorms or hurricanes]), and the potential presence of underwater structures. As described previously, there is uncertainty regarding the technical feasibility of installing the sheet pile containment due to Site conditions, including water depths up to 45 feet at the far edge of removal, water velocity greater than 3 ft/sec, 4-foot tidal fluctuations, and an assumed depth of 30 feet of sediment above bedrock. If it can be installed, the sheet pile containment wall would not be able to withstand vessel impacts (a potential risk due to the known boat traffic in this section of the river), nor would it be able to withstand ice loading. If this alternative is selected as the Site remedy, additional information would be collected during the PDI, and additional engineering analyses would be performed during the remedial design, to determine if the sheet pile walls can be installed safely and effectively.

Conducting sediment remediation activities within and adjacent to an active shipping channel that is maintained by the USACE and that falls within an area of the Hudson River that is used for recreational and other purposes presents numerous logistical challenges. Coordination with the USACE and other river users (e.g., Hudson Cruises,

Inc.) would be necessary and river work areas would need to be secured from these river users using signs, buoys, lights, and other markings consistent with USCG requirements. The operations associated with Hudson Cruises, Inc. would likely need to be temporarily re-located during the remediation activities.

In terms of administrative feasibility, permits from the USACE and NYSDEC would be required for work within the Hudson River, which is a navigable waterway. Sediment processing on land would also result in logistical challenges and would require National Grid to obtain access agreement(s) to allow for temporary access to accommodate sediment staging/processing and water treatment areas. Based on previous experience conducting sediment sampling within OU2, there may be difficulties gaining permission from the Mid-Hudson Cable to conduct remedial activities adjacent to the fiber optic line located to the north of the ARC. Implementation of Alternative 4 is considered to be administratively feasible with respect to the institutional controls. Selection of institutional controls would be performed in consultation with the appropriate parties, which could include New York State (owners of the river bottom), NYSDEC, USACE and the City of Hudson. Finally, this remedial alternative would need to be consistent with the goals set by the LWRP for this area of the river.

For purposes of this FS, this remedial alternative has been assumed to be both technically and administratively implementable. However, if this alternative were selected, this would need to be further evaluated and verified during the PDI and remedial design, particularly with respect to the ability to install safe and effective containment.

6.3.4.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. The rocky shoreline with steep banks and the deep water with swift currents present little or no potential for wading or swimming within the Site.

The implementation of Alternative 4 would not significantly affect the use of the river for navigation or recreational purposes. The only land use changes that would result from the implementation of Alternative 4 would likely be limited to activity restrictions associated with the selected institutional controls. For example, signs may be posted prohibiting anchoring within the capped area to reduce the potential for future disturbance of or damage to the cap. An SMP would be prepared to document

protocols to be followed in the event that intrusive activities (navigational dredging, construction of piers or docks, etc.) are required in the future that could disturb the cap and underlying NAPL- and PAH-containing sediments containing MGP constituents.

6.3.4.7 Overall Protectiveness of the Public Health and the Environment

Alternative 4 would mitigate potential for human and biota exposure to NAPL- and potentially toxic sediment through dredging and off-Site treatment of the top foot of sediment, including all of the sediment identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, and installing and maintaining an engineered cap over the remaining NAPL-and PAH-containing sediments at depth. Institutional controls would be established to limit the potential for disturbance of or damage to the cap. Alternative 4 would also mitigate the potential for the NAPL-containing sediments remaining within the ARC to result in the generation of sheens on the water surface through the placement of the engineered cap over those sediments.

The effectiveness of this alternative could be reduced if containment cannot be successfully and safely installed around the ARC; there could be significant resuspension and release of PAH-containing sediment and NAPL transport during dredging activities, which could result in long-term impacts in adjacent/downriver areas of the river.

Potential short-term impacts to the community from remedial construction activities and off-site transportation of dredged material would be managed by following site plans and establishing appropriate engineering controls. Potential short-term exposures of Site workers to NAPL- and PAH-containing sediments during implementation of this alternative would be mitigated by appropriate health and safety planning and practices. A cap monitoring and maintenance program would be implemented to enhance the long-term effectiveness of the cap.

Through dredging, capping and institutional controls, Alternative 4 would achieve the Site RAOs.

6.3.4.8 Cost

The estimated costs associated with Alternative 4 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $11,470,000. The estimated capital cost, including costs for conducting sediment

removal activities, installing the cap and establishing institutional controls, is approximately $9, 750,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting periodic cap monitoring and maintenance and verifying the status of institutional controls, is approximately $1,720,000.

6.3.5 Alternative 5 – Excavation of Sediments within the ARC to a depth of 2 feet with Treatment/Disposal of Excavated Sediments, Capping of the Excavated Area, and Institutional Controls

As described in Section 6.1.5, Alternative 5 is almost identical to Alternative 4 except that the top 2 feet of sediment would be removed within the footprint of the ARC (instead of the top foot). Therefore, the entire detailed analysis of Alternative 5 is not repeated herein. Rather, the significant changes from Alternative 4 to Alternative 5 with respect to the evaluation criteria are highlighted in the subsections that follow.

6.3.5.1 SCGs

The SCGs that apply to Alternative 4 would also apply to Alternative 5.

6.3.5.2 Long-term Effectiveness and Permanence

Assuming the engineered cap over the NAPL- and PAH-containing sediments remaining at depth within the ARC is properly maintained, Alternative 5 is expected to have the same long-term effectiveness as Alternative 4. The permanence of Alternative 5 would be slightly increased, however, as a result of the removal and off-site treatment of a greater quantity of NAPL- and PAH-containing sediment prior to capping (refer to 6.3.5.3 below).

6.3.5.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

Alternative 5 would include the removal and off-site treatment/disposal of the top 2 feet of sediment within the ARC, including all of the sediment identified during the 2009 bioavailability study as potentially being toxic to benthic macroinveretebrates, as well as a portion of the NAPL-containing sediment. A total of approximately 4,000 cy of NAPL-containing and potentially toxic sediment would be removed from the river and treated off-Site via LTTD. As with Alternative 4, these removal activities would result in the reduction of the volume of impacted sediment and associated potential toxicity.

6.3.5.4 Short-term Impact and Effectiveness

The short-term impacts and effectiveness for Alternative 5 are identical to the short-term impacts for Alternative 4, with the following exceptions:

- The number of truck trips estimated for the implementation of Alternative 5 is approximately 360, each carrying a total of 14 cy of material.
- Based on the volume of sediment to be dredged and the size of the cap, it is anticipated that the remediation activities associated with Alternative 5 would require approximately 4 months to complete.
- The longer duration of dredging activities (as a result of increase in dredge depth and associated dredge volume) associated with Alternative 5 would result in a greater potential for short-term exposures to Site workers and the community, and an increased potential for releases of resuspended sediment and NAPL downriver.

6.3.5.5 Implementability

The same technical and administrative implementability issues that apply for Alternative 4 would also apply to Alternative 5.

6.3.5.6 Land Use

The same land use issues that apply for Alternative 4 would also apply to Alternative 5.

6.3.5.7 Overall Protectiveness of the Public Health and the Environment

Alternative 5 would mitigate potential for human and biota exposure to NAPL- and PAH-containing sediment through the removal and off-site treatment/disposal of the top 2 feet of sediment within the ARC, the installation and maintenance of an engineered cap over the NAPL- and PAH-containing sediments remaining at depth within the ARC, and the establishment of appropriate institutional controls to limit the potential for disturbance of or damage to the cap. Alternative 5 would also mitigate the potential for the NAPL-containing sediments remaining within the ARC to result in the generation of sheens on the water surface through the placement of the cap over those sediments.

If containment cannot be successfully and safely installed, there would likely be significant resuspension and release of PAH-impacted sediment and NAPL transport during dredging activities, which could result in long-term impacts in adjacent/downriver areas of the river.

Through dredging, capping and institutional controls, Alternative 5 would achieve the Site RAOs.

6.3.5.8 Cost

The estimated costs associated with Alternative 5 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $12,940,000. The estimated capital cost, including costs for conducting sediment removal activities, installing the cap and establishing institutional controls, is approximately $11,220,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting cap monitoring and maintenance and verifying the status of institutional controls, is approximately $1,720,000.

6.3.6 Alternative 6– Excavation of Sediments within the ARC to Variable Depths (up to 6 feet) with Treatment/Disposal of Excavated Sediments, Partial Backfill and Capping of the Excavated Area, and Institutional Controls

As described in Section 6.1.6, Alternative 6 is very similar to Alternatives 4 and 5, with the exception that up to 6 feet of sediment would be removed within the footprint of the ARC. Therefore, the entire detailed analysis of Alternative 6 is not repeated herein. Rather, the significant changes from Alternative 4 and Alternative 5 with respect to the evaluation criteria are highlighted in the subsections that follow.

6.3.6.1 SCGs

The SCGs that apply to Alternatives 4 and 5 would also apply to Alternative 6.

6.3.6.2 Long-term Effectiveness and Permanence

Alternative 6 has the same long-term effectiveness as Alternatives 4 and 5; however, the permanence would be increased as a result of the larger quantity of sediment removed from the river (refer to 6.3.6.3 below).

6.3.6.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

Alternative 6 would include the removal and off-site treatment/disposal of all of the sediment identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediment within the ARC (a total of approximately 6,000 cy of sediment would be removed from the river). As with Alternatives 4 and 5, these removal activities would result in the reduction of the volume of NAPL- and PAH-containing sediment and associated potential toxicity. In addition, clean backfill and an engineered cap would be placed to isolate the NAPL- and PAH-containing sediments that would remain at depth within the ARC and mitigate the potential upward movement of those materials. Capping the remaining NAPL- and PAH-containing sediment would contain the sediments in place and provide a barrier, thereby reducing the potential for future human and biota exposure to those sediments. A properly designed and maintained cap would reduce the flux of NAPL to surface water, thereby reducing the potential for the remaining NAPL-containing sediments to generate sheens on the water surface.

6.3.6.4 Short-term Impact and Effectiveness

The short-term impacts for Alternative 6 are similar to Alternatives 4 and 5, with the following exceptions:

- The number of truck trips estimated for the implementation of Alternative 6 is approximately 500, each carrying a total of 14 cy of material.
- It is estimated that remediation activities associated with Alternative 6 would require approximately 5 months to complete.
- The longer duration of dredging activities (as a result of increase in dredge depth and volume) associated with Alternative 6 would result in a greater potential for short-term exposures to Site workers and the community, and an increased potential for releases of resuspended sediment and NAPL downriver.

6.3.6.5 Implementability

The same technical and administrative implementability issues that apply to Alternatives 4 and 5 also would apply to Alternative 6, with the additional technical implementability issue of installing bracing to protect the shoreline during dredging activities at deeper depths (i.e., greater than 4 feet). The equipment and materials

necessary to protect the shoreline with bracing are readily available. Remedial contractors are also available to perform these activities. Technical implementability issues associated with the installation of shoreline bracing would include potential for subsurface obstructions and existing man-made structures; these technical implementability issues could be mitigated with collection of the necessary information during the PDI and through proper planning during remedial design.

6.3.6.6 Land Use

The same land use issues that apply to Alternatives 4 and 5 would also apply to Alternative 6.

6.3.6.7 Overall Protectiveness of the Public Health and the Environment

Alternative 6 would mitigate potential for human and biota exposure to NAPL- and PAH-containing sediment through the removal and off-site treatment of up to 6 feet of sediment within the ARC, the placement of backfill, and installation and maintenance of an engineered cap over the NAPL- and PAH-containing sediments remaining at depth within the ARC. Institutional controls would be established to limit the potential for disturbance of, or damage to, the cap. As noted previously, if containment cannot be successfully and safely installed, there would likely be significant resuspension and release of PAH-impacted sediment and NAPL transport during dredging activities, which could result in long-term impacts in adjacent/downriver areas of the river.

Through dredging, capping and institutional controls, Alternative 4 would achieve the Site RAOs.

6.3.6.8 Cost

The estimated costs associated with Alternative 6 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $15,170,000. The estimated capital cost, including costs for conducting sediment removal activities, partially backfilling the dredge area, installing the cap, and establishing institutional controls, is approximately $13,450,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting cap monitoring and maintenance and verifying the status of institutional controls, is approximately $1,720,000.

6.3.7 Alternative 7 – Excavation of Sediments within the ARC to Full Depth of NAPL (up to 15 feet) with Treatment/Disposal of Excavated Sediments and Partial Backfill of the Dredge Area

As described in Section 6.1.7, Alternative 7 involves the removal of all NAPL-containing sediment and potentially toxic sediment from within the footprint of the ARC (removal depths up to 15 feet) (Figure 6-6). Approximately 9,000 cy of sediment would be removed by the dredging activities (Figure 6-6a).

6.3.7.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. Potentially applicable chemical-specific SCGs for sediment include the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999), the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}, and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials (NYCRR 1995). Potentially applicable chemical-specific SCGs for surface water include the NYSDEC Class A standards and guidance values and 6 NYCRR Part 703.2 Water Quality Standards (NYCRR 1995).

Dredging, treating and disposing of the NAPL-containing and potentially toxic sediments in the ARC would permanently remove those sediments, resulting in achievement of the Site-specific threshold value and the RAOs.

Debris and sediment removed from within ARC would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 (NYCRR 1995) to determine appropriate off-site treatment/disposal requirements.

The dredging and capping activities associated with this alternative are assumed to be carried out within containment (i.e., sheet pile walls). If the containment walls can be successfully installed and maintained to be effective, they would minimize surface water quality impacts (turbidity and sheens) during dredging. However, as noted earlier, there is a high level of uncertainty regarding the technical feasibility of installing the sheet pile walls. If a containment system cannot be installed, this alternative would likely not meet the surface water quality SCGs (6 NYCRR Part 703.2 Narrative Water Quality Standards [NYCRR 1995]) during the remedy implementation period due to

NAPL transport, excessive sheen generation, and sediment re-suspension (i.e., exceedances of turbidity standards) expected to occur as a result of the dredging.

Clean backfill material placed into the river under Alternative 7 would be required to meet the CWA criteria (33 USC 1341 through 1346).

Action-Specific SCGs

Action-specific SCGs are presented in Table 3-2. Permits/approvals from the USACE and NYSDEC would be required for conducting construction activities within a navigable waterway of New York State. Debris and sediment would be subject to USDOT and New York State regulations for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved remedial design and using licensed waste transporters and permitted treatment/disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). For purposes of this FS, it is assumed that all excavated material would be treated via LTTD. Additionally, a SPDES permit would be required to discharge treated water to the Hudson River. The permit would establish maximum discharge limits and treatment requirements that the water treatment system would have to achieve prior to discharge.

Other applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

Additionally, the following activities under Alternative 7 are consistent with the core elements of USEPA's Green Cleanup Standard Initiative (USEPA 2009):

- Biodiesel fuels would be utilized (if available), resulting in the employment of a renewable energy source that is cleaner and would mitigate the generation of greenhouse gases.

- Field operations would be modified to reduce idling equipment (to the extent possible), thus mitigating total energy use and greenhouse gas emissions.

- Dredged sediments would be staged and processed within an enclosed structure equipped with an air handling and treatment system, thus addressing the generation and transport of airborne contaminants and dust through BMPs

- BMPs would be employed to mitigate impacts to stormwater, thereby minimizing impacts to water resources.

- Water generated during sediment processing would be treated and returned to the Hudson River under a SPDES permit, which in turn would minimize impacts to water resources.

- Shoreline rip-rap in the ARC would be removed, temporarily staged on Site, and re-used for slope protection along the shoreline. This beneficial re-use of Site material would reduce the consumption of virgin materials, the generation of greenhouse gases through transportation of materials from off-Site sources, and the generation of waste.

Location-Specific SCGs

Location-specific SCGs are presented in Table 3-3. Potentially applicable location-specific SCGs include regulations on conducting dredging activities in navigable waters. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit, and applicable local permits, prior to conducting Site activities. In accordance with the LWRP, a Coastal Consistency Review through the New York Department of State will also be required prior to conducting Site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances, as applicable.

To minimize impacts to shortnose sturgeon from the dredging and placement of the cap, these activities would be conducted inside containment, which would be installed in the river prior to April 1 to allow the dredging and cap placement to occur during the peak construction season (i.e., summer months). In the event that the containment sheeting cannot be successfully installed, the dredging and backfilling conducted under Alternative 7 would need to be conducted between October 1 and March 31.

6.3.7.2 Long-term Effectiveness and Permanence

The potential for future impacts resulting from human and biota exposures to NAPL-containing sediment and sediments identified during the 2009 bioavailability study as

being potentially toxic to benthic macroinvertebrates would be eliminated through the implementation of this alternative. NAPL- and PAH-containing sediment in the ARC would be permanently removed from the river and treated off-site via LTTD.

However, as previously discussed, if effective containment cannot be installed around the ARC, there would likely be resuspension and release of PAH-containing sediment and NAPL transport during dredging activities which would likely result in long-term impacts in adjacent/downriver areas of the river.

6.3.7.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

This alternative would include the removal and off-site treatment of all NAPL-containing and potentially toxic sediment within the ARC (approximately 9,000 cy). The removal, in combination with off-site treatment, would result in the elimination of potential toxicity associated with these sediments, and would eliminate the potential for their mobility in the river environment.

6.3.7.4 Short-term Impact and Effectiveness

The short-term impacts on the environment resulting from implementation of Alternative 7 would include potential impacts to the water column, air, and biota in the Hudson River area during dredging and backfilling activities. These effects could be mitigated by the use of environmental controls. Potential impacts to the water column during dredging and backfill placement could be addressed through installation of containment sheeting around the dredging area. However, as noted previously, if the containment cannot be installed and maintained to be safe and effective, there could be significantly increased negative short-term impacts due to resuspension and release of PAH-impacted sediment and NAPL transport that would likely result from dredging activities. Potential air impacts during dredging and on-site sediment processing would be addressed through the use of engineering controls, including application of a surfactant such as Biosolve® to address odors and processing of sediments within an enclosed structure equipped with an air handling and treatment system. Implementation of this alternative could also result in temporary impacts to biota in the Hudson River as a result of dredging activities due to temporary destruction of habitat. However, restoration of the previous benthic communities is expected to occur in relatively short timeframes following backfill as a result of re-colonization.

Implementation of this alternative may result in short-term exposure of the Site workers surrounding community to MGP-related constituents as a result of dredging, material

handling, backfilling, and off-site transportation activities. Potential exposure mechanisms would include incidental ingestion of, and dermal contact with, NAPL- and PAH-containing sediment and/or surface water (workers only) and inhalation of organic vapors or dust containing MGP-related constituents. Potential exposure of remedial workers would be mitigated through the use of appropriately trained field personnel and the appropriate level of PPE, as specified in a site-specific HASP that would be developed as part of the remedial design, as well as by using an enclosed structure with air treatment for sediment processing. Air monitoring would be performed during dredging activities to evaluate the need for additional engineering controls (e.g., use of a surfactant such as Biosolve® to suppress odors, modifying the rate of dredging). Community access to the upland work areas (e.g., sediment staging/processing area) would be restricted by temporary fencing. River use in the remediation area would also be restricted using signs, buoys, lighting, and/or other controls. A site-specific CAMP would be prepared and community air monitoring would be performed during dredging activities to evaluate the need for additional engineering controls.

Additional worker safety concerns include working with and around large construction equipment, working on and around water, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of backfill materials. If the containment walls cannot be feasibly installed, worker safety would also potentially include working in cold temperatures due to the requirement for any uncontained in-water construction to be performed outside the fish protection period (i.e., work would be conducted between October 1 and March 31). These concerns would be mitigated by using engineering controls and appropriate health and safety practices.

Additionally, short-term impacts on the local community resulting from implementation of Alternative 7 would include increased vehicular traffic associated with the off-site transportation of dredged material and importation of clean materials for backfill. The number of truck trips estimated for the implementation of Alternative 7 is approximately 1,000 tri-axle trucks, each carrying approximately 14 cy of material. The increased potential for total emissions and motor vehicle accidents on local roadways would be managed through the use of appropriate BMPs for clean fuel and emission (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels), the use of appropriate health and safety practices (29 CFR Part 1910), compliance with the site-specific HASP, and planned truck routes to minimize impacts on local community.

In this alternative, energy would be used for construction, transportation, and treatment operations primarily through fuel consumption. Dredging of sediments, transportation of dredged sediments, treatment of sediments via LTTD, and backfill placement would result in the emission of greenhouse gases from remediation equipment, transportation vehicles, and the sediment treatment process itself. BMPs that would be utilized to mitigate impacts and improve sustainability include would include modifying field operations to reduce idling equipment (to the extent possible), and using biodiesel fuels (if available).

Implementation of Alternative 7 would have short-term impacts on land use during the remedy implementation period. Recreational users of the river would not be able to access the portion of the river where remedial activities are being conducted, likely to include some additional buffer zone for safety purposes. Buoys, signs, lights or other means of demarcation (in accordance with USCG requirements) would be used to keep recreational and commercial boaters out of the work area. The docks currently being installed by the City of Hudson within Embayments #1 and #2, and just north of Embayment #1, would be restricted from access during the remedy implementation period, and some or all of the docks could possibly require temporary removal. In addition, the operations of the Hudson Cruise Lines would likely require temporary relocation. Likewise, portions of the upland area adjacent to OU2, including portions of the public park, would be restricted from public access during the remedy implementation as a result of shoreline stabilization, sediment off-loading and handling, and water treatment activities.

Based on the volume of sediment to be dredged, it is anticipated that construction activities associated with Alternative 7 would require approximately 6 months to complete.

6.3.7.5 Implementability

Equipment, materials, and remedial contractors necessary to dredge, treat and dispose of sediments are readily available. Technical implementability issues for this alternative would be associated with potential severe weather conditions (conducting activities in water may be limited by conditions such as winds and storms [e.g., thunderstorms or hurricanes]), the installation of containment sheeting around the dredge area, shoreline protection in areas where dredging would occur along the shoreline, and the potential presence of underwater structures. At this time, there is considerable uncertainty regarding the technical feasibility of installing the sheet pile containment around the dredge area due to Site conditions. If it can be installed, the sheet pile containment

wall would not be able to withstand vessel impacts (a potential risk due to the known boat traffic in this section of the river), nor would it be able to withstand ice loading. If this alternative were to be selected as the Site remedy, additional information would be collected during the PDI phase, and additional engineering analyses would be performed during the remedial design phase, to determine if the sheet pile walls can be installed where they will be safe and effective.

Conducting sediment remediation activities within and adjacent to an active shipping channel that is maintained by the USACE and that falls within an area of the Hudson River that is used for recreational and other purposes presents numerous logistical challenges. Coordination with the USACE and other river users (e.g., Hudson Cruises, Inc. and the City of Hudson) would be necessary and river work areas would need to be secured from these river users. The operations associated with Hudson Cruises, Inc. would likely need to be temporarily relocated during the remedial activities.

In terms of administrative feasibility, permits from the USACE and NYSDEC would be required for work within the Hudson River, which is a navigable waterway. Sediment processing on land would also result in logistical challenges and would require National Grid to obtain access agreement(s) to allow for temporary access to accommodate sediment staging/processing and water treatment areas. Based on previous experience conducting sampling/monitoring sediment within OU2, there may be difficulties gaining permission from the Mid-Hudson Cable to conduct remedial activities adjacent to the fiber optic line located to the north of the ARC.

For purposes of this FS, this remedial alternative has been assumed to be both technically and administratively implementable. However, if this alternative were selected, this would need to be further evaluated and verified during the PDI and remedial design, particularly with respect to the ability to install safe and effective containment.

6.3.7.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. The rocky shoreline with steep banks and the deep water with swift currents present little or no potential for wading or swimming within the Site.

The implementation of Alternative 7 would not result in any future limitations on the use of the river for navigation or recreational purposes.

6.3.7.7 Overall Protectiveness of the Public Health and the Environment

Alternative 7 would eliminate the potential for human and biota exposure to MGP-related constituents by completely removing the NAPL-containing and potentially toxic sediment within the ARC. Dredged material would be transported off-site for treatment via LTTD.

The effectiveness of this alternative could be reduced if containment cannot be successfully and safely installed around the ARC; there could be significant resuspension and release of PAH-impacted sediment and NAPL transport during dredging activities, which could result in long-term impacts in adjacent/downriver areas of the river.

Potential short-term impacts to Site workers and the community from dredging, sediment processing, and off-site transportation of dredged material would be managed by following site plans and establishing appropriate engineering controls. Potential short-term exposures of Site workers to MGP-related constituents during implementation of this alternative would be mitigated by appropriate health and safety planning and practices, including the use of appropriate PPE.

Through dredging and off-site treatment via LTTD, Alternative 7 would achieve the RAOs.

6.3.7.8 Cost

The estimated costs associated with Alternative 7 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $15,340,000. There are no O&M costs associated with this alternative.

6.3.8 Alternative 8 – Sediment Excavation to 4 mg/kg TPAHs (all depths) with Treatment/Disposal and Backfill

As described in Section 6.1.8, Alternative 8 involves the removal of all sediment with PAH concentrations greater than 4 mg/kg to full depth (up to 15 feet) within OU2 (Figure 6-7 and 6-7a), with the exception of sediments within Embayment #3, which, as described previously, have been determined to be non-Site-related. The estimated

remedial area measures 6.1 acres. A total of approximately 41,000 cy of sediment would be removed by the dredging activities.

6.3.8.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 3-1. As noted previously, NYSDEC requested that National Grid give consideration to a remedial alternative that would address all sediments with PAH concentrations greater than the criteria established (i.e., ERL - 4 mg/kg) in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999). As a result, and despite the fact that previous Site-specific investigation activities have shown those sediments outside the ARC at concentrations exceeding 4 mg/kg to be non-toxic to benthic macroinvertebrates, the ERL criteria of 4 mg/kg TPAHs is applicable for this remedial alternative. Other potentially applicable chemical-specific SCGs include the CWA criteria (33 USC 1341 through 1346) for discharges of fill into U.S. waters, and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for surface water include the NYSDEC Class A standards and guidance values and 6 NYCRR Part 703.2 Water Quality Standards.

Under this alternative, all sediment containing PAHs at concentrations greater than 4 mg/kg would be dredged and transported off-site for treatment and/or disposal, resulting in achievement of the NYSDEC sediment screening criteria of 4 mg/kg. Debris removed from the dredge area and dredged material would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 to determine appropriate off-site treatment/disposal requirements. For purposes of this FS, the dredging within the ARC is assumed to be carried out within containment (sheet pile walls), which would minimize surface water impacts (turbidity and sheens); however, dredging outside the ARC would be performed without full containment. As discussed Section 6.1.8 there is uncertainty regarding the technical feasibility to install the sheet pile walls around the ARC. Without the containment system around the ARC, there would be the potential for NAPL transport, excessive sheen generation and exceedances of turbidity standards from dredging within the ARC.

Action-Specific SCGs

Action-specific SCGs are presented in Table 3-2. Permitting/approvals with the USACE and NYSDEC would be required for conducting construction activities within a

navigable waterway of New York State. Debris, sediment, and rip-rap (not appropriate for re-use) may be subject to USDOT and New York State regulation requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved remedial design and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). For the purposes of this FS, all excavated MGP-impacted material (inside the ARC) is assumed to be treated via LTTD. All sediment with PAH concentrations greater than 4 mg/kg excavated outside of the ARC would be disposed off-site in a non-hazardous landfill. Additionally, a SPDES permit would be required to discharge treated water to the Hudson River. The permit would establish maximum discharge limits and treatment requirements that the water treatment system would have to achieve prior to discharge.

Potentially applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

Additionally, the following activities under Alternative 8 are consistent with the core elements of USEPA's Green Cleanup Standard Initiative (USEPA 2009):

- Biodiesel fuels would be utilized (if available), resulting in the employment of a renewable energy source that is cleaner and would mitigate the generation of greenhouse gases.

- Field operations would be modified to reduce idling equipment (to the extent possible), thus mitigating total energy use and greenhouse gas emissions.

- Dredged sediments would be staged and processed within an enclosed structure equipped with an air handling and treatment system, thus addressing the generation and transport of airborne contaminants and dust through BMPs

- BMPs would be employed to mitigate impacts to stormwater, thereby minimizing impacts to water resources.

- Water generated during sediment processing would be treated and returned to the Hudson River under a SPDES permit, which in turn would minimize impacts to water resources.

- Shoreline rip-rap in the ARC would be removed, temporarily staged on Site, and re-used for slope protection along the shoreline. This beneficial re-use of Site material would reduce the consumption of virgin materials, the generation of greenhouse gases through transportation of materials from off-Site sources, and the generation of waste.

As noted above, Alternative 8 would include the removal of PAH-containing sediment outside of the ARC that has been determined through Site-specific testing to be non-toxic to the benthic community. Removal of those sediments would result in temporary destruction of existing habitats. Therefore, this alternative would not meet the core element of the Green Cleanup Standard Initiative of protecting land and ecosystems by unnecessarily disturbing habitat.

Location-Specific SCGs

Location-specific SCGs are presented in Table 3-3. Potentially applicable location-specific SCGs generally include regulations on conducting dredging activities in navigable waters. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit, and applicable local permits, prior to conducting site activities. In accordance with the LWRP, a Coastal Consistency Review through the New York Department of State would also be required prior to conducting Site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances, as applicable.

The time of year when the shortnose sturgeon are likely to be present at the Site (i.e., April 1 through September 30) is also the preferred time to conduct dredging. To minimize impacts to shortnose sturgeon from the dredging, some of the dredging activities would be conducted inside containment (approximately 1.1 acres – the ARC). However, Site conditions preclude the installation of containment sheeting around all of the 4 mg/kg PAH area, so dredging activities conducted outside the containment sheeting (i.e., outside the ARC) would need to be conducted outside of the fish protection period. In the event that the containment sheeting cannot effectively be installed at the Site, all of the dredging conducted under Alternative 8 would be conducted outside of this fish protection period.

6.3.8.2 Long-term Effectiveness and Permanence

The potential for human and biota exposure to NAPL- and PAH-containing Site sediment would be eliminated through the implementation of this alternative. All NAPL-containing and potentially toxic sediment, as well as all sediment with PAH concentrations greater than 4 mg/kg in OU2, would be permanently removed and either treated off-Site via LTTD or disposed off-site in a RCRA landfill. Dredging of Site sediment is an irreversible process that would permanently reduce the volume of NAPL- and PAH-containing sediments.

As previously discussed, if containment cannot be successfully installed around the ARC, there would likely be resuspension and release of PAH-impacted sediment and NAPL transport during dredging activities within the ARC, which could result in greater long-term impacts in areas adjacent to and downriver from the ARC. In addition, because the dredging outside of the ARC would be performed without full containment, there is the potential for additional resuspension and downstream release of PAH-containing sediments.

6.3.8.3 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment

This alternative would include the removal and off-site treatment of all of the NAPL-containing sediment and all of the sediment identified during the 2009 bioavailability study as being potentially toxic (approximately 9,000 cy), as well as the removal and off-site disposal of an additional 32,000 cy of sediments outside the ARC with PAH concentrations greater than 4 mg/kg (sediments outside the ARC are not considered to be bioavailable or toxic).

6.3.8.4 Short-term Impact and Effectiveness

The short-term effects on the environment resulting from implementation of Alternative 8 would include potential impacts to the water column, air, and biota in the Hudson River area during dredging activities. These effects would be mitigated by the use of environmental controls (e.g., containment walls and enclosed structure with air treatment system). If the containment walls cannot be installed, there would be increased negative short-term impacts due to resuspension and release of PAH-containing sediment and NAPL movement that would result from dredging activities within the ARC. These impacts would be in addition to the resuspension and release of sediments occurring from dredging performed without full containment outside of the ARC.

Implementation of this alternative may result in short-term exposure of the surrounding community, including boaters and other users of the river, and Site workers to MGP-related constituents as a result of dredging, material handling, and off-site transportation activities. Additionally Site workers may be exposed to impacted surface water, sediment, and NAPL during dredging. Potential exposure mechanisms would include ingestion and dermal contact with impacted sediment and/or surface water and inhalation of organic vapors or dust containing MGP-related constituents. Potential exposure of remedial workers would be mitigated through the use of appropriately trained field personnel and the appropriate level of PPE, as specified in a site-specific HASP that would be developed as part of the remedial design, as well as performing sediment staging and processing operations within an enclosed structure with air treatment system. A site-specific CAMP would be prepared and community air monitoring would be performed during dredging activities to evaluate the need for additional engineering controls (e.g., use of water to suppress nuisance dust, application of a surfactant such as Biosolve® to suppress odors, modifying the rate of dredging). Materials staging would take place under a temporary structure with an air collection and treatment system.

Additional worker safety concerns include working with and around large construction equipment, working on and around water, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the Site and delivery of fill materials. Worker safety would also include working in cold temperatures due to the requirements for uncontained in-water construction to be done outside the fish protection period (i.e., work would be performed from October 1 to March 31). These concerns would be mitigated by using engineering controls and appropriate health and safety practices and PPE.

Short-term impacts on the local community resulting from implementation of Alternative 8 would include increased vehicular traffic associated with the off-site transportation of dredged material and importation of clean materials for backfill in the river. The total number of truck trips estimated for the implementation of Alternative 8 is approximately 4,500 tri-axle trucks, each carrying a total of 14 cy of material. The increased potential for total emissions and motor vehicle accidents on local roadways would be mitigated through the use of appropriate BMPs for clean fuel and emission (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels), careful planning of truck routes to mitigate impacts on local community, the use of appropriate health and safety practices (29 CFR Part 1910), and compliance with the site-specific HASP.

Under this alternative, energy would be used for construction, transportation, and treatment operations primarily through fuel consumption. Dredging of sediments, transportation of dredged sediments, and treatment of sediments via LTTD would result in the emission of GHGs from remediation equipment, transportation vehicles, and the sediment treatment process itself. Site management practices that would be put in place to minimize impacts and improve sustainability include: modifying field operations to reduce idling equipment, using biodiesel fuels (if available), and installing a fully enclosed structure with an air handling and treatment system for the sediment staging and processing activities.

Implementation of Alternative 8 would have significant short-term impacts on land use during the remedy implementation period. Recreational users of the river would not be able to access the portion of the river where remedial activities are being conducted (likely to include some additional buffer zone beyond the immediate work area for safety purposes). Buoys, signs, lights or other means of demarcation (in accordance with USCG requirements) would be used to keep recreational and commercial boaters out of the work area. The docks currently being installed by the City of Hudson within Embayments #1 and #2, and just north of Embayment #1, would be restricted from access during the remedy implementation period, and some or all of the docks could possibly require temporary removal. In addition, the operations of the Hudson Cruise Lines would require temporary relocation. Under Alternative 8, the barge docking area located south of Embayment #4 would be restricted from access, as would all of the floating docks to the north of the Spirit of Hudson docking area. In addition to the impacts on river access and use, portions of the upland area adjacent to OU2, possibly including portions of the public park, would be restricted from public access during the remedy implementation as a result of shoreline sloping, sediment off-loading and handling, and water treatment activities. Because sediment remediation activities would be performed within a large area of the shipping channel, Alternative 8 could present risks to recreational and commercial vessels.

Based on the volume of sediment to be dredged under Alternative 8, it is anticipated that construction activities would require approximately 21 months to complete, which would include a summer dredging season (i.e., dredging within the ARC) and 2 winter dredging seasons (4 mg/kg PAH Area). Since the work outside of the ARC would be performed through the winter there is a potential for ice formation/movement to extend the schedule.

6.3.8.5 Implementability

The equipment, materials and remedial contractors necessary to dredge the Site sediment are readily available. Technical implementability issues for this alternative would be associated with the ability to install effective containment around the ARC dredge area, potential for sediment resuspension and release to downriver areas while dredging outside of the ARC (dredging outside of the ARC would not be performed within full containment, as described in Section 6.1.8), potential severe weather conditions (conducting activities in water may be limited by conditions such as winds and storms [e.g., thunderstorms or hurricanes]), and the potential presence of underwater structures. Also, working during the winter months (i.e., in areas outside the ARC containment) would likely result in a reduction in dredge productivity rates, which would add to the longer dredging schedule required for Alternative 8. The formation/movement of ice on the river during the winter could also influence the implementability of dredging outside the ARC and prolong the schedule further.

At this time, there is considerable uncertainty regarding the technical feasibility of installing the sheet pile containment due to Site conditions, including water depths up to 45 feet at the far edge of removal, water velocity greater than 3 ft/sec, 4-foot tidal fluctuations, and an assumed depth of 30 feet of sediment above bedrock. The sheet pile wall will not be able to withstand vessel impacts (a potential risk due to the known boat traffic in this section of the river), nor will the sheet pile wall be able to withstand ice loading. Therefore, the sheeting would be installed around the ARC prior to the start of the fish protection period (i.e., April 1) so that the dredging work within the ARC could be performed during the spring and summer.

Conducting sediment remediation activities within a large area of an active shipping channel that is also used for recreational purposes, as would be required under Alternative 8, would also present numerous logistical challenges. Coordination with the USCG and known river users (e.g., the Hudson Cruises, Inc.) would be necessary and river work areas would need to be secured from these river users using signs, buoys, lights or other means in accordance with USCG requirements. Sediment processing on land would also result in similar logistical challenges and would require National Grid to obtain access agreement(s) to allow for temporary access for staging and water treatment areas. Portions of the City Park would be unavailable for use during the remedy implementation period. Permits would also be required for Alternative 8 for work within a waterway. Based on previous experience sampling sediment within OU2, there may be difficulties implementing remedial activities adjacent to the Mid-Hudson Cable fiber optic line located to the north of the ARC. In addition, this remedial

alternative would need to be consistent with the goals set by the LWRP for this area of the river.

For purposes of this FS, this remedial alternative has been assumed to be both technically and administratively implementable. However, if this alternative were selected, the technical implementability would need to be further evaluated and verified during the PDI and remedial design, particularly with respect to the ability to install safe and effective containment.

6.3.8.6 Land Use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for river-based recreation activities. The rocky shoreline with steep banks and the deep water with swift currents present little or no potential for wading or swimming within the Site.

The implementation of Alternative 8 would not result in any future limitations on the use of the river for navigation or recreational purposes.

6.3.8.7 Overall Protectiveness of the Public Health and the Environment

Alternative 8 would permanently eliminate the potential for human and biota exposure to NAPL-containing sediment and sediment identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates, as well as sediments with PAH concentrations greater than 4 mg/kg (although they have been determined through Site-specific testing to not be bioavailable or toxic) through dredging. The dredged sediment would be permanently transported off-site for LTTD treatment or disposal.

The effectiveness of this alternative is dependent, in part, upon the technical feasibility of installing containment around the ARC during dredging. Without containment, there would likely be resuspension of potentially toxic sediment and/or sheen generation from NAPL movement during dredging activities within the ARC, which would result in long-term impacts downstream of the ARC.

Potential short-term impacts to Site workers and the community from dredging, sediment processing, and off-site transportation of sediment would be mitigated by

following site plans and establishing appropriate engineering controls (e.g., fencing, signage, barricades). Potential short-term exposures to MGP-related constituents during implementation of this alternative would be mitigated by appropriate health and safety practices.

Through dredging and off-Site treatment/disposal, Alternative 8 would achieve the Site RAOs.

6.3.8.8 Cost

The estimated costs associated with Alternative 8 are presented in Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $41,710,000. There are no O&M activities or costs associated with this alternative.

7 Comparative Analysis

After the remedial alternatives were evaluated individually against the evaluation criteria, all eight alternatives were compared against each other using those same criteria. This section presents the results of that comparative analysis and identifies the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria.

7.1 Compliance with SCGs

The compliance with SCGs comparison includes an evaluation of the alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance.

7.1.1 Chemical-Specific SCGs

Potentially applicable chemical-specific SCGs for sediments include the Sediment Screening Levels established in the NYSDEC document Technical Guidance for Screening Contaminated Sediments, the Site-specific threshold value for Hudson River sediment in the vicinity of the Site of 5.4 SPME pore water TU_{34}, 6 NYCRR Part 703.2 Water Quality Standards, 6 NYCRR Parts 700-705, Technical and Operational Guidance Series (TOGS) 1.1.1 SCOs, and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Results of the comparative analysis for chemical-specific SCGs are presented below.

Alternatives 1 and 2 would not involve sediment removal, treatment or containment; therefore, chemical-specific SCGs would not be readily met under these alternatives, except through long-term natural recovery processes.

Alternative 3 would achieve the chemical-specific SCGs by capping the ARC sediment. The placement of the cap may result in a small amount of sediment resuspension and NAPL movement, which could potentially result in short-term exceedances of surface water quality standards (i.e., sheens on water surface). However, the likelihood is low given the characteristics of the surface sediments (i.e., natural armoring layer). Implementation of appropriate controls (e.g., use of absorbent booms to manage sheens and stopping or slowing the pace of work until turbidity reaches acceptable levels) would minimize these potential short-term impacts.

Alternatives 4, 5, and 6 would achieve the chemical-specific SCGs through partial sediment removal and capping within the ARC. Alternatives 7 and 8 would both achieve the chemical-specific SCGs because these alternatives would remove all of the NAPL-containing sediment and potentially toxic sediment within the ARC. However, if containment measures cannot be successfully installed and maintained around the ARC under Alternatives 4 through 8, PAH-containing sediments and NAPL would likely be transported downriver/to adjacent areas, and could lead to surface water quality violations. The potential for releases and violations of the surface water quality standards would increase with sediment removal areas and volumes (i.e., risk increases progressively for Alternatives 3 through 8, with Alternatives 7 and 8 presenting much more significant risks due to much larger volumes of sediment to be removed and managed). If effective containment cannot be installed around the ARC, the dredging operations included in Alternatives 4 through 8 are anticipated to result in much higher potential for releases than for capping alone under Alternative 3.

In summary, Alternatives 3 through 8 all could achieve the chemical-specific SCGs, but Alternatives 4 through 8 would have greater potential for resuspension and release of PAH-containing sediments and NAPL downriver due to the dredging component of those alternatives (the potential progressively increases for Alternatives 4 through 8 due to the dredge volume/depth, duration and size), particularly if containment measures can't be installed.

7.1.2 Action-Specific SCGs

Alternative 1 does not include any active remediation to remove, treat, or contain MGP-related constituents; therefore, the action-specific SCGs are not considered applicable. For Alternatives 2 through 8, a site-specific HASP would be developed to address the health and safety SCGs. The required permits/approvals from the USACE and NYSDEC would be secured to conduct construction activities within a navigable waterway of New York State under Alternatives 3 through 8. For Alternatives 4 through 8, appropriate federal and state regulations and guidance would be followed to address sediment disposal SCGs, and on-site water treatment with discharge to the Hudson River would be performed in accordance with a SPDES permit to address water disposal SCGs.

Overall, Alternatives 2 through 8 would be equally effective at achieving the applicable action-specific SCGs, assuming proper project planning, design, and implementation of appropriate controls. Although the construction of the above-grade

cap under Alternative 3 is anticipated to meet the substantive technical requirements associated with USACE and NYSDEC permits, securing the applicable permits for this activity could prove difficult and time-consuming. Likewise, securing the necessary approvals from the USACE and USCG for installing sheeting and dredging within the navigation channel could also prove difficult and time-consuming.

7.1.3 Location-Specific SCGs

Alternatives 1 and 2 would not include any active remedial actions; therefore, location-specific SCGs are not applicable.

Alternatives 3 through 8 would achieve the regulatory requirements for conducting dredging, capping, backfilling, and construction activities in navigable water ways by obtaining a joint USACE and NYSDEC permit and coordinating with the USCG. In addition, remedial activities conducted under Alternatives 3 through 8 would be completed in accordance with applicable local building/construction codes and ordinances.

Overall, Alternatives 3 through 8 would be equally effective at achieving the location-specific SCGs, assuming implementation of appropriate controls (e.g., installation of containment around the ARC) or proper project planning (e.g., any in-river work not performed within containment would be performed outside the fish protection period, which runs from April 1 through September 30). Implementation of Alternatives 3 and 8 would require that work be conducted outside the fish protection period, during the fall and winter months, because all of the in-river work under Alternative 3, and some of the in-river work under Alternative 8, would be performed without containment.

7.2 Implementability

Alternatives 1 and 2 would not involve any active remedial activities and therefore pose no technical implementability issues. The monitoring plan that would be developed to assess and document the progress of natural recovery for Alternative 2 can be readily designed and implemented.

The equipment, materials and contractors required for implementing Alternatives 3 through 8 are expected to be readily available. The long-term monitoring plan for the engineered cap component of Alternatives 3 through 6 can be readily designed and implemented to monitor the effectiveness and integrity of the engineered cap associated with these alternatives. Off-Site landfill disposal facilities are readily

available to accept the MGP-impacted debris (and sediment for Alternative 8 only) that would be generated under Remedial Alternatives 3 through 8; and off-site LTTD treatment facilities are readily available to accept the MGP-impacted sediment that would be generated under the Remedial Alternatives 4 through 8.

Implementability of the remedial alternatives involving construction activities in the river (i.e., Alternatives 3 through 8) could be affected by weather conditions. Severe weather conditions (winds, thunderstorms, hurricanes, high flows, reduced visibility) could impact safety and limit work activities, thus resulting in potential schedule delays. The implementability issues and associated risks would progressively increase for Alternatives 3 through 8 as a result of the increasing complexity, size and duration of the remedial alternatives. Of all the active remedial alternatives, Alternative 8 would have the most implementation challenges as a result of weather because it would require dredging activities to be completed during one summer construction season and two winter construction seasons. This expanded schedule is due to the higher dredging volume associated with Alternative 8 and the requirement that any dredging activities performed without full containment (i.e., the dredging to be performed outside the ARC) be performed outside the fish protection period. Dredging during the winter months would likely result in reduced dredge productivity rates, which would add to the longer dredging schedule required for Alternative 8. The formation and movement of ice could prolong the schedule for Alternative 8 even further.

Other implementability issues associated with the active remedial alternatives include: the need to obtain access agreements with adjacent property owners for non-impacted material and equipment staging areas (Alternatives 3 through 8), and sediment staging/processing areas and water treatment areas (Alternatives 4 through 8 only); the potential presence of underwater structures and obstructions (such as the fiber optic cable or unknown pipes or vessels); and working in a waterway used for recreation and navigation purposes. Alternative 8 would pose the most implementability issues as it would require significantly more work within the navigation channel than the other remedial alternatives.

As noted previously, for Alternatives 4 through 8, the technical implementability of installing containment around the ARC for the dredging and capping activities is uncertain due to the water depth, water velocity, tidal fluctuations, and depth to bedrock beneath the sediments. If an effective containment system cannot be installed around the ARC, there would likely be PAH–containing sediment resuspension and release downstream during the sediment removal activities. The risk of such releases would progressively increase for Alternatives 4 through 8, with Alternative 8 having

substantially greater risks as a result of the additional sediment to be dredged outside the ARC without full containment.

Permits would be required for Alternatives 3 through 8, because these alternatives would involve placing fill within the Hudson River and/or dredging materials from the river. While the final elevation of the river bottom within the ARC would be slightly higher (approximately 6 inches) after installation of the above-grade engineered cap under Alternative 3, this increase in the elevation of the river bed is expected to have no impact on river flows, currents, or hydraulics due to the small size of the area to be capped relative to the overall size of the Hudson River. The slight increase in elevation is also anticipated to have no impact on navigation or the recreational use of this section of the Hudson River since the water is relatively deep immediately off-shore from the Site, the cap thickness is negligible, and the majority of the ARC is outside of the navigation channel.

The institutional controls associated with Alternatives 2 through 6 are both technically and administratively implementable.

Overall, although all of the active remedial alternatives are both technically and administratively implementable, as described above the technical implementability issues progressively increase with Alternatives 3 through 8. Alternative 3 would pose the least technical implementability issues as it would not require the installation of containment within the river, nor would it require the dredging, handling and upland processing of MGP-impacted sediments. Alternatives 4 through 8 involve varying degrees of sediment removal (ranging from 2,000 cy under Alternative 4 to 41,000 cy under Alternative 8). As noted above, the technical implementability issues increase progressively with these alternatives as a result of the increasing volumes of sediment to be dredged and handled (as well as the much larger area to be remediated under Alternative 8), and the uncertainty and risks associated with the ability (or lack thereof) to install effective containment around the ARC dredge area.

7.3 Reduction of Toxicity, Mobility or Volume through Treatment

Neither Alternative 1 nor Alternative 2 would include any actions to actively remediate the MGP-impacted sediment. Therefore, the toxicity, mobility, and volume of MGP-related constituents in sediment would only be reduced to the extent these reductions occur through natural recovery processes. Under Alternative 2, the progress of such natural recovery processes would be assessed and documented through the design

and implementation of a long-term monitoring program. However, no such monitoring would be performed under Alternative 1.

Alternative 3 would not reduce the volume or toxicity of the MGP-impacted sediment in the ARC; however, if properly designed and maintained, the engineered cap would reduce the mobility of NAPL-containing sediments and sediments identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates. The engineered cap would also mitigate the potential for human and biota exposure to the NAPL-containing and potentially toxic sediments.

Alternatives 4 through 6 would involve the removal and off-site treatment via LTTD of all of the sediment identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates and a portion of the NAPL-containing sediment in the ARC. Therefore, these alternatives would reduce the mobility, toxicity, and volume of MGP-impacted sediments in the river. The degree of reduction would increase with the increased sediment removal volume, which would be approximately 2,000 cy under Alternative 4, approximately 4,000 cy under Alternative 5, and approximately 6,000 cy under Alternative 6. In addition, Alternatives 4 through 6 would reduce the mobility of the NAPL-containing sediment remaining at depth within the ARC through the placement of an engineered cap over the remaining sediments.

Alternative 7 would involve the removal of all of the NAPL-containing and potentially toxic sediment within the ARC (approximately 9,000 cy), with off-site treatment via LTTD. Thus, this alternative provides the greatest degree of reduction in the mobility, toxicity, and volume of NAPL- and potentially toxic sediment within the ARC.

Alternative 8 would involve the removal and off-site treatment of all of the NAPL-containing and potentially toxic sediment within the ARC, as well as removal and treatment/disposal of additional sediment located outside of the ARC with PAH concentrations greater than 4 mg/kg (total removal volume of approximately 41,000 cy). Although implementation of Alternative 8 would result in a much greater volume of PAH-containing sediments removed from the river, it offers no advantage over the other removal alternatives (Alternatives 4 through 7) with regards to reduction of toxicity because all of the sediments identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates would be removed from the river under Alternatives 4 through 7.

7.4 Short-term Impact and Effectiveness

Alternative 1 would not include any active remedial measures or monitoring; therefore, this alternative does not present any short-term impacts to Site workers, the community, or the environment. No time is required to implement Alternative 1.

Alternative 2 also would not include any active remedial measures; however, the implementation of institutional controls under Alternative 2 are expected to make it slightly more effective than Alternative 1 in the short-term with respect to reduction in potential for human exposure to NAPL- and PAH-containing sediments. Because Alternative 2 would also involve the implementation of a program to monitor the progress of natural recovery processes, it could result in potential exposures of Site workers to NAPL- and PAH-containing sediments during sampling. Those short-terms risks would be mitigated by using properly trained personnel and following appropriate health and safety practices, including the use of PPE. There are no significant impacts to the community associated with Alternative 2. The timeframe for natural recovery to occur is uncertain; however, for purposes of developing costs, monitoring is assumed to be performed on a periodic basis for up to 30 years.

Alternatives 3 through 8 would include active remedial measures and would therefore result in a number of short-term impacts to Site workers, the community and the environment as further described below.

Alternatives 3 through 8 may result in exposure of workers to NAPL and/or PAHs in the sediments through inhalation, ingestion or dermal contact. These potential exposures would be mitigated through proper training, the use of PPE, implementation of air, surface water, and work space monitoring programs, and implementation of other engineering controls. The potential for worker exposure increases progressively for Alternatives 3 through 8 as a result of the larger quantities of sediment to be dredged and processed and the larger quantities of water to be treated, as well as the increasing implementation timeframes associated with those alternatives.

Short-term impacts of Alternatives 3 through 8 also include the generation of noise and dust associated with the operation of large construction equipment, and excess vehicle traffic in the vicinity of the Site. Alternative 3 would require the least number of truck trips and energy consumption, and would therefore result in the least amount of GHG emissions. Truck trips, energy consumption, and GHG emissions would progressively increase with increasing volumes of impacted sediment to be removed and transported

off-Site for treatment/disposal, and increasing volumes of clean fill materials to be placed back in the river.

Short-term impacts associated with Alternatives 4 through 8 are expected to be greater than Alternative 3, particularly if containment measures cannot be successfully installed and maintained around the dredging area to control the transport of NAPL and re-suspended sediments that would likely occur as a result of the dredging component of Alternatives 4 through 8. Given the water depths, velocities, and tidal fluctuations at the Site, the ability to install effective containment around the ARC is uncertain. Based on experience installing a similar cap at another site on the Hudson River with NAPL, placement of the engineered cap associated with Alternative 3 is not anticipated to result in significant disturbance of NAPL and sheen generation, and therefore containment would not be necessary for installation of the engineered cap under Alternative 3. Therefore, Alternatives 4 through 8 have the potential for greater short-term (and longer-term) impacts to the community and environment than Alternative 3. Further, because there would be some removal without containment under Alternative 8, that alternative could result in an increased short-term risk for resuspension of PAH-impacted sediments and release downriver as compared to Alternatives 4 through 7.

Implementation of Alternatives 3 through 8 would also have short-term impacts on land use during the remedy implementation period (Alternative 3 would have the least impact and Alternative 8 the most). Recreational users of the river would not be able to access the portion of the river where remedial activities are being conducted, likely to include some additional buffer zone for safety purposes. Buoys, signs, lights or other means of demarcation (in accordance with USCG requirements) would be used to keep recreational and commercial boaters out of the work area. In addition, under Alternatives 4 through 8, the dredge area would be contained by temporary sheeting (if it can be successfully installed). The docks currently being installed by the City of Hudson within Embayments #1 and #2, and just north of Embayment #1, would be restricted from access during the remedy implementation period, and some or all of the docks could possibly require temporary removal. In addition, the operations of the Hudson Cruise Lines would likely require temporary relocation from its current location just north of Embayment #1. Under Alternative 8, the barge docking area located south of Embayment #4 would be restricted from access, as would all of the floating docks to the north of the Spirit of Hudson docking area.

Because Alternative 3 would be performed in the fall (after October 1) after the peak recreational boating season, it is expected to have fewer impacts than Alternatives 4 through 8; the remedial activities within the ARC for Alternatives 4 through 8 are

expected to be performed within containment during the spring and summer months (i.e., when recreational boating is more prevalent).

In addition to the impacts on river use during the remedy implementation period, portions of the upland area adjacent to OU2, including portions of the City of Hudson public park, would be restricted from public access during the remedy implementation period. Again, these impacts to the upland areas would be more significant for Alternatives 4 through 8 as a result of sediment handling/processing and water treatment activities associated with those alternatives.

Of the alternatives involving sediment removal, Alternative 4 would have the least short-term impacts and Alternative 8 would have the most. Alternative 3 would be more sustainable than the removal and treatment alternatives (Alternatives 4 through 8) because it would involve fewer truck trips, much less heavy equipment use, and less potential for impacts on the environment (both air and water) during implementation. Of the six active remedial alternatives, Alternative 4 would have the shortest duration (approximately 3 months), followed by Alternatives 3 and 5 (4 months), Alternative 6 (5 months), Alternative 7 (6 months) and Alternative 8 (21 months).

7.5 Long-term Effectiveness and Permanence

Alternatives 1 and 2 would not involve any active remedial activities to address the NAPL-containing and potentially toxic sediment. While some progress toward achieving the RAOs is expected to occur in the long-term due to natural recovery processes, only Alternative 2 would include monitoring to document the progress of such processes. The implementation of institutional controls under Alternative 2 would further reduce the potential for human exposure to NAPL- and PAH-containing sediments compared to Alternative 1, but would not prevent biota exposure to the NAPL-containing and potentially toxic surface sediment. For Alternative 2, the long-term effectiveness and permanence would be a function of the progress of the natural recovery processes and willingness of the affected parties to comply with the selected institutional controls.

Alternative 3 would involve the installation of an engineered above-grade cap over the NAPL-containing and potentially toxic sediment within the ARC. Alternatives 4 through 6 would involve the removal and off-site treatment/disposal of the sediment identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediment within the ARC, followed by the installation of an engineered cap over the remaining NAPL-and

PAH-containing sediment at depth. Institutional controls would be established for Alternatives 3 through 6 to reduce the potential for future disturbance of the cap. A monitoring program would also be implemented and cap maintenance activities would be performed as necessary to enhance the long-term effectiveness of Alternatives 3 through 6.

Assuming the engineered cap for each alternative is appropriately monitored and maintained, Alternatives 3 through 6 are generally considered equally effective in the long term at mitigating the mobility of, and potential human and biota exposure to, MGP constituents. The permanence of each of the Alternatives 4 through 6 would be progressively greater than Alternative 3 because each of those alternatives involves the permanent removal of all of the sediments identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediments, from the river via dredging. Those sediments would be treated off-Site via LTTD.

Alternatives 7 and 8 would both involve the removal and off-site treatment of all of the NAPL-containing and potentially toxic sediment within the ARC (approximately 9,000 cy), which would permanently eliminate the potential human health and ecological risks associated with exposure to those sediments. Alternative 8 would also involve the removal and off-site treatment/disposal of additional sediment located outside the ARC with PAH concentrations greater than 4 mg/kg (approximately 32,000 cy). However, because the PAH-containing sediments outside of the ARC have been shown through previous Site investigation activities to not be bioavailable or toxic to benthic macroinvertebrates, Alternative 8 is not considered more effective than Alternative 7. Alternatives 7 and 8 would each, however, provide a greater degree of permanence than the other active remedial alternatives (Alternatives 3 through 6) as a result of the larger quantity of sediment removed from the river and treated/disposed off-site.

Overall, Alternative 8 offers the greatest degree of permanence. However, Alternatives 3 through 7 would be equally effective at achieving the RAOs assuming the engineered cap component of Alternatives 3 through 6 is properly designed and maintained. The long-term effectiveness of Alternatives 4 through 8 could be reduced if effective containment cannot be installed around the ARC; as noted previously, if containment cannot be installed, there would likely be resuspension and release of PAH-containing sediments and NAPL to adjacent/downriver areas of the river as a result of dredging. The potential for such releases to downriver/adjacent areas would be progressively higher for Alternatives 4 through 8 as a result of the larger quantity of sediment removed with each alternative, and corresponding increase in schedule.

7.6 Land use

The current and anticipated future use of the property adjacent to the river is a mixed commercial/residential urban setting, including a city-owned park and nearby commuter rail station. The current and anticipated future use of the river itself is as a navigable waterway and for recreation activities.

None of the Alternatives are expected to result in changes in the current or future use of the adjacent upland properties. The institutional controls that would be implemented under Alternative 2 would likely place limitations on activities that could be performed within the ARC; for example, anchoring may be prohibited within the ARC to reduce the potential for disturbance of the NAPL-containing sediments that could potentially result in the generation of sheens on the water surface. Likewise, the institutional controls that would be implemented under Alternatives 3 through 6 would likely place limitations on activities that could disturb or damage the engineered cap component of those alternatives and jeopardize its effectiveness. Such activity limitations could include no anchoring and construction within the ARC. An SMP would be prepared under Alternatives 2 through 6 to document protocols to be followed in the event that intrusive activities (navigational dredging, construction of piers or docks, etc.) are required in the future that could disturb the MGP-containing sediments (Alternative 2) or the engineered cap (Alternatives 3 through 6). Alternatives 7 and 8 would not require the placement of any limitations on the use of the river following implementation.

Overall, of the active remedial alternatives, Alternatives 7 and 8 would result in the least amount of restrictions on use of the river, though the restrictions associated with Alternatives 2 through 6 would be minimal and would not significantly affect the use of the river for navigation or recreational purposes. The construction of public docks by the City within Embayments #1 and #2 would reduce the likelihood that boaters would anchor within the ARC.

7.7 Overall Protectiveness of Public Health and the Environment

Alternatives 1 and 2 would not involve any remedial activities to actively address in the NAPL-containing and potentially toxic sediments. Under Alternative 2, the potential for human exposure to MGP-impacted sediments and the potential for the NAPL-containing sediments to generate sheens would be reduced through the implementation of institutional controls that would be aimed at reducing the potential disturbance of the sediments. The potential impacts to both human health and biota

could be further reduced in the long term under both Alternatives 1 and 2 as a result of natural recovery processes such as chemical weathering, degradation, and natural capping via deposition of clean sediments over the impacted sediments. However, only Alternative 2 would include monitoring to document that these processes are occurring.

Alternative 3 would achieve the RAOs by reducing the mobility of, and the potential for human and biota exposure to, NAPL-containing sediment and sediment identified during the 2009 bioavailability study as being potentially toxic to benthic macroinvertebrates through the installation, monitoring and maintenance of an above-grade engineered cap. Alternatives 4 through 6 would achieve the RAOs through removal of the sediment identified during the 2009 bioavailability study as potentially toxic to benthic macroinvertebrates and a portion of the NAPL-containing sediments within the ARC followed by installation of an engineered cap over the remaining NAPL-containing sediments at depth. Institutional controls would be implemented as part of Alternatives 3 through 6 to reduce the potential for disturbance of, or damage to, the engineered cap. For Alternatives 4 through 6, the degree of potential short-term risk increases with the volume of removal (i.e., potential for short-term exposures and impacts on the surrounding community progressively increases for Alternatives 4, 5, and 6). However, the degree of permanency also increases with the amount of removal of impacted sediment because dredging and off-site treatment of the sediments is an irreversible process. The short-term (and potentially long-term) risks would likely be progressively and significantly higher for Alternatives 4 through 8 if containment cannot be successfully installed around the dredging area. Due to the depth of water in the ARC, water velocities, tidal fluctuations, and depth to bedrock there is a significant amount of uncertainty as to whether effective containment can be installed. Implementation of these alternatives without containment is expected to result in a significant increase in both short-term and long-term risks as a result of NAPL and PAH-containing sediment transport to adjacent/downriver areas.

Alternative 7 would achieve the RAOs through complete removal of the NAPL-containing sediments and sediments identified during the 2009 bioavailability study as potentially toxic to benthic macroinvertebrates. The degree of potential short-term risk for Alternative 7 would be greater than for Alternatives 4 through 6 due to the removal, handling, and transport of a larger quantity of MGP-impacted sediments. Implementation of Alternative 7 would, however, provide a greater degree of permanence as it would include complete removal and off-site treatment of all NAPL-containing and potentially toxic sediment within the ARC. However, similar to Alternatives 4 through 6, if Alternative 7 cannot be completed within containment, this alternative is expected to have significant increases in short-term and long-term risks

associated with PAH-impacted sediment and NAPL resuspension and transport to adjacent areas.

Alternative 8 would achieve the RAOs and reduce potential risk to human health and the environment through removal of all NAPL-containing and potentially toxic sediment within the ARC. As requested by NYSDEC, Alternative 8 would also involve the removal of sediment with PAH concentrations greater than 4 mg/kg outside the ARC, despite the fact that Site-specific studies have determined the PAH-containing sediment located outside of the ARC to not be bioavailable or toxic to benthic macroinvertebrates. The degree of potential short-term risk anticipated for Alternative 8 would be much greater than any of the other active remedial alternatives due to the significantly longer duration, multiple mobilizations/demobilizations, much greater amount of work within the active shipping channel, and removal, handling, and transport of a significantly larger quantity of MGP-impacted sediments. Alternative 8 would provide the greatest degree of removal of PAH-containing sediment. However, because the PAH-containing sediments outside of the ARC have been shown through previous Site investigation activities to not be bioavailable or toxic to benthic macroinvertebrates, Alternative 8 is no more effective at achieving the RAOs than Alternatives 3 through 7. Similar to Alternatives 4 through 7, if the dredging within the ARC cannot be completed within containment, Alternative 8 is expected to result in significant increases in short-term, and potentially long-term, risks associated with PAH-impacted sediment and NAPL resuspension and transport to adjacent areas.

In summary, Alternatives 3 through 8 are all effective at achieving the RAOs that have been established for the OU2 sediments. Alternative 3 would result in the least amount of short-term exposures to Site workers and impacts on the surrounding community during implementation, and Alternative 8 the most. Alternatives 4 through 8 each provide a greater degree of permanence than Alternative 3 because Alternatives 4 through 8 each involve removal of all of the sediments identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates, as well as a portion of the NAPL-containing sediments within the ARC. If containment cannot be successfully installed and maintained around the ARC as proposed for Alternatives 4 through 8, the dredging components of those alternatives would need to be performed without containment; if that were to occur, the short-term and long-term risks are expected to increase significantly and any long-term benefits associated with permanent removal of some or all of the MGP-impacted sediments could be reduced. If any of Alternatives 4 through 8 were selected as the Site remedy, further investigation would be necessary during the PDI, and further engineering analyses would be

performed during the remedial design, to verify whether effective containment could be installed around the ARC.

7.8 Cost Effectiveness

The following table summarizes the estimated costs associated with each of the remedial alternatives. The detailed cost estimates for each remedial alternative are presented in Appendix B.

Table 7-1 Summary of Remedial Alternative Costs

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost	Total Estimated Cost
1 – No Further Action	$0	$0	$0
2 - Monitored Natural Recovery of Sediments within the ARC with Institutional Controls	$150,000	$1,280,000	$1,430,000
3 - Capping Sediments within the ARC and Institutional Controls	$7,170,000	$1,720,000	$8,890,000
4 - Excavation of Sediments within the ARC to a Depth of 1 foot with Treatment/Disposal of the Excavated Sediments, Capping of the Excavated Area, and Institutional Controls	$9,750,000	$1,720,000	$11,470,000
5 - Excavation of Sediments within the ARC to a Depth of 2 feet with Treatment/Disposal of the Excavated Sediments, Capping of the Excavated Area, and Institutional Controls	$11,220,000	$1,720,000	$12,940,000

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost	Total Estimated Cost
6 - Excavation of Sediments within the ARC to Variable Depths (up to 6 feet) with Treatment/Disposal of the Excavated Sediments, Backfill and Capping of the Excavated Area, and Institutional Controls	$13,450,000	$1,720,000	$15,170,000
7 - Excavation of Sediments within the ARC to Full Depth of NAPL (up to 15 feet) with Treatment/Disposal of the Excavated Sediments and Backfill of the Excavated Area	$15,340,000	$0	$15,340,000
8 - Sediment Excavation to 4 mg/kg PAH with Treatment/Disposal of the Excavated Sediments and Backfill of the Excavated Area	$41,710,000	$0	$41,710,000

Although Alternatives 1 and 2 have the lowest costs, they are not expected to meet the RAOs in the short-term. Their ability to achieve the RAOs in the long term would be dependent upon the progress of natural recovery processes. Alternatives 3 through 8 all would achieve the RAOs, but at a wide array of costs, as presented in Table 7-1 above. The costs associated with Alternative 8 are much higher than the other Alternatives and therefore it is not considered cost-effective.

8 Recommended Remedy

Based on a review of the array of potential remedial alternatives presented in this FS, National Grid has selected Alternative 4 to address the OU2 sediments. As described in Section 6, the primary components of the Alternative 4 consist of the following:

- Installing temporary containment around the ARC (if possible given Site conditions)
- Removing debris and shore-line rip-rap within the ARC
- Mechanical dredging of the top foot of sediment within the ARC
- On-site processing of sediment in preparation for off-site treatment of the sediment via LTTD
- Placing an engineered cap over the sediments remaining at depth within the ARC
- Establishing and maintaining institutional controls to reduce the potential for damage to or disturbance of the cap
- Designing and implementing a monitoring and maintenance program to enhance the long-term effectiveness of the cap

This alternative would achieve the RAOs that have been established for the Site. The sediment identified during the 2009 bioavailability study as potentially being toxic to benthic macroinvertebrates and a portion of NAPL-containing sediment would be permanently removed from the river and treated off-Site (approximately 2,000 cy total), thus resulting in a reduction in both volume and toxicity of MGP-impacted sediments in the river. In addition, the engineered cap would mitigate the mobility of, and the potential for human and biota exposure to, the NAPL-containing sediments that would remain at depth beneath the cap.

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Tables

Table 3-1
Summary of Federal and State Chemical-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
Clean Water Act (CWA) - Ambient Water Quality Criteria	40 CFR Part 131; EPA 440/5-86/001 "Quality Criteria for Water - 1986", superseded by "National Recommended Water Quality Criteria: 2009"	**S**	Criteria for protection of aquatic life and/or human health depending on designated water use.	Applicable to the evaluation of potential impacts to the Hudson River from Site-related constituents.
CWA Section 136	40 CFR 136	**G**	Identifies guidelines for test procedures for the analysis of pollutants.	Applicable to the evaluation of potential impacts to the Hudson River from site-related constituents.
CWA Section 404	33 USC Chapter 26 Subchapter 4 Section 1341-1346	**S**	Regulates discharges to surface waters, indirect discharges of water to POTWs, and discharge of dredged or fill material into waters of the U.S. (including wetlands).	Applicable for remedial activities that include dredging or capping and/or the treatment of water generated during excavation and dewatering activities.
RCRA-Regulated Levels for Toxicity Characteristic Leaching Procedure (TCLP) Constituents	40 CFR Part 261.24	**S**	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Dredged materials may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs)	40 CFR Part 268.48	**S**	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	Applicable if waste is determined to be hazardous and off-site land disposal is contemplated.

Table 3-1
Summary of Federal and State Chemical-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York State				
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants ("MGPs")	TAGM 4061 (2002) (Division of Environmental Remediation [DER]-4)	**G**	Outlines the criteria for conditionally excluding coal tar waste and impacted soils/sediment (destined for thermal treatment) from the hazardous waste requirements of 6 NYCRR Parts 370 - 374 and 376; includes waste from former MGPs exhibiting the hazardous characteristic of toxicity for benzene (D018).	This guidance will be used as appropriate in the management of MGP-impacted sediment and coal tar waste generated during the remedial activities.
"Contained-In Criteria" for Environmental Media; Soil Action Levels	TAGM 3028 (1997)	**G**	Establishes health-based "contained-in" levels for environmental media and debris.	This guidance will be used as appropriate in the management of waste generated during the remedial activities.

Table 3-1
Summary of Federal and State Chemical-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Technical Guidance for Screening Contaminated Sediments	Division of Fish, Wildlife, and Marine Resources (January 1999).	**G**	Describes the methodology for establishing numeric sediment cleanup standards. It also provides guidance when evaluating risk management options for contaminated sediment and when determining final contaminant concentrations that will be achieved through remedial efforts.	As specifically stated, "Once it has been determined that a sediment criterion is exceeded, more information is required to determine if remediation is necessary and what actual risks to the environment are present. The volume and location of sediment exceeding a criterion, which levels or protection are exceeded, the persistence of the contaminant, the uncertainty about the criteria, and the results of more detailed, site-specific sediment tests all play a role in making decisions about how, and how much sediment to cleanup in order to eliminate or minimize adverse effects." Consistent with this guidance, Site-specific bioavailability and toxicity assessments were used in determining the sediment remediation area (i.e. the ARC) and a Site-specific SPME pore water TU34 threshold of 5.4.

Table 3-1
Summary of Federal and State Chemical-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98, addended 4/00 and 6/04)	**G**	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	To be considered in evaluating surface water quality.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	**S**	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371, 373, and 376.	Applicable for determining if materials generated during implementation of remedial activities are hazardous wastes.
New York State Surface Water and Groundwater Quality Standards	6 NYCRR Part 703	**S**	Establishes quality standards for surface water and groundwater.	Potentially applicable for assessing water quality at the site during remedial activities.

Notes:

CFR = Code of Federal Regulations

EPA = United States Environmental Protection Agency

NYCRR = Official Compilation of Codes, Rules and Regulations of the State of New York

NYSDEC = New York State Department of Environmental Conservation

POTW = publicly owned treatment works

SCGs = Standards, criteria, and guidance

USC = United States Code

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
Occupational Safety and Health Administration (OSHA) - General Industry Standards	29 CFR Part 1910	**S**	These regulations consist of occupational safety and health standards which have been found to be national consensus standards or established Federal standards; including worker exposure limits (e.g., 8-hour time-weighted average and ceiling concentrations) for various compounds, and associated training requirements for workers at hazardous waste operations.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below required concentrations. Appropriate training requirements will be met for remedial workers.
OSHA - Safety and Health Standards	29 CFR Part 1926	**S**	These regulations provide general construction safety and health standards. These regulations specify the type of safety equipment to be utilized and procedures to be followed during site remediation.	Appropriate safety equipment will be on-site and appropriate procedures will be followed during remedial activities.
OSHA - Record-keeping, Reporting and Related Regulations	29 CFR Part 1904	**S**	These regulations outline record-keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate and maintain remedial actions at hazardous waste sites.
RCRA - Preparedness and Prevention	40 CFR Part 264.30 - 264.37	**S**	These regulations outline requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.	Safety and communication equipment will be installed at the Site as necessary. Local authorities will be familiarized with the Site.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
RCRA - Contingency Plan and Emergency Procedures	40 CFR Part 264.50 - 264.56	**S**	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Emergency and contingency plans will be developed during remedial design. Copies of the plan will be kept on-site.
Clean Water Act (CWA) - Discharge to Waters of the U.S., General Pretreatment Regulations for Existing and new Sources of Pollution and Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 CFR Parts 403, and 230 Section 404 (b) (1); 33 USC 1341-1346	**S**	Establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality. Types of discharges regulated under CWA include: indirect discharge to a POTW, and discharge of dredged or fill material into U.S. waters.	Applicable to remedial activities within and/or adjacent to the Hudson River.
CWA Section 401	33 USC 1341	**S**	Requires that 401 Water Quality Certification permit be provided to federal permitting agency (USACE) for any activity including, but not limited to, the construction or operation of facilities which may result in any discharge into jurisdictional waters of the U.S..	Applicable to remedial activities within and/or adjacent to the Hudson River.
90 Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	**S**	Allows generators of hazardous waste to store hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.	Potentially applicable to remedial alternatives that involve the storing of hazardous materials on-site.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Rivers and Harbors Act, Sections 9 & 10	33 USC 401 and 403; 33 CFR Parts 320- 330	**S**	Prohibits unauthorized obstruction or alteration of navigable waters of the U.S. (dredging, fill, cofferdams, piers, etc.). Requirements for permits affecting navigable waters of the U.S.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River.
RCRA - Closure Performance Standard	40 CFR Part 264.111	**S**	This regulation establishes performance standards required for closing hazardous waste facilities, including: minimizing the need for further maintenance; controlling, minimizing or eliminating post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products; and decontaminating or disposing of contaminated equipment, structures and soils.	Decontamination actions and facilities will be constructed for remedial activities and disassembled after completion.
Standards Applicable to Transporters of Hazardous Waste - RCRA Sections 3002 and 3003	40 CFR Parts 262 and 263	**S**	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the Site.
United States Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1 - 172.558	**S**	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the Site.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Clean Air Act-National Ambient Air Quality Standards	40 CFR Part 60	**S**	Establishes ambient air quality standards for protection of public health.	Remedial operations will be performed in a manner that minimizes the production of certain air emissions.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270 and 124	**S**	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the Site must be properly permitted. Implementation of the Site remedy will include consideration of these requirements.
Land Disposal Restrictions	40 CFR Part 268	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes Universal Treatment Standards (UTSs) to which hazardous waste must be treated prior to land disposal.	Excavated materials that display the characteristic of hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
CERCLA-National Oil and Hazardous Substances Pollution Contingency Plan (NCP)	42 U.S.C. Section 9605; 33 U.S.C. 1321 (d); 40 CFR Part 300	**S**	Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.	Potentially applicable to remedial activities that include (but are not limited to) the dredging and disposal or capping of waste material from the Site.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
RCRA Subtitle C	42 U.S.C. Section 6901 et seq.; 40 CFR Part 268	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	Potentially applicable to remedial activities that include the dredging and disposal or capping of waste material from the Site.
New York State				
Use and Protection of Waters Program	6 NYCRR Part 608	**S**	Protection of waters permit program regulates: 1) any disturbance of the bed or banks of a protected stream or water course; 2) construction and maintenance of dams; and 3) excavation or fill in navigable waters of the State.	A permit will be required for the excavation and/or placement of fill associated with the remediation of MGP-impacted sediment in the Hudson River.
Guidelines for the Control of Toxic Ambient Air Contaminants	Division of Air Resources (DAR)-1 (Air Guide 1)	**G**	Provides guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution.	This guidance may be applicable for remedial alternatives that result in certain air emissions.
Air Resources - Prevention and Control of Air Contamination and Air Pollution, Air Quality Classifications and Standards	6 NYCRR Parts 200, 201, 256, 257, and 269	**S**	Provides methods to prevent and control air contamination and establishes air quality standards, general classifications, and air quality classifications specific to Columbia County.	These regulations may be applicable for remedial alternatives that result in certain air emissions.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Discharges to Public Waters	New York State Environmental Conservation Law, Section 71-3503	**S**	Provides that a person who deposits gas tar, or the refuse of a gas house or gas factory, or offal, refuse, or any other noxious, offensive, or poisonous substances into any public waters, or into any sewer or stream running or entering into such public waters, is guilty of a misdemeanor.	During the remedial activities, MGP-impacted materials will not be deposited into public waters or sewers.
New York Hazardous Waste Management System - General	6 NYCRR Part 370	**S**	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	**S**	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 370-373 and 376.	Applicable for determining if solid waste generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	**S**	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and treatment, storage or disposal facilities in New York State.	This regulation will be applicable to any company(s) contracted to transport or manage hazardous material generated at the Site.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3 a-d	**S**	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous waste from the site.
Waste Transporter Permits	6 NYCRR Part 364	**S**	Governs the collection, transport and delivery of regulated waste within New York State.	Properly permitted haulers will be used for any waste materials transported off-site.
NYSDEC Technical and Administrative Guidance Memorandums (TAGMs)	NYSDEC TAGMs	**G**	TAGMs are NYSDEC guidance that are to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
NYSDEC Technical Guidance for Site Investigation and Remediation	Division of Environmental Remediation (DER)-10 (2010)	**G**	Outlines the minimum technical activities DEC accepts for remedial projects administered under DER.	This guidance is applicable for various stages of the remediation process (e.g., remedy selection, remedial design, remedial action).
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1 - 373.1.8	**S**	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
Management of Soil and Sediment Contaminated With Coal Tar From Former Manufactured Gas Plants	NYSDEC Program Policy	**G**	Purpose of the guidance is to facilitate the permanent treatment of soil contaminated with coal tar from former MGPs.	Policy will be considered for D018 hazardous and non-hazardous material removed during removal activities.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Land Disposal Restrictions	6 NYCRR Part 376	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria.	New York defers to USEPA for UTS/LDR regulations.
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants	TAGM 4061(2002) (DER-4)	**G**	Outlines the criteria for conditionally excluding coal tar waste and impacted soils/sediment from former MGPs which exhibit the hazardous characteristic of toxicity for benzene (D018) from the hazardous waste requirements of 6 NYCRR Parts 370 - 374 and 376 when destined for thermal treatment.	This guidance will be considered, as appropriate, in the management of MGP-impacted sediment and coal tar waste generated during the remedial activities.
National Pollutant Discharge Elimination System (NPDES) Program Requirements, administered under New York State Pollution Discharge Elimination System (SPDES)	40 CFR Parts 122 Subpart B and 125; CWA Sections 301, 303, and 307 (Administered under 6 NYCRR 750-758)	**S**	Establishes permitting requirements for point source discharges; regulates discharge of water into navigable waters including the quantity and quality of discharge.	Removal activities may involve treatment/disposal of water. If so, water generated at the site will be managed in accordance with NYSDEC SPDES permit requirements.
Remedial Program	6 NYCRR 375.1.8	**S**	Provides general actions to be considered during the remedial process.	This guidance is applicable for various stages of the remediation process (e.g., remedy selection, remedial design, remedial action).
Presumptive/Proven Remedial Technologies	DER-15 (2007)	**G**	Provides brief descriptions of generally accepted presumptive/proven (presumptive) remedial technologies suitable for implementing and complying with 6 NYCRR Section 375.1.8.	This guidance is applicable for the remedy selection process and remedial design process.

Table 3-2
Summary of Federal and State Action-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Notes:
CFR = Code of Federal Regulations
EPA = United States Environmental Protection Agency
MGP = Manufactured Gas Plant
NYCRR = Official Compilation of Codes, Rules and Regulations of the State of New York
NYSDEC = New York State Department of Environmental Conservation
POTW = publicly owned treatment works
SCGs = Standards, criteria, and guidance
USACE = United States Army Corps of Engineers
USC = United States Code

Table 3-3
Summary of Federal and State Location-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
National Environmental Policy Act Executive Orders 11988 and 11990	40 CFR 6.302; 40 CFR Part 6, Appendix A	**S**	Requires federal agencies, where possible, to avoid or minimize adverse impact of federal actions upon wetlands/floodplains and enhance natural values of such. Establishes the "no-net-loss" of waters/wetland area and/or function policy.	To be considered if remedial activities are conducted within the floodplain.
CWA Section 470	33 USC 1344, Section 404; 33 CFR Parts 320-330; 40 CFR Part 230	**S**	Discharge of dredge or fill materials into waters of the U.S., including wetlands, are regulated by the USACE.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River.
Fish and Wildlife Coordination Act	16 USC 661; 40 CFR 6.302	**S**	Actions must be taken to protect fish or wildlife when diverting, channeling or otherwise modifying a stream or river.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River. Fish protection period is April 1 to September 30.
Historical and Archaeological Data Preservation Act	16 USC 469a-1	**S**	Provides for the preservation of historical and archaeological data that might otherwise be lost as a result of alteration of the terrain.	The National Register of Historic Places website indicated no records present for historical sites in the immediate vicinity of the site.
National Historic Preservation Act	16 USC 470; 36 CFR Part 65; 36 CFR Part 800	**S**	Requirements for the preservation of historic properties.	The National Register of Historic Places website indicated six historic sites are present within 1 mile of the site.

Table 3-3
Summary of Federal and State Location-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Rivers and Harbors Act	33 USC 401/403	**S**	Prohibits unauthorized obstruction or alteration of navigable waters of the U.S. (dredging, fill, cofferdams, piers, etc.). Requirement for permits affecting navigable waters of the U.S.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River.
Hazardous Waste Facility Located on a Floodplain	40 CFR Part 264.18(b)	**S**	Requirements for a treatment, storage and disposal (TSD) facility built within a 100-year floodplain.	Hazardous waste TSD activities (if any) will be designed to comply with applicable requirements cited in this regulation.
Endangered Species Act	16 USC 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402	**S**	Requires federal agencies to confirm that the continued existence of any endangered or threatened species and their habitat will not be jeopardized by a site action.	The Atlantic Sturgeon (candidate), Short-nose Sturgeon (endangered), the Indiana bat (endangered), the New England cottontail rabbit (candidate), and the bog turtle (threatened) are on the USFWS list of Threatened, Endangered, Sensitive Species for Columbia County.
Floodplains Management and Wetlands Protection	40 CFR 6 Appendix A	**S**	Activities taking place within floodplains and/or wetlands must be conducted to avoid adverse impacts and preserve beneficial value. Procedures for floodplain management and wetlands protection provided.	To be considered if remedial activities are conducted within the floodplain.

Table 3-3
Summary of Federal and State Location-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York State				
New York State Floodplain Management Development Permits	6 NYCRR Part 500	**S**	Provides conditions necessitating NYSDEC permits and provides definitions and procedures for activities conducted within floodplains.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River.
New York State Tidal Wetlands Land Use Regulations	6 NYCRR Part 661	**S**	Establish regulations that allow only those uses of tidal wetlands and areas adjacent thereto that are compatible with the preservation, protection and enhancement of the present and potential values of tidal wetlands.	Potentially applicable if remedial activities are conducted where waters are shallower than 6 feet at mean low tide.
New York State Parks, Recreation, and Historic Preservation Law	New York Executive Law Article 14	**S**	Requirements for the preservation of historic properties.	The National Register of Historic Places website indicated no records present for historical sites in the immediate vicinity of the MGP site.
Use and Protection of Waters Program	6 NYCRR Part 608	**S**	Protection of waters permit program regulates: 1) any disturbance of the bed or banks of a protected stream or water course; 2) construction and maintenance of dams; and 3) excavation or fill in navigable waters of the state.	Potentially applicable to remedial activities within and/or adjacent to the Hudson River. Applicable to remedial activities that would increase the river bed elevation.

Table 3-3
Summary of Federal and State Location-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Endangered & Threatened Species of Fish and Wildlife	6 NYCRR Part 182	**S**	Identifies endangered and threatened species of fish and wildlife in New York.	The shortnosed sturgeon (endangered) is on the List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State.
New York State Coastal Management Program	Significant Fish and Wildlife Habitat Policies 7 and 8	**S**	Requires that a Consistency Determination be obtained for activities proposed within Significant Fish and Wildlife Habitats	The Hudson River adjacent to the Site is not designated as a Significant Fish and Wildlife Habitat.
Local				
Local Building Permits	N/A	**S**	Local authorities may require a building permit for any permanent or semi-permanent structure, such as an on-site water treatment system building or a retaining wall.	Substantive provisions are potentially applicable to remedial activities that require construction of permanent or semi-permanent structures.
Codes and Regulations for Sewers	City of Hudson's Code Part II Chapter 240	**S**	Local coordination with the City of Hudson Department of Municipal Utilities would be required to coordinate water release from the site into the POTW, if applicable.	Removal activities may involve treatment/disposal of water. If so, potential coordination with the City of Hudson may be required.
City Code and Charter	City of Hudson Local Waterfront Revitalization Program (LWRP) – Draft Generic Environmental Impact Statement (DGEIS)	**S**	Requires that a Coastal Consistency Review be obtained for activities proposed within LWRP, and may require that an EIS be prepared under SEQRA.	Site is located within an area that is included in a LWRP and will require a Coastal Consistency Review through the New York Department of State.

Table 3-3
Summary of Federal and State Location-Specific SCGs

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York
National Grid

Notes:

CFR = Code of Federal Regulations
ECL = Environmental Conservation Law
EIS = Environmental Impact Statement

MGP = Manufactured Gas Plant

NYCRR = Official Compilation of Codes, Rules and Regulations of the State of New York

NYSDEC = New York State Department of Environmental Conservation

POTW = publicly owned treatment works
SCGs = Standards, criteria, and guidance
SEQRA = State Environmental Quality Review Act
USACE = United States Army Corps of Engineers
USC = United States Code
USFWS = United States Fish and Wildlife Service

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
No Action	No Action	No Action	Alternative would not include any actions to address the mobility, volume or toxicity of MGP-impacted sediments; nor would it include any actions to monitor future site conditions	A "No Action" alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a No Action alternative is required by the NCP, DER-10, and USEPA.	Would not achieve RAOs in the short term. However, some reduction in mobility, volume and toxicity of MGP-impacted sediments is expected to occur over the long term as a result of natural recovery processes.	Implementable	None	Yes
Institutional Controls	Institutional Controls	Legal and/or administrative controls that would mitigate the potential for exposure to sediments containing MGP-related constituents and/or enhance the effectiveness of other remedies (e.g., engineered sediment cap).	Examples of institutional controls include notification requirements, governmental controls, proprietary controls, enforcement and permit controls, and/or informational devices such as posted signs.	Technically implementable.	Alone, this option would not achieve the RAO for potential biota exposure to sediments containing MGP-related constituents and NAPLs. This option could reduce the potential for human exposure to sediments containing MGP-related constituents.	Implementable. Would require coordination with third party landowners/lessees, New York State, United States Army Corps of Engineers, and any parties with easements (e.g., utility crossings), as well as cooperation of the users of the Hudson River.	Low capital and O&M costs	Yes
In-Situ Treatment	Natural Recovery	Monitored Natural Recovery	Ongoing, naturally occurring degradation of MGP-related constituents and NAPL in the sediments over time via natural physical/chemical processes of advection, dispersion, burial, dissolution, sorption, photo-oxidation and biodegradation. Periodic sampling and visual observations of the sediment would be required over time to monitor the progress of the natural recovery processes.	Technically Implementable.	May achieve the RAOs over time. Requires monitoring to document changes in the sediment conditions and progress toward achieving the RAOs.	Implementable. Equipment and contractors are readily available to conduct periodic monitoring of NAPL-impacted and potentially toxic sediments.	Low capital costs Moderate O&M costs	Yes
	Immobilization	Solidification/Stabilization	Addition and mixing of materials (e.g. Portland cement) into sediments containing MGP-related constituents to limit the mobility of the NAPL- and MGP-impacted sediment. Involves treating sediment to produce a stable material with low leachability that physically and chemically locks NAPL and MGP-related constituents in the solidified/stabilized matrix.	The presence of rocks/cobbles at the Site may interfere with mixing process (most applicable for fine-grained, homogenous sediments). This technology has not been successfully implemented on a full-scale for treatment of impacted sediments. Not retained for secondary screening.				

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
In-Situ Containment/ Controls	Capping	Engineered Cap	Covering or encapsulating sediments with natural material (e.g., gravel, sand, clays), modified natural materials (e.g. organoclays), synthetic materials (Aquablok™ pellet, geotextile membranes), and/or armoring to physically, isolate sediments containing MGP-related constituents and NAPL. The specific details of the cap (i.e., material types and thicknesses) would be determined during the remedial design. This option could be applied as a stand-alone alternative, or combined with other GRAs (e.g., removal, institutional controls).	**Technical Implementability**	Would reduce the mobility of MGP-related constituents through isolation and if properly designed and maintained, would eliminate human and biota exposure to MGP-impacted sediments. Would require periodic monitoring and potential maintenance to verify and maintain the cap effectiveness over the long term.	Implementable. Equipment and materials necessary to construct an engineered cap are readily available. The Hudson River, including the bed of the Hudson River, is owned by the State of New York. An application for use of land underwater must be submitted to the NY Office of General Services.	Moderate capital and O&M costs.	Yes
Removal	Dredging	Mechanical	Removing impacted sediment using barge-mounted dredges (e.g., clamshell) and/ or conventional construction equipment on barges within the river. Can also be implemented with other GRAs (ex-situ treatment/disposal, in-situ containment).	Technically implementable but would require installation of containment around the removal area to maintain surface water quality of adjacent areas and prevent migration of contamination to non-impacted areas. The technical feasibility of installing engineering controls for containment around the dredge area during remediation is highly uncertain due to water depths and velocities.	Proven process for removing and reducing volume of MGP-impacted sediments.	Implementable. Equipment and materials necessary to dredge sediment are readily available. An upland area to stage and dewater excavated sediment would be necessary. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required. The Hudson River, including the bed of the Hudson River, is owned by the State of New York. An application for use of land underwater must be submitted to the NY Office of General Services.	Moderate to high capital costs No O&M costs	Yes

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Removal (continued)	Dredging	Hydraulic	Sediments are removed in liquid slurry form using pumps, suction hose, horizontal auger and/or cutter-head dredge. Simultaneously removes large quantities of water, which requires handling/treatment. Can be implemented alone or with other GRAs (ex-situ treatment/disposal, in-situ containment).	Technically implementable but would require installation of containment around the removal area to maintain surface water quality of adjacent areas and prevent migration of contamination to non-impacted areas. The technical feasibility of installing engineering controls for containment around the dredge area during remediation is highly uncertain due to water depths and velocities.	Proven process for effectively removing sediment. Effectiveness reduced with larger-grained sediments (i.e., cobbles, boulders, rip-rap), debris, and/or excessive vegetation is present.	Implementable; however, significant quantity of upland space needed for sediment dewatering and water treatment facilities. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required. The Hudson River, including the bed of the Hudson River, is owned by the State of New York. An application for use of land underwater must be submitted to the NY Office of General Services.	Very high capital cost No O&M costs.	Due to very high capital costs compared to mechanical dredging, small volume of sediment, and presence of larger grained sediments (natural armoring layer), this process option has not been retained.
Ex-situ On-Site Pre-Treatment, Treatment and/or Disposal	Gravity Drainage	Dewatering	Sediment is stockpiled and allowed to gravity dewater as a pre-treatment or pre-disposal step. Water is collected and treated on-site or off-site.	Technically implementable. Typically used in conjunction with other technologies (e.g., sediment treatment/disposal, water treatment).	Effective means of reducing water content in sediments requiring treatment/disposal.	An upland area to dewater excavated sediment and a means for water collection and treatment would be necessary. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required.	Low capital costs. No O&M costs	Yes
	Immobilization	Solidification	Addition of material to the removed sediment as a pretreatment process to aid in the dewatering and/or to stabilize the sediments (i.e., produce a stable, non-leachable material, that physically or chemically locks the constituents within the solidified/stabilized matrix).	Technically Implementable.	Common and proven process for solidifying MGP-impacted sediments in preparation for subsequent transportation over public roads (i.e., pass the paint filter test) and treatment/disposal.	Implementable. An upland area to temporarily stage, dewater, and solidify sediment would be required. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required.	Low to Moderate capital costs. No O&M costs.	Yes

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Ex-situ On-Site Pre-Treatment, Treatment and/or Disposal (continued)	Thermal Extraction	Low Temperature Thermal Desorption (LTTD)	Excavated sediments are heated and the organic compounds are desorbed from the sediments into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified. Treatment is conducted in a thermal treatment unit that is mobilized to and constructed on the Site.	Technically implementable.	Proven process for treating organic constituents. The efficiency of the system and rate of removal of organic constituents would require evaluation during bench-scale and/or pilot-scale testing. Not appropriate for coarse-sized material (e.g., cobbles).	Implementable. LTTD treatment units are available and could be mobilized to the Site to treat excavated sediments. No precedence exists for the placement of treated material back in river bed after thermal treatment; treatment would likely be done in combination with a disposal option. An upland area to treat the sediment would be required. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required. Compliance with permit requirements for emission discharge would be required. May not be acceptable to the local community due to proximity to residential areas and commuter rail.	Very high capital cost for system mobilization and set-up; O&M costs for an on-site LTTD treatment system would be dependent upon the physical and chemical characteristics of the sediment and the volume of sediment to be treated.	Not retained due to: small quantity of sediment that would be removed at the Site; the very high costs involved to pilot test, design, mobilize and construct a treatment system on-site; and the local availability of off-site permitted LTTD facilities.

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Ex-situ On-Site Pre-Treatment, Treatment and/or Disposal (continued)	Thermal Destruction	Incineration	Use of a mobile incineration unit installed on-site for high temperature thermal destruction of the organic compounds present in the media. Sediments are conditioned prior to incineration. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified such as backfill in the sediment excavation area.	Technically implementable	Proven process for treating organic constituents. The efficiency of the system and rate of destruction of organic constituents would require evaluation during bench-scale and/or pilot-scale testing. Not appropriate for coarse-sized material (e.g., cobbles).	Implementable. Treatment units are available and could be mobilized to the Site to treat excavated sediments. No precedence exists for the placement of treated material back in river bed after thermal treatment; treatment would likely be done in combination with a disposal option. An upland area to treat the sediment would be required. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required. Compliance with permit requirements for emission discharge would be required. May not be acceptable to the local community due to proximity to residential areas and commuter rail.	Very high capital cost for system mobilization and set-up; O&M costs for an on-site incineration unit would be dependent upon the physical and chemical characteristics of the sediment, and the volume of sediment to be treated. .	Not retained due to: small quantity of sediment that would be removed at the Site; the very high costs involved to pilot test, design, mobilize and construct a treatment system on-site; and the local availability of off-site permitted LTTD facilities that are more appropriate for treating MGP constituents.
	Chemical Destruction	Chemical Oxidation	Sediments are mixed with oxidizing agents to reduce the mass of organic constituents. Chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate or potassium permanganate. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified such as backfill in the sediment excavation.	Not effective for treating NAPL-impacted sediment. Would require multiple treatments of chemicals to reduce organic constituents. Not retained for secondary screening.				
	On-site Disposal	RCRA Landfill	Construction of a landfill that would meet RCRA requirements.	Not implementable. Limited on-site space, shallow depth to groundwater and close proximity to Hudson River would make siting a landfill infeasible. Not retained for secondary screening.				

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Ex-situ On-Site Pre-Treatment, Treatment and/or Disposal (continued)		Confined Disposal Facility (CDF)	Construction of an in-water or upland facility to contain dredged sediments.	Technically Implementable. On-site embayments may be suitable for CDF construction.	Effective method for disposing and controlling the release of dredged sediments into the environment.	Potentially Implementable. further evaluation of embayments would be required. May not be acceptable to public due to proximity to existing City park and city of Hudson's future plans for waterfront re-vitalization. Further, this process option is not generally suitable small volumes of sediment.	High capital and O&M costs.	Due to small volume of sediment to be removed and the very high capital costs to site, design and construct a CDF, this process option would not be a cost-effective method for sediment management at this Site.
Off-Site Treatment and/or Disposal	Recycle/Reuse	Asphalt Concrete Batch Plant	Sediment is used as a raw material in asphalt concrete paving mixtures. The impacted sediment is transported to an offsite asphalt concrete facility and can replace part of the aggregate and asphalt concrete fraction. The hot-mix process melts asphalt concrete prior to mixing with aggregate. During the cold-mix process, aggregate is mixed at ambient temperature with an asphalt concrete/water emulsion. Organics are bound in the asphalt concrete. Some organics may volatilize in the hot-mix.	Not implementable. Permitted facilities and demand are limited. Not retained for secondary screening.				
		Brick/Concrete Manufacture	Impacted sediment is transported off-site and used as a raw material in the manufacture of bricks or concrete. Heating in ovens during the manufacturing process volatilizes organics.	Not implementable. Permitted facilities and demand are limited. Not retained for secondary screening.				
	Extraction	Low Temperature Thermal Desorption	Process by which excavated sediments are heated and the organic compounds are desorbed from the sediments into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified such as backfill or landfill daily cover.	Technically implementable.	Effective and common means for treatment of MGP-related waste materials as discussed in the Management of Coal Tar Waste and Coal tar Contaminated Soils and Sediment From Former Manufactured Gas Plants (DER-4), (NYSDEC 2002).	Implementable. Treatment facilities are available in relatively close proximity to the Site (i.e. Fort Edward, New York)	Moderate to high capital costs No O&M Cost	Yes

Table 5-1
Remedial Technology and Process Option Screening

Feasibility Study for Operable Unit 2
Hudson (Water Street) Site, Hudson New York
National Grid

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Off-Site Treatment and/or Disposal (continued)	Thermal Destruction	Incineration	Sediments are incinerated off-site for high temperature thermal destruction of the organic compounds present in the media. Sediments are excavated and conditioned prior to incineration.	Technically implementable; however, not as appropriate for treatment of MGP-impacted sediments as LTTD and a limited number of treatment facilities are available near the Site. Not retained for secondary screening.				
	Disposal	RCRA Landfill	Disposal of impacted soil in an existing RCRA permitted landfill facility.	Technically implementable.	Proven process for disposal of environmental remediation wastes.	Implementable. Pre-treatment of sediment via LTTD may be required to meet New York State LDRs. Closest RCRA landfill in New York is Chemical Waste Management located in Model City, NY.	Moderate to high capital costs No O&M Cost	Yes
		Solid Waste Landfill	Disposal of non-impacted soil/debris in an existing permitted non-hazardous landfill.	Technically implementable.	Effective alternative for other non-impacted wastes generated during remedial activities.	Implementable. Non-hazardous solid waste landfills are in close proximity to the Site.	Moderate capital costs No O&M Cost	Yes
Residual Management	On-site Water Treatment	On-Site Treatment System	Impacted surface water is passed through an on-site treatment process to remove constituents of concern utilizing chemical treatment or physical separation processes, in addition to suspended solids removal. Treated water is discharged back to the surface water provided that quality and quantity meet the allowable discharge requirements for surface waters (NYSDEC SPDES compliance).	Technically Implementable.	Effective process to manage residual liquid wastes.	Implementable. Would require permits from the City of Hudson for construction of treatment system on-Site and from NYSDEC to discharge residual liquid wastes. Permit conditions would be required to be met in order to discharge liquids to the Hudson River. An upland area to treat the water would be required. Since National Grid does not own the adjacent upland parcels, third party access agreements would be required.	Low to moderate capital costs No O&M Cost	Yes
	Off-site Water Treatment	Discharge to Sanitary Sewer/WWTP	Pre-treated or untreated water is collected/transported or discharged directly to a sanitary sewer and treated at a local POTW facility.	Technically implementable. City of Hudson operates a POTW facility.	Effective process to manage residual liquid wastes.	Implementable. Would require permits from the City of Hudson and/or NYSDEC to discharge residual liquid wastes. Permit conditions would be required to be met in order to discharge liquids to the sanitary sewer.	Low to moderate capital costs No O&M Cost	Yes

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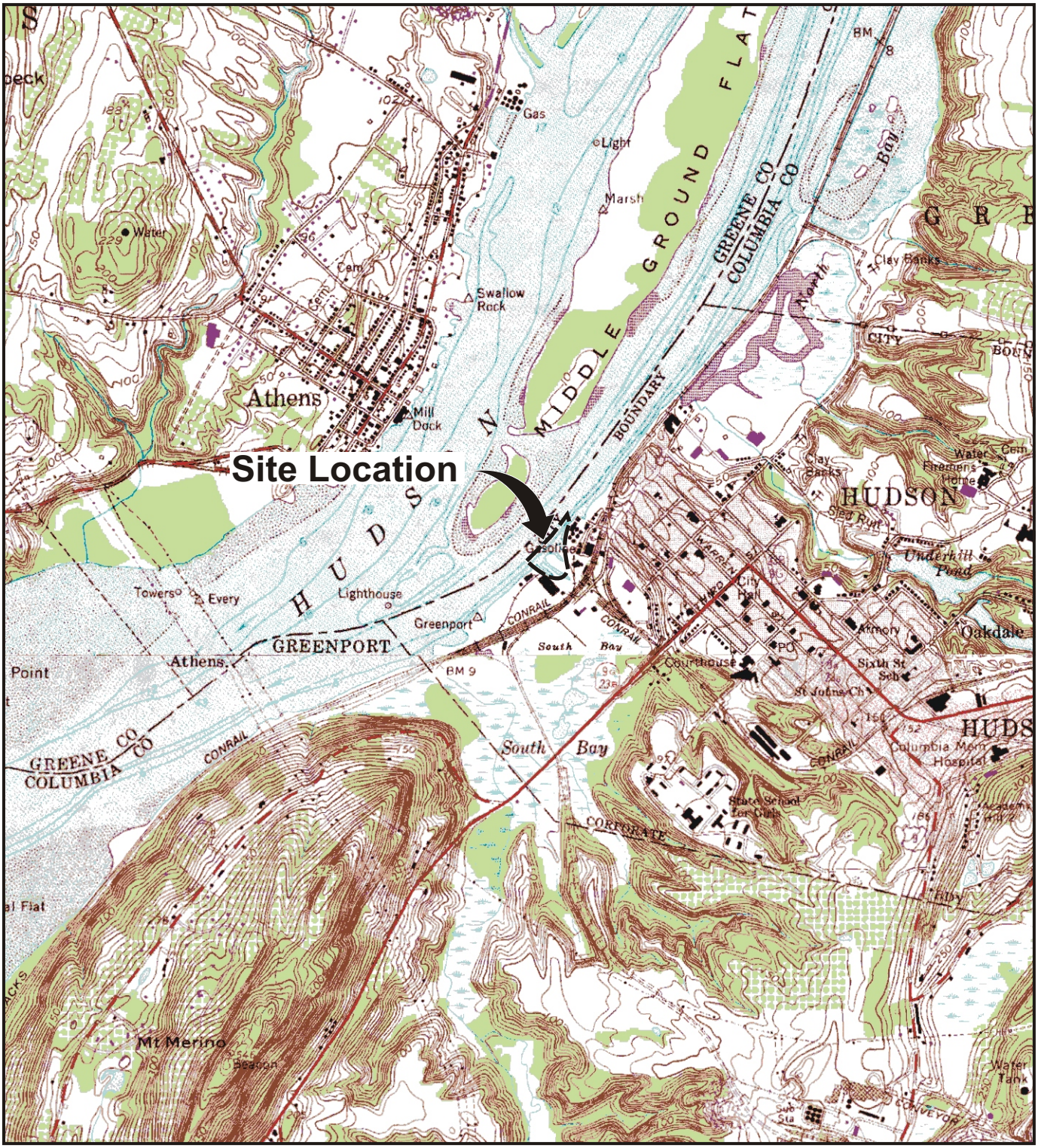
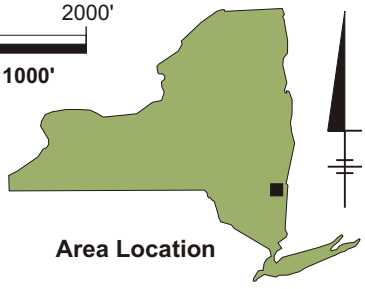
Figures



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD.,HUDSON NORTH, NY, 1953, AND HUDSON SOUTH, NY, 1963. PHOTOREVISED 1980.

2000' 0 2000'

Approximate Scale: 1" = 1000'



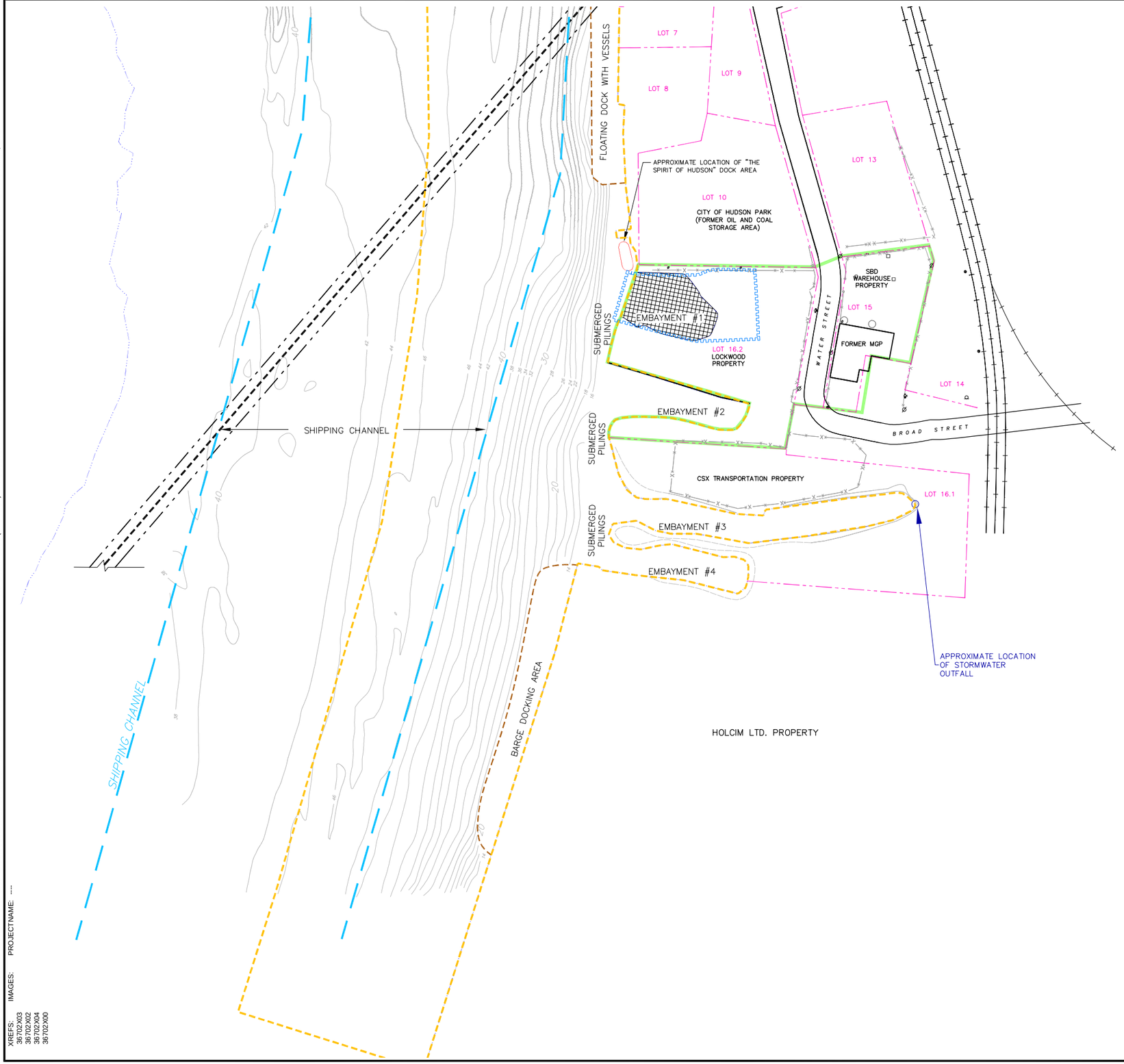
NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

SITE LOCATION MAP

ARCADIS

FIGURE
1-1

04/05/2011 SYRACUSE, NY-ENV/CAD-141 DJHOWES
B0036702/0001/00004/CDR/36702N01.CDR



LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- APPROXIMATE PROPERTY LINE (SEE NOTE 6)
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE 5)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE 4)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE 7)

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. OU2 IS IDENTIFIED BY NYSDEC AS A PORTION OF THE HUDSON RIVER ADJACENT TO THE SITE INCLUDING SEDIMENTS IN EMBAYMENTS #2, #3, AND #4.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION NORTHEAST OF LOT 10 WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 1009.11, DATED MARCH 1987.
4. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLEVISION, INC., CATSKILL, NEW YORK.
5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
6. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEET PILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN–PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

SITE PLAN

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FIGURE
1-2

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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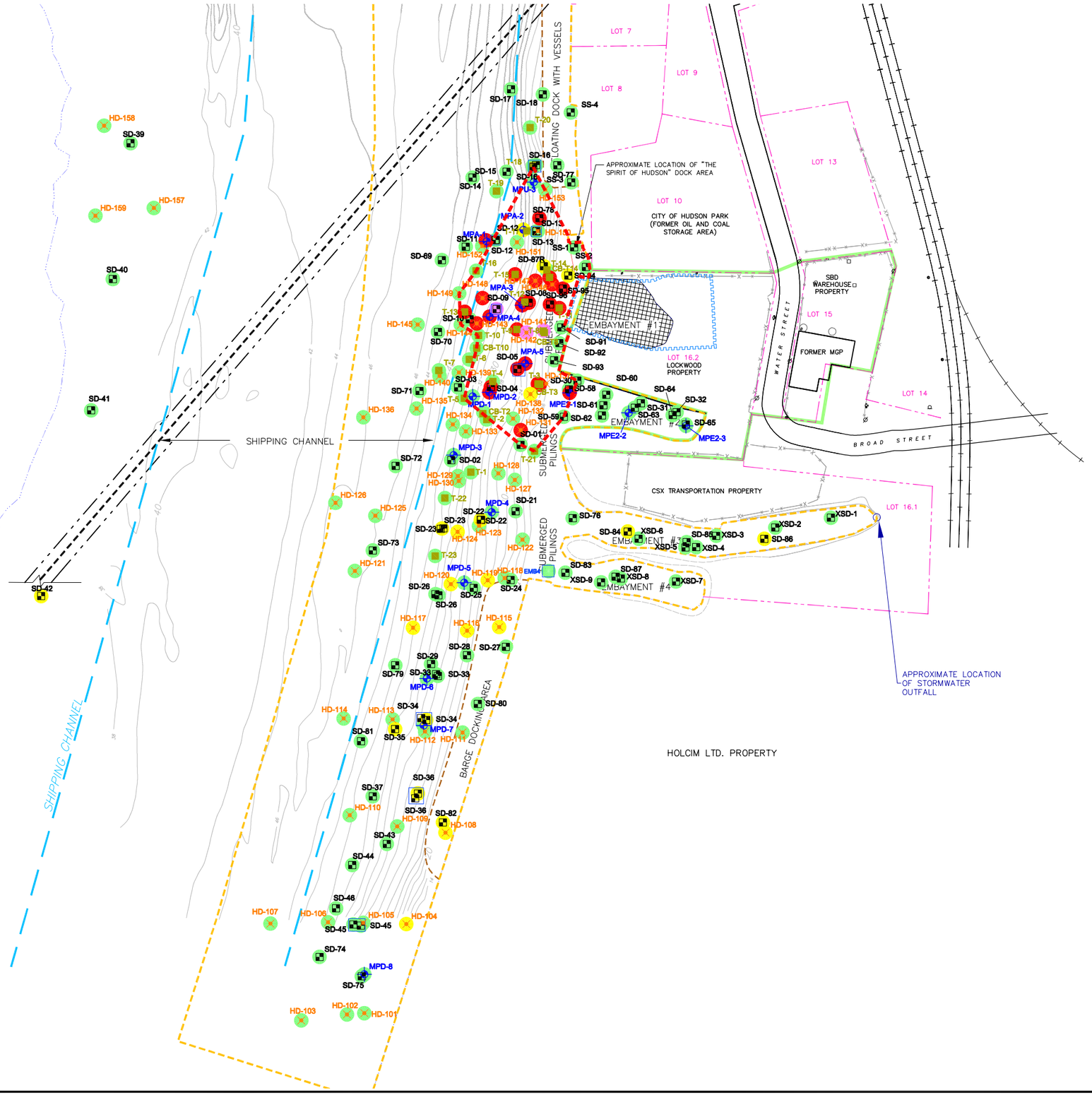

LEGEND:

- SD-21 SEDIMENT SAMPLE AND/OR CORE LOCATION
- EMB4 BENTHIC SURVEY SAMPLE LOCATION
- HD-132 BIOAVAILABILITY STUDY SAMPLING LOCATION
- T-2 TARGOST AND/OR TARGOST CONFIRMATION BORING LOCATION
- MPD-2 2007 – 2009 OU2 SEDIMENT MONITORING PROGRAM LOCATION
- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- APPROXIMATE PROPERTY LINE (SEE NOTE 7)
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE 6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE 5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE 8)
- EXTENT OF NAPL IN SEDIMENTS
- COAL, TAR, NAPL, AND/OR BLEBS
- STAIN
- SHEEN
- NO VISUAL IMPACTS

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. OU2 IS IDENTIFIED BY NYSDEC AS A PORTION OF THE HUDSON RIVER ADJACENT TO THE SITE INCLUDING SEDIMENTS IN EMBAYMENTS #2, #3, AND #4.
3. SEDIMENT SAMPLE LOCATIONS WERE SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
4. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION NORTHEAST OF LOT 10 WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLEVISION, INC., CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
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8. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEET PILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN–PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

EXISTING SITE CONDITIONS - EXTENT OF NAPL IN SEDIMENTS

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FIGURE
2-1

CITY: SYRACUSE DV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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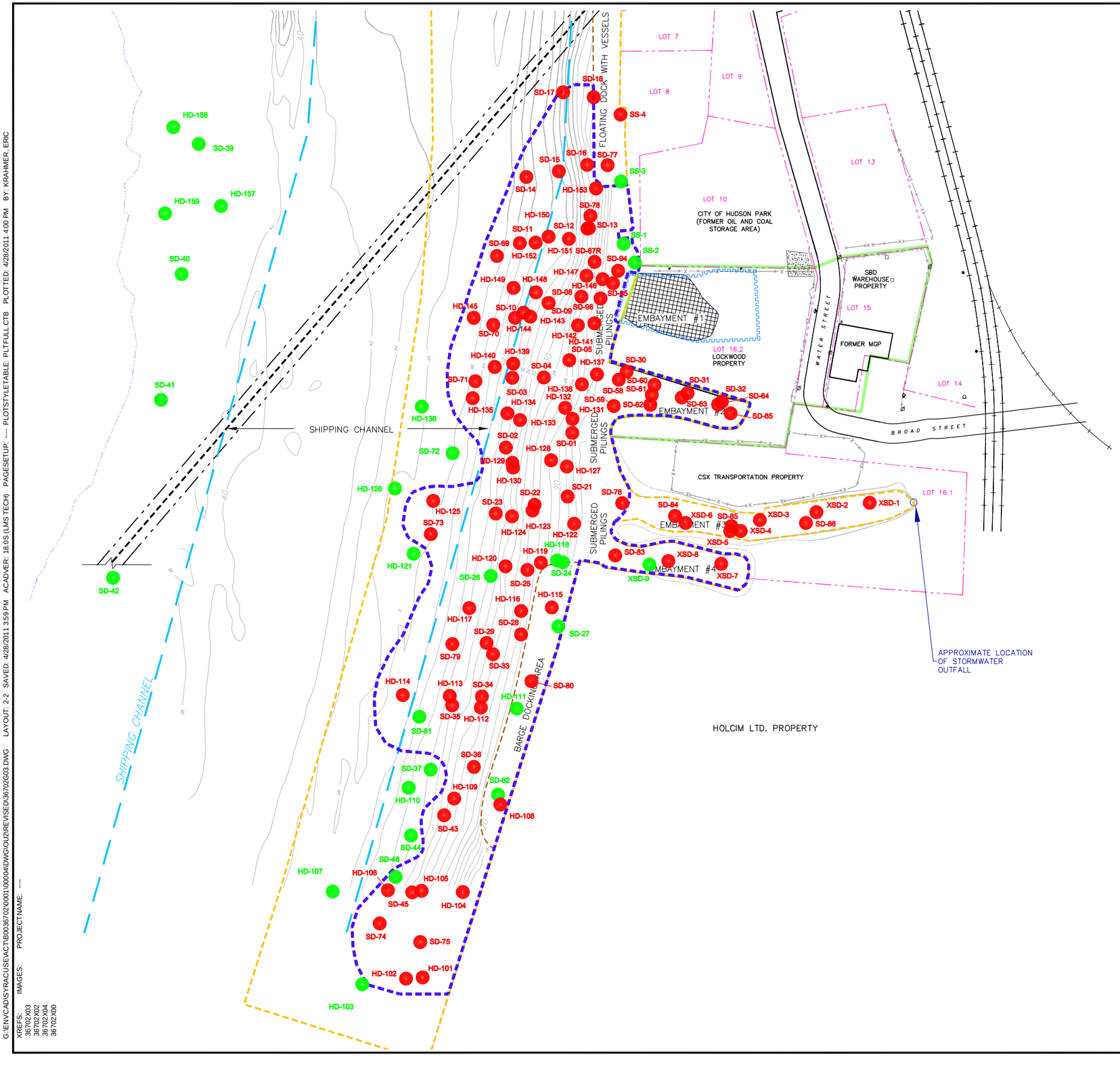

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- APPROXIMATE PROPERTY LINE (SEE NOTE 7)
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE 5)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE 4)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE 8)
- AREA CONTAINING PAHs > 4 mg/kg (SEE NOTE 6)
- PAH CONCENTRATION > 4 mg/kg (SUM OF THE 16 PRIORITY POLLUTANT PAHs)
- PAH CONCENTRATION < 4 mg/kg (SUM OF THE 16 PRIORITY POLLUTANT PAHs)

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. SEDIMENT SAMPLE LOCATIONS WERE SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION NORTHEAST OF LOT 10 WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLEVISION, INC., CATSKILL, NEW YORK.
5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
6. PAH RESULTS SHOWN ARE A COMPILATION OF DATA COLLECTED IN 1996, 1998, 2000, 2001, 2002, 2007, AND 2009. ALTHOUGH PAHs WERE DETECTED ABOVE 4 mg/kg IN EMBAYMENT #3, THEY WERE DETERMINED NOT TO BE SITE RELATED AS DESCRIBED IN THE CSIR.
7. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
8. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEET PILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN–PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

EXISTING SITE CONDITIONS - SEDIMENTS CONTAINING PAHs > 4 mg/kg

ARCADIS

FIGURE
2-2

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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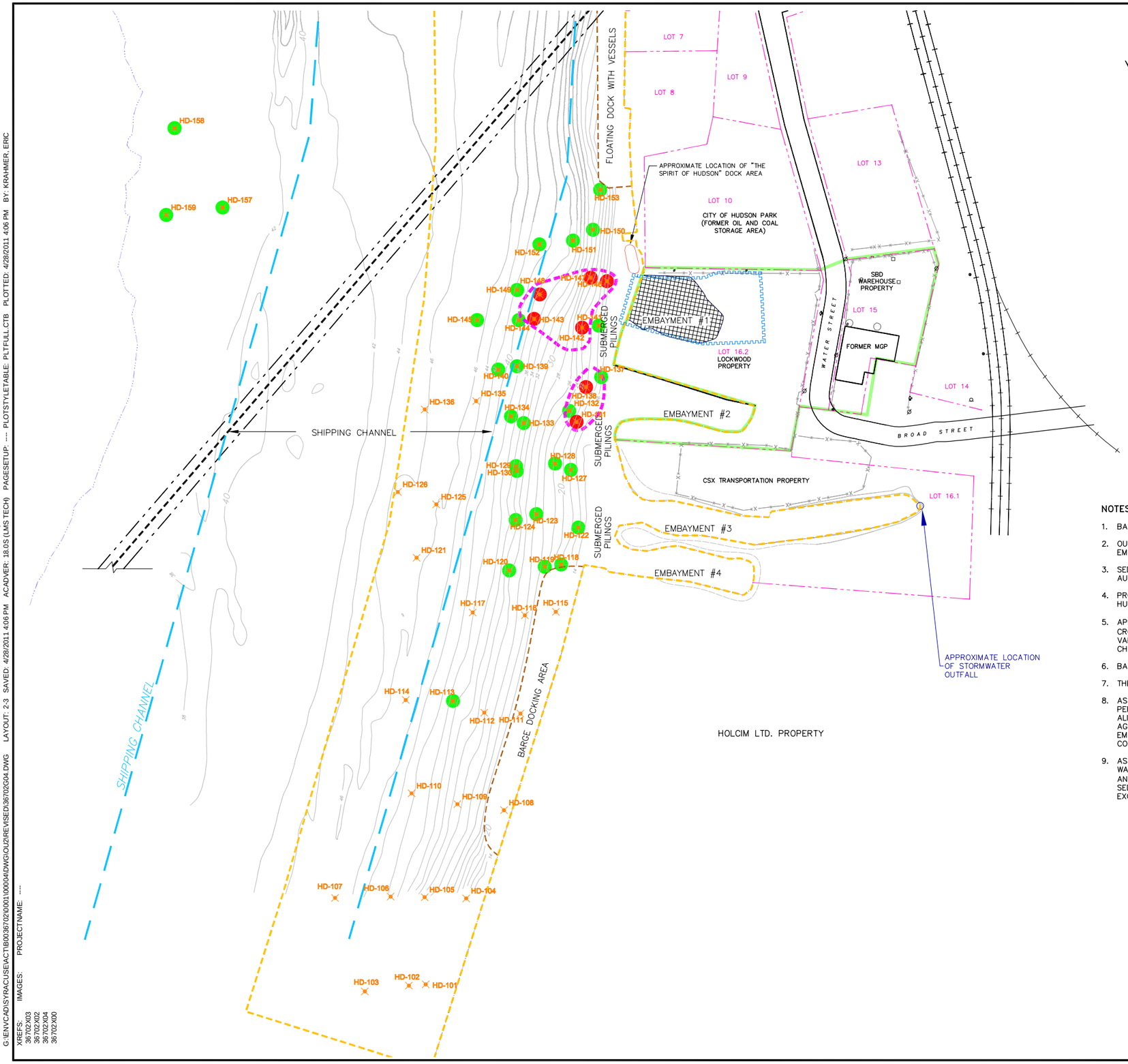

LEGEND:

- HD-132 — BIOAVAILABILITY STUDY SAMPLING LOCATION
- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- APPROXIMATE PROPERTY LINE (SEE NOTE 7)
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE 6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE 5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE 8)
- AREA OF POTENTIAL SEDIMENT TOXICITY (SEE NOTE 9)
- 2009 SEDIMENT TOXICITY TEST RESULTS (H. AZTECA) SIGNIFICANTLY REDUCED SURVIVAL (SEE NOTE 9)
- 2009 SEDIMENT TOXICITY TEST RESULTS (H. AZTECA) SURVIVAL NOT IMPACTED (SEE NOTE 9)

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. OU2 IS IDENTIFIED BY NYSDEC AS A PORTION OF THE HUDSON RIVER ADJACENT TO THE SITE INCLUDING SEDIMENTS IN EMBAYMENTS #2, #3, AND #4.
3. SEDIMENT SAMPLE LOCATIONS WERE SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
4. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION NORTHEAST OF LOT 10 WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLEVISION, INC., CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
8. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEET PILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN–PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.
9. AS DESCRIBED IN THE COMPREHENSIVE SEDIMENT INVESTIGATION REPORT, THE AREA OF POTENTIAL SEDIMENT TOXICITY WAS DETERMINED USING A WEIGHT OF EVIDENCE ASSESSMENT CONSISTING OF SEDIMENT CHEMISTRY, TOXICITY TESTING, AND BENTHIC MACROINVERTEBRATE SURVEY (I.E., SEDIMENT QUALITY TRIAD ASSESSMENT). THE AREA OF POTENTIAL SEDIMENT TOXICITY CORRESPONDS TO BOTH SOLID PHASE MICRO EXTRACTION PORE WATER TU34 CONCENTRATIONS THAT EXCEED 5.4 TOXIC UNITS AND SIGNIFICANT REDUCTION IN H. AZTECA SURVIVAL.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

EXISTING SITE CONDITIONS - AREAS OF POTENTIAL SEDIMENT TOXICITY

ARCADIS

FIGURE
2-3

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=REF*
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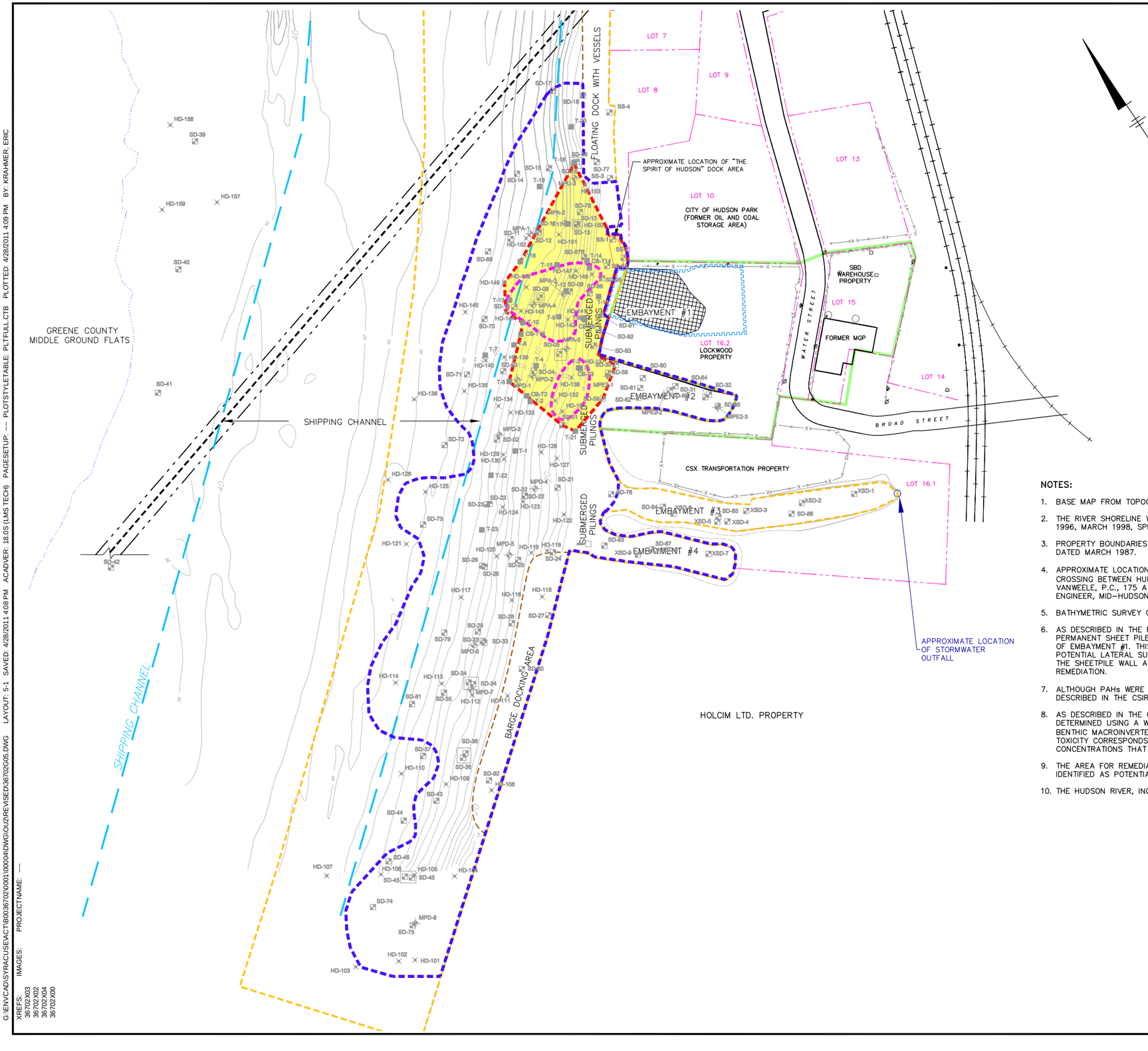

LEGEND:

- SD-21 — SEDIMENT SAMPLE AND/OR CORE LOCATION
- BBM — BENTHIC SURVEY SAMPLE LOCATION
- HD-132 — BIOAVAILABILITY STUDY SAMPLING LOCATION
- T-2 — TARGOST AND/OR TARGOST CONFIRMATION BORING LOCATION
- MPD-2 — MONITORING PROGRAM LOCATION
- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE 10)
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE 5)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE 4)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE 6)
- AREA CONTAINING PAHs > 4 mg/kg (SEE NOTE 7)
- AREA OF POTENTIAL SEDIMENT TOXICITY (SEE NOTE 8)
- AREA FOR REMEDIAL CONSIDERATION (SEE NOTE 9)

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLEVISION, INC., CATSKILL, NEW YORK.
5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
6. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEET PILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN–PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.
7. ALTHOUGH PAHs WERE DETECTED ABOVE 4 mg/kg IN EMBAYMENT #3, THEY WERE DETERMINED NOT TO BE SITE RELATED AS DESCRIBED IN THE CSIR.
8. AS DESCRIBED IN THE COMPREHENSIVE SEDIMENT INVESTIGATION REPORT, THE AREA OF POTENTIAL SEDIMENT TOXICITY WAS DETERMINED USING A WEIGHT OF EVIDENCE ASSESSMENT CONSISTING OF SEDIMENT CHEMISTRY, TOXICITY TESTING, AND BENTHIC MACROINVERTEBRATE SURVEY (IE., SEDIMENT QUALITY TRIAD ASSESSMENT). THE AREA OF POTENTIAL SEDIMENT TOXICITY CORRESPONDS TO SAMPLE LOCATIONS WITH BOTH SOLID PHASE MICRO EXTRACTION PORE WATER TU34 CONCENTRATIONS THAT EXCEED 5.4 TOXIC UNITS AND SIGNIFICANT REDUCTION IN H. AZTECA SURVIVAL.
9. THE AREA FOR REMEDIAL CONSIDERATION CORRESPONDS TO THE SITE SEDIMENTS CONTAINING NAPL AND SEDIMENTS IDENTIFIED AS POTENTIALLY BEING TOXIC TO BENTHIC MACROINVERTEBRATES.
10. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

AREA FOR REMEDIAL CONSIDERATION

ARCADIS

FIGURE
5-1

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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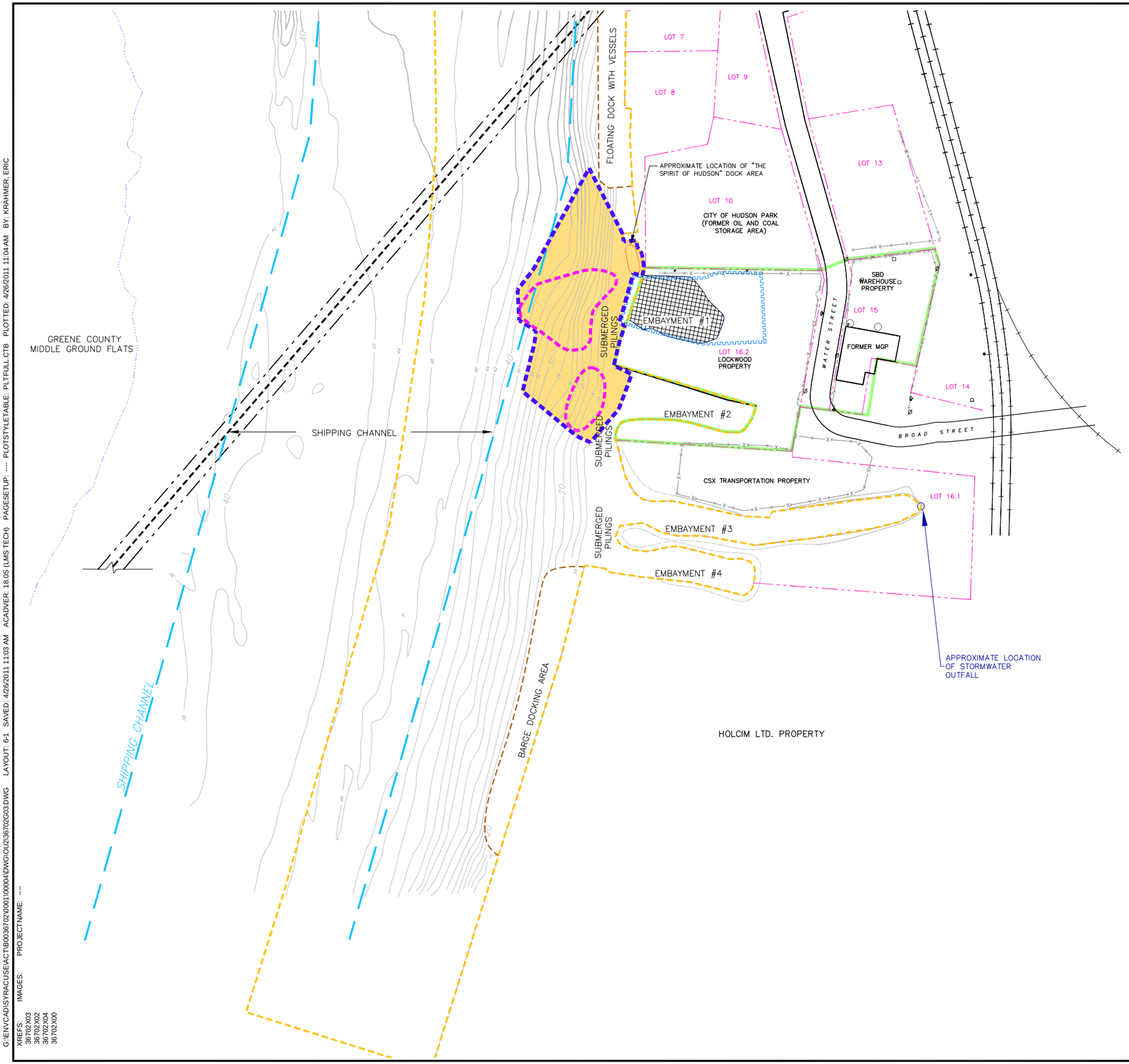

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS–BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO MONITORED NATURAL RECOVERY (MNR) AND INSTITUTIONAL CONTROLS

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLE, CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEETPILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SOUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 2 - MONITORED NATURAL RECOVERY OF SEDIMENTS WITH INSTITUTIONAL CONTROLS

ARCADIS

FIGURE
6-1

CITY: SYRACUSE DV/GROUP: ENVCAD DB: A. SCHILLING, L. FORAKER, E. KRAHMER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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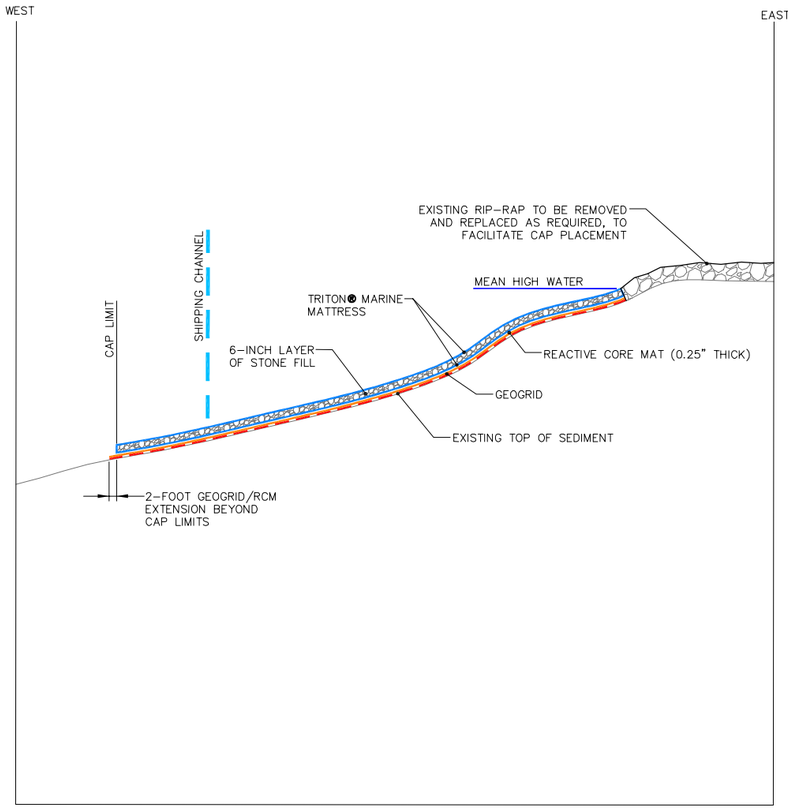

SECTION A-A'

VERTICAL & HORIZONTAL SCALE: 1"=20'±

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY-GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID-HUDSON CABLE, CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEETPILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO CAPPING AND INSTITUTIONAL CONTROLS

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 3 - CAPPING SEDIMENTS WITHIN THE ARC WITH INSTITUTIONAL CONTROLS

ARCADIS

FIGURE
6-2

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: A. SCHILLING, L. FORAKER, E. KRAHMER PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*;OFF=*REF*
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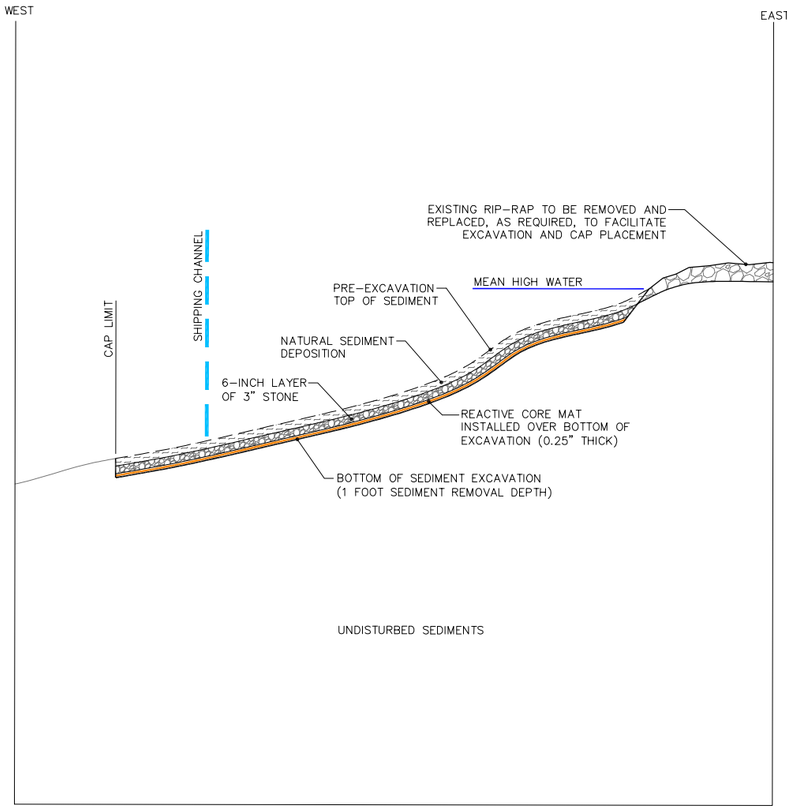
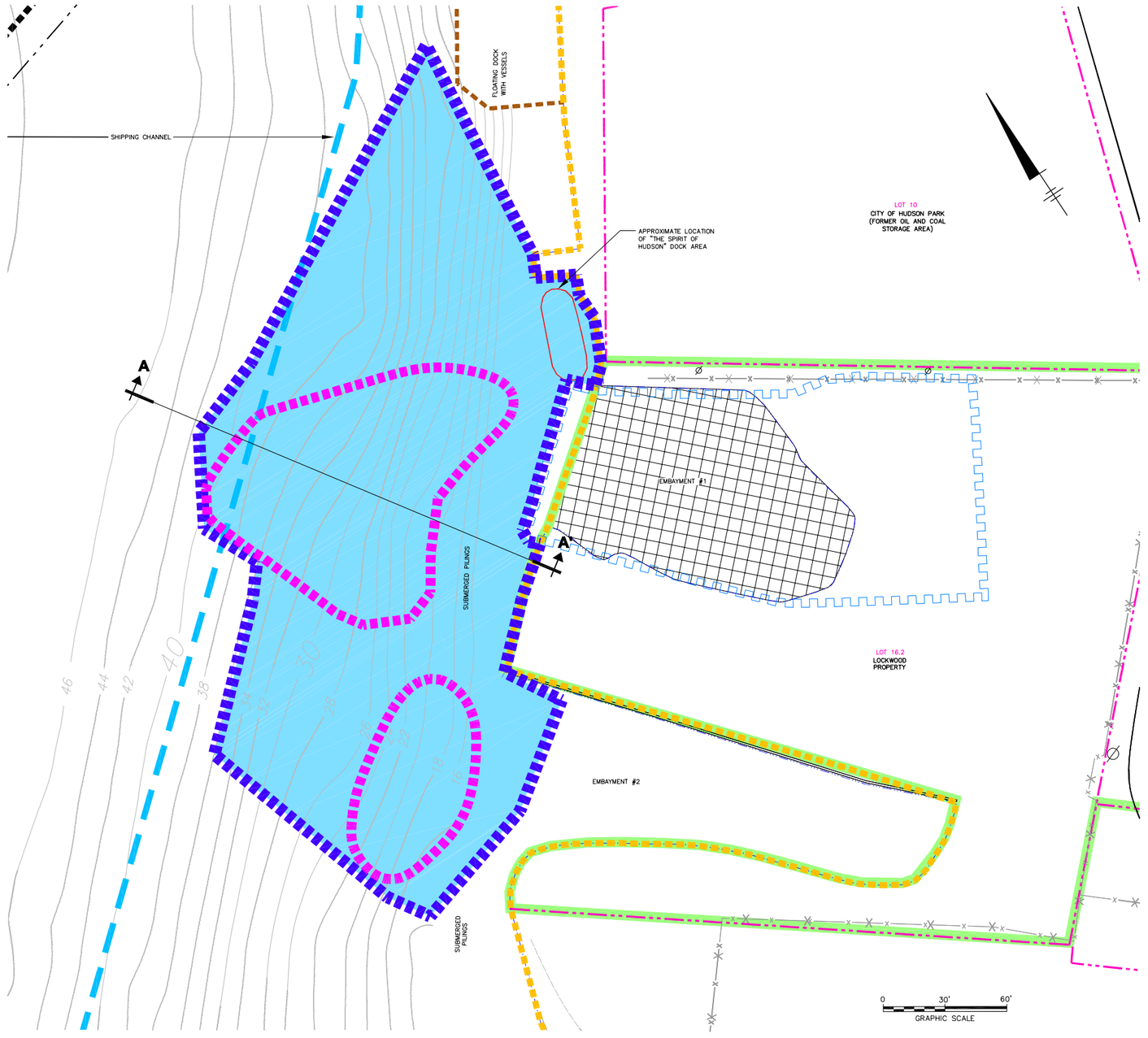


SECTION A-A'

HORIZONTAL SCALE: 1"=20'±



NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY-GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID-HUDSON CABLE, CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEETPILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO DREDGING AND CAPPING

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 4 - EXCAVATION OF SEDIMENTS WITHIN THE ARC TO A DEPTH OF 1-FOOT WITH TREATMENT/DISPOSAL OF EXCAVATED SEDIMENTS, CAPPING OF EXCAVATED AREA, AND INSTITUTIONAL CONTROLS

ARCADIS

FIGURE **6-3**

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*; OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0036702\0001\000004\DWG\OU2\CROSS-SECTIONS\36702V05.DWG LAYOUT: 6-3 SAVED: 4/26/2011 2:01 PM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/28/2011 11:54 AM BY: KRAHMER, ERIC
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REMOVED SEDIMENT

HD-146
SD-96
HD-141
T14
HD-138
HD-131
HD-150
HD-147
SD-08
HD-142
MPA-5
MPA-3 (2007)
MPA-2 (2008)
SD-87R
MPA-3 (2008)
MPA-2 (2009)
MPD-2
MPA-4 (2008)
MPA-1
MPA-4 (2009)
HD-148
HD-143
MPD-1
T13

REMAINING NAPL AND PAH-CONTAINING SEDIMENT

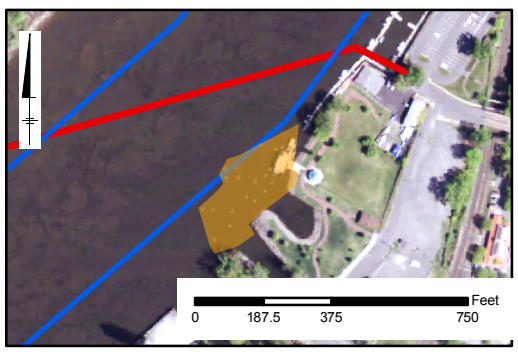
SD-94
SD-95
SD-77
CB-T14
SD-96
T11
SD-58
SD-31
MPU-3
SD-87R
SD-61
SD-65
SD-78
MPE2-1
SD-16
T14
T8
SD-13
CB-T14
SD-08
T3
SD-62
SD-63
MPA-3
SD-30
T14
T9
SD-05
T3
SD-01
T15
SD-08
SD-09
SD-04
MPA-4
HD-144
SD-22
SD-70

NOTES:
1. THE REMAINING NAPL AND PAH-CONTAINING SEDIMENT WOULD BE CAPPED WITH 0.25 INCH REACTIVE CORE MAT OVERLAIN BY 6-INCHES OF D50 3-INCH STONE

LEGEND

SEDIMENT OBSERVATIONS
- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

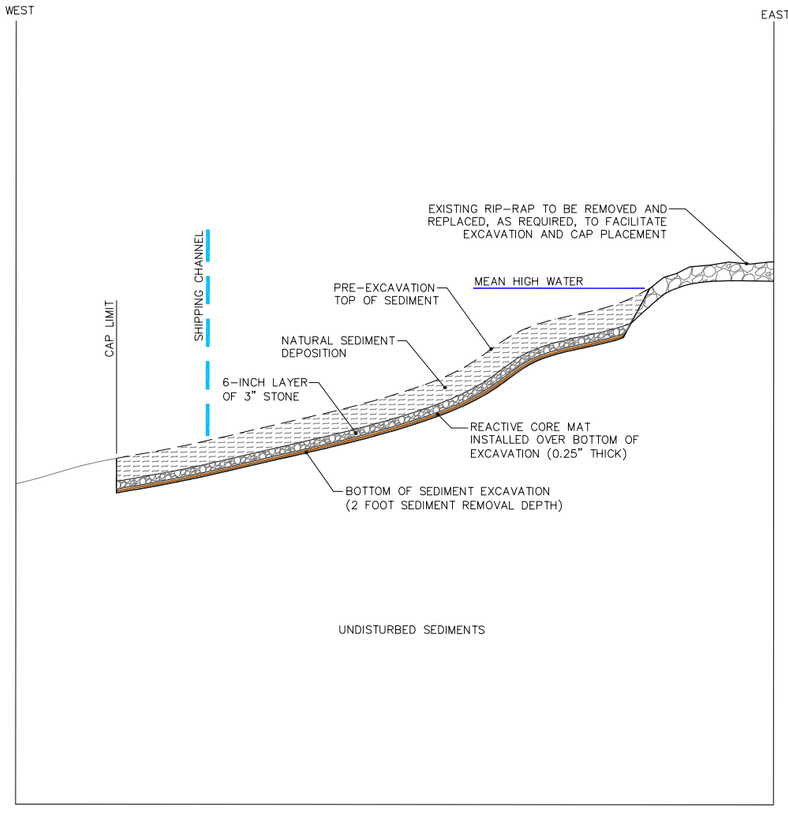


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 7 - 3-DIMENSIONAL VIEW ILLUSTRATING EXTENT OF NAPL-CONTAINING SEDIMENTS TO BE REMOVED

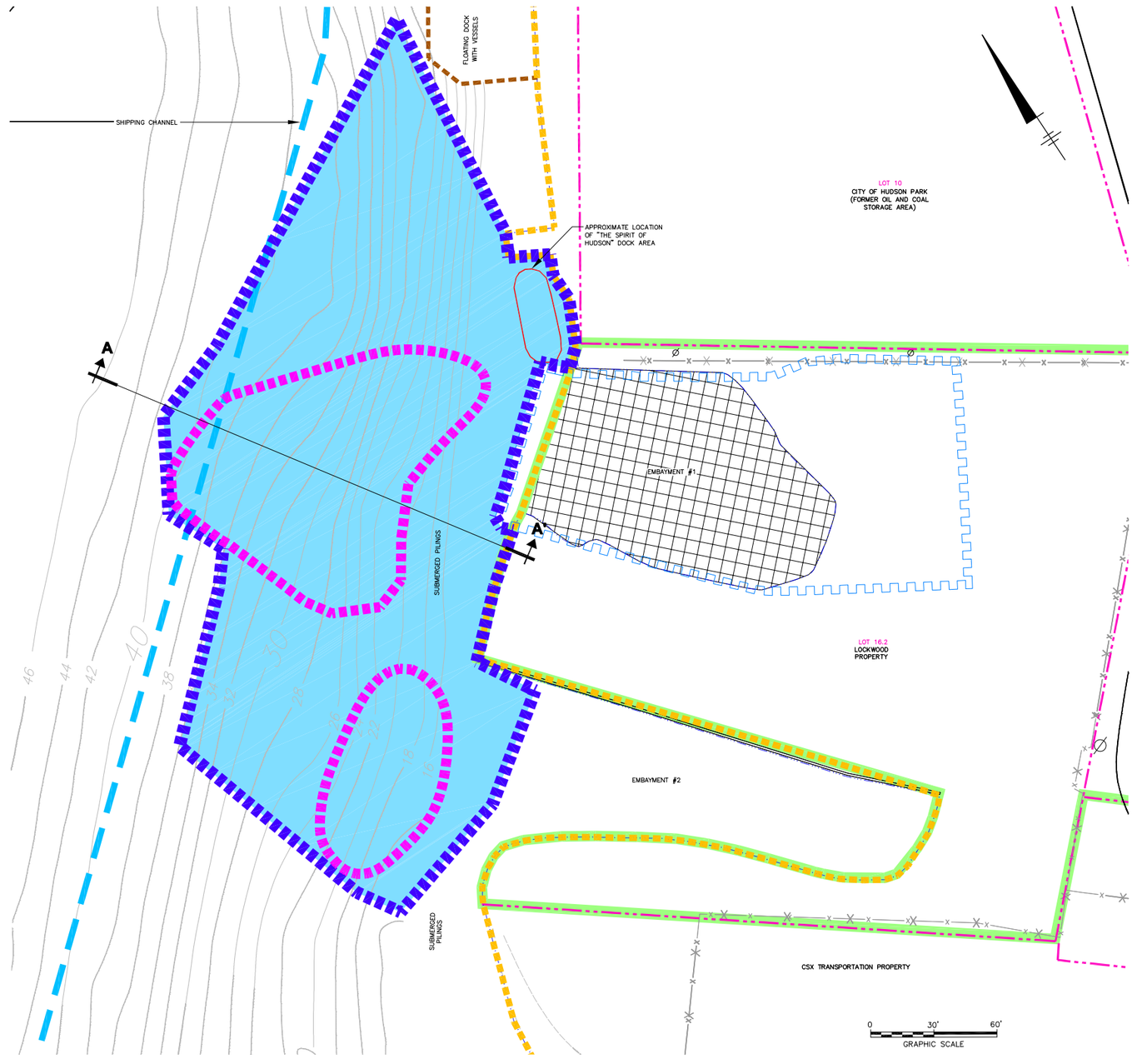
ARCADIS

FIGURE 6-3a



SECTION A-A'

HORIZONTAL SCALE: 1"=20'±



NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY-GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID-HUDSON CABLE, CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEETPILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT OFF AT THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO DREDGING AND CAPPING

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 5 - EXCAVATION OF SEDIMENTS WITHIN THE ARC TO A DEPTH OF 2-FEET WITH TREATMENT/DISPOSAL OF EXCAVATED SEDIMENTS, CAPPING OF EXCAVATED AREA, AND INSTITUTIONAL CONTROLS

ARCADIS

FIGURE
6-4

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: A.SCHILLING, L. FORAKER, E. KRAHMER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*; OFF=*REF*
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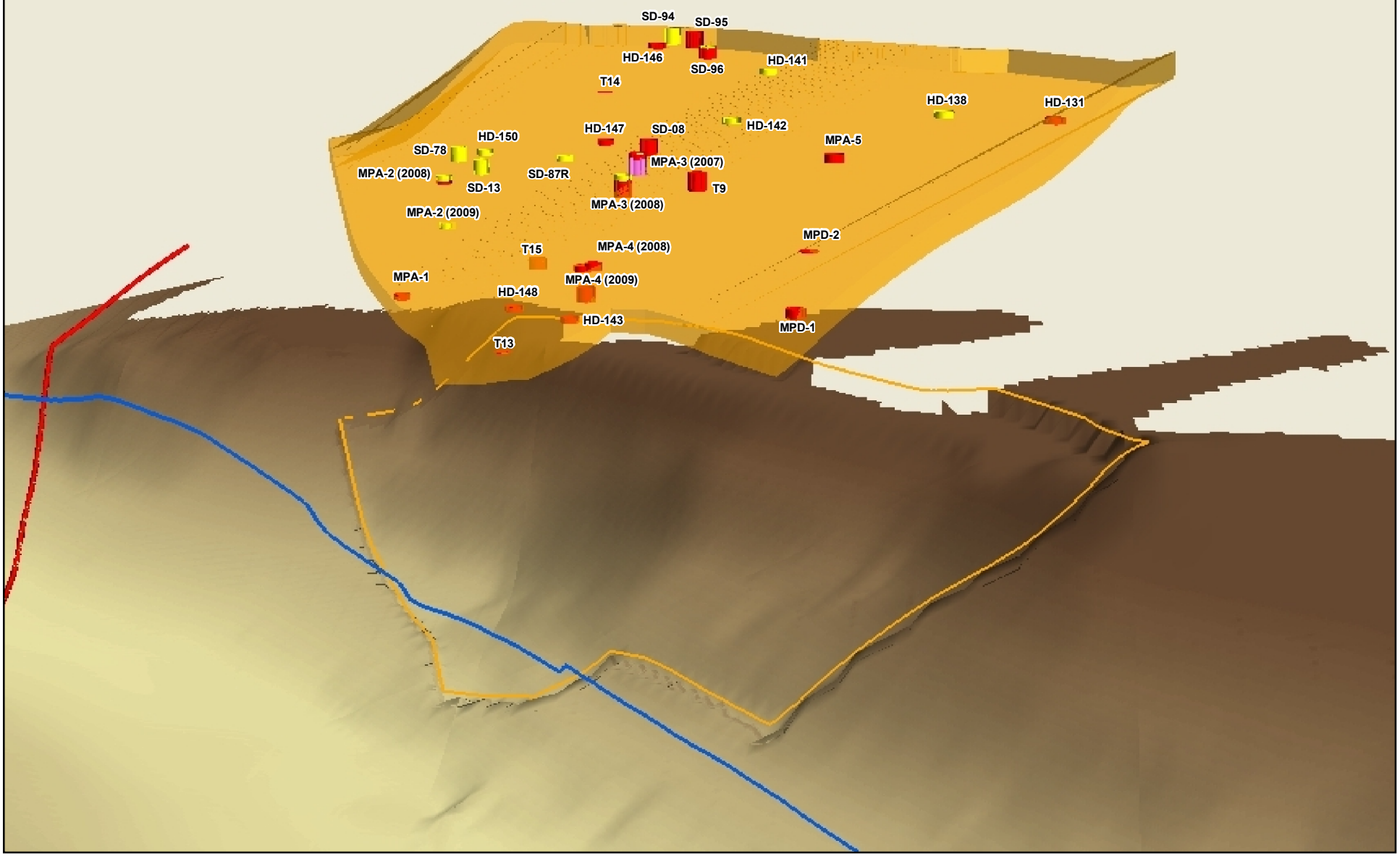
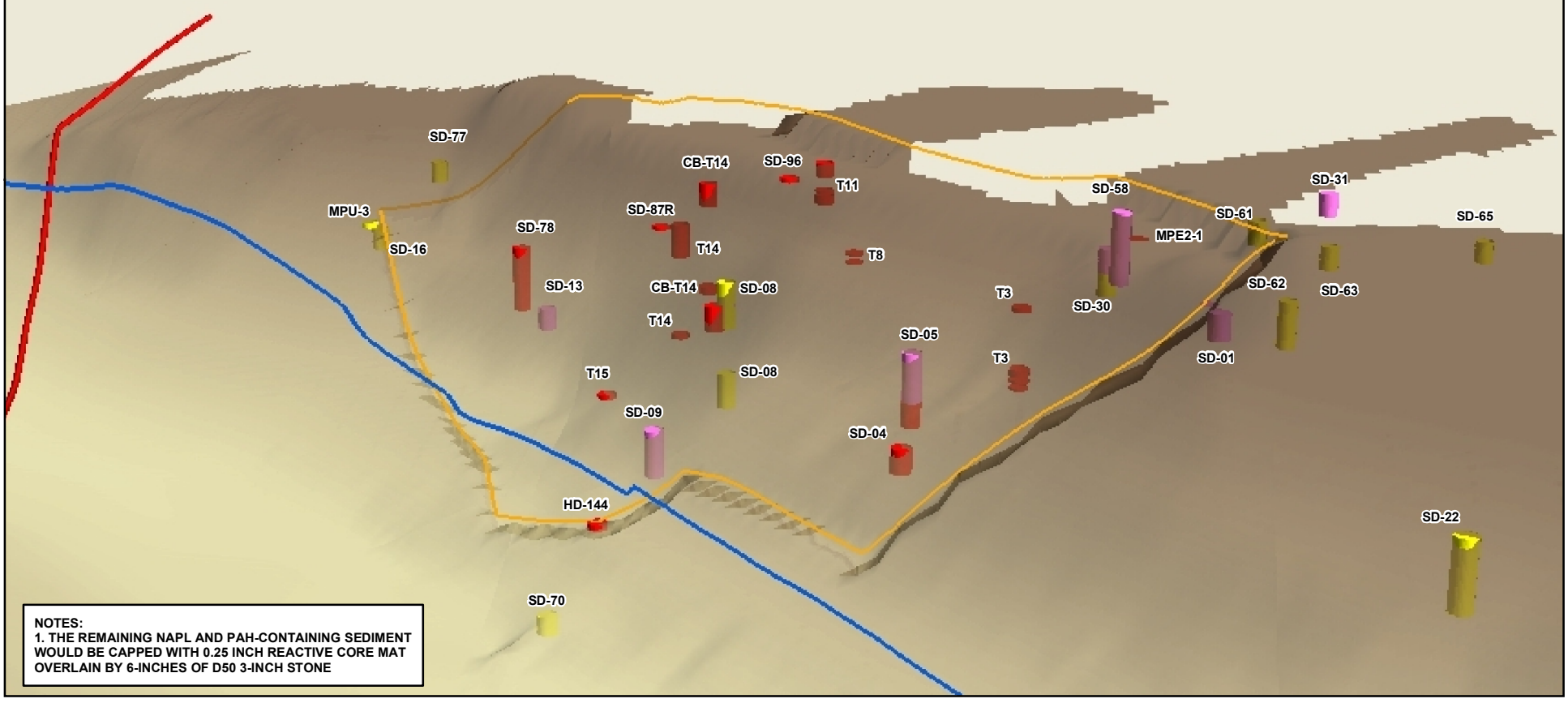
REMOVED SEDIMENT



REMAINING NAPL AND PAH-CONTAINING SEDIMENT

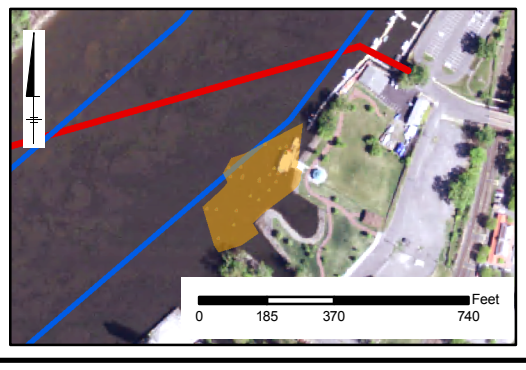


NOTES:
1. THE REMAINING NAPL AND PAH-CONTAINING SEDIMENT WOULD BE CAPPED WITH 0.25 INCH REACTIVE CORE MAT OVERLAIN BY 6-INCHES OF D50 3-INCH STONE

LEGEND

SEDIMENT OBSERVATIONS
- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

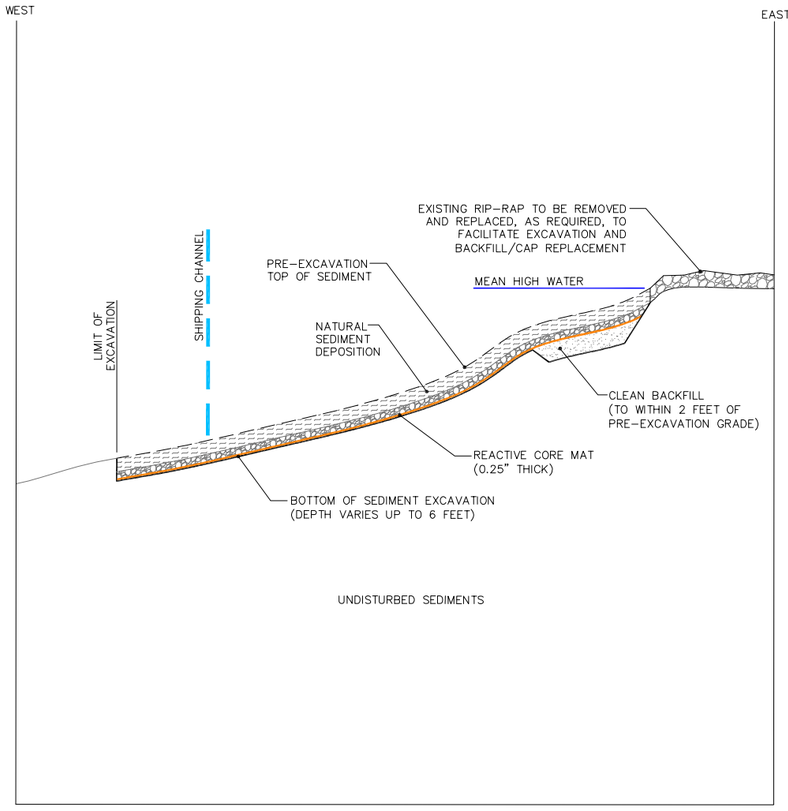


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 4 - 3-DIMENSIONAL VIEW ILLUSTRATING EXTENT OF NAPL-CONTAINING SEDIMENTS TO BE REMOVED

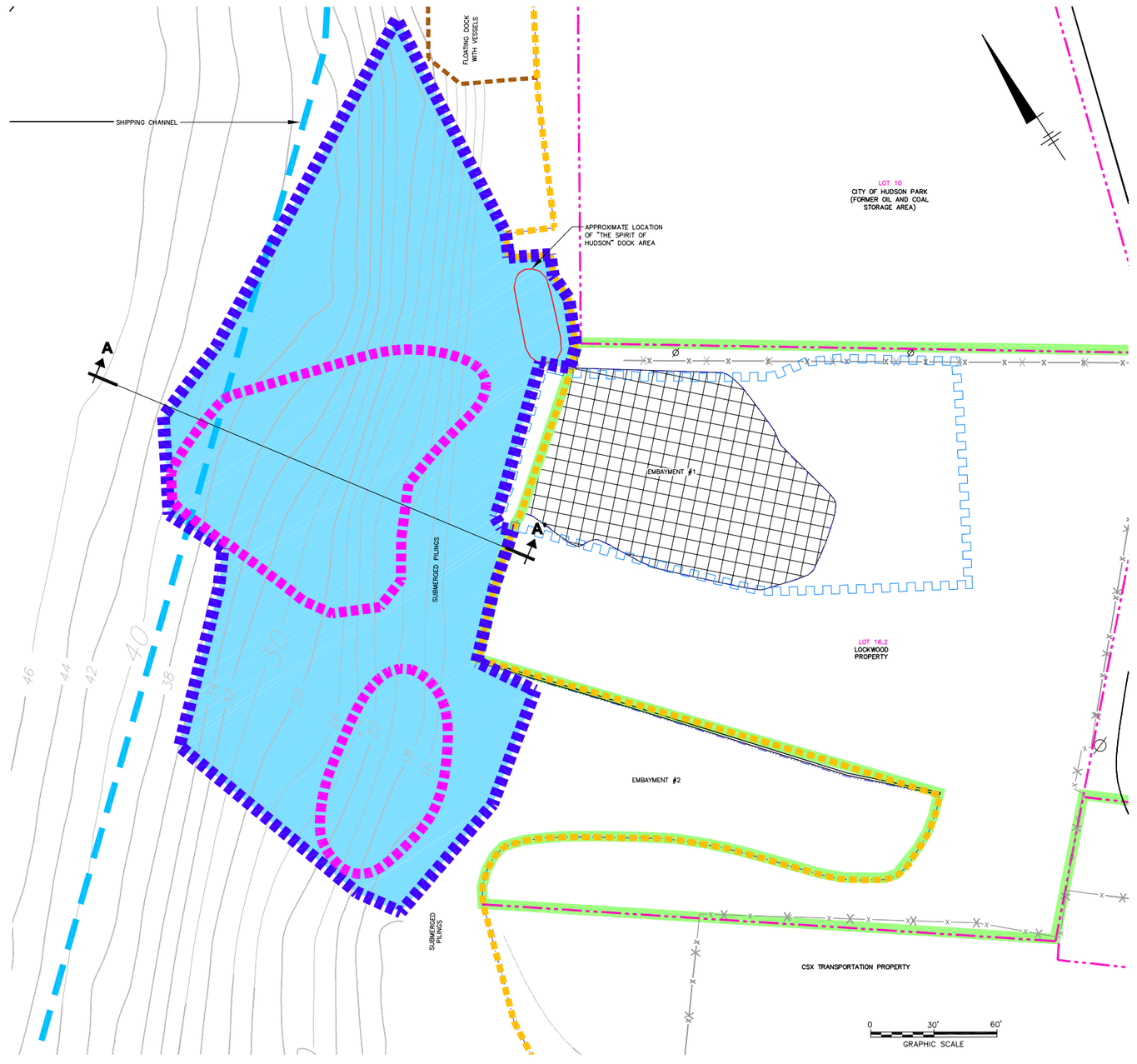
ARCADIS

FIGURE 6-4a



SECTION A-A'

HORIZONTAL SCALE: 1"=20'±



NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
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LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO DREDGING, BACKFILLING, AND CAPPING

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 6 -
EXCAVATION OF SEDIMENTS WITHIN THE ARC TO VARIABLE DEPTHS (UP TO 6-FEET) WITH TREATMENT/DISPOSAL OF EXCAVATED SEDIMENTS, BACKFILL, AND CAPPING OF EXCAVATED AREA, AND INSTITUTIONAL CONTROLS

ARCADIS

FIGURE
6-5

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W.JONES A.SCHILLING E.KRAHMER LD: PIC: J.NUSS PM: A.WEEKS TM: A.WEEKS LYR: ON=*; OFF=*REF*
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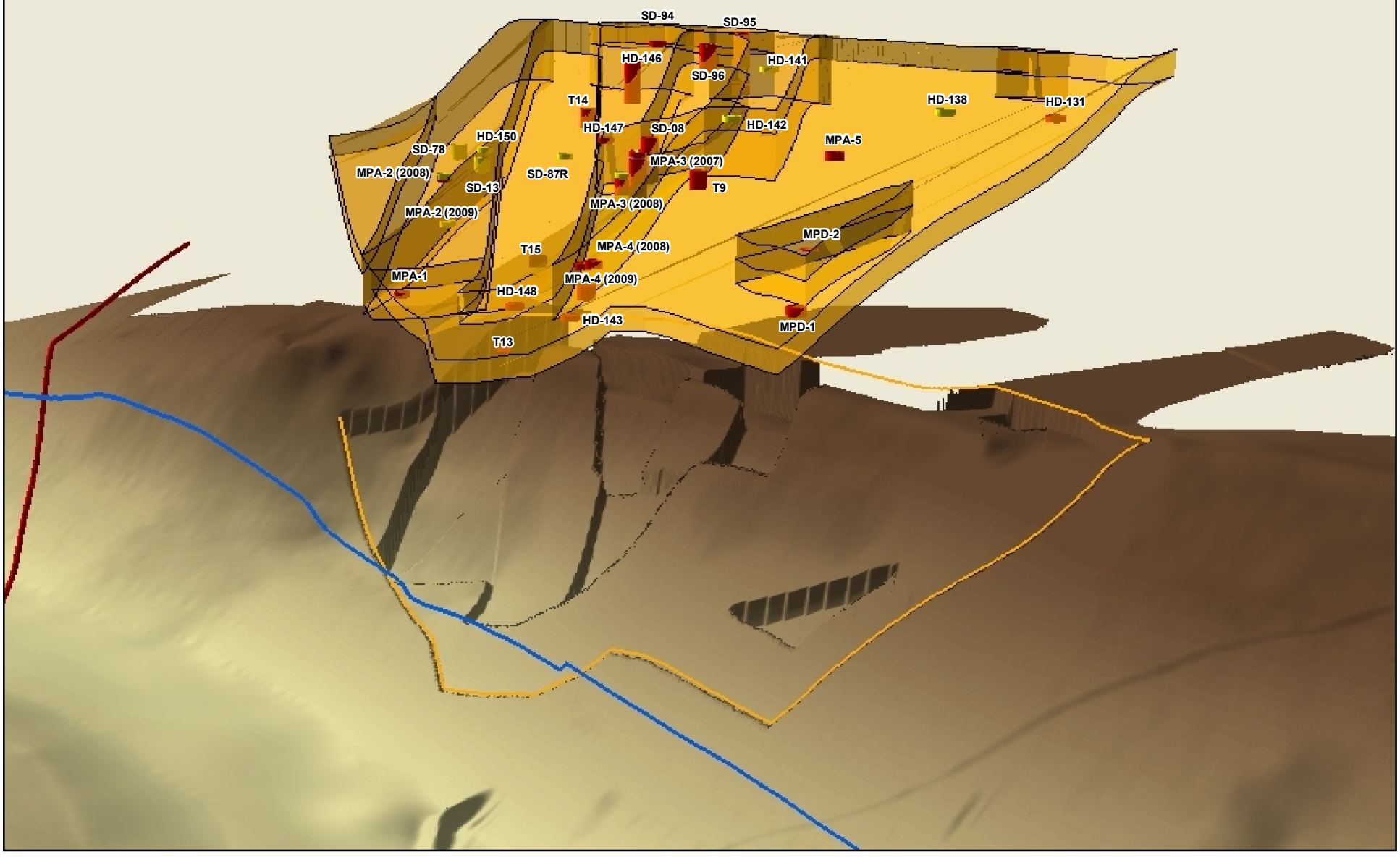
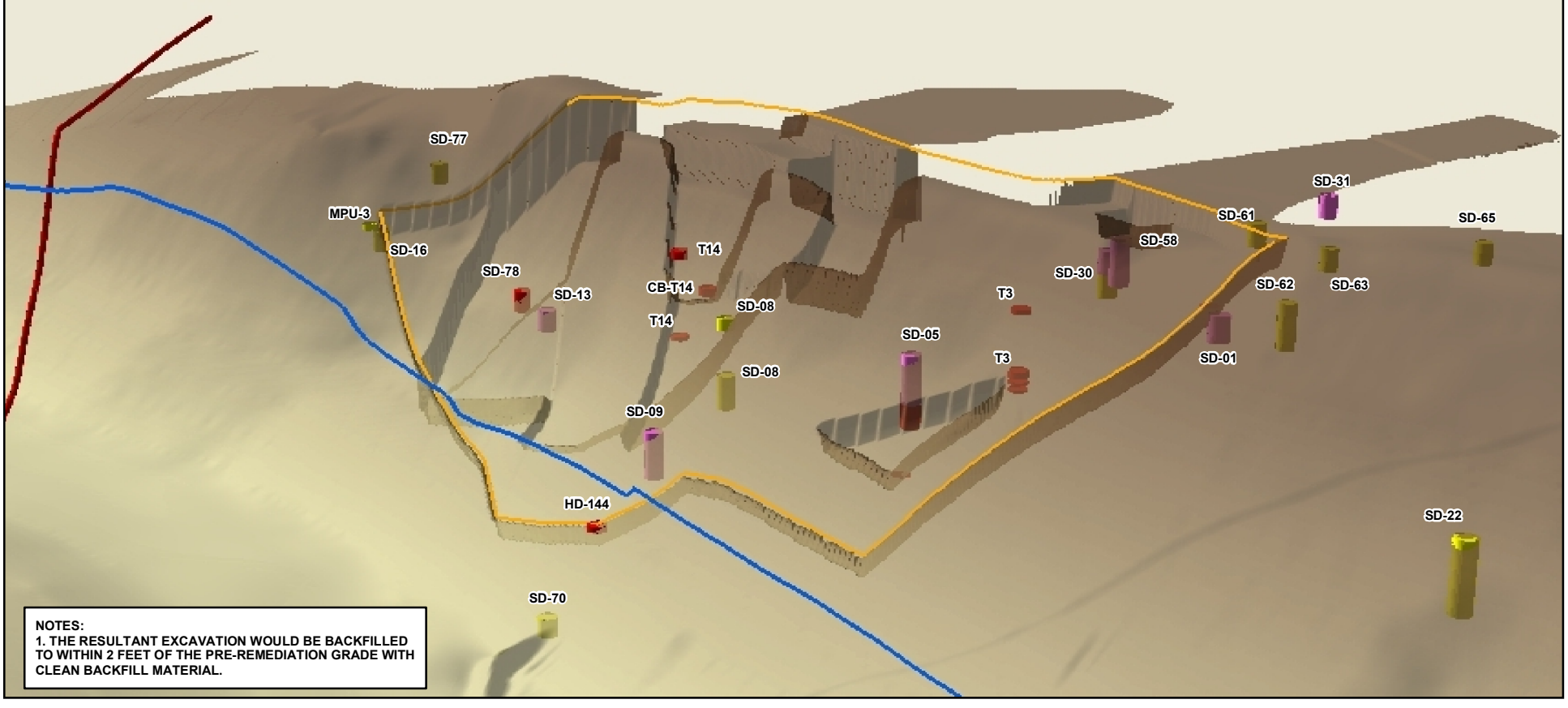


REMAINING NAPL AND PAH-CONTAINING SEDIMENT



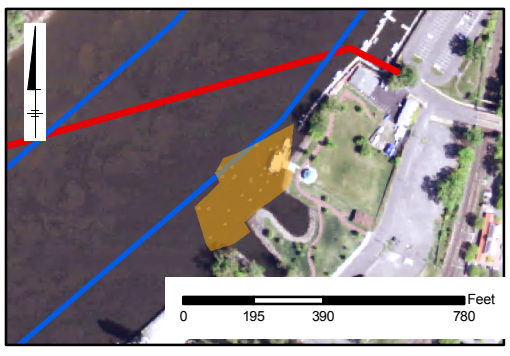
NOTES:
1. THE RESULTANT EXCAVATION WOULD BE BACKFILLED TO WITHIN 2 FEET OF THE PRE-REMEDIATION GRADE WITH CLEAN BACKFILL MATERIAL.

LEGEND

SEDIMENT OBSERVATIONS

- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

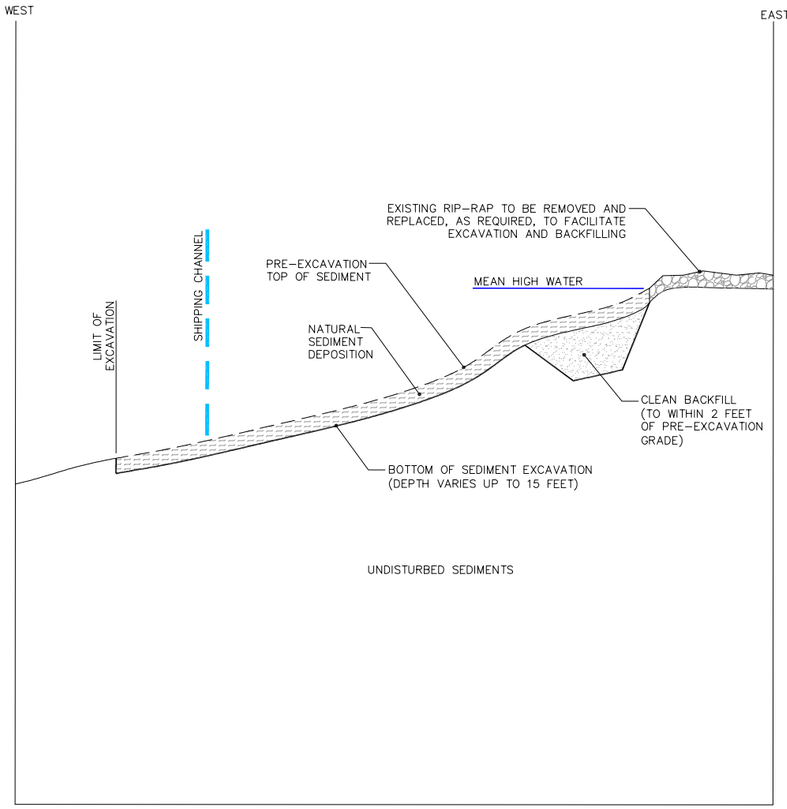


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 5 - 3-DIMENSIONAL VIEW ILLUSTRATING EXTENT OF NAPL-CONTAINING SEDIMENTS TO BE REMOVED

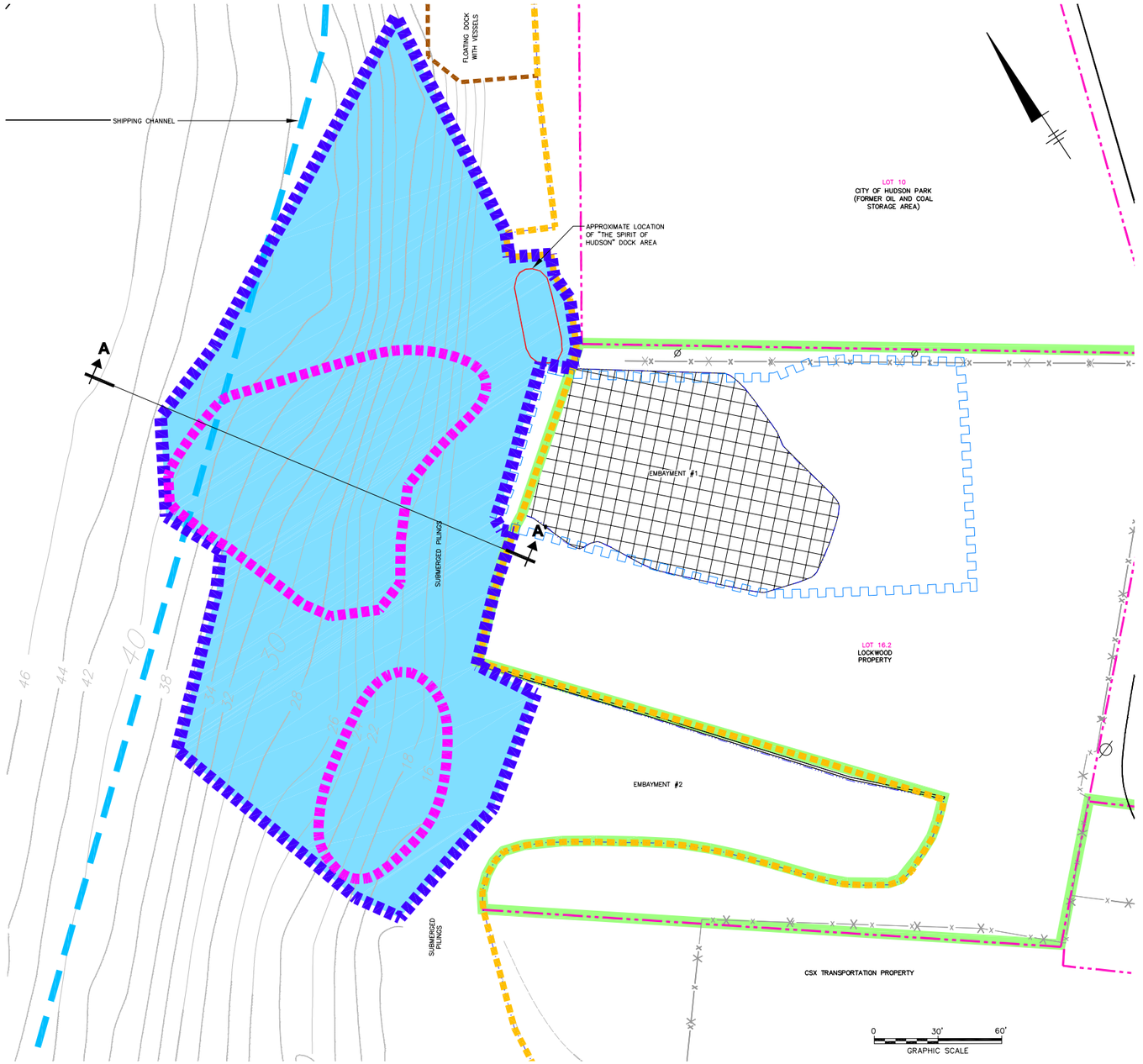
ARCADIS

FIGURE 6-5a



SECTION A-A'

VERTICAL SCALE: 1"=20'±



NOTES:

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6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
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LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO DREDGING AND BACKFILLING

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 7 -
EXCAVATION OF SEDIMENTS WITHIN THE ARC TO FULL DEPTH OF NAPL WITH TREATMENT/DISPOSAL OF EXCAVATED SEDIMENTS AND BACKFILL OF EXCAVATED AREA

ARCADIS

FIGURE
6-6

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING E. KRAHMER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*; OFF=*REF*
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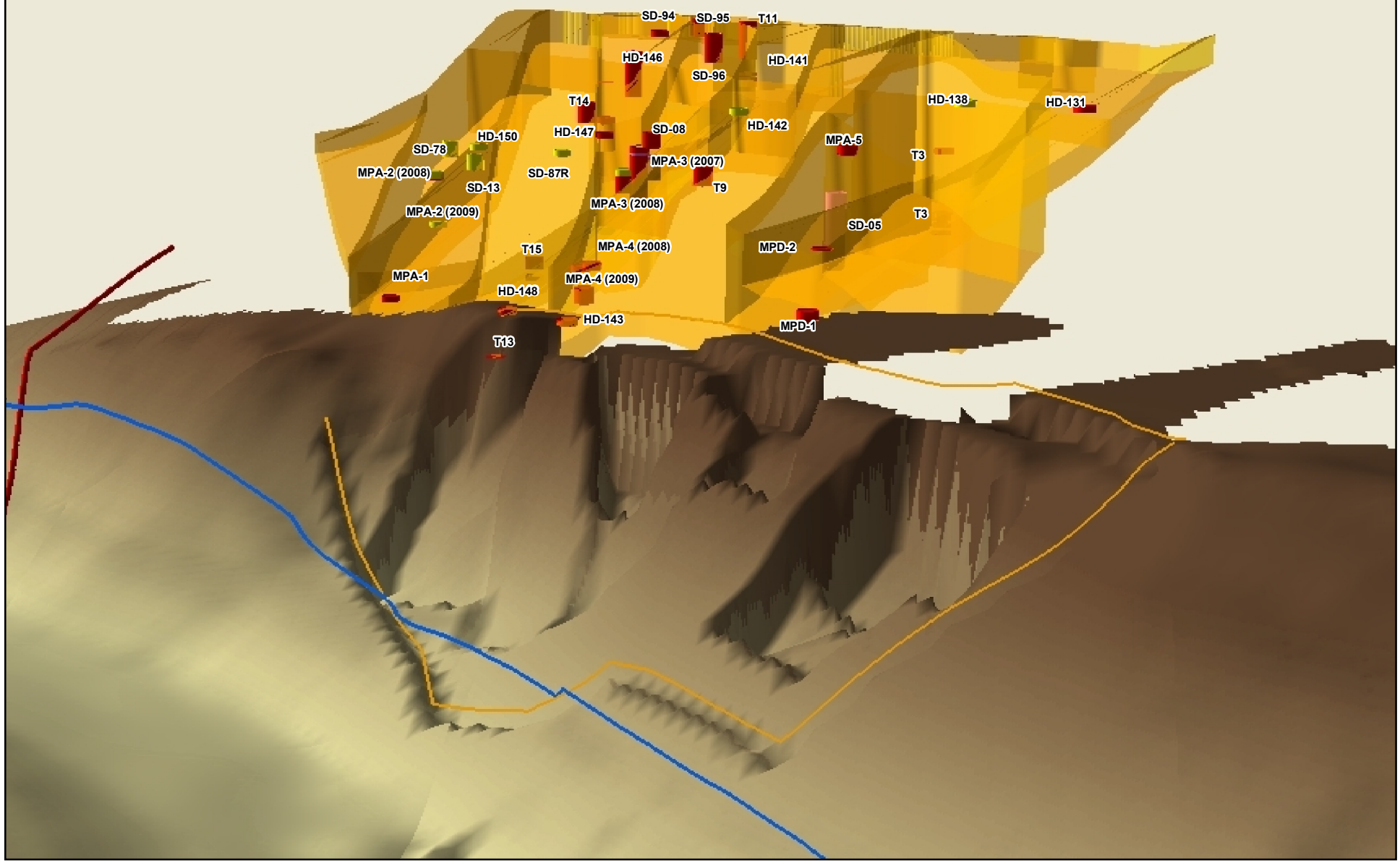
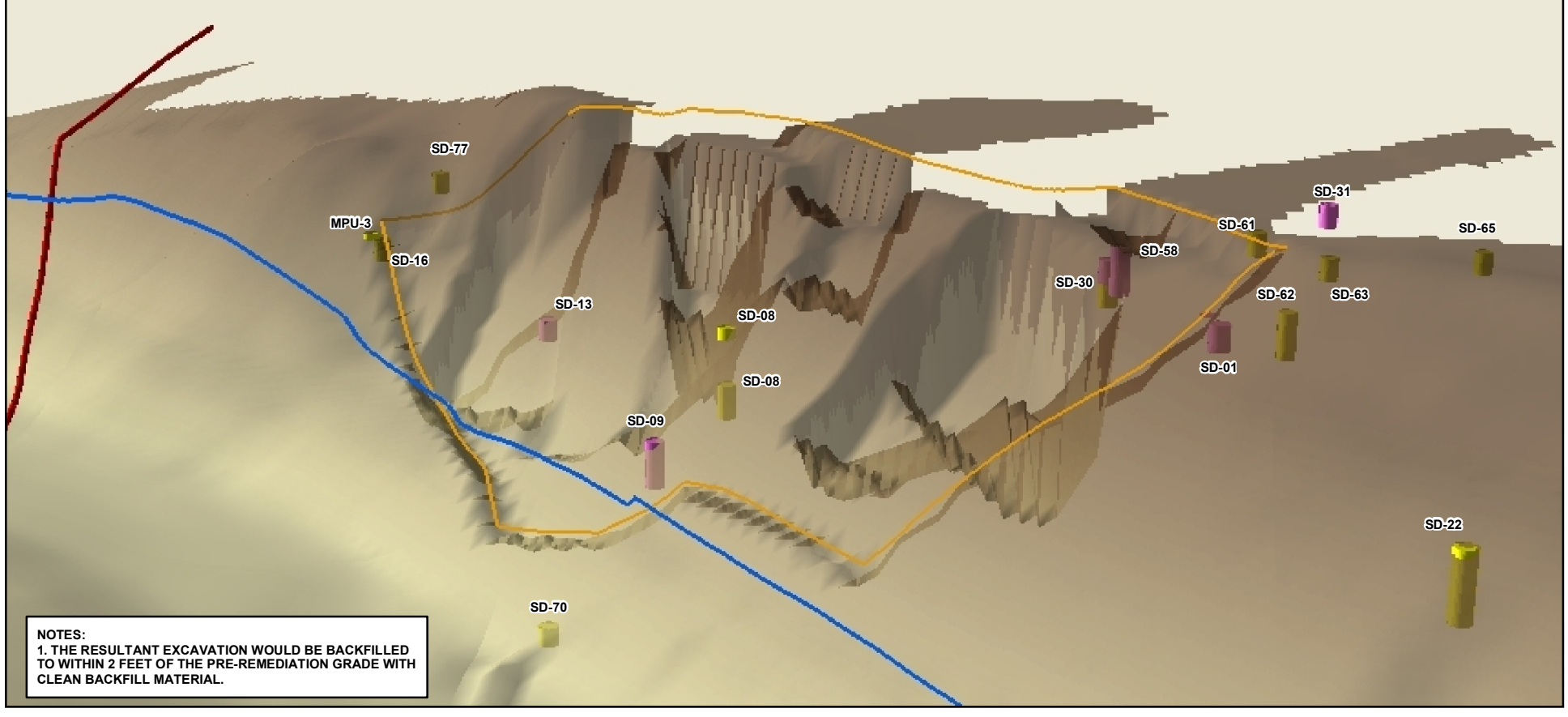
REMOVED SEDIMENT



REMAINING SEDIMENT



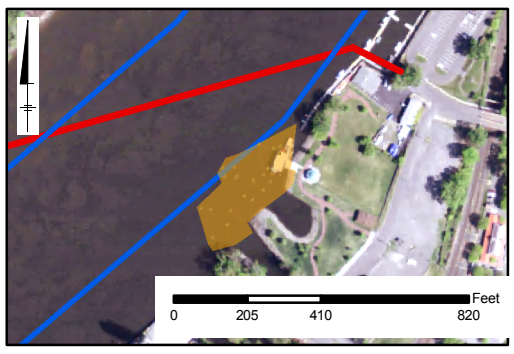
NOTES:
1. THE RESULTANT EXCAVATION WOULD BE BACKFILLED TO WITHIN 2 FEET OF THE PRE-REMEDIATION GRADE WITH CLEAN BACKFILL MATERIAL.

LEGEND

SEDIMENT OBSERVATIONS

- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

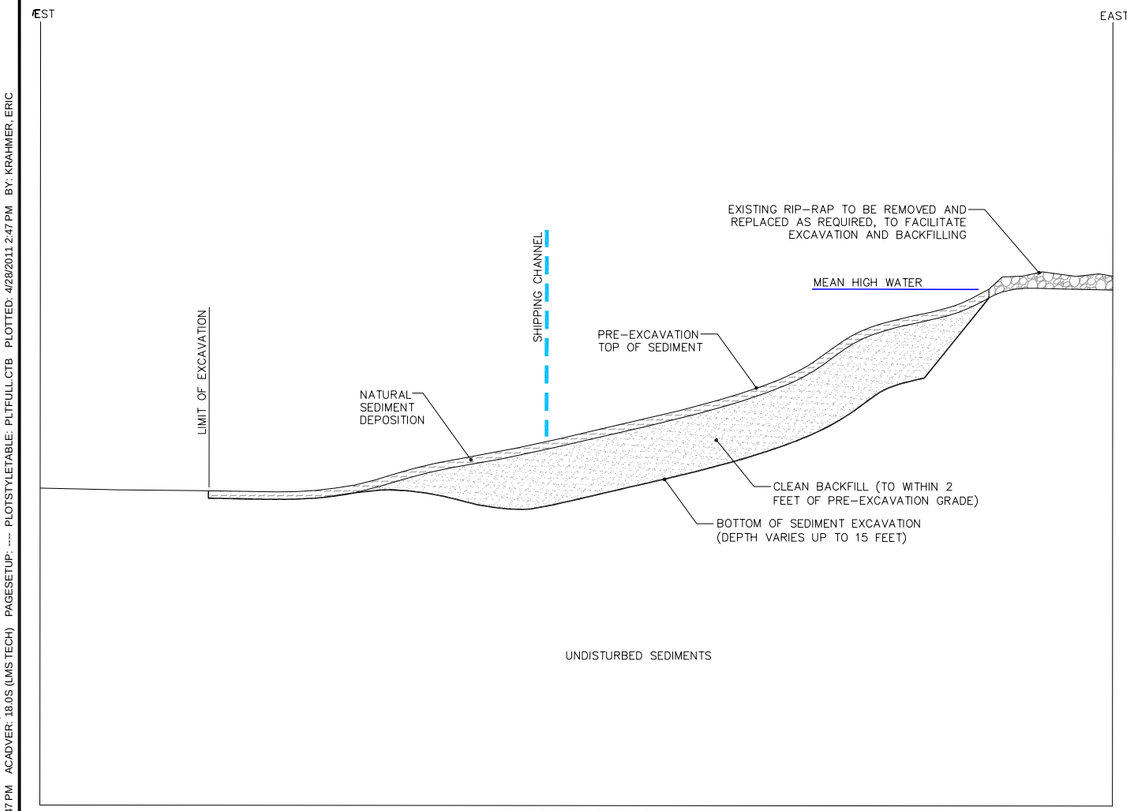


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 6 - 3-DIMENSIONAL VIEW ILLUSTRATING EXTENT OF NAPL-CONTAINING SEDIMENTS TO BE REMOVED

ARCADIS

FIGURE 6-6a



SECTION A-A'

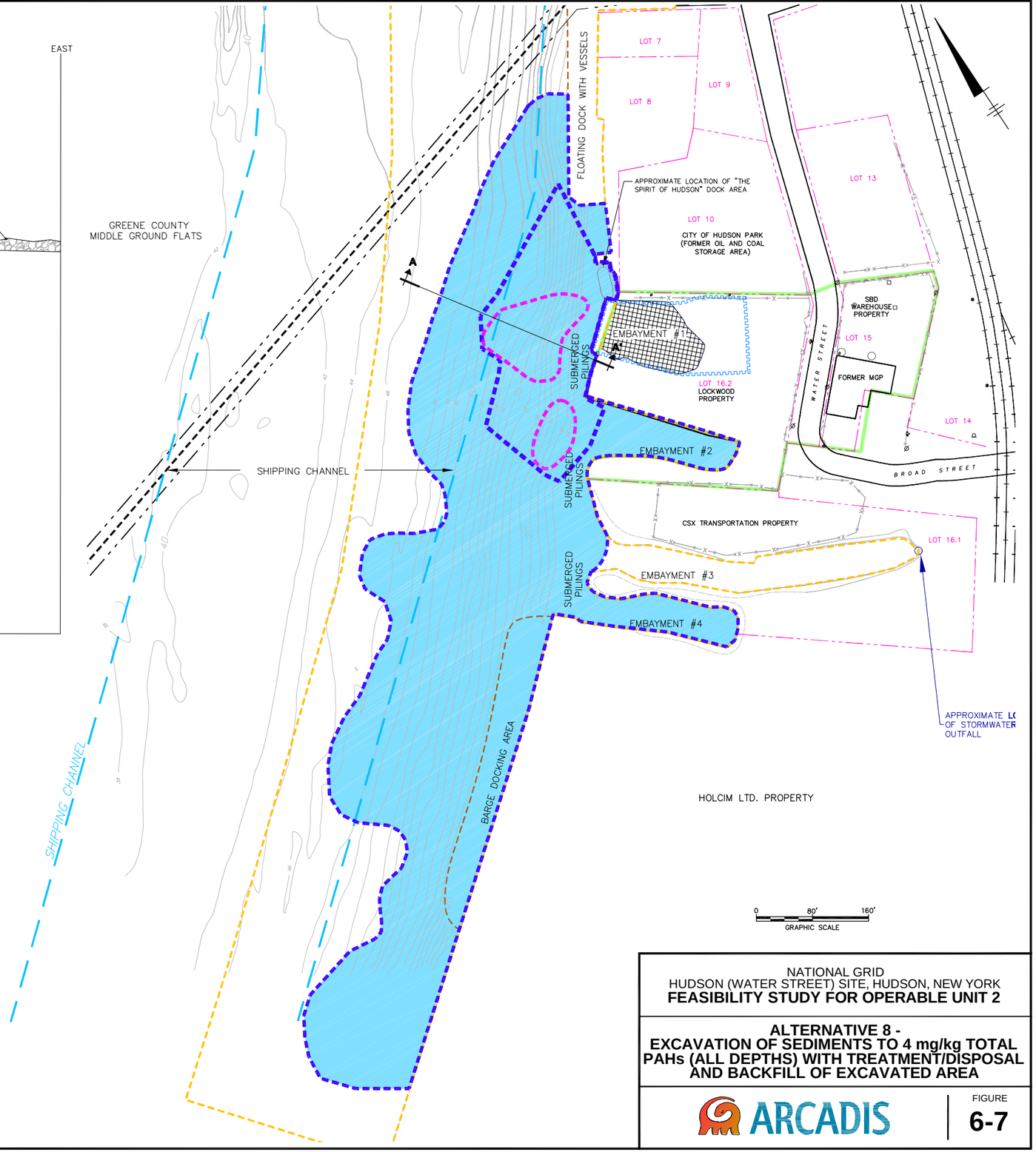
VERTICAL SCALE: 1"=20'±

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY-GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
3. PROPERTY BOUNDARIES AND ADDITIONAL SHORELINE INFORMATION WERE OBTAINED FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
4. THE HUDSON RIVER, INCLUDING THE BED OF THE HUDSON RIVER, IS OWNED BY THE STATE OF NEW YORK.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID-HUDSON CABLE, CATSKILL, NEW YORK.
6. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
7. AS DESCRIBED IN THE FINAL ENGINEERING REPORT – REMEDIAL ACTION IMPLEMENTATION OF OPERABLE UNIT 1, A PERMANENT SHEETPILE WALL WAS INSTALLED AROUND THE SEDIMENT REMOVAL AREA AND ALONG THE WESTERN ALIGNMENT OF EMBAYMENT #1. THIS STEEL SHEET PILE WALL WAS LEFT IN PLACE TO PROVIDE ADDITIONAL PROTECTION AGAINST THE POTENTIAL LATERAL SUBSURFACE MIGRATION OF IMPACTED MATERIAL FROM SURROUNDING PROPERTIES INTO EMBAYMENT #1. THE SHEETPILE WALL AT THE MOUTH OF EMBAYMENT #1 WAS CUT TO THE MUDLINE FOLLOWING COMPLETION OF THE OU1 REMEDIATION.

LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE (SEE NOTE #4)
- CHAIN-LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2-FOOT INTERVAL) (SEE NOTE #6)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT #1 REMEDIATED AREA
- AS-BUILT SHEETPILE (SEE NOTE #7)
- AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO DREDGING AND BACKFILLING



NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 8 - EXCAVATION OF SEDIMENTS TO 4 mg/kg TOTAL PAHs (ALL DEPTHS) WITH TREATMENT/DISPOSAL AND BACKFILL OF EXCAVATED AREA

ARCADIS

FIGURE
6-7

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: W. JONES A. SCHILLING L. FORAKER LD: PIC: J. NUSS PM: A. WEEKS TM: A. WEEKS LYR: ON=*; OFF=*REF*
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36702X02
36702X04
36702X00

CITY:CLE DIV/GROUP:AIT/IM DB:L.GREENE LD: PIC: PM: TM: TR:
Project (Project #)B0036702.0001
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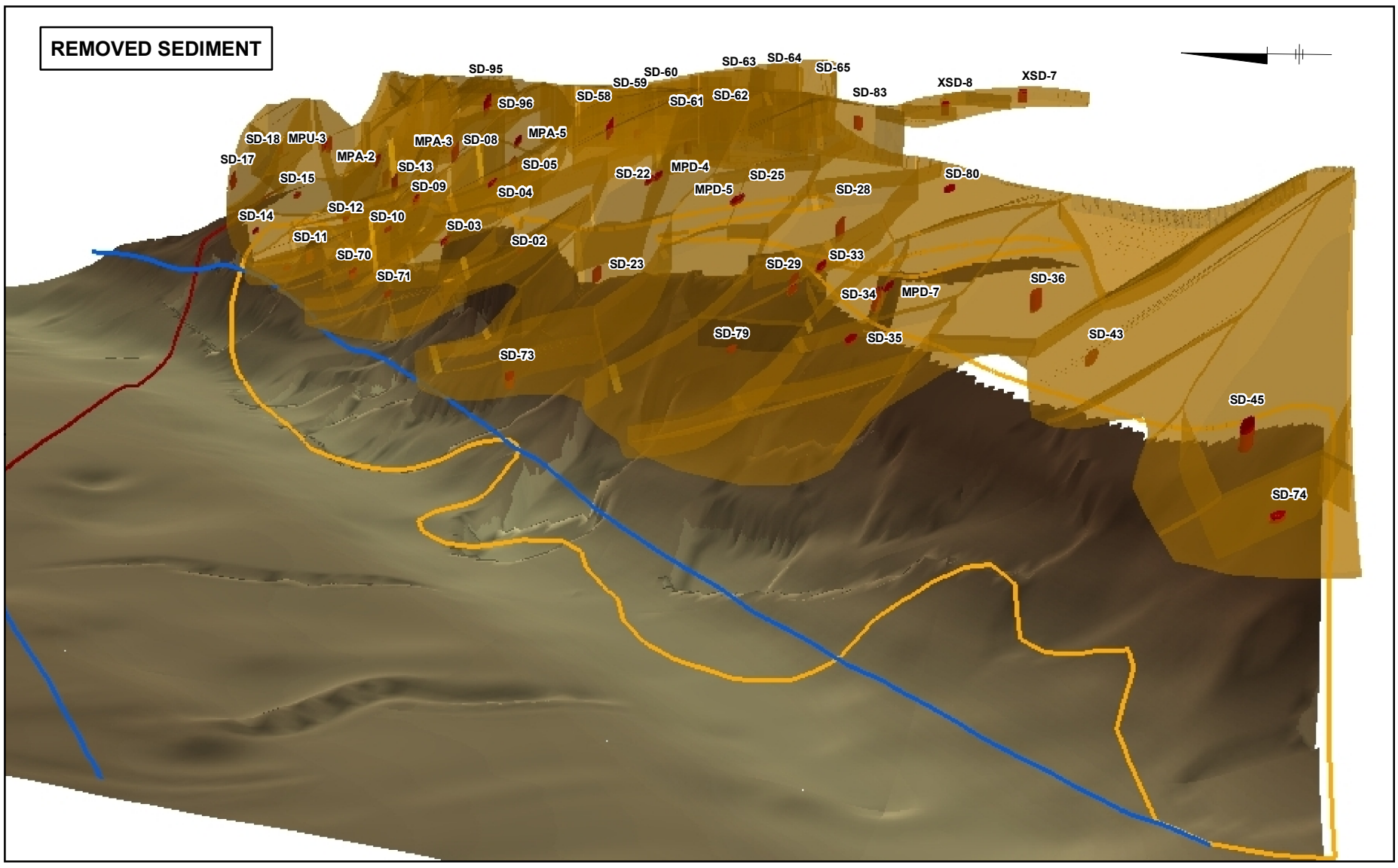
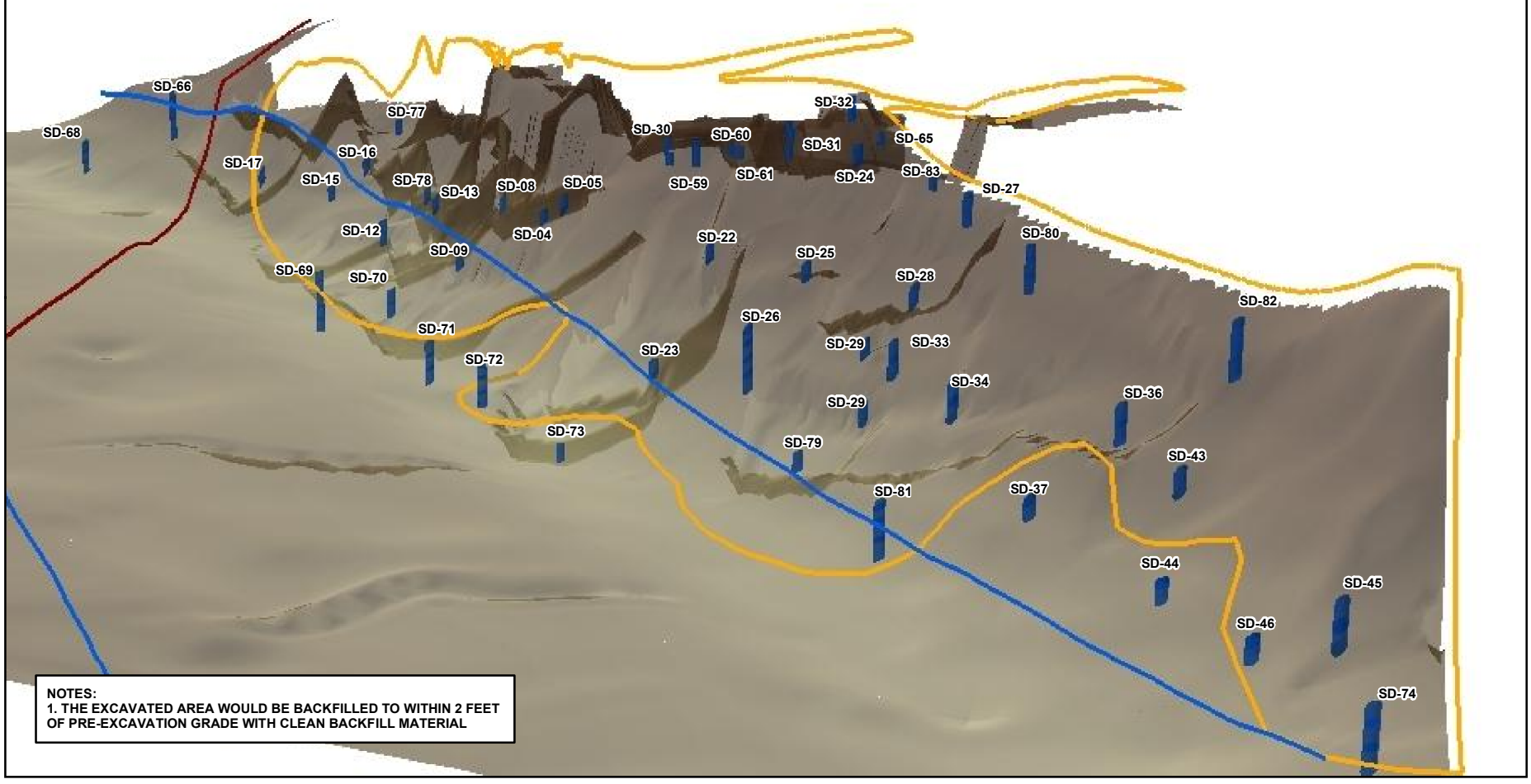
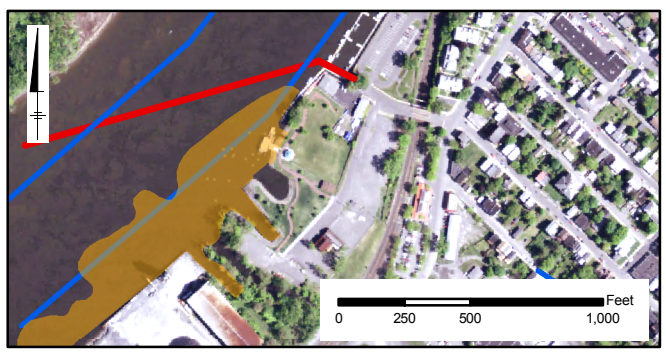




LEGEND

SEDIMENT OBSERVATIONS

- > 4 PPM TOTAL PAHs
- <4 PPM TOTAL PAHs
- AREA WITH > 4 mg/kg TOTAL PAHs
- SHIPPING CHANNEL
- FIBER OPTIC LINE



NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK
FEASIBILITY STUDY FOR OPERABLE UNIT 2

ALTERNATIVE 8 - 3-DIMENSIONAL VIEW ILLUSTRATING EXTENT OF PAH-CONTAINING SEDIMENTS TO BE REMOVED

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FIGURE
6-7a

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Appendix A

August 30, 2010 Letter from ARCADIS to NYSDEC presenting Proposed Remedial Action Objectives and Remedial Alternatives for Consideration

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ENVIRONMENT

Mr. Anthony Karwiel
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233

Subject:
National Grid
Hudson (Water St.) Site, Hudson, NY
NYSDEC Site No. 4-11-005

Date:
August 30, 2010

Contact:
Mark O. Gravelding

Phone:
315.671.9235

Email:
mark.gravelding@arcadis-us.com

Our ref:
B0036702.0001

Dear Mr. Karwiel:

As a follow-up to our Feasibility Study (FS) scoping meeting on July 26, 2010, and on behalf of National Grid, ARCADIS is providing herein revised remedial action objectives (RAOs) and potential remedial alternatives for consideration in the FS for the Hudson (Water St.) Site in Hudson, New York (NYSDEC Site No. 4-11-005) (the Site). As described in further detail below, the RAOs and remedial alternatives for the Site have been developed considering the technical discussions held on July 26, 2010 and based on further review and evaluation of various technical and administrative issues.

Remedial Action Objectives

At the meeting on July 26, 2010, NYSDEC indicated that National Grid and ARCADIS should refer to DER-10/Technical Guidance for Site Investigation and Remediation (DER-10) for appropriate RAOs. The RAOs for the Site were prepared using the generic DER-10 sediment RAOs with consideration to the specific contaminants present at the Site. Specifically, instead of reference to "contamination", the RAOs for the Site reference manufactured gas plant (MGP) tar and MGP-related constituents. The proposed RAOs are:

1. To eliminate or reduce, to the extent practicable, the potential for human contact with MGP tar and MGP-impacted sediments
2. To eliminate or reduce, to the extent practicable, the release(s) of contaminant(s) from MGP tar and MGP-impacted sediments that would

result in surface water concentrations in excess of surface water quality standards

3. To eliminate or reduce, to the extent practicable, impacts to biota due to ingestion/direct contact with MGP tar and MGP-impacted sediments that would cause toxicity or bioaccumulation through the marine or aquatic food chain

To address the first RAO, the MGP-related non-aqueous phase liquid (NAPL) impacts were delineated as described below and used to develop the Area for Remedial Consideration (ARC). To address the second RAO, the potential for exceedance of the surface water quality standards was evaluated. Based on the results of the fate and transport evaluation presented in the Revised Comprehensive Sediment Investigation Report (CSIR, ARCADIS 2010), as well as an evaluation of sheens observed during previous sampling events (as described below), the area where potential surface water quality exceedances could occur is equivalent to the ARC. Finally, to address the third RAO, the areas of potential sediment toxicity were delineated during the 2009 investigation activities and the results were presented in the Revised CSIR. As illustrated on the attached figures, both areas of potential sediment toxicity are within the ARC.

Remedial Alternatives for Consideration in the FS

In consideration of the RAOs described above and applicable guidance for conducting feasibility studies, the remedial alternatives for consideration in the FS are presented below along with the basis for inclusion in the FS.

- Alternative #1 – No Further Action (NFA)
    - NYSDEC DER-10 guidance requires that an NFA alternative be evaluated in an FS.
- Alternative #2 – Monitored Natural Recovery (MNR) of sediments within the ARC
    - Completion of source removal activities (OU1 remediation) in 2005 and the results of the OU2 Sediment Monitoring Program indicate that natural recovery of polycyclic aromatic hydrocarbons (PAHs) is occurring in the Site sediments.

- Alternative #3 – Capping of sediments within the ARC

    - Above-grade capping of sediments has been implemented at numerous contaminated sediment sites across the country and is a remedy that EPA recommends be considered along with MNR and sediment removal. From a technical perspective it is a viable remedial alternative for the Site.

- Alternative #4 – Removal of sediments in the ARC to a depth of 1 foot with capping and restoration

    - This remedial alternative is similar to Remedial Alternative #3 but the cap would be installed below the surface. To place the subsurface cap, a 1-foot dredge cut would be included in this remedial alternative. Figure 3a illustrates the sediments and associated MGP impacts that would be removed by implementation of this remedial alternative.

- Alternative #5 – Removal of sediments in the ARC to a depth of 2 feet with capping and restoration

    - This remedial alternative is similar to Remedial Alternative #4, but provides for greater mass removal of MGP-related constituents. Figure 4a illustrates the sediments and associated MGP impacts that would be removed by implementation of this remedial alternative.

- Alternative #6 – Removal of sediments in the ARC to variable depths (up to 6 feet) with capping and restoration

    - This remedial alternative is similar to Remedial Alternatives #4 and #5, but provides for greater mass removal of MGP-related constituents. Figure 5a illustrates the sediments and associated MGP impacts that would be removed by implementation of this remedial alternative.

- Alternative #7 – Removal of sediments in the ARC to full depth of NAPL and restoration

  - This remedial alternative would include the removal of all NAPL-impacted sediments, regardless of depth, and would provide the greatest mass removal of MGP-related constituents. Figure 6a illustrates the sediments and associated MGP impacts that would be removed by implementation of this remedial alternative.

- Alternative #8 – Sediment Removal to 4 milligrams per kilogram (mg/kg) total PAHs (all depths) and restoration

  - This remedial alternative would include the removal of all sediments, regardless of depth, origin, or toxicity containing PAH concentrations greater than 4 mg/kg (see Expanded ARC on Figure 7). This remedial alternative would achieve sediment guidance values provided in the Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999).

Basis of ARC Boundaries for the FS

The OU2 sediment ARC is illustrated on the attached figures that have been developed for each of the remedial alternatives presented above. Note that the ARC is identical for Remedial Alternatives 2 through 7, and the basis for this area is presented below. Remedial Alternative 8 differs from the other remedial alternatives and consists of the area containing sediments at any depth with total PAH concentrations greater than 4 mg/kg (see Expanded ARC on Figure 7).

The ARC for remedial alternatives 2 through 7 includes the sediments containing NAPL and sediments defined as potentially toxic during the 2009 supplemental sediment investigation activities, and was conservatively estimated using the following steps:

1. Plotting the locations where NAPLs and potentially toxic sediment were observed in surface and/or subsurface sediments
2. Determining the next closest sampling locations where NAPLs/potentially toxic sediments were not observed (considering also whether the sample extended deep enough to encounter potential NAPL impacts)
3. Drawing a conservative outermost extent of the NAPL/potentially toxic sediment area by connecting the sample locations described in Step 2 above

The sample locations used to determine the conservative outermost extent of the ARC are as follows:

Sample Location (Depth)	Comments
T-18 (18.68), SD-16 (10)	No NAPLs/potential NAPLs (based on TarGOST) observed.
SD-12 (14)	No NAPLs observed.
T-16 (18.81)	No potential NAPLs (based on TarGOST) observed.
HD-149 (0.5)	No NAPLs observed. This surface sample used to delineate potential NAPL (based on TarGOST) at the surface (0.03 foot) of T-13
HD-144 (0.5)	No NAPLs observed. This surface sample used to delineate potential NAPL (based on TarGOST) at the surface (0.03 foot) of T-13
T-10 (16.61)	Slightly elevated TarGOST reading at 8 to 8.2 feet; however, no NAPL observed in adjacent boring. Concluded no NAPLs present.
CB-T10 (18)	No NAPLs observed.
T-6 (8.39)	No potential NAPLs (based on TarGOST) observed.
T-5 (16.6)	No potential NAPLs (based on TarGOST) observed.
T2 (19.51)/ CB-T2 (20)	Slightly elevated TarGOST reading at 6.5 to 6.6 feet; however, no NAPL observed in adjacent boring. Concluded no NAPLs present.
SD-01 (5.5)	Some staining observed at 2 to 4 feet; no NAPL observed; total PAHs= 56.1 ppm (2-4 feet) Concluded no NAPLs present.
T-21 (18.1)	No potential NAPLs (based on TarGOST) observed.
SD-59 (20)	Some staining observed at 7.5 feet; no NAPL observed; total PAHs= 263 ppm (6-8 feet). Concluded no NAPL present.

The actual area subject to remediation is expected to be smaller than the conservatively estimated area and could be further refined during pre-design investigations.

At the FS scoping meeting on July 26, 2010, NYSDEC stated that according to 6 NYCRR Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, sediments cannot generate sheens on the water surface; therefore, any sheen-generating sediments would need to be addressed by the remedial alternatives presented in the FS. In particular, NYSDEC raised concern about the four sediment cores located downstream of Embayment #4 (SD-34, SD-35, SD-36, and SD-82) where sheens were reported in the upper 2 feet of sediment. As requested by NYSDEC at the meeting, ARCADIS reviewed the sediment core logs for those four cores to determine if there was any additional information regarding the nature of the observed sheens. The results of that review are presented on the attached Table 1. In summary, all sheens noted on the surface of the sediment cores were described as either trace or light oil sheens.

In addition, ARCADIS also reviewed the field notes from the recent investigation activities completed from 2007 through 2009 (including the three rounds of sampling performed as part OU2 Sediment Monitoring Program and the 2009 Supplemental Sampling Activities) to determine if any sheens were observed on the water surface during the investigation activities (e.g., when retrieving samples or spuds). The results of that review are presented on the attached Table 2. In summary, all locations where a sheen or other NAPL impacts were observed on the water surface are within the boundary of the ARC with the exception of MPE2-3, which is at the far east side of Embayment #2.

Based on the information presented above, any sediment with the potential to generate surface water sheens would be addressed by the remedial alternatives to be considered in the FS.

If you have any questions regarding the information presented herein, please contact me at (315) 671-9235 or William Jones of National Grid at (315) 428-5690. ARCADIS and National Grid would be available to meet with NYSDEC personnel to discuss the information presented herein at a time that is convenient to all parties.

Sincerely,

ARCADIS of New York, Inc.

Mark O. Gravelding, P.E.
Vice President

Copies:
William Jones, National Grid
Edward Neuhauser, National Grid
Stuart Messur, ARCADIS
Doug Weeks, ARCADIS
Nancy Gensky, ARCADIS

ARCADIS

Tables

National Grid - Hudson (Water Street) Site Operable Unit 2
Hudson, New York

Table 1 - Summary of Sediment Core Descriptions and Sheen Observation for Select Sediment Core Locations

Date Collected	Core ID	Approximate Water Depth (feet)	Depth Interval	Sediment Core Description [1]	Sheen Description [2]	Total PAH (mg/kg)
3/24/1998	SD-34	32	0 – 0.5	Dark gray silt, fine sand, gravel, mussels	Trace oil sheen	28
			0 – 2	Dark gray fine sand, trace silt, gravel, coal, mussels	N/A	36
5/13/2002	SD-34	32	0 – 2	0-0.5 - dark gray fine sand, some shells, little fine gravel, trace coal, little to trace silt 0.5-1.25 – dark gray medium to fine sand, little silt, trace shells	Surface sheen	NS
			2 – 4	Dark gray medium to fine sand, little silt	N/A	1.1
			4 – 6	Dark gray medium to fine sand, some to little silt	N/A	0.2
3/24/1998	SD-35	36	0 – 0.5	Dark gray fine sand, trace silt, gravel, mussels, wood, coal	Trace oil sheen	25
			0 – 2	Dark gray fine sand, trace silt, gravel, mussels, wood, coal	Trace oil sheen on top of gray fine sand	14
3/23/1998	SD-36	28	0 – 0.5	Dark gray fine sand with silt, coarse sand, coarse gravel, slag, mussels, shells	Slight coal oil sheen	14
			0 – 2	Dark gray fine sand with silt, coarse sand, coarse gravel, slag, mussels	Slight oil sheen on top of dark gray fine sand	31
5/13/2002	SD-36	28	0 – 2	0-0.5 brown to black cinders, gravel and sand, little silt , trace shells 0.5 – 1 – dark gray fine to medium sand, little gravel, trace silt, trace shells 1 – 2 – gray to brown fine to coarse sand, trace fine gravel	N/A	NS
			2 – 4	Dark gray fine to medium sand, little silt, trace fine gravel.	N/A	0.42U
			4 – 6	Dark gray fine to medium sand, little silt, trace fine gravel	N/A	0.45U

Table 1 - Summary of Sediment Core Descriptions and Sheen Observation for Select Sediment Core Locations

Date Collected	Core ID	Approximate Water Depth (feet)	Depth Interval	Core/Sample Description [(1)]	Sheen Description [(2)]	Total PAH (mg/kg)
5/1/2002	SD-82	18	0 – 0.5	0 – 0.2 rounded to angular and rounded gravel, concrete, zebra mussels 0.2 – 0.5 – gray coarse to very coarse sand, fine to medium size angular gravel, trace fine to medium sand, large angular 2" gravel within.	0 – 0.2 slight oil sheen	0.23
			0.5 – 2	Gray/dark gray medium to very coarse sand, angular gravel over gray fine sand and little silt.	N/A	1.1
			2 – 4	Gray/dark gray fine sand, trace medium sand over fine sand, little silt	N/A	0.42U
			4 – 6	Gray fine to very coarse sand with silt	N/A	0.44U

Notes:

1. Sediment core descriptions were presented in the Comprehensive Sediment Investigation Report (CSIR, ARCADIS, Foth, and GEI, 2010).
2. Sheen descriptions taken from core/sample descriptions presented in the CSIR.
3. N/A = Not applicable
4. NS = Samples from the respective depth interval were not collected for chemical analysis.
5. Total PAH is the sum of the 16 priority pollutant PAHs.
6. mg/kg – milligrams per kilogram
7. U indicates the analyte was analyzed for but not detected. The associated value is the analyte instrument detection limit.

National Grid - Hudson (Water Street) Site Operable Unit 2
Hudson, New York

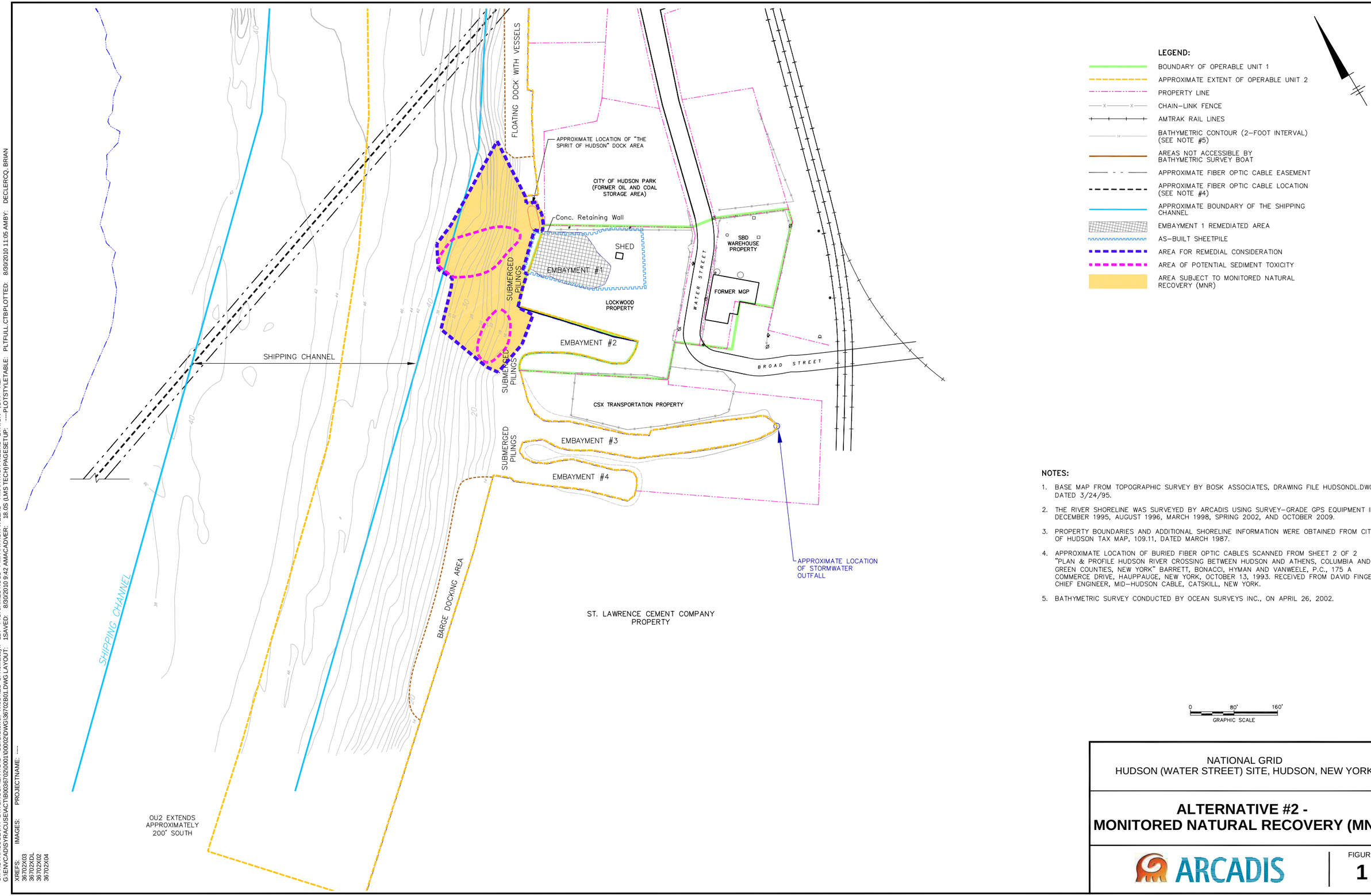
Table 2 - Summary of Water Surface Sheen Observations

Year	Location	Sheen Observation [1]
2009	HD-131	Sheen observed on water surface during sample collection
2009	HD-142	Sheen observed on water surface during sample collection
2009	HD-143	Sheen observed on water surface during sample collection
2009	HD-146	Sheen observed on water surface during sample collection
2009	HD-148	Sheen observed on water surface during sample collection
2009	HD-150	Sheen on water surface during sample collection
2007	SD-91	Sheen on water surface after probing with iron rod
2007	MPE2-3	Sheen on water surface when probing with iron rod
2007	MPE2-1	Sheen on water surface when probing with iron rod
2007	SD-95	Sheen noted on water surface when spud was dropped
2007	SD-94	Sheen noted on water surface when spud was dropped
2009	Outside Embayment #1	Sheen observed on water surface when lifting spuds

Notes:

1. Sheen observations are based on a review of field notes and photographs for sampling conducted from 2007 to 2009.

Figures



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5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #2 - MONITORED NATURAL RECOVERY (MNR)

ARCADIS

FIGURE 1

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES S. Kowalczyk LD: PIC:JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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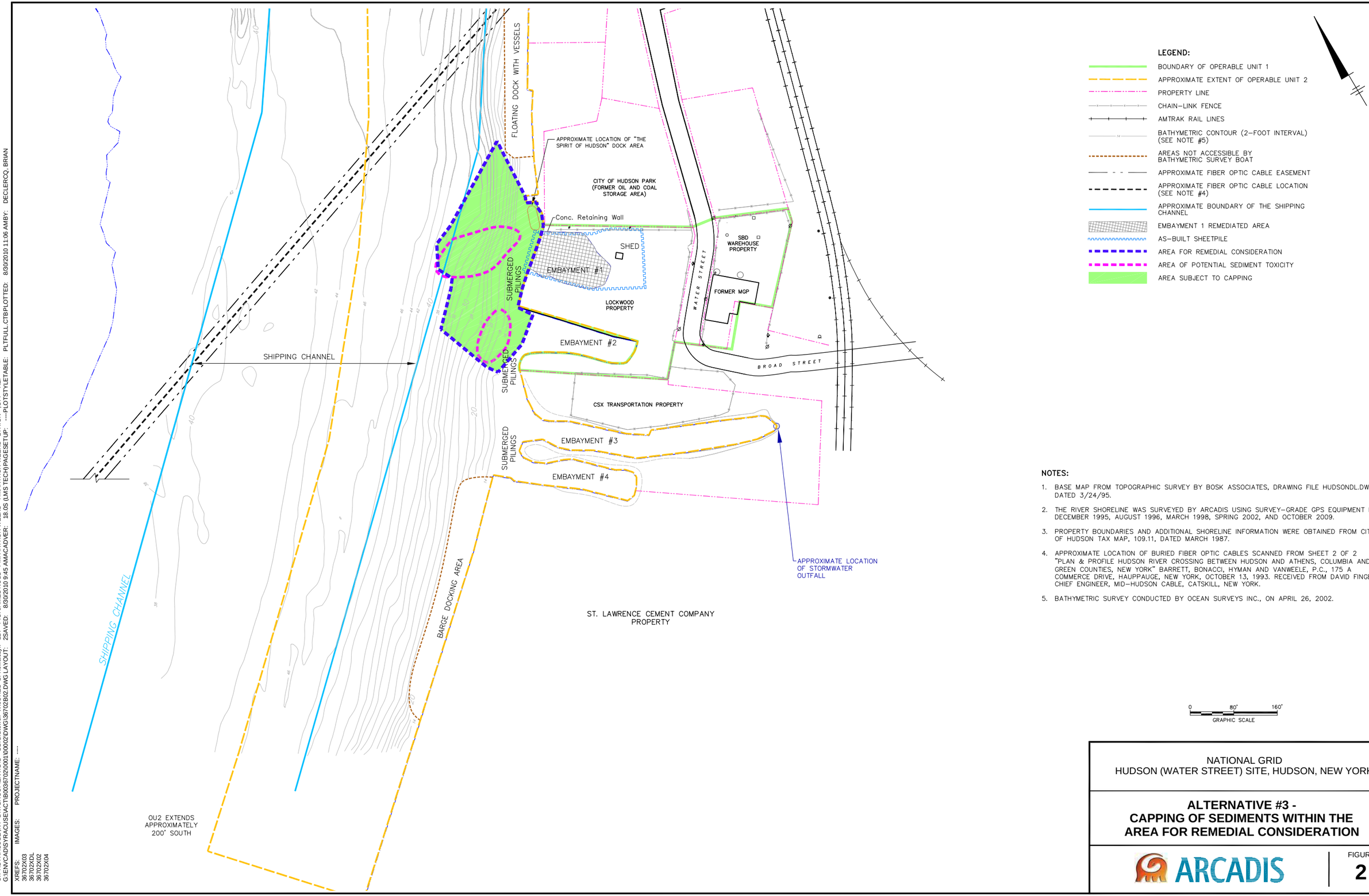

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0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #3 - CAPPING OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION

ARCADIS

FIGURE
2

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES S. Kowalczyk LD: PIC:JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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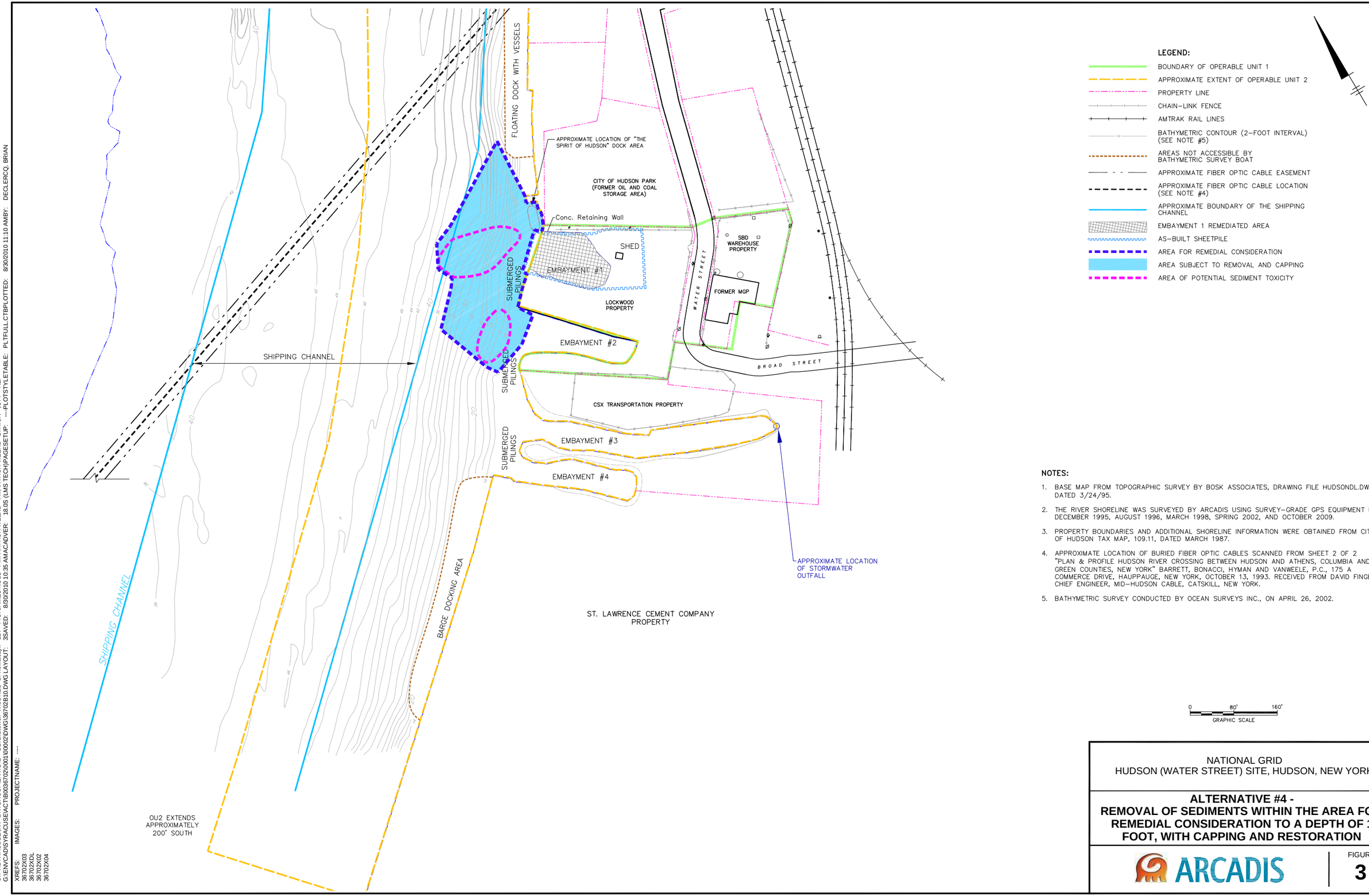

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5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #4 - REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO A DEPTH OF 1 FOOT, WITH CAPPING AND RESTORATION

ARCADIS

FIGURE 3

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES S. Kowalczyk LD: PIC: JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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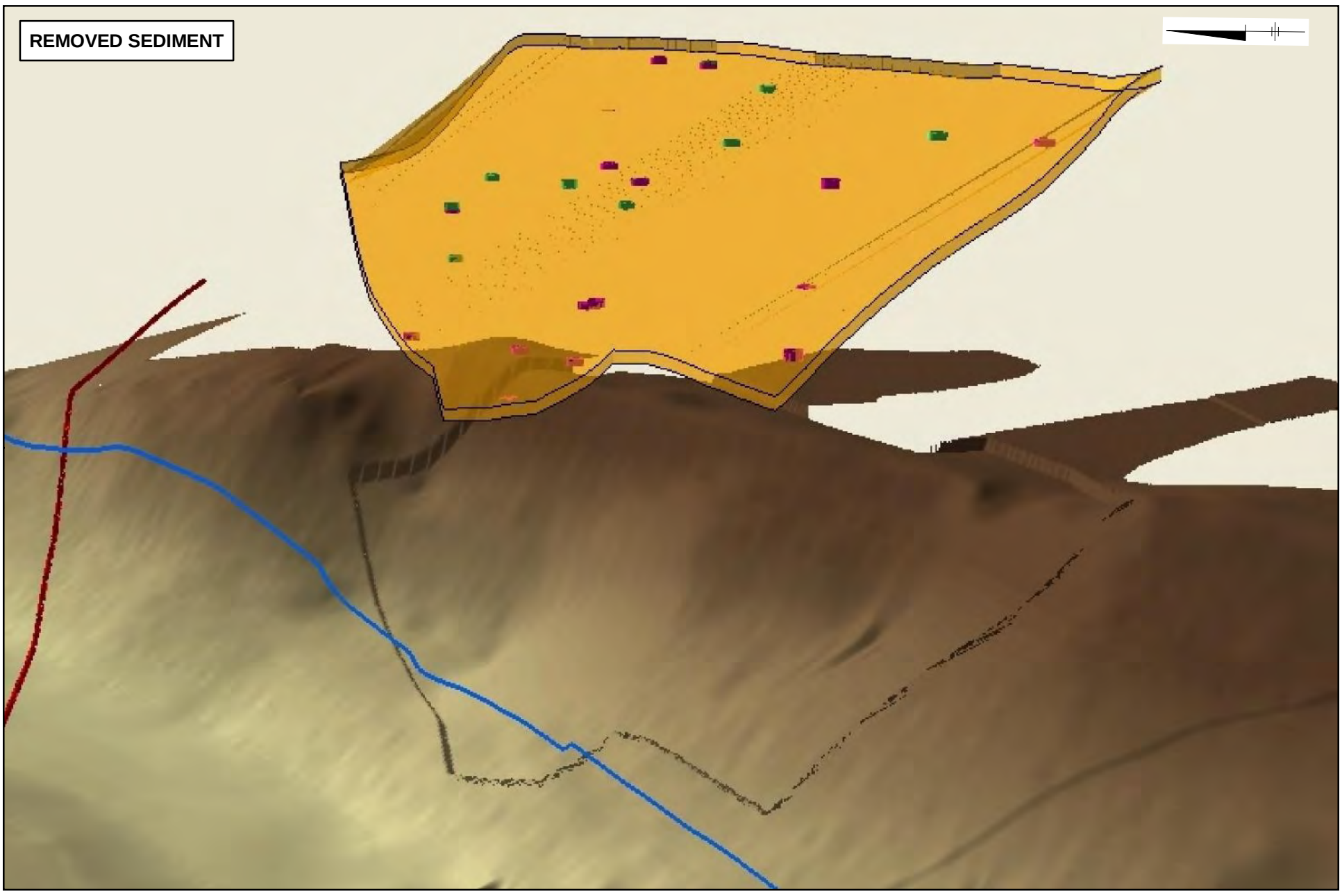
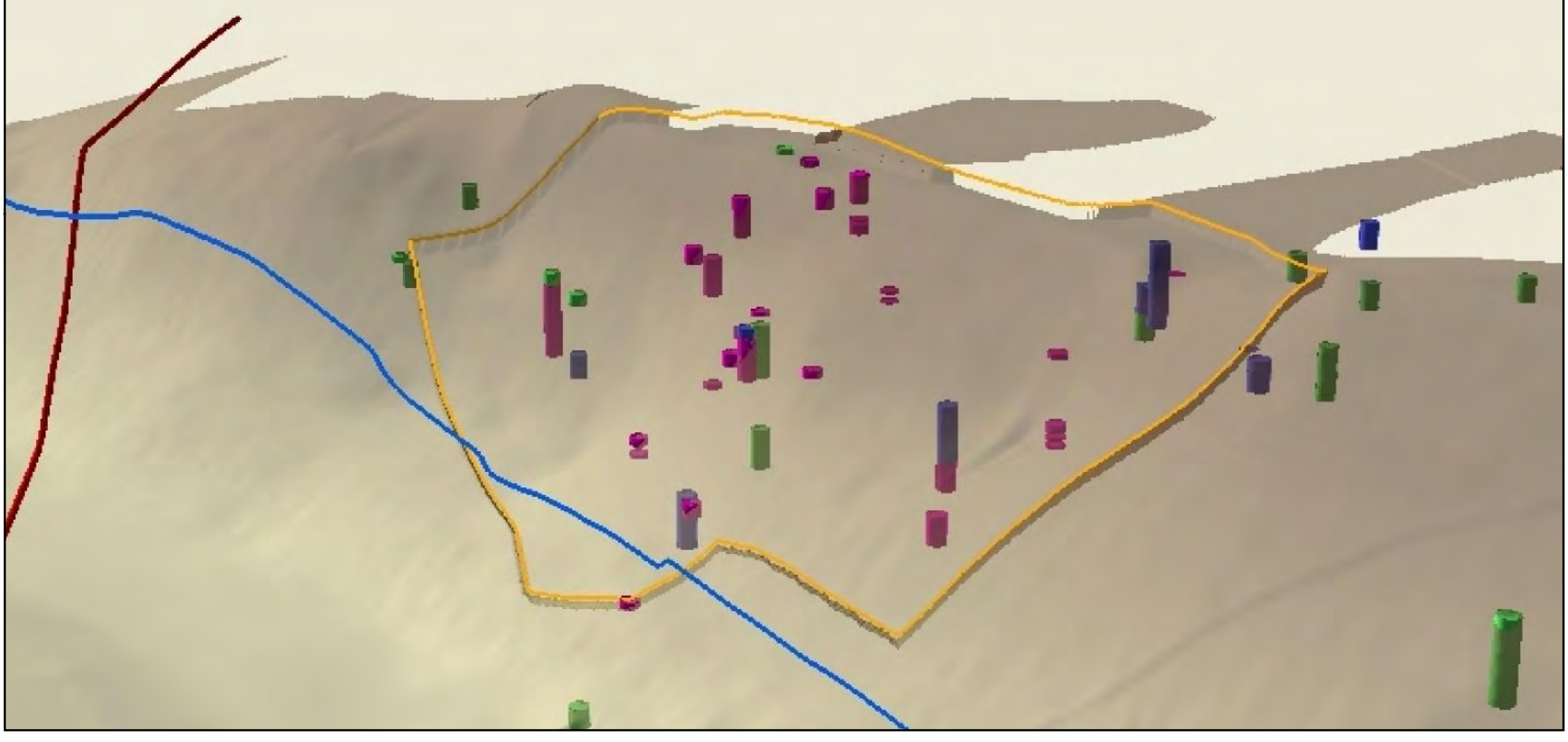


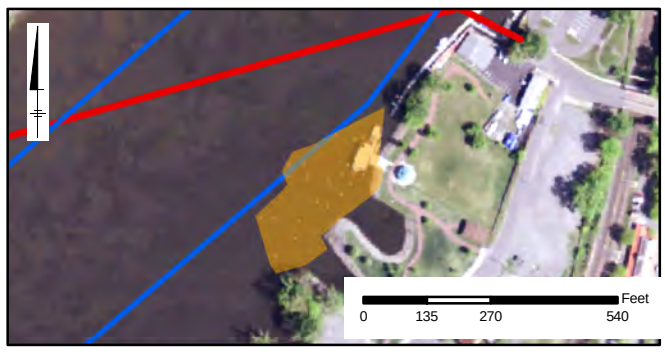
REMAINING SEDIMENT



LEGEND

OBSERVATIONS
- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

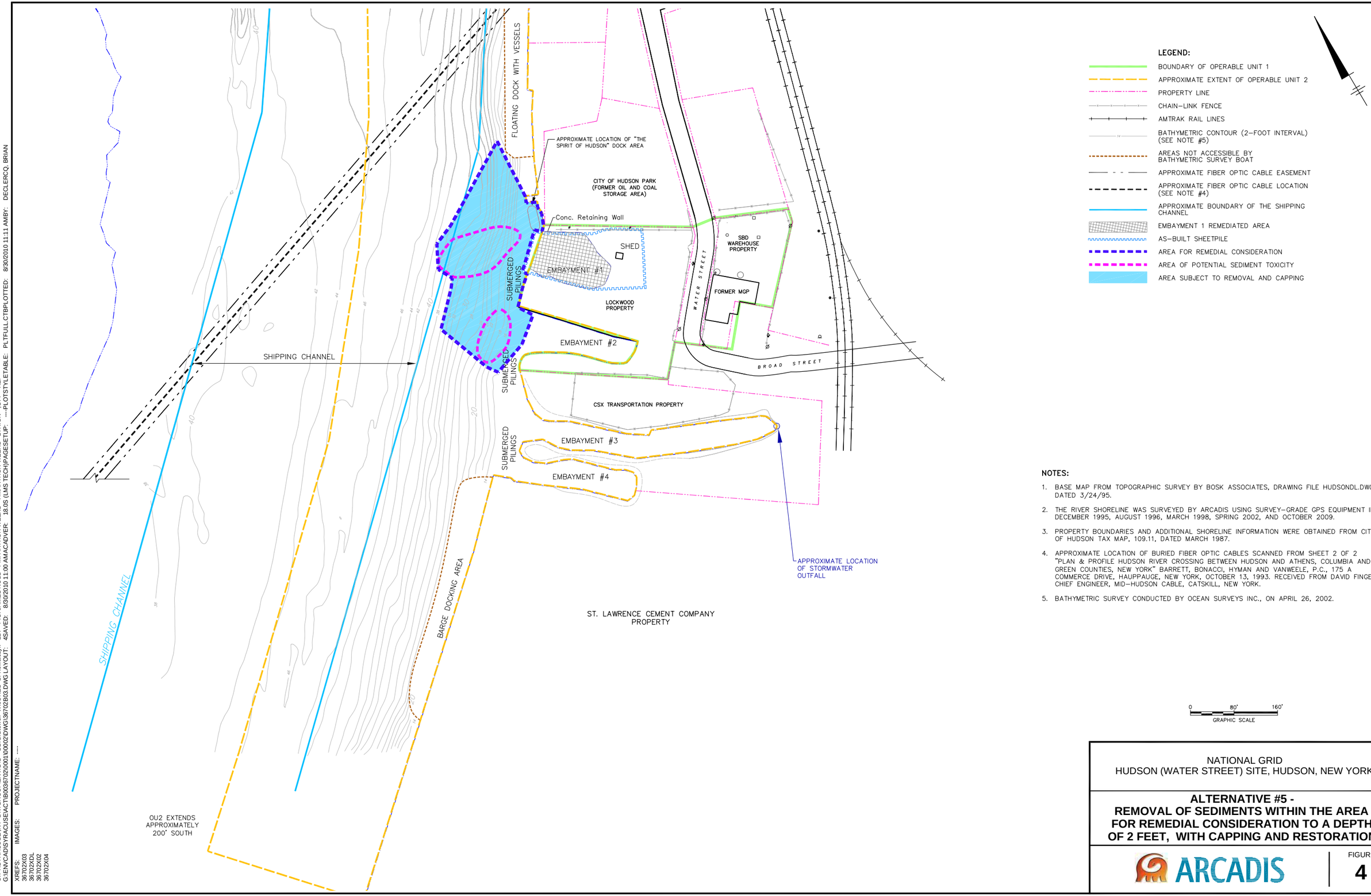


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO A DEPTH OF 1 FOOT WITH CAPPING AND RESTORATION

ARCADIS

FIGURE
3a



NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. THE RIVER SHORELINE WAS SURVEYED BY ARCADIS USING SURVEY–GRADE GPS EQUIPMENT IN DECEMBER 1995, AUGUST 1996, MARCH 1998, SPRING 2002, AND OCTOBER 2009.
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5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #5 - REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO A DEPTH OF 2 FEET, WITH CAPPING AND RESTORATION

ARCADIS

FIGURE 4

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES S. Kowalczyk LD: PIC:JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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REMOVED SEDIMENT

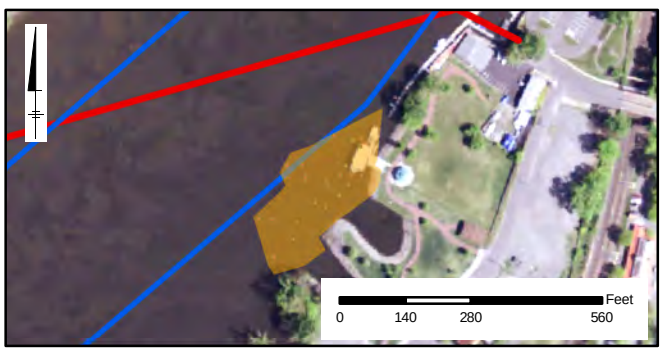
REMAINING SEDIMENT

LEGEND

OBSERVATIONS

- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

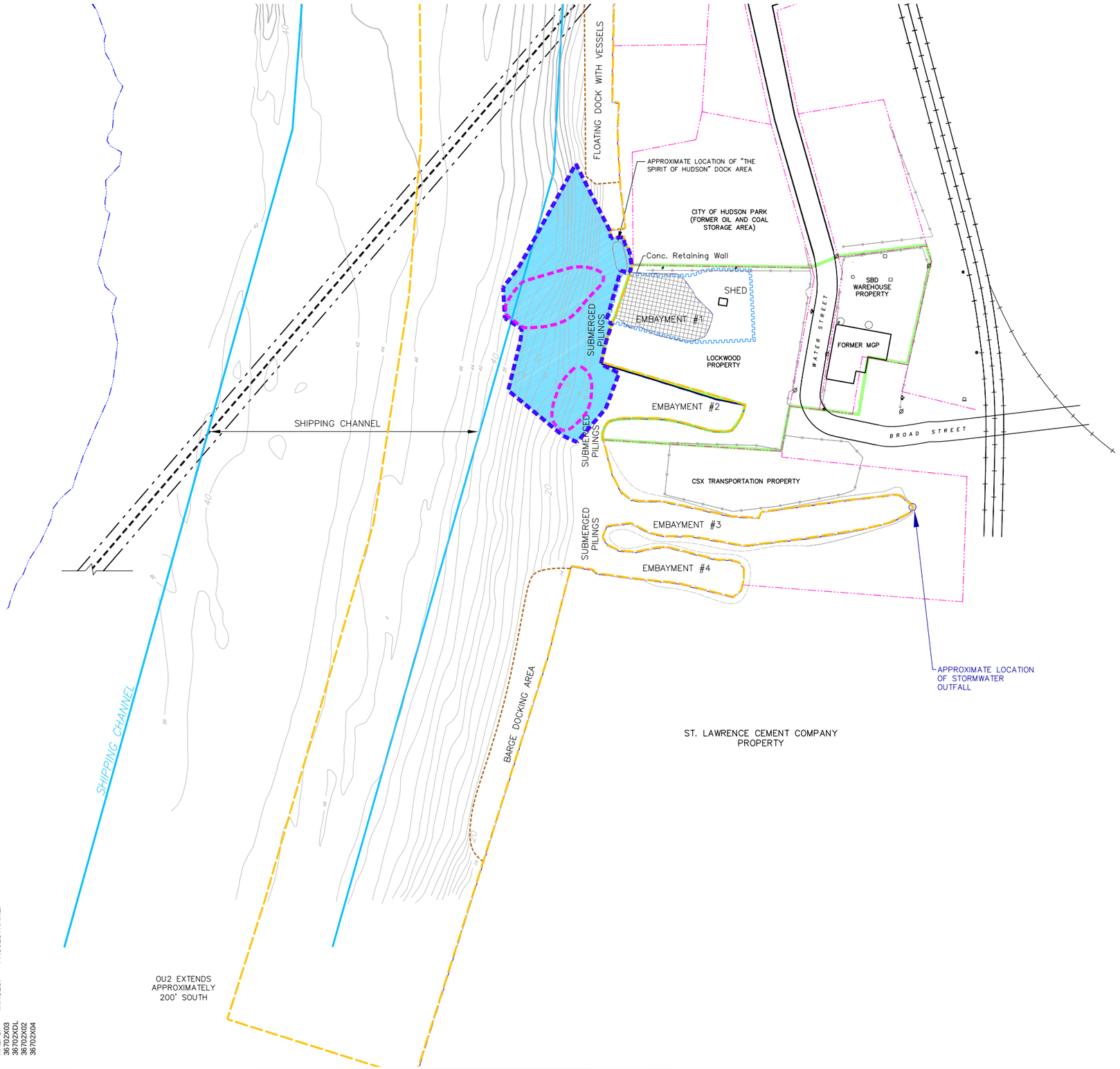


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO A DEPTH OF 2 FEET, WITH CAPPING AND RESTORATION

ARCADIS

FIGURE
4a



LEGEND:

- BOUNDARY OF OPERABLE UNIT 1
- APPROXIMATE EXTENT OF OPERABLE UNIT 2
- PROPERTY LINE
- CHAIN–LINK FENCE
- AMTRAK RAIL LINES
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL) (SEE NOTE #5)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #4)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL
- EMBAYMENT 1 REMEDIATED AREA
- AS–BUILT SHEETPILE
- NAPL IMPACTED AREA – AREA FOR REMEDIAL CONSIDERATION
- AREA OF POTENTIAL SEDIMENT TOXICITY
- AREA SUBJECT TO REMOVAL AND CAPPING

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
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5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #6 - REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO VARIABLE DEPTHS (UP TO 6 FEET), WITH CAPPING AND RESTORATION

ARCADIS

FIGURE 5

CITY:CLE DIV/GROUP:AIT/IM DB:L.GREENE LD: PIC: PM: TM: TR:
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REMOVED SEDIMENT

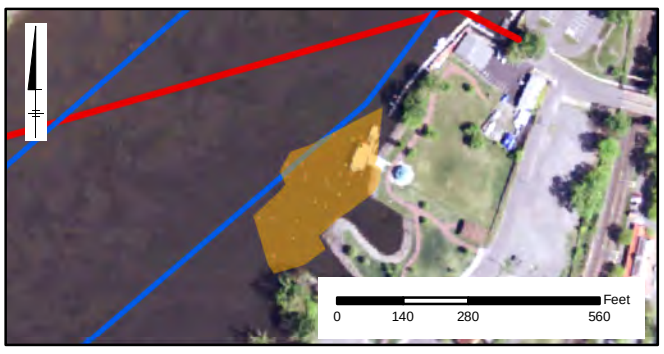
REMAINING SEDIMENT

LEGEND

OBSERVATIONS

- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

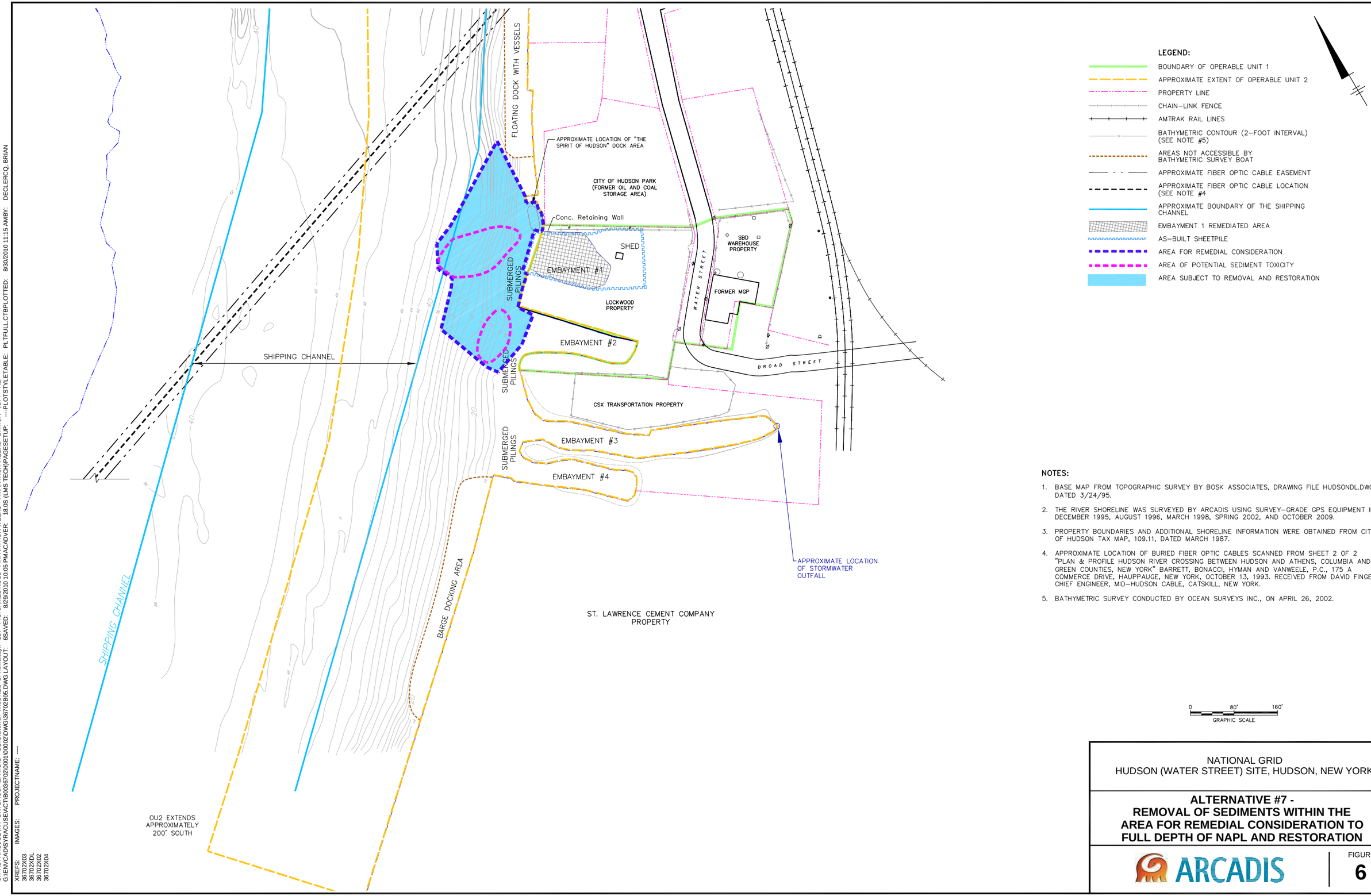


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO VARIABLE DEPTHS (UP TO 6 FEET) WITH CAPPING AND RESTORATION

ARCADIS

FIGURE
5a



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5. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.

0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #7 - REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO FULL DEPTH OF NAPL AND RESTORATION

ARCADIS

FIGURE 6

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES S. Kowalczyk LD: PIC: JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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REMOVED SEDIMENT

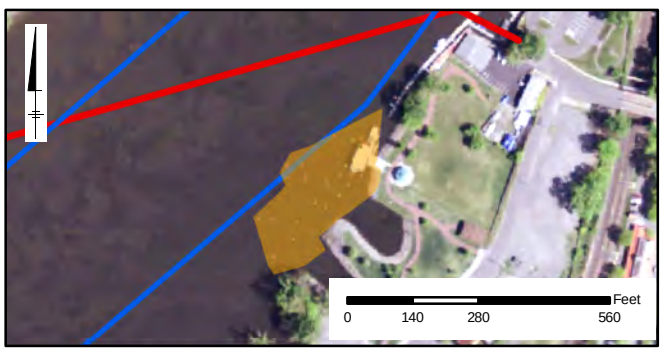
REMAINING SEDIMENT

LEGEND

OBSERVATIONS

- NAPL
- STAINING
- SHEEN

- AREA FOR REMEDIATION CONSIDERATION
- SHIPPING CHANNEL
- FIBER OPTIC LINE

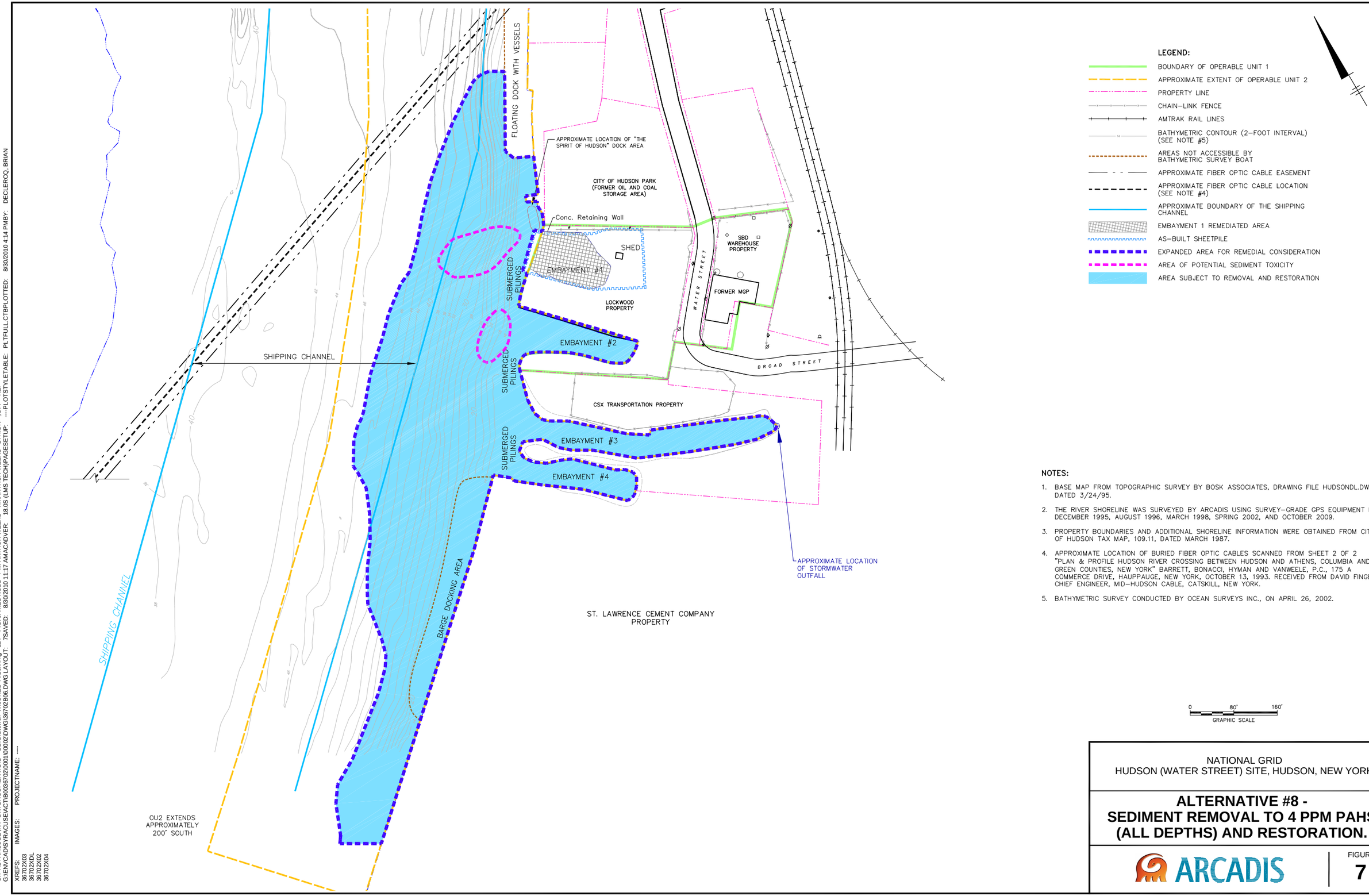


NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

REMOVAL OF SEDIMENTS WITHIN THE AREA FOR REMEDIAL CONSIDERATION TO FULL DEPTH OF NAPL AND RESTORATION

ARCADIS

FIGURE 6a



NOTES:

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0 80' 160'
GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

ALTERNATIVE #8 - SEDIMENT REMOVAL TO 4 PPM PAHS (ALL DEPTHS) AND RESTORATION.

ARCADIS

FIGURE
7

CITY:SYRACUSE_NY DIV/GROUP:ENV/141 DB:G.Stowell W.JONES A.Schilling LD: PIC:JAMES NUSS PM: ARTHUR WEEKS TM:ARTHUR WEEKS LYR:ON=*;OFF=*REF*
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ARCADIS

Appendix B

Detailed Cost Estimates for Remedial Alternatives

Table B-1
Cost Estimate Summary

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Remedial Alternative	Description	Cost		
		Capital	O&M	Total
1	No Further Action	$ -	$ -	$ -
2	Monitored Natural Recovery of Sediment in the Area for Remedial Consideration with Institutional Controls	$ 150,000	$ 1,280,000	$ 1,430,000
3	Capping Sediments within the Area for Remedial Consideration with Institutional Controls	$ 7,170,000	$ 1,720,000	$ 8,890,000
4	Excavation of Sediments within the Area for Remedial Consideration to a Depth of 1 foot, Capping, and Institutional Controls	$ 9,750,000	$ 1,720,000	$ 11,470,000
5	Excavation of Sediments within the Area for Remedial Consideration to a Depth of 2 feet, Capping, Restoration, and Institutional Controls	$ 11,220,000	$ 1,720,000	$ 12,940,000
6	Excavation of Sediments within the Area for Remedial Consideration to Variable Depths (up to 6 feet), Backfill, Capping, and Institutional Controls	$13,450,000	$1,720,000	$15,170,000
7	Excavation of Sediments within the Area for Remedial Consideration to Full Depth of NAPL, and Backfill	$15,340,000	$ -	$15,340,000
8	Excavation of Sediments within the 4 mg/Kg PAH Area, and Backfill	$41,710,000	$ -	$41,710,000

Table B-2
Cost Estimate for Alternative 1
No Further Action

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	No Further Action	1	LS	$0	$0
				Subtotal Capital Cost	$0
2				Administration & Engineering (15%)	$0
				Total Capital Cost	$0
Operation and Maintenance Costs					
3	No Further Action	1	LS	$0	$0
				Subtotal O&M Cost	$0
				Contingency (20%)	$0
				Total Annual O&M Cost	$0
4				30-Year Total Present Worth Cost of O&M	$0
				Total Estimated Cost:	**$0**
				Rounded To:	**$0**

LS = Lump Sum

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Assumptions:

1. The “No Further Action” alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives. The “No Further Action” alternative would not involve implementation of any remedial activities to treat, remove, contain, or monitor impacted sediment within the Area for Remedial Consideration, and no effort would be made to change or monitor future site conditions.

Table B-3
Cost Estimate for Alternative 2
Monitored Natural Recovery of Sediment in the Area for Remedial Consideration with Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Sediment Monitoring Work Plan	1	LS	$30,000	$30,000
2	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$130,000
3				Administration & Engineering (15%)	$19,500
				Total Capital Cost	$149,500
Operation and Maintenance Costs					
4	Sediment Sampling and Laboratory Analysis	1	LS	$97,000	$97,000
5	Periodic Monitoring Report	1	LS	$30,000	$30,000
6	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$137,000
				Contingency (20%)	$27,400
				Total Annual O&M Cost	$164,400
7				30-Year Total Present Worth Cost of O&M	$1,280,000
				Total Estimated Cost:	**$1,429,500**
				Rounded To:	**$1,430,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-3
Cost Estimate for Alternative 2
Monitored Natural Recovery of Sediment in the Area for Remedial Consideration with Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Sediment Monitoring Work Plan cost estimate includes labor necessary to prepare a work plan for submittal to NYSDEC identifying the scope and sampling plans to perform the monitored natural recovery alternative.

2. Establish institutional controls cost estimate includes legal expenses to establish appropriate institutional controls, as well as address requirements for future activities that could encounter impacted sediments (e.g. repairs for utilities crossing the

3. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

4. Sediment sampling cost estimate includes all labor, equipment (barge, drill rig, and skiff), subsistence and materials necessary to conduct biennial sediment monitoring activities. Estimate includes laboratory analysis of porewater PAH concentrations using solid phase micro-extraction (SPME) methods, and off-site disposal of investigation-derived wastes. Sampling to be performed once every two years for the first five years and then every five years thereafter until year 30.

5. Annual Monitoring Report cost estimate includes labor necessary to prepare an annual report for submittal to NYSDEC summarizing the verification and certification of institutional controls, as well as results of sediment monitoring activities (when performed).

6. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and

7. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with OSWER Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (USEPA, 1993).

Table B-4
Cost Estimate for Alternative 3
Capping Sediments within the Area for Remedial Consideration with Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$449,000	$449,000
3	Pre-Design Investigation	1	LS	$165,000	$165,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$75,000	$75,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Floating Work Platform	1	LS	$100,000	$100,000
8	Absorbent Booms	1	LS	$7,000	$7,000
9	Debris Removal	1.1	AC	$10,000	$12,000
10	Sediment Cap				
	Mattress Config (6" stone, RCM, and geogrid)	49,100	SF	$80	$3,928,000
11	Upland Restoration	0.4	AC	$30,000	$12,000
12	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$4,938,000
13				Administration & Engineering (15%)	$740,700
14				Construction Management (10%)	$493,800
				Contingency (20%)	$987,600
				Total Capital Cost	$7,170,000
Operation and Maintenance Costs					
15	Cap Monitoring	1	LS	$75,000	$75,000
16	Cap Maintenance	1	LS	$50,000	$50,000
17	Annual Monitoring and Maintenance Report	1	LS	$30,000	$30,000
18	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$165,000
				Contingency (20%)	$33,000
				Total Annual O&M Cost	$198,000
19				30-Year Total Present Worth Cost of O&M	$1,720,000
				Total Estimated Cost:	**$8,890,000**
				Rounded To:	**$8,890,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-4
Cost Estimate for Alternative 3
Capping Sediments within the Area for Remedial Consideration with Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to install sediment cap. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-cap placement), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $7 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based capping operations. Assumes structure will consist of flexi-floats and piles.

8. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms around the Area for Remedial Consideration.

9. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the capping area.

10. Sediment cap cost estimate includes labor, materials and equipment necessary for, or incidental to, the construction and placement of the engineered sediment cap. The cap material will be comprised of a series of marine matteress containing the following layers, top to bottom: 6" thick layer of stone, RCM, and geogrid. Cap placement is assumed to be completed utilizing general construction equipment with diver-guided assistance and without containment.

11. Upland restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and access road.

12. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to river and use of the river, as well as limit future activities that could damage the sediment cap.

13. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

14. Construction management cost is based on an assumed 10% of the total capital costs.

15. Cap monitoring cost estimate includes labor, equipment, and materials necessary to conduct cap monitoring activities. Assumes cap monitoring will be conducted annually for the first 5 years and then once every 5 years until year 30. Cap monitoring activities will consist of diver inspections. Cost estimate assumes two workers and two divers will be required to complete the monitoring activities.

16. Cap Maintenance cost estimate assumes 10% of the total capital cost of the alternative to be perfomed annually for the first 5 years and once every 5 years until year 30.

17. Annual Monitoring Report cost estimate includes labor necessary to prepare an annual report for submittal to NYSDEC summarizing the verification and certification of institutional controls, as well as results of sediment monitoring activities (when performed).

18. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and

19. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with OSWER Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (USEPA, 1993).

Table B-5
Cost Estimate for Alternative 4
Excavation of Sediments within the Area for Remedial Consideration to a Depth of 1 foot, Capping, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$611,000	$611,000
3	Pre-Design Investigation	1	LS	$200,000	$200,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$150,000	$150,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Open Span Structure	1	LS	$289,000	$289,000
	Air Treatment	1	LS	$172,000	$172,000
8	Floating Work Platform	1	LS	$100,000	$100,000
9	Absorbent Booms	1	LS	$10,000	$10,000
10	Temporary Water Treatment System				
	Installation and Operation	3.4	MONTH	$150,000	$514,000
11	Dredge Area Containment				
	Containment Sheeting	49,000	SF	$65	$3,185,000
12	Debris Removal	1.1	AC	$10,000	$12,000
13	Sediment Excavation and Handling	2,000	CY	$250	$500,000
14	Sediment Dewatering and Stabilization				
	Blending Operations	2,000	CY	$30	$60,000
	Stabilization Admixture	300	TON	$115	$35,000
15	Sediment Cap				
	RCM	49,000	SF	$6	$294,000
	Stone cover	900	CY	$35	$32,000
16	Transportation and Disposal				
	Transportation and Disposal - LTTD	3,300	TON	$85	$281,000
17	Solid Waste Characterization	7	each	$1,200	$8,400
18	Upland and Shoreline Restoration	1	LS	$75,000	$75,000
19	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$6,718,400
20				Administration & Engineering (15%)	$1,007,760
21				Construction Management (10%)	$671,840
				Contingency (20%)	$1,343,680
				Total Capital Cost	$9,750,000
Operation and Maintenance Costs					
22	Cap Monitoring	1	LS	$75,000	$75,000
23	Cap Maintenance	1	LS	$50,000	$50,000
24	Annual Monitoring and Maintenance Report	1	LS	$30,000	$30,000
25	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$165,000
				Contingency (20%)	$33,000
				Total Annual O&M Cost	$198,000
26				30-Year Total Present Worth Cost of O&M	$1,720,000
				Total Estimated Cost:	**$11,470,000**
				Rounded To:	**$11,470,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-5
Cost Estimate for Alternative 4
Excavation of Sediments within the Area for Remedial Consideration to a Depth of 1 foot, Capping, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments offsite for treatment/disposal and install sediment cap. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including waste transportation and disposal.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-excavation), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes all labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch bermed and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $12 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Open span structure and air treatment cost estimate includes rental of an approximately 75-foot by 150-foot Sprung structure to enclose material staging area. Cost estimate assumes a lease price of $4 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out to support operation of the sprung structure.

8. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based excavation and capping operations. Assumes structure will consist of flexi-floats and piles.

9. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms and a 50% replacement rate around the Area for Remedial Consideration.

10. Dredge Area Containment cost estimate includes labor, equipment, and materials necessary to purchase, install, and extract sheet piles. Containment sheeting cost assumes temporary sheeting installed to a 70 feet depth over approximately 700 feet in length to enclose the NAPL Area.

11. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit or the Hudson River under a SPDES permit at no additional cost.

12. Debris removal includes labor, materials, equipment, disposal and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the dredging/capping area.

13. Excavation cost estimate includes labor, equipment, and materials necessary to excavate material from the NAPL and potentially toxic sediment removal area via mechanical dredging in the wet, load into scows and transport scows to the floating work platform for offloading via a long reach excavator. Volume estimate assumes 1-foot cut over entire area (1.1 acres) and 3:1 side slopes around

14. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the material staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in assocation with sediment management will be treated onsite through the temporary water treatment system.

15. Sediment cap cost estimate includes labor, materials, equipment, and services necessary for, or incidental to, the placement of sediment cap. The cap material will be comprised of a layer of RCM followed by a 6" thick layer of D50- 3" stone. Cap placement is assumed to be completed utilizing general construction equipment within containment.

16. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Assumes 100% of the dredged material will be transported to and treated at ESMI - Fort Edward, New York. Cost estimate assumes treated soil will not require disposal at a

17. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, TCLP metals, PCBs, VOCs, SVOCs, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/ disposal.

18. Upland and shoreline restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and access road.

19. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to river and use of the river, as well as limit future activities that could damage the sediment

20. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

21. Construction management cost is based on an assumed 10% of the total capital costs.

22. Cap monitoring cost estimate includes labor, equipment, and materials necessary to conduct cap monitoring activities. Assumes cap monitoring will be conducted annually for the first 5 years and then once every 5 years until year 30. Cap monitoring activities will consist of diver inspections. Cost estimate assumes two workers and two divers will be required to complete the monitoring activities.

23. Cap Maintenance cost estimate assumes 10% of the total capital cost of the alternative to be perfomed annually for the first 5 years and once every 5 years until year 30.

24. Annual Monitoring Report cost estimate includes labor necessary to prepare an annual report for submittal to NYSDEC summarizing the verification and certification of institutional controls, as well as results of sediment monitoring activities (when performed).

25. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

26. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with OSWER Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (USEPA, 1993).

Table B-6
Cost Estimate for Alternative 5
Excavation of Sediments within the Area for Remedial Consideration to a Depth of 2 feet, Capping, Restoration, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$704,000	$704,000
3	Pre-Design Investigation	1	LS	$200,000	$200,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$150,000	$150,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Open Span Structure	1	LS	$304,000	$304,000
	Air Treatment	1	LS	$188,000	$188,000
8	Floating Work Platform	1	LS	$100,000	$100,000
9	Absorbent Booms	1	LS	$10,000	$10,000
10	Temporary Water Treatment System				
	Installation and Operation	3.8	MONTH	$150,000	$564,000
11	Dredge Area Containment				
	Containment Sheeting	49,000	SF	$65	$3,185,000
12	Debris Removal	1.1	AC	$10,000	$12,000
13	Sediment Excavation and Handling	3,850	CY	$250	$963,000
14	Sediment Dewatering and Stabilization				
	Blending Operations	4,000	CY	$30	$120,000
	Stabilization Admixture	600	TON	$115	$69,000
15	Sediment Cap				
	RCM	49,000	SF	$6	$294,000
	Stone cover	900	CY	$35	$32,000
16	Transportation and Disposal				
	Transportation and Disposal - LTTD	6,600	TON	$85	$561,000
17	Solid Waste Characterization	14	each	$1,200	$16,800
18	Upland and Shoreline Restoration	1	LS	$75,000	$75,000
19	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$7,737,800
20				Administration & Engineering (15%)	$1,160,670
21				Construction Management (10%)	$773,780
				Contingency (20%)	$1,547,560
				Total Capital Cost	$11,220,000
Operation and Maintenance Costs					
22	Cap Monitoring	1	LS	$75,000	$75,000
23	Cap Maintenance	1	LS	$50,000	$50,000
24	Annual Monitoring and Maintenance Report	1	LS	$30,000	$30,000
25	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$165,000
				Contingency (20%)	$33,000
				Total Annual O&M Cost	$198,000
26				30-Year Total Present Worth Cost of O&M	$1,720,000
				Total Estimated Cost:	**$12,940,000**
				Rounded To:	**$12,940,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-6
Cost Estimate for Alternative 5
Excavation of Sediments within the Area for Remedial Consideration to a Depth of 2 feet, Capping, Restoration, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments offsite for treatment/disposal and install sediment cap. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including transportation and disposal.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-excavation), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch bermed and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $12 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Open span structure and air treatment cost estimate includes rental of an approximately 75-foot by 150-foot Sprung structure to enclose material staging area. Cost estimate assumes a lease price of $4 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out to support operation of the sprung structure.

8. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based excavation and backfill operations. Assumes structure will consist of flexi-floats and

9. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms and a 50% replacement rate around the Area for Remedial Consideration.

10. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit or the Hudson River under a SPDES permit at no additional cost.

11. Dredge Area Containment cost estimate includes labor, equipment, and materials necessary to purchase, install, and extract sheet piles. Containment sheeting cost assumes temporary sheeting installed to a 70 feet depth over approximately 700 feet in length to enclose the NAPL Area.

12. Debris removal includes labor, materials, equipment, disposal and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the dredging/capping area.

Table B-6
Cost Estimate for Alternative 5
Excavation of Sediments within the Area for Remedial Consideration to a Depth of 2 feet, Capping, Restoration, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

13. Excavation cost estimate includes labor, equipment, and materials necessary to excavate material from the NAPL and potentially toxic sediment removal area via mechanical dredging in the wet, load into scows and transport scows to the floating work platform for offloading via a long reach excavator. Volume estimate assumes 2-foot cut over entire area (1.1 acres) and 3:1 side slopes around the excavation area.

14. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the material staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in assocation with sediment management will be treated onsite through the temporary water treatment system.

15. Sediment cap cost estimate includes labor, materials, equipment, transport and services necessary for, or incidental to, the placement of sediment cap. The cap material will be comprised of a layer of RCM followed by a 6" thick layer of D50 - 3" stone. Cap placement is assumed to be completed utilizing general construction equipment within containment. Sediment cap cost assume natural sediment redeposition and does not assumes placement of benthic layer.

16. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Assumes 100% of the dredged material will be transported to and treated at ESMI - Fort Edward, New York. Cost estimate assumes treated soil will not require disposal at a solid waste landfill.

17. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, TCLP metals, PCBs, VOCs, SVOCs, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/ disposal.

18. Upland and shoreline restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and

19. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to river and use of the river, as well as limit future activities that could damage the sediment cap.

20. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

21. Construction management cost is based on an assumed 10% of the total capital costs.

22. Cap monitoring cost estimate includes labor, equipment, and materials necessary to conduct cap monitoring activities. Assumes cap monitoring will be conducted annually for the first 5 years and then once every 5 years until year 30. Cap monitoring activities will consist of diver inspections. Cost estimate assumes two workers and two divers will be required to complete the monitoring activities.

23. Cap Maintenance cost estimate assumes 10% of the total capital cost of the alternative to be perfomed annually for the

24. Annual Monitoring Report cost estimate includes labor necessary to prepare an annual report for submittal to NYSDEC summarizing the verification and certification of institutional controls, as well as results of sediment monitoring activities (when performed).

25. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and

26. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with OSWER Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (USEPA, 1993).

Table B-7
Cost Estimate for Alternative 6
Excavation of Sediments within the Area for Remedial Consideration to Variable Depths (up to 6 feet), Backfill, Capping, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$844,000	$844,000
3	Pre-Design Investigation	1	LS	$250,000	$250,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$150,000	$150,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Open Span Structure	1	LS	$350,000	$350,000
	Air Treatment	1	LS	$239,000	$239,000
8	Floating Work Platform	1	LS	$100,000	$100,000
9	Absorbent Booms	1	LS	$10,000	$10,000
10	Temporary Water Treatment System				
	Installation and Operation	4.8	MONTH	$150,000	$715,000
11	Dredge Area Containment				
	Shoreline Bracing	2,100	SF	$50	$105,000
	Containment Sheeting	49,000	SF	$65	$3,185,000
12	Debris Removal	1.1	AC	$10,000	$12,000
13	Sediment Excavation and Handling	6,000	CY	$250	$1,500,000
14	Sediment Dewatering and Stabilization				
	Blending Operations	6,000	CY	$30	$180,000
	Stabilization Admixture	900	TON	$115	$104,000
15	Sediment Cap				
	Leveling Layer	2,100	CY	$35	$74,000
	RCM	49,000	SF	$6	$294,000
	Stone cover	900	CY	$35	$32,000
16	Transportation and Disposal				
	Transportation and Disposal - LTTD	9,900	TON	$85	$841,500
17	Solid Waste Characterization	20	each	$1,200	$24,000
18	Upland and Shoreline Restoration	1	LS	$75,000	$75,000
19	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$9,274,500
20				Administration & Engineering (15%)	$1,391,175
21				Construction Management (10%)	$927,450
				Contingency (20%)	$1,854,900
				Total Capital Cost	$13,450,000
Operation and Maintenance Costs					
22	Cap Monitoring	1	LS	$75,000	$75,000
23	Cap Maintenance	1	LS	$50,000	$50,000
24	Annual Monitoring and Maintenance Report	1	LS	$30,000	$30,000
25	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$165,000
				Contingency (20%)	$33,000
				Total Annual O&M Cost	$198,000
26				30-Year Total Present Worth Cost of O&M	$1,720,000
				Total Estimated Cost:	**$15,170,000**
				Rounded To:	**$15,170,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-7
Cost Estimate for Alternative 6
Excavation of Sediments within the Area for Remedial Consideration to Variable Depths (up to 6 feet), Backfill, Capping, and Institutional Controls

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments offsite for treatment/disposal and install sediment cap. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including transportation and disposal.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-excavation), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch bermed and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $12 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Open span structure and air treatment cost estimate includes rental of an approximately 75-foot by 150-foot Sprung structure to enclose material staging area. Cost estimate assumes a lease price of $4 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out to support operation of the sprung structure.

8. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.

9. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms and a 50% replacement rate around the Area for Remedial Consideration.

10. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit or the Hudson River under a SPDES permit at no additional cost.

11. Dredge Area Containment cost estimate includes labor, equipment, and materials necessary to purchase, install, and extract sheet piles. Shoreline bracing assumes temporary sheeting installed to a 20 feet depth over approximately 60 feet in length. Containment sheeting cost assumes temporary sheeting installed to a 70 feet depth over approximately 700 feet in length to enclose the NAPL Area.

12. Debris removal includes labor, materials, equipment, disposal and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the dredging/capping area.

13. Excavation cost estimate includes labor, equipment, and materials necessary to excavate material from the NAPL and potentially toxic sediment removal area via mechanical dredging in the wet, load into scows and transport scows to the floating work platform for offloading via a long reach excavator. Volume estimate assumes excavation cuts up to 6-feet, based on dredge prisms over the removal area (1.1 acres) and 3:1 side slopes around the excavation perimeter area.

14. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the material staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in assocation with sediment management will be treated onsite through the temporary water treatment system.

15. Sediment cap cost estimate includes labor, materials, equipment, transport and services necessary for, or incidental to, the placement of sediment cap. Prior to cap placement, the excavation surface will receive a leveling layer of sand to -2-feet below ground surface. The cap material will be comprised of a layer of RCM followed by a 6" thick layer of D50 - 3" stone. Cap placement is assumed to be completed utilizing general construction equipment within containment. Sediment cap cost assume natural sediment redeposition and does not assumes placement of benthic layer.

16. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Assumes 100% of the dredged material will be transported to and treated at ESMI - Fort Edward, New York. Cost estimate assumes treated soil will not require disposal at a solid waste landfill.

17. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, TCLP metals, PCBs, VOCs, SVOCs, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/ disposal.

18. Upland and shoreline restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and

19. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to river and use of the river, as well as limit future activities that could damage the sediment cap.

20. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

21. Construction management cost is based on an assumed 10% of the total capital costs.

22. Cap monitoring cost estimate includes labor, equipment, and materials necessary to conduct cap monitoring activities. Assumes cap monitoring will be conducted annually for the first 5 years and then once every 5 years until year 30. Cap monitoring activities will consist of diver inspections. Cost estimate assumes two workers and two divers will be required to complete the monitoring activities.

23. Cap Maintenance cost estimate assumes 10% of the total capital cost of the alternative to be perfomed annually for the first

24. Annual Monitoring Report cost estimate includes labor necessary to prepare an annual report for submittal to NYSDEC summarizing the verification and certification of institutional controls, as well as results of sediment monitoring activities (when performed).

25. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

26. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with OSWER Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (USEPA, 1993).

Table B-8
Cost Estimate for Alternative 7

Excavation of Sediments within the Area for Remedial Consideration to Full Depth of NAPL, and Backfill

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$962,000	$962,000
3	Pre-Design Investigation	1	LS	$200,000	$200,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$150,000	$150,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Open Span Structure	1	LS	$392,000	$392,000
	Air Treatment	1	LS	$285,000	$285,000
8	Floating Work Platform	1	LS	$100,000	$100,000
9	Absorbent Booms	1	LS	$10,000	$10,000
10	Temporary Water Treatment System				
	Installation and Operation	5.7	MONTH	$150,000	$855,000
11	Dredge Area Containment				
	Shoreline Bracing	2,100	SF	$50	$105,000
	Containment Sheeting	49,000	SF	$65	$3,185,000
12	Debris Removal	1.1	AC	$10,000	$11,300
13	Sediment Excavation and Handling	9,000	CY	$250	$2,250,000
14	Sediment Dewatering and Stabilization				
	Blending Operations	9,000	CY	$30	$270,000
	Stabilization Admixture	1350	TON	$115	$156,000
15	Backfill				
	Sand Layer	5,200	CY	$35	$182,000
16	Transportation and Disposal				
	Transportation and Disposal - LTTD	14,850	TON	$85	$1,262,300
17	Solid Waste Characterization	30	each	$1,200	$36,000
18	Upland and Shoreline Restoration	1	LS	$75,000	$75,000
				Subtotal Capital Cost	$10,576,600
19				Administration & Engineering (15%)	$1,586,490
20				Construction Management (10%)	$1,057,660
				Contingency (20%)	$2,115,320
				Total Capital Cost	$15,340,000
				Total Estimated Cost:	**$15,340,000**
				Rounded To:	**$15,340,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-8
Cost Estimate for Alternative 7

Excavation of Sediments within the Area for Remedial Consideration to Full Depth of NAPL, and Backfill

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to dredge and transport excavated sediments offsite for treatment/disposal and backfill. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including transportation and disposal.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-excavation), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch bermed and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $12 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Open span structure and air treatment cost estimate includes rental of an approximately 75-foot by 150-foot Sprung structure to enclose material staging area. Cost estimate assumes a lease price of $4 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out to support operation of the sprung structure.

8. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.

9. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms and a 50% replacement rate around the Area for Remedial Consideration.

10. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit or the Hudson River under a SPDES permit at no additional cost.

11. Dredge Area Containment cost estimate includes labor, equipment, and materials necessary to purchase, install, and extract sheet piles. Shoreline bracing assumes temporary sheeting installed to a 35 feet depth over approximately 60 feet in length. Containment sheeting cost assumes temporary sheeting installed to a 70 feet depth over approximately 700 feet in length to enclose the NAPL Area.

12. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the dredging area.

13. Excavation cost estimate includes labor, equipment, and materials necessary to excavate material from the NAPL and potentially toxic sediment removal area via mechanical dredging in the wet, load into scows and transport scows to the floating work platform for offloading via a long reach excavator. Volume estimate assumes excavation to the full depth of NAPL, based on dredge prisms over the removal area (1.1 acres) and 3:1 side slopes around the excavation perimeter

14. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the material staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in assocation with sediment management will be treated onsite through the temporary water treatment system.

15. Backfill cost estimate includes labor, materials (including transpor/delivery), equipment, necessary for, or incidental to, the placement of backfill following sediment excavation activities. Backfill will include placement of clean sand to -2-feet below pre-dredge elevation over the entire removal footprint area. Backfill placement is assumed to be completed utilizing general construction equipment.

16. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Assumes 100% of the dredged material will be transported to and treated at ESMI - Fort Edward, New York. Cost estimate assumes treated soil will not require disposal at a solid waste landfill.

17. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, TCLP metals, PCBs, VOCs, SVOCs, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/ disposal.

18. Upland and shoreline restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and

19. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

20. Construction management cost is based on an assumed 10% of the total capital costs.

Table B-9
Cost Estimate for Alternative 8

Excavation of Sediments within the 4 mg/Kg PAH Area, and Backfill

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permits and Approvals	1	LS	$100,000	$100,000
2	Mobilization/Demobilization	1	LS	$2,615,000	$2,615,000
3	Pre-Design Investigation	1	LS	$200,000	$200,000
4	Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000
5	Construct and Maintain Material Staging Area	1	LS	$150,000	$150,000
6	Construct Access Roadway	1	LS	$25,000	$25,000
7	Open Span Structure	1	LS	$1,093,000	$1,093,000
	Air Treatment	1	LS	$1,064,000	$1,064,000
8	Floating Work Platform	1	LS	$100,000	$100,000
9	Absorbent Booms	1	LS	$10,000	$10,000
10	Temporary Water Treatment System				
	Installation and Operation	21.3	MONTH	$150,000	$3,191,600
	Winterization	1	LS	$20,000	$20,000
11	Dredge Area Containment				
	Shoreline Bracing	35,000	SF	$50	$1,750,000
	Containment Sheeting	49,000	SF	$65	$3,185,000
12	Debris Removal	6.1	AC	$10,000	$62,000
13	Sediment Excavation and Handling				
	NAPL Area	9,000	CY	$250	$2,250,000
	PAH Area	32,000	CY	$150	$4,800,000
14	Sediment Dewatering and Stabilization				
	Blending Operations	41,000	CY	$30	$1,230,000
	Stabilization Admixture	6,150	TON	$115	$707,300
15	Backfill				
	Sand Layer	21,000	CY	$35	$735,000
16	Transportation and Disposal				
	Transportation and Disposal - LTTD	14,850	TON	$85	$1,262,300
	Transportation and Disposal - Non-Hazardous Waste	52,800	TON	$75	$3,960,000
17	Solid Waste Characterization	136	each	$1,200	$163,200
18	Upland and Shoreline Restoration	1	LS	$75,000	$75,000
				Subtotal Capital Cost	$28,763,400
19				Administration & Engineering (15%)	$4,314,510
20				Construction Management (10%)	$2,876,340
				Contingency (20%)	$5,752,680
				Total Capital Cost	$41,706,929
				Total Estimated Cost:	**$41,706,929**
				Rounded To:	**$41,710,000**

General Notes:

1. Cost estimate is based on ARCADIS of New York's (ARCADIS') past experience and vendor estimates using 2011 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

3. All costs assume field work to be conducted by non-union labor.

Table B-9
Cost Estimate for Alternative 8

Excavation of Sediments within the 4 mg/Kg PAH Area, and Backfill

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

Assumptions:

1. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from Federal, state and local agencies for two years. Access agreement costs not included.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to dredge and transport excavated sediments offsite for treatment/disposal and backfill. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including transportation and disposal.

3. Pre-design investigation cost estimate includes labor, equipment, materials, laboratory analysis necessary to conduct pre-design investigation sediment sampling activities (5 sampling locations), two bathymetric surveys (pre- and post-excavation), hydraulic modeling, lodging, subsidence, and oversight. Cost estimate assumes work to be completed via a barge-mounted drill rig, which includes drill rig operator and crew.

4. Decontamination area cost estimate includes labor, equipment, and materials necessary to construct and remove a 60-foot by 30-foot decontamination pad and appurtenances. The decontamination pad would consist of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil HDPE liner and a 6-inch layer of gravel.

5. Material staging area cost estimate includes labor, equipment, and materials necessary to construct a 75-foot by 150-foot material staging area constructed of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch bermed and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization. Maintenance includes inspecting and repairing staging area as necessary. Estimate assumes construction cost of approximately $12 per square-foot of pad.

6. Construct access roadway cost estimate includes labor, equipment, and material necessary to construct a construction vehicle access roadway. Cost estimate assumes roadway is 200 feet long, 25 feet wide, and 1 foot thick, construct of graded and compacted run-of-crusher material.

7. Open span structure and air treatment cost estimate includes rental of an approximately 75-foot by 150-foot Sprung structure to enclose material staging area. Cost estimate assumes a lease price of $4 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of vapor collection and treatment equipment, delivery and set-up fees, and filter media change out to support operation of the sprung structure.

8. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.

9. Absorbent booms cost estimate includes materials, labor, and equipment to install absorbent booms and a 50% replacement rate around the Area for Remedial Consideration.

10. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit or the Hudson River under a SPDES permit at no additional cost.

11. Dredge Area Containment cost estimate includes labor, equipment, and materials necessary to purchase, install, and extract sheet piles. Shoreline bracing assumes temporary sheeting installed to a 35 feet depth over approximately 1000 feet in length. Containment sheeting cost assumes temporary sheeting installed to a 70 feet depth over approximately 700 feet in length to enclose the NAPL Area.

12. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles, debris (e.g., boulders, wood pilings, etc.) from the dredging area.

13. Excavation cost estimate includes labor, equipment, and materials necessary to excavate material from the NAPL and potentially toxic sediment removal area via mechanical dredging in the wet, load into scows and transport scows to the floating work platform for offloading via a long reach excavator. Volume estimate assumes excavation of all 4 mg/Kg PAH sediment within the excavation area (7 acres) and 3:1 side slopes around the excavation perimeter area. Duration assumes average excavation rate of 150cy/day, due to extended construction season through winter.

Table B-9
Cost Estimate for Alternative 8

Excavation of Sediments within the 4 mg/Kg PAH Area, and Backfill

Feasibility Study Report for Operable Unit 2
National Grid
Hudson (Water Street) Site - Hudson, New York

14. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the material staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in assocation with sediment management will be treated onsite through the temporary water treatment system.

15. Backfill cost estimate includes labor, materials (including transpor/delivery), equipment, necessary for, or incidental to, the placement of backfill following sediment excavation activities. Backfill will include placement of clean sand to -2-feet below pre-dredge elevation over the entire removal footprint area. Backfill placement is assumed to be completed utilizing general construction equipment.

16. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Assumes 100% of the dredged material within the NAPL Area for Remedial Consideration and 80% within the PAH Area will be transported to and treated at ESMI - Fort Edward, New York. Cost estimate assumes treated soil will not require disposal at a solid waste landfill. The remaining 20% of the PAH Area and potentially toxic sediment area materials excavated are assumed to be characterized as non-hazardous and will be transported to and disposed of at a licensed and approved facility to be determined.

17. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, TCLP metals, PCBs, VOCs, SVOCs, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/ disposal.

18. Upland and shoreline restoration cost estimate includes labor, equipment, and materials necessary to seed and install erosion protection materials (e.g., erosion control fabric, straw/mulch) for the areas disturbed from the staging areas and

19. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.

20. Construction management cost is based on an assumed 10% of the total capital costs.