

Prepared for:
BASF Corporation
Florham Park, New Jersey

Site Investigation Report Hudson River Operable Unit 2 BASF Rensselaer Rensselaer, New York

ENSR Corporation
June 2007
Document No.: 00760-171-250



The Chemical Company

June 11, 2007

Mr. Daniel Lightsey
New York Department of Environmental Conservation
Region 4 Headquarters
1130 North Westcott Road
Schenectady, NY 12306

Re: Phase II Sediment Remediation Investigation
BASF's Rensselaer Site

Dear Mr. Lightsey:

Accompanying this letter please find three copies of the "Site Investigation Report, Hudson River Operable Unit 2, BASF Rensselaer". This report was originally provided to you in draft form in February 2007 and has been revised in response to comments from your agency. I am pleased to say that we have made a great deal of progress in understanding the river system and the distribution of contaminants near BASF's Rensselaer site. Please distribute this report to your project team and don't hesitate to contact me should you need additional copies.

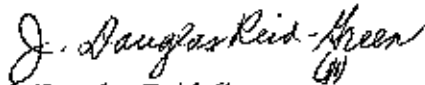
On a parallel track, we have prepared a draft scope of work focusing on filling in data gaps identified in the Site Investigation Report and evaluating the potential for long-term risks associated with exposure to contaminants found in sediment.

I look forward to meeting with you and the rest of the project team on June 26 to discuss the report and work with your team to complete the scope for the next phase of fieldwork.

Please don't hesitate to contact me at (908) 507-8820 if you have any questions or comments.

Yours truly,

BASF CORPORATION


J. Douglas Reid-Green
Remediation Team Member



Page 2

Attachment

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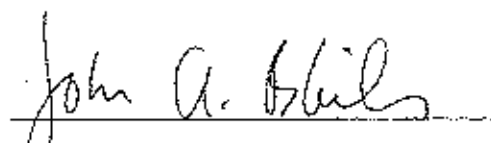
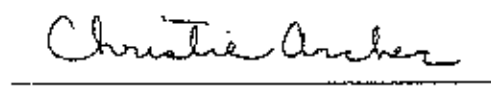
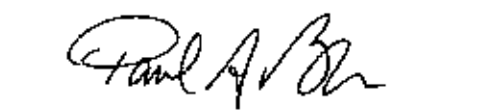
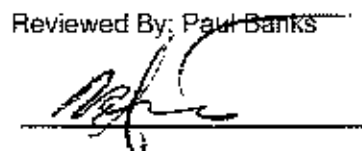
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Site Investigation Report Hudson River Operable Unit 2 BASF Rensselaer Rensselaer, New York


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Contents

Executive Summary.....	ES-1
1.0 Introduction.....	1-1
1.1 Program Objectives.....	1-1
1.2 Investigation Scope and Summary Conclusions	1-2
1.3 Site History	1-3
1.4 Previously Completed Studies.....	1-3
1.4.1 Investigations Related to Future Industrial Use of the Property	1-3
1.4.2 BASF Sediment Screening Study.....	1-3
1.4.3 NYSDEC Benthic Survey Program	1-4
1.4.4 Regulatory Authority.....	1-4
1.5 Document Organization	1-4
2.0 Site Background and Environmental Setting.....	2-1
2.1 Hydrology	2-1
2.2 Geology	2-2
2.3 Hydrogeology	2-2
2.4 Geomorphology.....	2-2
2.5 Navigational Dredging Operations.....	2-3
2.6 Bathymetry	2-3
2.7 Physical Description of Sediments	2-3
2.7.1 Grain Size	2-4
2.7.2 Erosional/Depositional Characteristics	2-4
2.8 Regional Trends in Sediment Quality (Historic Data)	2-5
2.9 Local Trends in Sediment Quality (Historic Data)	2-5
2.9.1 Distribution of Metals of Interest	2-5
2.9.2 Distribution of VOCs.....	2-6
2.10 Potential Relationships between Compound Concentration and Other Factors	2-6
2.11 Groundwater.....	2-7
2.12 Biology	2-7
2.12.1 Aquatic Vegetation	2-7
2.12.2 Fish Community	2-8
2.12.3 Benthic Community	2-8
2.13 Development of a Preliminary Conceptual Site Model	2-9
2.14 Identification of Data Gaps.....	2-10

3.0 Field Sampling Materials and Methods	3-1
4.0 Field Program Results	4-1
4.1 Geophysical Survey	4-1
4.2 Sediment Grain Size	4-1
4.3 Inorganic Compounds in Sediment	4-2
4.4 Organic Compounds in Sediment	4-3
4.5 Simultaneously Extracted Metals, Acid Volatile Sulfides and TOC in Sediment	4-4
4.6 Benthic Macroinvertebrate Community Analysis	4-4
4.7 Surface Water VOCs and Inorganic Compounds	4-5
5.0 Statistical Analysis of Upstream/Downstream Sediment Quality	5-1
5.1 Data Selection and Treatment	5-1
5.2 Statistical Methods	5-2
5.3 Results of Statistical Analyses	5-3
6.0 Analysis of Potential Risks to Human Health	6-1
6.1 Potential Exposure Pathways Evaluated in the Human Health Risk Assessment	6-1
6.1.1 Potential Exposure Pathways for Sediment	6-1
6.1.2 Potential Exposure Pathways for Surface Water	6-1
6.2 Human Health Risk Screening Results	6-2
6.2.1 Sediment	6-2
6.2.2 Surface Water	6-3
6.3 Conclusions	6-3
7.0 Analysis of Potential Risks to the Environment	7-1
7.1 Potential Exposure Pathways	7-1
7.2 Ecological Risk Analysis	7-1
7.2.1 Ecological Risk Screening Results	7-2
7.2.2 SEM and AVS Analysis	7-4
7.2.3 Benthic Macroinvertebrate Community Assessment	7-4
7.3 Conclusions	7-5
8.0 Conceptual Site Model	8-1
8.1 Primary Sources of Compounds in the River	8-1
8.1.1 Site Primary Sources	8-1
8.1.2 Near-Site Storm Sewers	8-2
8.1.3 Urban River Anthropogenic Contributions	8-2
8.2 Secondary Sources of Compounds	8-3

8.2.1	Distribution of VOCs.....	8-4
8.2.2	Distribution of Metals.....	8-4
8.3	Summary of Primary and Secondary Sources.....	8-6
8.4	Compound Transport Mechanisms.....	8-6
8.5	Human Receptors and Exposure Pathways.....	8-8
8.6	Ecological Receptors and Exposure Pathways.....	8-8
8.6.1	Aquatic Vegetation.....	8-9
8.6.2	Fish Community.....	8-9
8.6.3	Vertebrate Wildlife.....	8-9
8.6.4	Benthic Community.....	8-10
8.7	CSM Update Summary.....	8-10
9.0	Summary and Conclusions.....	9-1
9.1	Sediment Summary.....	9-1
9.2	Surface Water Summary.....	9-2
9.3	Summary of Preliminary Risk Analysis.....	9-2
9.3.1	Human Health Risk Screening.....	9-2
9.3.2	Ecological Risk Screening.....	9-3
9.4	Recommendation.....	9-3
10.0	Literature Cited.....	10-1

List of Appendices

Appendix A Summary of Site Investigation Field Program Methods

Appendix B Field Program Results

Appendix C Geophysical Survey

Appendix D Analytical Data

Appendix E Benthic Macroinvertebrate Survey

Appendix F Sediment Boring Logs

Appendix G Statistical Analysis of Upstream/Downstream Sediment Quality

Appendix H Analysis of Potential Risks to Human Health

Appendix I Screening Level Ecological Risk Assessment

List of Tables

Table 2-1 Hudson River at Green Island Summary Flow Statistics (1946-2003).....	2-12
Table 2-2 Summary of Metals of Interest Results for Hudson River Watershed Sediment Samples.....	2-13
Table 2-3 Summary of 2001 Sediment Metals Data.....	2-14
Table 2-4 Summary of 2004 Sediment Metals Data.....	2-15
Table 2-5 Range of Metals Concentrations Measured in 2004 Study in the Near-Site River Reach.....	2-16
Table 2-6 Summary of 2004 Sediment VOC Data.....	2-17
Table 3-1 Sediment and Surface Water Samples and Analyses.....	3-3
Table 4-1 Sediment Grain Size Results.....	4-6
Table 4-2 Summary of SEM and AVS Data Evaluation.....	4-8
Table 4-3 Surface Water Sampling Results.....	4-9
Table 5-1 Results of Statistical Analysis – Summary.....	5-5
Table 6-1 Summary of Human Health Risk Based Surficial Sediment Screening.....	6-5
Table 6-2 Summary of Human Health Risk Based Sub-Surficial Sediment Screening.....	6-6
Table 6-3 Summary of Human Health Risk Based Surface Water Screening.....	6-10
Table 7-1 Summary of Ecological Risk Based Surficial Sediment Screening – Inorganics.....	7-6
Table 7-2 Summary of Ecological Risk Based Surficial Sediment Screening – VOCs.....	7-9
Table 7-3 Summary of Ecological Risk Based Sub-Surficial Sediment Screening – Inorganics.....	7-10
Table 7-4 Summary of Ecological Risk Based Sub-Surficial Sediment Screening – VOCs.....	7-14
Table 7-5 Summary of Ecological Risk Based Surface Water Screening.....	7-16
Table 8-1 Inorganic Toxic Units in Surficial Sediment.....	8-12

List of Figures

Figure 1-1 Site Location.....	1-6
Figure 1-2 Risk Based Surface Water and Sediment Decision Path.....	1-7
Figure 1-3 Location of Outfalls Adjacent to the Site	1-8
Figure 1-4 Hudson River Sampling Reaches	1-9
Figure 2-1 Overview of the Hudson River	2-18
Figure 2-2 Bathymetric Profile Based on ENSR 2001 Survey	2-19
Figure 2-3 Bathymetric Profile Based on NYSDEC 2003 Survey	2-20
Figure 2-4 Grain Size Profile Based on NYSDEC 2003 Survey	2-21
Figure 2-5 Grain Size Samples and Bathymetry from the NYSDEC 2003 Survey	2-22
Figure 2-6 Sediment Environments Based on the NYSDEC 2003 Survey	2-23
Figure 2-7 NYSDEC and USGS Historic Sampling Locations	2-24
Figure 2-8 Sediment Sampling Locations in the Vicinity of the BASF Site.....	2-25
Figure 2-9 Correlation of Metals with Grain Size	2-26
Figure 3-1 Sampling Locations - 2005 and 2006 Field Efforts	3-7
Figure 4-1 Sediment Textural Classification – 2005 Geophysical Survey	4-10
Figure 4-2 Metals of Potential Interest in Surficial and Sub-surficial Sediment – Upstream, Adjacent Far Field, Upper Navigational Channel, and Downstream Regions	4-11
Figure 4-3 Metals of Potential Interest in Surficial and Sub-surficial Sediment – Adjacent Nearshore	4-12
Figure 4-4 Selected VOCs in Surface and Sub-surficial Sediment.....	4-13
Figure 7-1 Benthic Macroinvertebrate Community Similarity Analysis	7-18
Figure 8-1 Generalized Conceptual Site Model.....	8-21
Figure 8-2 Cross Section Index	8-22
Figure 8-3 Cross Section A-A'	8-23
Figure 8-4 Cross Section B-B'	8-24
Figure 8-5 Cross Section C-C'	8-25
Figure 8-6 Cross Section D-D'	8-26
Figure 8-7 TOC versus Percent Fines in Surficial Sediment.....	8-27
Figure 8-8 Mean Toxic Units versus Percent Fines in Surficial Sediment.....	8-28

List of Acronyms

ACOE	Army Corps of Engineers
AVS	Acid Volatile Sulfides
AWQC	Ambient Water Quality Criteria
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CERCLA	Comprehensive, Environmental Response, Compensation and Liability Act
cfs	Cubic Feet per Second
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
CSO	Combined Sewer Overflow
DGPS	Differential Global Positioning System
EPC	Exposure Point Concentration
EqP	Equilibrium Partitioning
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ESL	Ecological Screening Level
FS	Feasibility Study
FOD	Frequency of Detection
HHRA	Human Health Risk Assessment
LEL	Low Effect Level
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MLLW	Mean Lower Low Water
NAWQA	National Water-Quality Assessment Program
NOAA	National Oceanic and Atmospheric Administration
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NGVD	National Geodetic Vertical Datum
OU	Operable Unit
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
PBT	Persistent Bioaccumulative and Toxic
PCB	Polychlorinated Biphenyl
RI	Remedial Investigation

RM	River Mile
SEL	Severe Effect Level
SEM	Simultaneously Extracted Metals
SLCOPC	Screening Level Chemicals of Potential Concern
SMDP	Scientific/Management Decision Points
SQL	Sample Quantitation Limit
SVOC	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbon
TOC	Total Organic Carbon
TOGS	Technical and Operational Guidance Series
TSS	Total Suspended Solids
TU	Toxic Unit
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WDNR	Wisconsin Department of Natural Resources
WRS	Wilcoxon Rank Sum
WQS	Water Quality Standard

Executive Summary

BASF Corporation ("BASF") has been working with the New York State Department of Environmental Conservation ("NYSDEC") for several years to improve conditions at its former dye manufacturing facility in Rensselaer, New York ("Site").

To date, several remedial activities have been completed, pursuant to NYSDEC's approval and oversight. This work, undertaken in areas designated as Operable Unit 1 ("OU-1"), has been guided by BASF's corporate philosophy that environmental, health and safety activities are ongoing responsibilities and evolving components of its commitment to sustainable development.

Cleanup of the northern manufacturing area, the "South 40" parcel and two on-Site water lagoons has been completed. An on-Site groundwater treatment system incorporating a groundwater containment system that prevents groundwater from moving off-site has been installed. In addition, BASF is nearly finished converting a former landfill on the Site into a nine-acre wildlife habitat area; additional plantings will occur this spring. The primary remaining task is to place a cap over the Site, as dictated by NYSDEC's Record of Decision.

During the implementation of these land-based activities, BASF also evaluated potential impacts of historic discharges to the Hudson River in the areas adjacent to the Site. This investigation is on-going and is the subject of this document, the Site Investigation Report — Hudson River (the "Report").

To begin the investigation of the river surface water and sediment, BASF committed to follow the guiding principles that had been used for the OU-1 work:

1. Identify areas/sub-habitats in the river where Site-related chemicals of potential concern (COPCs) represent a significant potential risk to human health or ecological receptors;
2. Implement actions needed to reduce or eliminate the identified risk, consistent with sediment management guidance provided by the NYSDEC and United States Environmental Protection Agency (USEPA);
3. Provide for ongoing improvement of conditions in the river environment(s) where Site-related COPCs may be present; and
4. Provide ecological enhancement and value to the river, as appropriate.

The initial river study began in 2004 with the collection of a limited number of sediment samples to determine if Site-related compounds were present in river sediments. The study was focused on areas near three storm sewer outfalls (two of which are owned by municipalities) and two inactive industrial sewer outfalls, all of which exit into the river adjacent to the Site. This preliminary study identified the presence of certain volatile organic compounds ("VOCs"), semi-volatile organic compounds ("SVOCs"), and metals that exceeded published ecological screening criteria in some sediments. These data were reported to NYSDEC in 2004 (Roux, 2004b).

Based on these findings, BASF prepared a work plan (Roux, 2004b) designed to further investigate environmental conditions in Hudson River sediments. NYSDEC approved this work plan on April 28, 2004.

Following the approval of the initial work plan, BASF developed a more specific work plan (ENSR, 2005a) which described the field efforts planned for the OU-2 investigation. To develop this plan, BASF reviewed studies conducted at the Site by ENSR in 2001 and sonar mapping conducted by NYSDEC in 2003 and 2004. A summary of these evaluations is contained in Sections 1 and 2.

The work plan contained a preliminary Conceptual Site Model ("CSM") that defined the river system and the fate and transport mechanisms at work within it. The work plan included a number of additional studies to further refine this CSM, including:

- A geophysical investigation, including a side-scan sonar survey over more than two miles of river bottom, to provide information on river bathymetry and to identify the type of material on the river bottom.
- Additional sediment sampling in areas upstream of, adjacent to and downstream of the Site, in each type of sub-habitat, to better characterize distribution of compounds in the sediments.
- Surface water sampling from within the water column to determine potential impacts to surface water.
- Sampling of the benthic macroinvertebrate communities in each type of sub-habitat from upstream of, adjacent to and downstream of the Site to evaluate diversity and abundance of species.
- Screening level risk assessments to determine the potential for risk to human health and/or the environment.

BASF conducted the associated fieldwork for these studies from November 2005 through May 2006. This program included the collection of nearly 200 sediment samples at depths ranging from the surface of the river bottom to 12 feet below the surface. Samples were analyzed for a wide range of compounds and physical characteristics. Detailed evaluations followed, resulting in the following initial observations, which may be subject to further investigation:

- Compound concentrations in surface water samples adjacent to the Site were similar to upstream concentrations. Within the dissolved surface water data set, the maximum concentrations of all inorganic analytes, except nickel and zinc, were higher upstream of the Site. In the total recoverable inorganic constituent data set, the maximum concentrations of half of the 22 analytes were detected upstream of the Site. The largest difference between the two areas for any analyte in surface water was observed for dissolved zinc (maximum value in Adjacent Nearshore was 3.1 times the Upstream value). Concentrations of the two detected VOCs (acetone and toluene) were slightly more elevated in the Adjacent Nearshore area, but the observed values are still very low relative to regulatory criteria.
- River sediments located immediately adjacent to the Site contain high levels of inorganic compounds (e.g., cadmium, chromium, copper, lead, mercury, and zinc) and VOCs (e.g., several chlorinated benzenes, benzene, ethylbenzene, toluene and total xylenes). These compounds are primarily located in sediment near the five outfalls located adjacent to the Site. Compounds were detected in deep and surficial sediments.
- Coarser-grained sediments located in the same vicinity of the Site, but further west of the nearshore area, do not contain elevated levels of compounds, suggesting that the extent of Site-related impacts does not extend far beyond the Site to the west.
- Elevated levels of certain inorganic compounds (e.g., cadmium, chromium, copper, lead, mercury, and zinc) are present in sediment in the central portion of the river located downstream of the southern-most outfall. This area is now a depositional environment that is located where historic navigational dredging operations occurred.
- A screening level human health risk assessment indicated that there is no unacceptable risk to human health from exposure to sediment or surface water adjacent to the Site. Compound concentrations in surface water samples adjacent to the Site were similar to upstream concentrations and most were below applicable surface water standards. Moreover, individuals are not expected to come into contact with the sediments in the vicinity of the Site because of a vertical metal bulkhead that forms the shoreline between the Site and the river. Industrial facilities located

on the opposite bank further limit Site access. The Site is securely fenced and guarded, further restricting access to the river. Finally, the impacted sediment is located beneath at least five feet of water. If conditions change in the future and sub-surface sediments become exposed, additional risk analysis may be necessary. There is some uncertainty as to whether levels of benzene or other VOCs present in sediment are likely to bioaccumulate into fish since they were generally not detected in the surface water.

- A screening level ecological risk assessment indicated that surface water concentrations adjacent to the Site were similar to upstream conditions. Despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments, review of the available macroinvertebrate biology data indicates that the diversity and abundance of the macroinvertebrate communities observed upstream of, adjacent to, and downstream of the Site are similar. Similarly, no relationship between elevated levels of compounds in the sediment and the macroinvertebrate community health was observed. There is some uncertainty as to whether compounds in sediment are likely to bioaccumulate into fish and additional data collection may be warranted to address the lack of analytical data in the 0.5 – 2 ft sediment horizon.

Based on this latest investigation, BASF recommends additional studies to further characterize conditions in river sediments. BASF will discuss the results and conclusions contained in this Report with NYSDEC and subsequently prepare and submit to the Agency a work plan detailing additional data collection activities and risk assessment analysis that are needed to complete the investigation.

1.0 Introduction

This Site Investigation Report ("Report") presents the results of the recently completed surface water and sediment investigation of the Hudson River adjacent to the BASF Corporation ("BASF") facility ("Site") in Rensselaer, New York (Figure 1-1). The study area consisted of a 3.2-mile reach of the Hudson River, extending from a turning basin located south of the Site to a point approximately 600 feet south of the Interstate 90 Bridge ("Study Area"). This Report has been prepared by ENSR Corporation ("ENSR") on behalf of BASF. The Draft Site Assessment Report was submitted to the New York State Department of Environmental Conservation ("NYSDEC") in February 2007. This revised report was prepared in response to comments from NYSDEC, which were provided to BASF in April 2007.

Prior to undertaking this most recent work, BASF completed several remedial actions at the Site under NYSDEC regulatory authority. Part of this work included an investigation of sediment conditions at locations near existing municipal storm sewers outfalls and inactive industrial sewer lines in the Hudson River adjacent to the Site.

During this initial investigation, selected organic compounds (primarily benzene, chlorobenzene, and dichlorobenzenes) and heavy metals were detected in nearshore sediments at levels greater than published ecological screening criteria. These results were provided to NYSDEC (Roux, 2004b). Based on these data, BASF prepared a work plan (ENSR, 2005) to better characterize the river environment, evaluate the vertical and horizontal extent of inorganic or organic compounds, determine whether other compounds are present in river sediments, and preliminarily assess potential impacts of exposure to benthic organisms. Field work implementing this work plan was conducted from November 2005 through May 2006, and the results and conclusions of the work are contained in this Report.

BASF used these data as a basis for an evaluation of the potential for risk to human health and the environment in the Study Area and to update the preliminary Conceptual Site Model (CSM) presented in the work plan (ENSR, 2005). BASF will use the CSM to guide the next steps for the continued investigation of this Study Area, which may include implementation of actions to reduce or eliminate risk, as appropriate.

1.1 Program Objectives

As reflected in the Risk Based Surface Water and Sediment Decision Path (Figure 1-2), BASF's objectives for the sediment and surface water in the river adjacent to the Site are:

1. Identify areas/sub-habitats in the river where Site-related chemicals of potential concern (COPCs) represent a significant potential risk to human health or ecological receptors;
2. Implement actions needed to reduce or eliminate the identified risk, consistent with sediment management guidance provided by the NYSDEC and United States Environmental Protection Agency (USEPA);
3. Provide for ongoing improvement of conditions in the river environment(s) where Site-related COPCs may be present; and
4. Provide ecological enhancement and value to the river, as appropriate.

As indicated in Figure 1-2, this Report addresses Task 1 and provides the basis for a preliminary evaluation of the potential for risks to human health and ecological receptors in various locations in the vicinity of the Site.

1.2 Investigation Scope and Summary Conclusions

The scope of this investigation, as detailed in the work plan (ENSR, 2005), consisted of the following primary components:

- A geophysical survey, consisting of a side-scan sonar survey over more than two miles of river bottom, was conducted to provide detail on river bathymetry and the type of river bottom material over the entire Study Area. This information helps to differentiate sub-habitats, based on the type of bottom material, river depth, and location within the river channel.
- Sediment sampling and analysis in areas upstream of, adjacent to, and downstream of the Site, in each type of sub-habitat. Nearly 200 sediment samples were obtained at depths ranging from the surface to 12 feet below the sediment surface. Samples were analyzed for a wide range of chemical parameters and physical characteristics. The data collected provide a very good understanding of COPC distribution in the sediment, and the relationship between sediment types and COPC levels detected in the sediments.
- Surface water samples were collected from seven discrete river locations. Analysis for both physical characteristics and chemical parameters found no evidence of any effects on surface water from the compounds in the sediment.
- Samples of the benthic macroinvertebrate communities were obtained from locations upstream of, adjacent to, and downstream of the Site in each type of sub-habitat. A reconnaissance level evaluation found no significant difference in either the diversity or abundance of the macroinvertebrate communities when comparing the samples collected adjacent to and downstream of the Site with those collected upstream of the Site.
- A screening level risk assessment was conducted to assess the potential for risk to human health and the environment in the Study Area. The results of the risk screening indicate that there is no imminent threat to human health from exposure to surface water or sediment adjacent to the Site. Concentrations of COPCs in surface water were generally low and consistent with upstream concentrations, and it is unlikely that humans would come into contact with Hudson River sediments in the vicinity of the Site. The results of the screening level ecological assessment indicate that concentrations of certain compounds exceed NYSDEC benchmark screening criteria; however, despite the presence of inorganic and VOC concentrations in excess of criteria, review of the available macroinvertebrate biology data indicates that the diversity and abundance of the macroinvertebrate communities observed upstream of, adjacent to, and downstream of the Site are similar. Similarly, no relationship between elevated levels of compounds in the sediment and the macroinvertebrate community health was observed. There is some uncertainty as to whether levels of benzene or other VOCs present in sediment are likely to bioaccumulate into fish since they were generally not detected in the surface water.

The data collected during this investigation have been used to:

- Refine the CSM for the Study Area, which was originally presented in the work plan (ENSR, 2005).
- Confirm that, under current conditions, there is no complete direct contact pathway for human receptors to be exposed to the compounds that are found in sediment.
- Identify those areas with the greatest potential for risks to ecological receptors from exposure to COPCs in sediment.
- Focus additional data collection activities on areas with the highest potential for risks to occur.

1.3 Site History

Industrial use of the Rensselaer property dates to the late 1800s, when the first dye manufacturing plant was constructed by the Albany Aniline and Chemical Company. The Site was originally part of a larger property, which included the adjacent Albany Molecular Research, Inc. property to the north. Dye manufacturing was conducted on both properties. The two properties were separated in approximately 1917 when Sterling Drug Company ("Sterling") acquired the properties and sold what is now the BASF Site. The two properties continued to use common utilities, such as production sewers. The Site was owned and operated as a dye manufacturing plant by several corporate entities and the United States government (from World War II until 1964). BASF acquired the property in 1978 from the GAF Corporation. BASF ended manufacturing operations at the Site on December 31, 2001.

BASF has been performing site investigation and remedial action activities at the Site since its closure and, as of this time, has: (1) installed a Site-wide groundwater treatment system; (2) completed the remedial action of two former wastewater treatment lagoons; (3) implemented a large interim remedial measure, consisting of the removal of several thousands of tons of soil in the area known as the Main Plant; (4) performed *in-situ* treatment of arsenic in groundwater; and (5) completed the majority of the actions required by the NYSDEC for closure of the former on-Site landfill.

1.4 Previously Completed Studies

The Study Area has been the subject of several investigations during the past decade. The data collected from these various programs were used to develop the scope of work in the Work Plan (ENSR, 2005), and are discussed in Section 2 of this Report.

1.4.1 Investigations Related to Future Industrial Use of the Property

Local river conditions immediately adjacent to the Site were characterized in March 2001 to support the design of a proposed water intake and discharge structure for a planned power plant and newspaper recycling facility (ENSR, 2001). The field survey spanned approximately 1,600 feet (ft) of river adjacent to the Site, and included bathymetric, river current and water quality data collection, side-scan and sub-bottom imaging, and sediment grab samples. As part of this effort, three surface sediment grab samples and nine sediment cores were collected and analyzed for grain size, moisture content, total organic carbon (TOC), Total Petroleum Hydrocarbons (TPH) (gasoline range organics and diesel range organics), benzene, toluene, ethylbenzene, xylenes (BTEX), polychlorinated biphenyls (PCBs), pesticides, and metals.

1.4.2 BASF Sediment Screening Study

BASF conducted a screening level assessment of sediments in distinct locations within the Study Area in May 2004 (Roux, 2004b). As required by NYSDEC, historical maps and records were reviewed to identify all outfall locations to determine selection of river sediment sampling locations. Through this investigation, BASF identified the following five sewer outfalls to the Hudson River in the vicinity of the Site (Figure 1-3):

- One inactive, 8-inch, cast iron sewer in the northern part of the Lagoon Area (located in the westerly-most portion of the Site along the shoreline), probably related to storm water;
- Two inactive production sewers in the northern part of the Lagoon Area;
- A storm sewer owned and used by the Town of East Greenbush; and
- A storm sewer owned and used by the City of Rensselaer.

The two inactive production outfalls related to past facility operations were used until 1975, when the North and South Lagoons were constructed and the effluent from the GAF and Sterling wastewater treatment plants were discharged to the lagoons. One of the outfalls is an abandoned 30-inch tile sewer that was used before

lagoon construction, and the other is a 30-inch diameter cast iron temporary effluent line that was apparently used only during lagoon construction. The abandoned 30-inch tile sewer was also used by Sterling, a prior owner of the Albany Molecular Research site.

The Town of East Greenbush and City of Rensselaer storm sewers are not related to past plant operations, but continue to be used by those municipalities. Bedding surrounding these sewers was identified during the OU-1 investigation as a potential migration route for dissolved VOCs in groundwater. The City of Rensselaer storm sewer originates east of the Main Plant area, and may represent a conduit for compounds originating east of the Site to be transported to the Hudson River.

As part of this 2004 study, 17 sediment samples were collected and analyzed. Two sediment samples were collected in the immediate vicinity of each of the five outfalls, and additional samples were collected upstream (north) and downstream (south) of the Site, and across the river (west) of the Site.

Samples collected in the vicinity of the two municipal outfalls were analyzed for TOC, Target Analyte List (TAL) metals, and VOCs. All other samples also included semi-volatile organic carbons (SVOCs) in the analyte list. In addition, sludge samples were collected from manholes in the storm sewers near the outfalls, where possible. Analytical results were compared to NYSDEC regulatory screening criteria to provide a general understanding of sediment quality. Analysis of these results suggested that additional sediment sampling was needed to better characterize conditions in the area.

1.4.3 NYSDEC Benthic Survey Program

An extensive mapping survey of the entire 240-Kilometer tidal reach of the Hudson River, including swath bathymetry, side-scan sonar, sub-bottom profiling, sediment-profile imaging and grab samples, was performed by NYSDEC in 2003 (<http://benthic.info>). These data have been analyzed to develop reach-wide bathymetry, substrate and sediment environment maps and were made available to researchers for additional, detailed analysis. ENSR, on behalf of BASF, obtained an electronic copy of the NYSDEC data in July 2005 for review relative to the BASF Hudson River sampling program.

As part of work plan (ENSR, 2005) development, a critical review of the NYSDEC benthic survey was conducted to evaluate whether these existing geophysical data support bottom classifications and sediment transport regimes assigned by NYSDEC, and to determine whether or not the existing geophysical data were of adequate resolution to support the design of a sediment sampling and analysis program in the Study Area. This review determined that additional higher resolution survey work was needed in order to better understand substrate and habitat conditions.

1.4.4 Regulatory Authority

This Report has been prepared in accordance with the following relevant state guidance:

- Draft Voluntary Cleanup Program Guide (NYSDEC, 2002a); and
- Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002b).

1.5 Document Organization

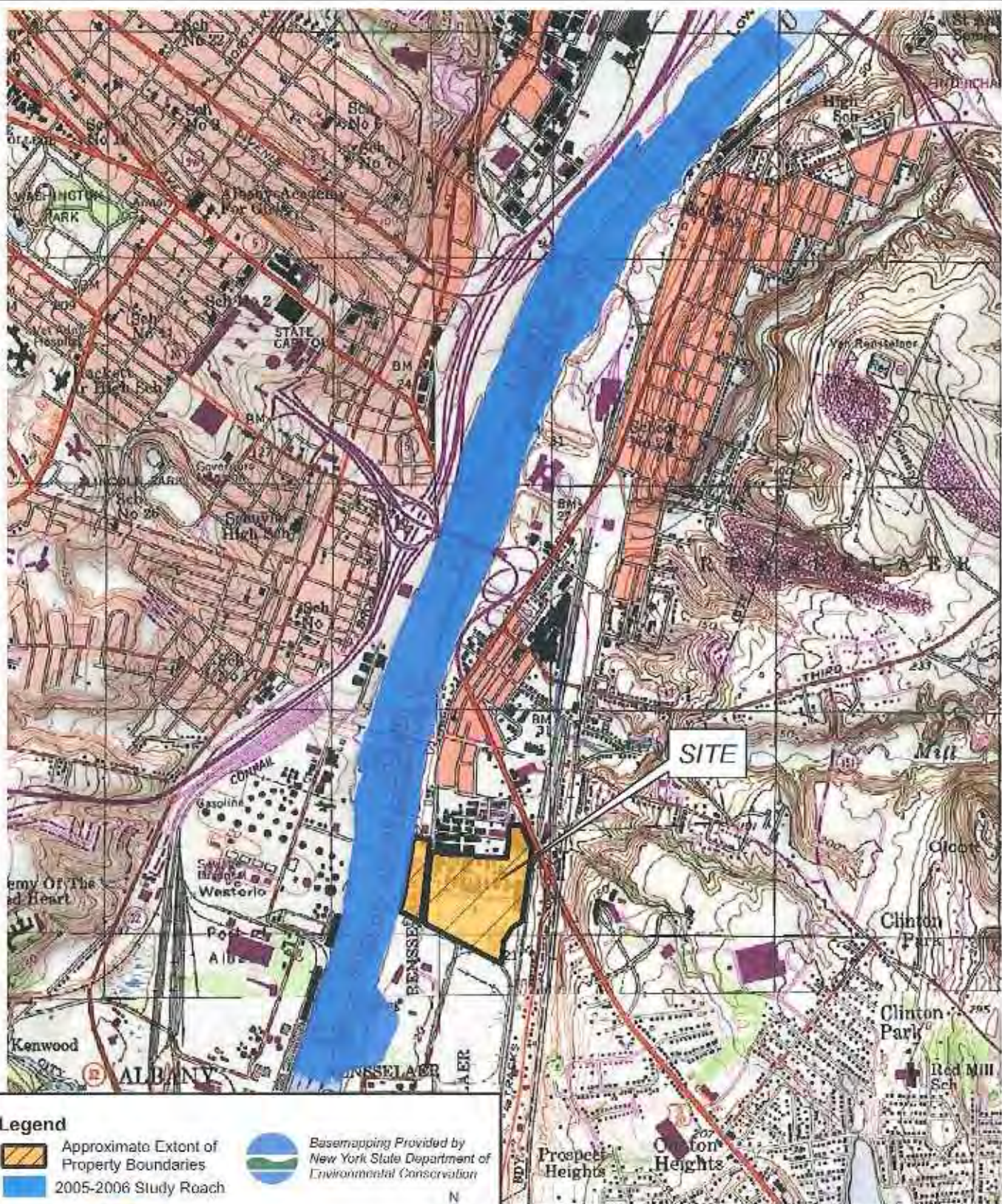
The remainder of this document is organized in the following manner:

- Section 2 presents more detailed information regarding historic environmental conditions at the Site before the undertaking of this current investigation;
- Section 3 presents a summary of the field sampling methodologies used in this study;
- Section 4 presents the results of the 2005 and 2006 field sampling program;

- Section 5 presents an analysis of Site data collected during this field sampling program;
- Section 6 presents a preliminary analysis of potential risks to human health;
- Section 7 presents a preliminary analysis of potential risks to the environment;
- Section 8 presents an updated CSM which considers sources of VOCs and inorganic compounds, transport mechanisms, and potential receptors.
- Section 9 presents a summary and conclusions of this Site Investigation.
- Section 10 presents the literature cited in this Report.

For the purposes of this Report, the data gathered from the various sampling and analysis activities have been segregated into discrete groupings based on proximity to the Site (Figure 1-4). Much of the remainder of this Report discusses the data within the context of the following reaches of the river:

- The **Upstream** data set includes samples collected upstream of the influence of the Site (i.e., this data set serves as the Reference Conditions data set). It is assumed that the data from this reach of the river are uninfluenced by Site conditions and represent anthropogenic urban background conditions.
- The **Adjacent Nearshore** data set includes samples located within a band of muddy sand immediately adjacent and to the west of the Site. This band of muddy sand extends from approximately 90 to 185 ft west of the Site bulkhead before transitioning to coarser-grained material (i.e., the Adjacent Far Field).
- The **Adjacent Far Field** data set includes samples collected in the more coarse-grained sediment located to the west of the muddy sand samples in the Adjacent Nearshore sampling reach. The Adjacent Far Field data set is within the same river reach as the Site, but may not be influenced by the Site.
- The **Upper Navigational Channel** data set includes samples collected immediately downstream of the Site, in a depositional environment that is co-located with what is understood to be the northernmost extent of an area where New York State has reportedly conducted periodic navigational dredging to maintain depth for shipping purposes (see Section 2.5 for a brief description of the navigational dredging operations). The deepwater (30 – 40 ft) navigational channel of the river continues north of the Site; however, navigational dredging is not known to occur beyond the southern edge of the Site.
- The **Downstream** data set includes samples collected downstream of the Adjacent Nearshore reach of the river, approximately 1,800 feet downstream from the southerly Site outfall owned by the City of Rensselaer. These samples are also located within the dredged navigational channel.



Legend

- Approximate Extent of Property Boundaries
- 2005-2006 Study Reach



Basemapping Provided by
New York State Department of
Environmental Conservation



USGS 7.5 MINUTE TOPOGRAPHIC
QUADRANGLES ALBANY, EAST
GRIENRUSH, TROY SOUTH AND DELMAR



0 1,500 3,000 6,000
Feet

Site Location

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

ENSR AECOM

Figure Number

1-1

SCALE

1:24000

DATE

02/07

PROJECT NO.

00760-171

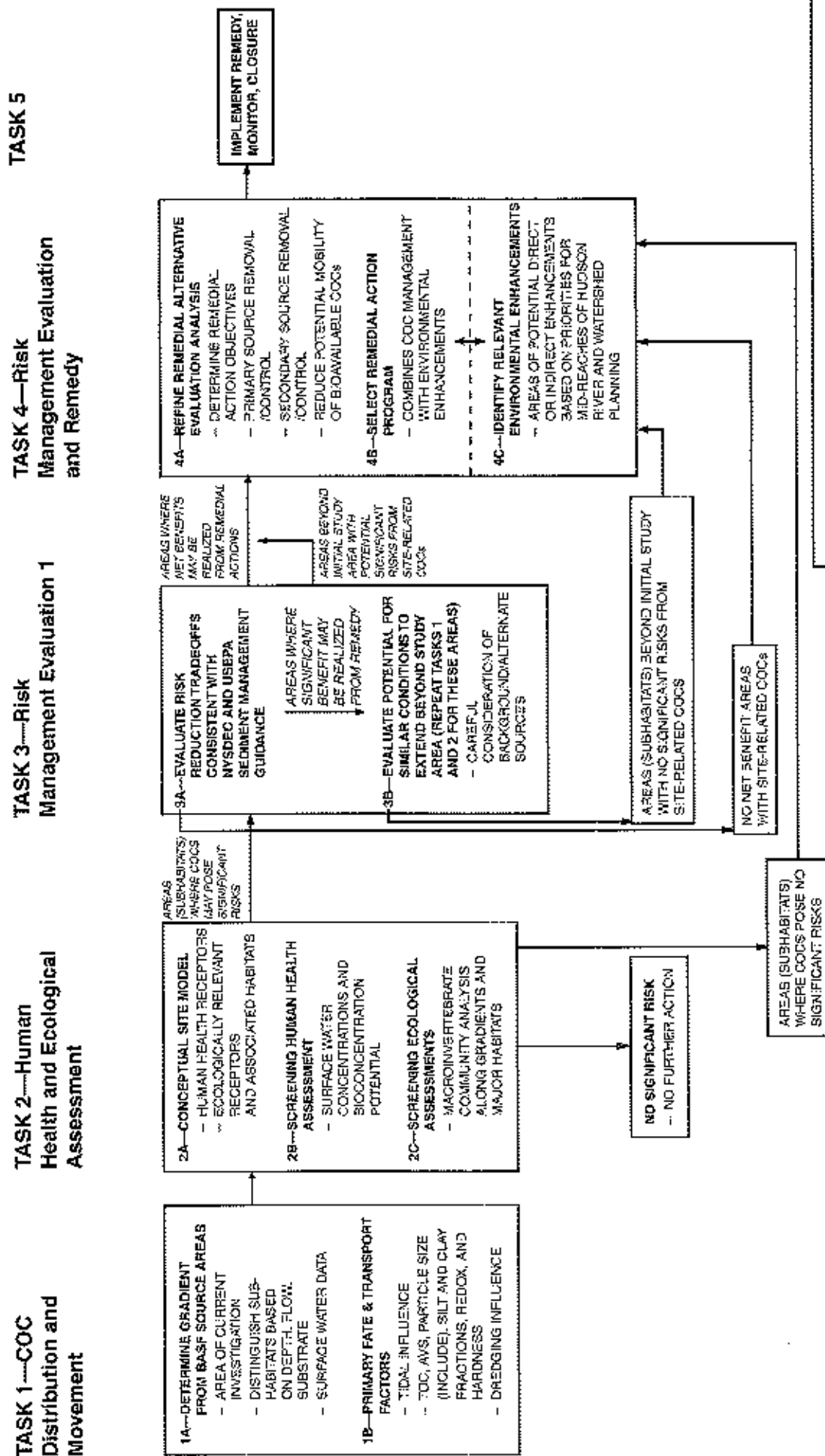
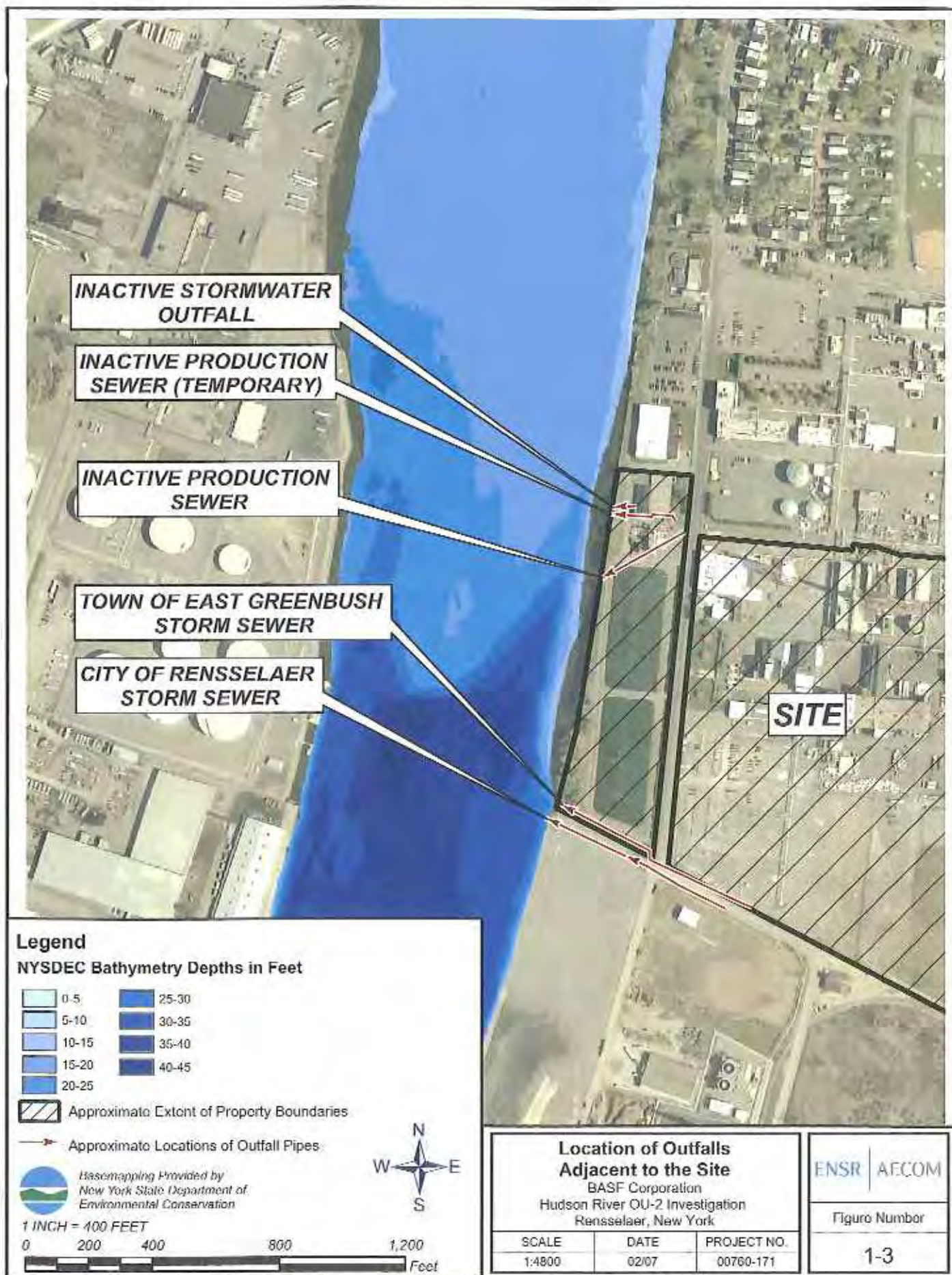


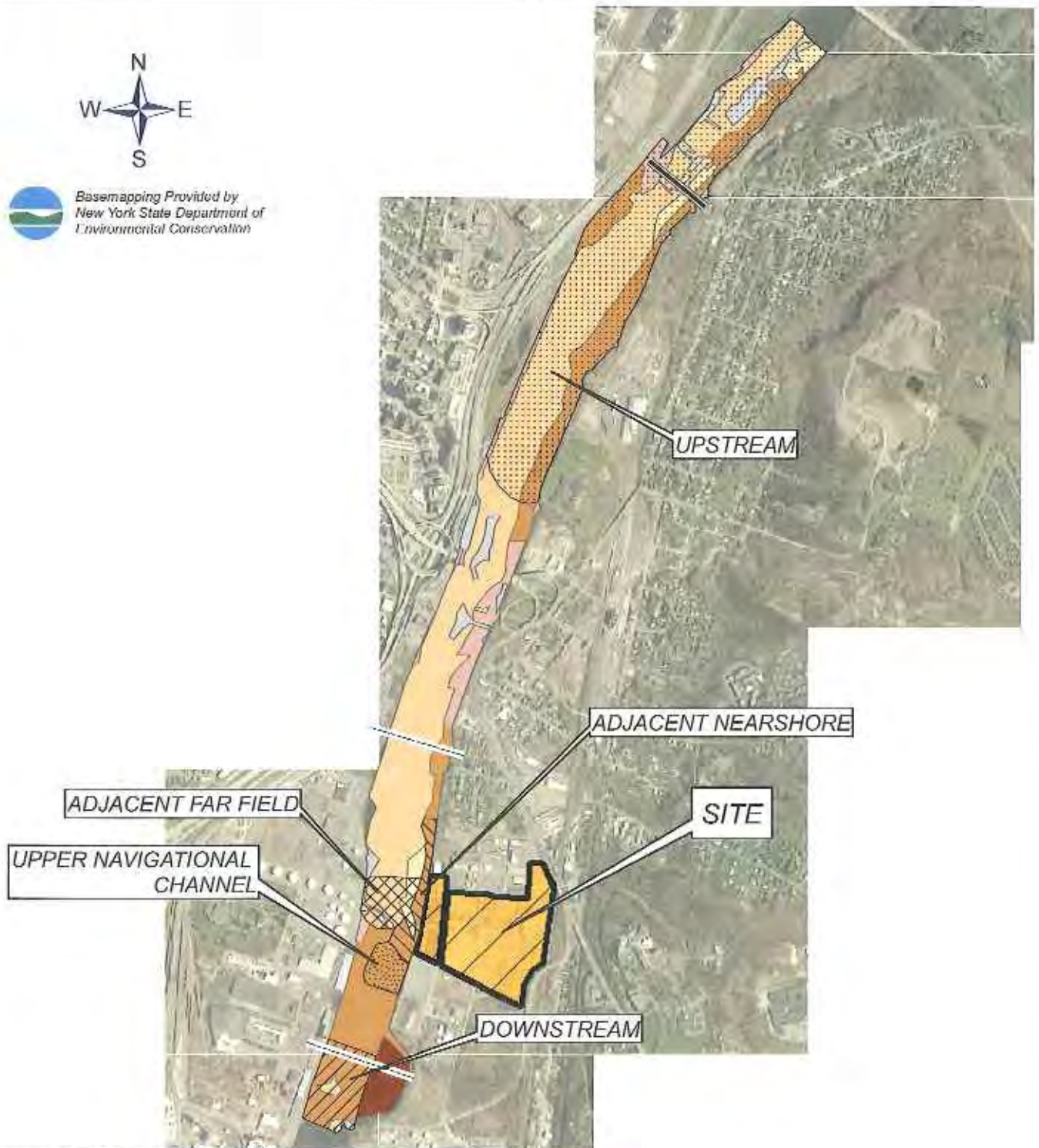
FIGURE 1-2
Risk-Based Surface Water and Sediment Decision Path
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

ENSR AECOM





Basemapping Provided by
New York State Department of
Environmental Conservation



Legend

Study Reaches

- Adjacent Far Field
- Adjacent Nearshore
- Downstream
- Upstream
- Upper Navigational Channel

Distance From Site

- 1500 Linear Feet
- 2 Linear Miles

2005 Geophysical Data

- Cobble
- Gravelly Sand
- Sand
- Muddy Sand
- Sandy Mud
- Mud
- Approximate Extent of Property Boundaries



Hudson River Sampling Regions

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
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ENSR | AECOM

Figure Number

1-4

2.0 Site Background and Environmental Setting

This section presents a description of the Site and the Hudson River, which forms the western boundary of the Site. The background information and historic data presented in this section were previously summarized in the work plan (ENSR, 2005) and provided the basis of the CSM developed in that document.

The 88-acre Site is situated on the east bank of the Hudson River. The Site is approximately 42 acres of developed areas, 23 acres of brushland, 11 acres of poor quality wetlands, 10 acres of unvegetated area, and 2 acres of closed man-made lagoons. It is bordered by Riverside Avenue and the Hudson River on the west, a truck access road (Irwin Stewart Port Expressway, also known as the Port Access Highway) on the east and south, and by another industrial facility on the north. An 80 MW (nominal) electrical cogeneration plant and a vehicle reclamation facility lie just south and west of the Site between Riverside Avenue and the Hudson River (ENSR, 2001).

The majority of the Site lies within the floodplain of the Hudson River, and the majority of the Site is situated below the 100-year flood elevation (approximately 20.5 ft above mean sea level).

2.1 Hydrology

The Hudson River watershed lies predominantly in New York (93%), with small areas in Vermont, Massachusetts, New Jersey and Connecticut (Figure 2-1). The 13,300 square mile (mi^2) watershed is divided into two main stretches: the upper and lower Hudson River basins separated by the Federal Dam. The headwaters of the upper Hudson basin ($4,590 \text{ mi}^2$) begin at Lake Tear of the Clouds in the Adirondack Mountains. The basin continues south for approximately 160 miles, where it ends at the Federal Dam at Troy, NY, located approximately 10 miles upstream of the Site. The lower Hudson basin ($5,200 \text{ mi}^2$), within which the Site is located, begins at the Federal Dam and flows 154 miles to New York Harbor. The lower Hudson River is tidal for its entire reach, and flow reverses direction up to four times per day in the lower portions of the reach.

Tidal flows in the Hudson River vary significantly as a function of upstream freshwater inflow and tidal and storm-driven flows from New York Harbor. Instantaneous tidal flows in the Hudson River at Poughkeepsie, approximately 80 miles downstream of Rensselaer (drainage area 143% of that at Rensselaer) typically range from 200,000 to 300,000 cubic feet per second ("cfs") in either direction. Watershed runoff flows are clearly dominated by tidal flow. The water levels in the Hudson River experience fairly large tidal variation. At Albany, across the river from and to the west of Rensselaer, the mean tidal range is 4.5 ft and the spring range is 5.1 ft, indicating little attenuation with distance upstream.

Typical average rainfall in the Hudson River basin is 40 to 48 in/yr (United States Geological Survey, [USGS], 1991), with substantial variation throughout the basin. The largest rainfall amount (greater than 50 in/yr) occurs in the high elevations of the basin and near the Atlantic Ocean at the mouth of the river (USGS, 1996). In the low-lying areas adjacent to the Hudson and Mohawk Rivers, rainfall averages less than 40 in/yr. Runoff varies from less than 22 in/yr to greater than 30 in/yr, and is well correlated to relief throughout the basin (USGS, 1996).

Freshwater inflow to the lower Hudson River is measured at Green Island, approximately eight miles upstream of Albany (where the drainage area is 200 mi^2 (2% smaller than that at the Site)). Summary flow statistics for the USGS gauge 01358000 for the period of record of 1946 to 2003 are presented in Table 2-1.

In March 2001, a current study was performed in the Study Area to characterize local flow velocities (ENSR 2001). During this survey, the tidal range was 5.3 ft, and water levels ranged from -1.2 ft National Geodetic Vertical Datum (NGVD) to 4.1 ft NGVD. Mean daily freshwater inflow measured at Green Island was

17,900 cfs (considerably above the daily average discharge for the period of record). Measured flow rates over the survey period ranged from 32,000 cfs (peak ebb) to -11,000 cfs (peak flood). Note that due to channel geometry and elevation, the tidal flow is much less at Albany than downstream at Poughkeepsie. In fact, given the relatively high importance of runoff flows, the daily periods of net upstream flow are likely to be less at Albany. In the 2001 survey, in which runoff flows were well above average, net upstream flows were observed only during one set of the flow measurements, approximately one hour after low tide. Peak ebb velocities were measured at 2.0 ft/s with fairly uniform currents across the channel. Flow reversal was observed on the ebb tide, near shore on the eastern side of the river where steep bathymetric gradients mark the upstream limit of the navigational channel. During flood tide, upstream currents in the main channel approached zero, while maximum upstream currents observed during flood tide were 0.85 ft/s along the east bank of the channel. The reverse flow eddy observed during ebb tide was not observed during the flood tide. At the peak flood velocity, a 0.6-mile upstream tidal excursion could occur over the hour that upstream currents were observed. During the 2001 survey, downstream flow was observed approximately 95% of the time, indicating minimal opportunity for the upstream transport of materials.

2.2 Geology

The Hudson River valley was formed by glaciers during the Pleistocene era (Nitsche et al., 2004). The terminal moraine across Long Island Sound blocked melt water from the retreating glacial ice, forming a glacial lake in the valley. Around 12,000 years ago, the lake broke through the moraine, drained, and formed the fluvial Hudson River valley. Rising sea levels drove saline ocean water up the river, forming the tidal estuary of the lower Hudson River.

Sediment cores indicate deep layers of glacial till overlain by glacial lacustrine clay and fluvial sand (Nitsche et al., 2004). The upper sediment layer consists of silt and clay estuarine sediments with high organic material content. North of Kingston (located approximately 55 miles downstream of Rensselaer), where freshwater inflows dominate the system, an increased fraction of sand has been observed in the sediment cores.

2.3 Hydrogeology

The major aquifers in the Hudson River basin are primarily small, unconsolidated glacial deposits with little or no hydraulic interconnection (USGS, 1996). The surficial sand and gravel aquifers underlie the flood plains along the Hudson River tributaries. There are four aquifers in the Hudson River basin that have been designated by NYSDEC as Primary-Water-Supply Aquifers and one designated by USEPA as a sole-source aquifer.

Bedrock underlying the upper Hudson River basin is predominantly igneous and metamorphic rock, while bedrock in the Mohawk River basin is composed of limestone, shale, and shaley sandstone (USGS, 1991). The lower Hudson River basin bedrock is similar to that of the Mohawk River basin – predominantly shale and sandstone with some metamorphic and igneous rock.

2.4 Geomorphology

The sediment bed of the lower Hudson River transitions from a sandy substrate at the most downstream points (from the river mouth and traveling upstream nine miles) to a more muddy substrate from the inner New York City harbor to Kingston (approximately 90 miles). From Kingston to Troy (50 miles), where fluvial processes dominate the river, estuarine muddy sands are being buried by fluvial sands (McHugh et al., 2004). The Hudson River is characterized by loading of sediments in the upper watershed that are transported over the Federal Dam at Troy. The sediment load in the tidal portion of the Hudson River ranges from 1.2 to 2.6×10^5 metric tons/year (McHugh et al., 2004). These sediments are generally transported as suspended sediments through most reaches of the tidal Hudson River. Radiocarbon dating of oyster shells and the presence of coal burning relics found on the estuary floor indicate that there has been little sediment

accumulation for several hundreds of years (McHugh et al., 2004). Sedimentation rates have been estimated from less than 0.05 in/year (correlated to a sea level rise of ~0.05 in/year) to 0.4 in/year along narrow reaches in the vicinity of the estuarine turbidity maximum, about 15 miles from the mouth, to more than 10 cm/year in New York Harbor (Bopp and Simpson, 1998; McHugh et al., 2004).

During the flood tide, sediments may be moved a short distance upriver, but the net transport direction is downriver, towards the Harbor, as downstream velocities are generally higher than upstream velocities (Gary Wall, USGS Pers. Comm.). During large storm events, the dominant sediment transport can be reversed. However these reversals generally have a short temporal duration (on the order of a day), and are followed by transport back in the downstream direction.

2.5 Navigational Dredging Operations

The Hudson River is maintained by the U.S. Army Corps of Engineers ("ACOE") for commercial navigation from New York City to the Port of Albany, at river mile (RM) 148. (The Site is located at approximately RM 148.) The ACOE is required to maintain the shipping channel to a minimum depth of 32 ft and width of 400 ft. According to the ACOE Troy Field Office (Robert Berrian, personal communication), navigational dredging last occurred in the vicinity of RM 148 in the mid-1960s.

At the Port of Albany, located approximately 1,200 ft downstream of the southern Site boundary, a turning basin of 1,100 ft allows ships with overall length of 700 ft, maximum beam of 110 ft and a maximum air draft of 135 ft, to navigate the Hudson River (www.portofalbany.com). Although the turning basin is scheduled for navigational dredging on a five- to seven-year cycle, the area has not been dredged since the mid-1980s (Berrian, personal communication). BASF is currently in the process of obtaining from ACOE specific dredge records, as well as on-going surveys to evaluate stability of the navigational channel.

2.6 Bathymetry

Bathymetry data in the vicinity of the Site were collected in 2001 by ENSR (Figure 2-2) and in 2003 by NYSDEC (Figure 2-3). In March 2001, ENSR performed a single-beam bathymetric survey, which covered more than 1,600 ft of the river, extending from the southern edge of the South Lagoon to the northern fence line along the Site. The data clearly demonstrated the sharp transition from the upstream limit of the Hudson River shipping channel to the undredged river bottom. The sharp bathymetric transition located at the Site and the Albany turning basin may affect local hydrodynamics and sediment transport.

In 2003, NYSDEC performed a high-resolution multi-beam survey as part of the Hudson River Benthic Mapping Project. These data show that water depths range from 18 to 40 ft Mean Lower Low Water (MLLW). The upstream limit of the navigational channel, just upstream of the turning basin, is located adjacent to the center of the Site. Dredged water depths range from 35 to 40 ft MLLW, while water depths in the undredged area range from 18 to 24 ft MLLW. A very steep gradient was observed in water depth, transitioning from 20 to 40 ft depth MLLW over a distance of 60 ft along the channel.

The results of both studies are consistent, indicating that there has been no significant change in channel bathymetry (i.e., little net scour or deposition) between the two surveys.

2.7 Physical Description of Sediments

The ENSR and NYSDEC bathymetry and grain size surveys were also reviewed to evaluate whether these existing geophysical data supported bottom classifications and sediment transport regimes assigned by NYSDEC. The review was also conducted to determine whether or not the existing geophysical data were of adequate resolution to support the design of a sediment sampling and analysis program in the vicinity of the Site. This review was presented to NYSDEC in Appendix A of the Work Plan (ENSR, 2005).

Both surveys included side-scan sonar surveys to characterize surface sediments, and sub-bottom profiling to gather information about sediment structure with depth. In addition, NYSDEC collected 410 sediment cores and 600 grab samples to verify the acoustic survey characterization.

In general, BASF concluded that the studies were well conducted and met their overall project objectives; however, neither of the data sets was of sufficient resolution for any site-specific evaluation of benthic characteristics or sediment transport. Therefore, additional investigation was necessary for the OU-2 investigation.

2.7.1 Grain Size

Analysis of the NYSDEC 2003 bathymetry survey data along with the grain size data collected to verify the bathymetry survey resulted in a map of bottom sediment types (Figure 2-4). The mapped sediment types closely follow the local bathymetry (Figure 2-5). Coarse-grained sediments (e.g., sand, gravel, and cobble) are mapped in the northern section of the Study Area, corresponding to the undredged river bottom. Sediments in the center two-thirds of the channel are classified as sandy gravel, and, along the banks, the sediments are slightly finer and classified as gravelly sand. In the navigational channel, sediments are predominantly sand, with finer sediments (e.g., silts) along the banks and in the turning basin.

Sediment samples (nine cores and three grabs) collected by ENSR (2001) also were analyzed for grain size (Figure 2-4). In general, results are consistent with NYSDEC's grain size results. Fine-grained material was identified along the eastern bank adjacent to the Site. Toward mid-channel, sediments were silty, grading to coarser sediments; hard, coarse-grained sediments such as sand, gravel, and cobble were observed from mid-channel to the western shore.

2.7.2 Erosional/Depositional Characteristics

Sediment environments were mapped based on analysis of the NYSDEC bathymetry survey data and sediment grab sample results (Figure 2-6). The riverbed in the vicinity of the Site was classified as predominantly a dynamic-scour environment, indicative of a rough and/or hard surface. This region corresponds to areas of relatively coarse-grained sediments on the riverbed. Along the east bank of the river adjacent to the northern portion of the Site, the sediment bed was classified as "erosion-non-deposition", and adjacent to the southern portion of the Site, depositional. Along the east bank from the turning basin to the upstream limit of the navigational channel, a transition from erosional to depositional sediments was mapped. However, a close inspection of these data indicated that this mapped transition may be an artifact of the scale of the data and data interpretation (see Appendix A of Work Plan [ENSR 2005]).

ENSR (2001) data were also evaluated to characterize bottom sediment composition and stratigraphy. Along the east river bank, sub-bottom profiling indicated a predominantly depositional environment with occasional erosional events. In the deep portion of the river, the sub-bottom profiling indicated a thin surficial layer (<6 ft) of mixed sediments, mostly sand and silt interbedded with coarse sand and gravel that was an active erosional/depositional environment. Below the surficial layer was more than 20 ft of relatively homogeneous sediments, mostly silt and sand with thin lag deposits of gravel. These results and interpretations are generally consistent with NYSDEC's 2003 study.

The side-scan sonar survey indicated a mound of sediment adjacent to the Site bulkhead and possibly sub-aqueous holes in the steel sheeting of the bulkhead, likely the northernmost discharge location identified in the Roux (2004b) initial study of OU-2. Approximately 50 ft to the north, two parallel pipes were found extending 30 to 50 ft offshore from the bulkhead and surrounded by scattered debris. It is possible these are intake pipes associated with former Site operations.

2.8 Regional Trends in Sediment Quality (Historic Data)

Sediment cores and grab samples have been collected throughout the Hudson River and have typically been analyzed for metals, pesticides, and PCBs. While much of the focus of these studies has been PCBs, the discussion presented in this Report focuses on a variety of metals and organic compounds observed regionally that have also been observed on the Site.

Bopp and Simpson (1989) used radionuclides to trace sediment accumulation combined with analytical measurements of several contaminants to develop information on sources, fate and transport and depositional history in eight cores throughout the lower Hudson River. In upstream tidal cores (RM 46, 88.6 and 91.8), surficial copper and lead concentrations were much lower than deeper concentrations, and indicated a 50% drop in these metals between 1976 and 1986. This decline was attributed to decreases in industrial discharge of trace metals and/or the recent implementation of secondary sewage treatment by the city of Albany.

A number of metals of the kind potentially associated with the Site have generally been detected in sediments analyzed throughout the lower Hudson River (i.e., below Federal Dam) and its tributaries. In the USGS National Water-Quality Assessment Program (NAWQA) Study (Wall et al., 1998), metals were detected in 100% of the surficial sediment samples (with the exception of mercury, detected in 98% of the samples), compared with a national data set, where detection of metals ranged from 24% to 100% of all sediment samples. The highest metals concentrations were correlated to areas with urban land use (Wall et al., 1998). Paired sediment cores collected at six locations from RM 42 (Peekskill) to RM 140.5 (Albany) found metals concentrations at concentrations sufficient to potentially cause adverse biological effects at all locations (NYSDEC, 2000). At the turning basin in Albany, the highest metals concentrations were found in the deeper core segments (27 to 45 in). The range of surficial metals concentrations from the NYSDEC and the USGS study of the Hudson and its tributaries are presented in Table 2-2 (sampling locations from the NYSDEC and USGS studies are plotted in Figure 2-7).

Little historical or regional data are available characterizing the VOCs that have been observed in the vicinity of the Site. In a few samples collected for the NAWQA study, only low levels of VOCs were detected (1,2-dichlorobenzene [3% frequency of detection], 1,3-dichlorobenzene [3% frequency of detection], and 1,4-dichlorobenzene [12% frequency of detection]). Other organic contaminants (e.g., polycyclic aromatic hydrocarbons) were observed at a much higher rate of detection throughout the Hudson River watershed (Wall et al., 1998).

2.9 Local Trends in Sediment Quality (Historic Data)

Prior to the current OU-2 sediment investigation, sediment samples were collected by ENSR (2001) and Roux (2004b) in the vicinity of the Site (Figure 2-8). The complete set of results can be found in the summary reports of the individual investigations. This discussion is focused on compounds observed in these prior sediment studies above the selected NYSDEC screening criteria.

Based on these previous studies and a review of the historic OU-1 data, the following metals were identified as potentially Site-related COPCs: cadmium, chromium, copper, lead, mercury, and zinc. A sub-set of VOCs (benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene) were also identified as COPCs in sediments adjacent to the Site.

2.9.1 Distribution of Metals of Interest

Sediment samples in the vicinity of the Site were collected by ENSR (2001) and Roux (2004b) and analyzed for metals. Metals concentrations were compared against the NYSDEC Lowest Effect Levels (LELs) and Severe Effect Levels (SELs); these results are summarized in Tables 2-3 and 2-4.

Metals were detected in sediments at several locations adjacent to and downstream of the Site. The samples collected by ENSR to characterize river conditions adjacent to the Site (Table 2-3; ENSR, 2001) were composites of the upper three feet of sediment (except for the samples with a "G" in the location name, which are co-located surficial grab samples; see Figure 2-8). LELs were exceeded at least once for all six metals. None of the surficial grab samples showed metals exceedances of the SEL, while at two locations (HR02 and HR06) there were exceedances in the co-located cores, suggesting that metals concentrations may increase with depth. The sediment samples collected as part of the initial OU-2 sediment investigation (Table 2-4; Roux, 2004b) were composites of the upper two feet of sediment.

A summary of the range of observed metals concentrations grouped by location relative to the Site is presented in Table 2-5. In general, these concentrations are within the range observed within the Hudson River watershed (see Table 2-2). Despite this, some samples are highly elevated relative to NYSDEC guidelines (e.g., lead in HR-SS-17 was detected at 1,400 mg/kg) and sediments adjacent to and downstream of the Site appear to be elevated relative to those upstream and on the western bank; however, it is possible that these apparent trends may also be explained by differences in sediment texture and depositional characteristics, and are possibly related to the navigational dredging history of the river in the vicinity of the Site.

2.9.2 Distribution of VOCs

Several VOCs were detected above the NYSDEC screening criteria in sediments adjacent to the Site: benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene (Roux, 2004b). A summary of the sediment concentrations normalized to organic carbon content is presented in Table 2-6. The highest concentrations were generally located closest to the shoreline, in the vicinity of the historic outfalls. VOC concentrations were highly variable in the sediments. For example, all five VOCs of potential concern were detected at HR-SS-5, while only two (benzene and chlorobenzene) were detected at HR-SS-6, located approximately 30 feet downstream.

In several of the samples collected at the outfall locations, sediment staining and a hydrocarbon odor were observed. At two locations sampled in 2001 (HR03 and HR06G) a blue, oily sheen was observed in the upper six inches of the sediment column. At HR07, oil-like material was observed in the core at 29 inches and 46 inches. Although VOCs were not measured in these samples, they were generally located in the vicinity of the 2004 samples where VOCs were detected.

Table 2-6 also presents the selected NYSDEC screening criteria for VOCs (i.e., the Benthic Aquatic Life Acute and Chronic Toxicity Criteria normalized to TOC content of the sediment). Concentrations of all five VOCs exceeded the NYSDEC criteria in at least some locations. All exceedances were observed at nearshore locations, and VOCs were not detected in off-shore sampling locations. Exceedances were observed in the vicinity of the five outfalls adjacent to the Site.

2.10 Potential Relationships between Compound Concentration and Other Factors

The observed concentrations of the metals of interest (i.e., cadmium, chromium, copper, lead, mercury, and zinc) are generally correlated with sediment grain size. Higher concentrations were observed in finer-grained areas of muddy sand and sand, and lower concentrations were observed in gravelly sand and sandy gravel substrates. Figure 2-9 presents several examples of how metals concentrations vary with grain size in the 2001 sediment cores and grab samples. In these examples, sediment size was characterized as the sum of percent gravel and percent sand, representing the coarse fraction. In general, the observed metals concentrations decrease with an increased coarse grain size fraction. For all metals, sample HR01 (located along the eastern shoreline) had a low sand and gravel content and also low metals concentrations, which resulted in fairly low correlation coefficients (without data from HR01, correlation coefficients were 0.8 to 0.95).

Grain size data were not collected in 2004; however, TOC data were collected and applied to normalize VOC concentrations. While VOCs were generally not detected in areas with low TOC, the organic carbon normalized VOC concentrations were higher near historic outfalls.

2.11 Groundwater

Groundwater flow patterns beneath the Site were inferred based on three rounds of synoptic water level sampling events performed in support of the OU-1 and OU-2 investigations. Groundwater generally flows across the Site from east to west, towards the Hudson River. Observed perturbations in this pattern were assumed to be the influence of subsurface sewers. In the vicinity of the sewers, groundwater flow is toward the sewers, potentially discharging to the bedding of the utilities.

To the north of the Site, water level measurements indicated that an east-west groundwater divide runs through the center of the Albany Molecular property. South of this divide, groundwater flows towards the sewers on the BASF Site. Groundwater level data indicated that groundwater from both the Albany Molecular property and the BASF Site discharge to the bedding of the BASF sanitary sewer and subsequently to the bedding of the Town of East Greenbush and City of Rensselaer storm sewers.

A steel bulkhead runs the length of the Site shoreline. This bulkhead is driven into underlying silt and clay and likely prevents on-Site groundwater from seeping into the river. A review of water level gage data in the river and in the water table on-Site indicated that water levels in the river fluctuated over five feet and groundwater fluctuated less than 0.2 feet, at a point 28 feet east of the river. This has been interpreted to indicate little hydraulic connectivity between the river and the on-Site groundwater (N. Epler, Pers. Comm.). The presence of the bulkhead suggests that any groundwater discharge to the river is likely from the sewer bedding and/or the sewers.

Based on observations made during the investigations of the Main Plant area, the relatively low transmissivity of the saturated fill, fluctuating tidal levels (i.e., minimal net flux toward the river) and the presence of the bulkhead preclude groundwater from being a significant source of compounds to the Hudson River. VOCs have not been detected significantly in groundwater beneath the lagoon area, which is adjacent to the river. The only compound present in high concentrations in groundwater beneath the lagoon area was arsenic. Arsenic was not observed in high concentrations in the river sediment immediately adjacent to the Site.

Moreover, the presence of the perimeter groundwater containment system further reduces the already limited potential for migration of dissolved compounds in groundwater toward the river.

2.12 Biology

The biological resources of the Hudson River have been studied by a variety of government agencies, industries, academic institutions, and interest groups. The information presented in the following sub-sections summarizes some of the data currently available to describe aquatic vegetation, fish, and benthic communities within the Hudson River adjacent to the Site.

2.12.1 Aquatic Vegetation

Submerged aquatic vegetation has been mapped in a joint effort by NYSDEC, Cornell University, the Institute for Ecosystem Studies, New York SeaGrant, and others. Beds of vegetation were identified and mapped using true color aerial photographs from 1997 (NYSDEC, 2000b), then large-scale maps were created, and data verified with sampling and visual observation of vegetation. According to this study, submerged aquatic vegetation beds in the vicinity of the Site tend to be limited, and are dominated by water celery (*Vallisneria spiralis*). Lesser amounts of pondweed (*Potamogeton* sp.) are also found throughout the beds. Distribution of plants is light-limited, with the highest abundance in water less than three feet deep at low tide.

(NYSDEC, 2000b). The area where water depth is less than three feet at low tide is very limited adjacent to the Site, thus limiting the development of submerged aquatic vegetation.

2.12.2 Fish Community

The Hudson River in the vicinity of the Site is designated as a Class C water. NYSDEC regulations indicate that the best usage of Class C waters is fishing and that Class C waters shall be suitable for fish propagation and survival, as well as primary and secondary contact recreation.

Due to the tidal nature of the Hudson River adjacent to the Site, the fish community is composed of estuarine species, diadromous species (those that migrate from the sea), and a few euryhaline species (those able to travel between freshwater and saltwater environments) (Odum, 1971).

In a report on the fish species composition of the Hudson River estuary, Beebe and Savidge (1988) determined that the fish fauna of the Hudson River estuary was typical of that found in Atlantic Coast temperate zone drowned-river valley estuaries. However, the 140 species recorded in the Hudson River constituted one of the most diverse fish assemblages of any Atlantic Coast river. In the Albany area of the Hudson, the report listed a total of 58 fish species representing 26 families (Beebe and Savidge, 1988).

An additional 16 species have been recorded during various Albany Steam Station sampling programs which, when combined with the Beebe and Savidge inventory, results in a total of 74 fish species representing 28 families utilizing the Albany area of the lower Hudson River estuary (NMPC, 1999). Of those species, approximately 60% are classified as freshwater, 25% are classified as diadromous, and 15% are classified as marine. The large percentage of freshwater species reflects the water conditions prevalent at the Site throughout the year. The relatively large number of marine species collected in the Albany area is attributable to the Hudson River's low stream gradient, seasonal upstream penetration of marine waters, and the free-flowing nature of the Hudson River between the Troy Dam and the Battery (Smith and Lake, 1990).

Shortnose sturgeon (*Acipenser brevirostrum*), a federally-listed endangered species, and the Atlantic sturgeon (*Acipenser oxyrinchus*), a species of concern, may be present in the Hudson River near the Site. Bridle shiner (*Notropis bifrenatus*), central mudminnow (*Umbra limi*), and northern hogsucker (*Hypentelium nigricans*) are regionally rare species that may be present in the Hudson River near the Site. Alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), Atlantic shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), and striped bass (*Morone saxatilis*) are commercially and/or recreationally important species likely present in the area (ENSR, 2001).

2.12.3 Benthic Community

The benthic macroinvertebrate community associated with the Hudson River near the Site was investigated in 2001 (ENSR, 2001). The investigation was aimed at identifying the general habitat characteristics of this reach of the Hudson River and to provide additional supporting qualitative data to supplement existing data collected by others. The 2001 field study included collection of nine sediment samples from various locations adjacent to the Site and three additional samples from the opposite side of the river for comparison.

Observations at that time indicated that the substrate type and water depth varied considerably across the river. Based on species richness, there was an apparent difference in the diversity of organisms corresponding to substrate type. Those sampling locations with more heterogeneous substrate composition, including sand, rocks, or cobble tended to have a greater diversity of organisms present. The samples collected on the western side of the river (opposite from the Site) were represented by nine primary taxa, while the samples collected on the eastern side of the river (adjacent to the Site) were represented by six primary taxa. Chironomids were not identified to the species level in this survey, and therefore this group may include multiple taxa (ENSR, 2001).

Previous studies indicated that the benthic community in the reach nearest the Site was generally dominated by oligochaetes (primarily tubificid worms) (Simpson et al., 1986). Simpson et al. (1986) also indicated that the benthic community in the south Albany area exhibited the lowest diversity from Troy to Albany. Benthic macroinvertebrate data collected downstream of the Site by New York State Department of Health (NYSDOH) for use in the Revised Baseline Ecological Risk Assessment Hudson River Polychlorinated Biphenyl Reassessment (TAMS and MCA, 2000) also documented a benthic community dominated by oligochaetes and chironomids at Stockport Flats (RM 120) as well as other stations downstream of that location (TAMS and MCA, 2000). Those studies concluded that there was evidence of adverse impacts to the benthic macroinvertebrate community associated with PCBs in the river and sediment as far downstream as RM 89.

Zebra mussels were first observed in the Hudson River in May 1991 resulting in a decrease in the abundance of macroinvertebrates in deeper areas of the Hudson River and an increase in the abundance in shallow waters (Strayer et al., 1999). These researchers have suggested that the decline in deep water areas may be associated with a decline in the flux of edible suspended particles into the deep water caused by the efficient filtering of water by the zebra mussels. Zebra mussels were found in samples collected near the Site in March 2001 (ENSR, 2001).

The results of qualitative sampling of the benthic macroinvertebrate community near the Site document a community dominated primarily by oligochaetes and chironomids. These results are consistent with the results of prior studies of the freshwater tidal portions of the Hudson River, and are typical for benthic communities in a large river system. Based on the available data, the benthic community in the Hudson River near the Site is characterized by low diversity (ENSR, 2001).

2.13 Development of a Preliminary Conceptual Site Model

A CSM serves to depict an environmental system and the chemical, biological, and physical processes that govern the movement or transport of compounds from primary and secondary sources to human health and ecological receptors (USEPA, 2005). The CSM is also critical for helping to define relationships between Site-related compounds and background or reference conditions, as well as for developing an understanding of the effects of anthropogenic factors (e.g., releases and navigational dredging) as well as natural factors (e.g., effects of grain size, carbon content, depositional and erosional patterns, etc.) on compound concentration patterns in sediment. In addition, a well-designed CSM is helpful relative to identifying data gaps and data needs, should additional studies be required at a sediment site, and may be a valuable tool for evaluating the effectiveness of remedial alternatives, should unacceptable risks be identified.

The work plan (ENSR, 2005) provided a preliminary CSM for the Hudson River in the vicinity of the Site based on a review of the historic data summarized above. This preliminary CSM considered both the physical processes and contaminant distribution. An understanding of the historical and existing conditions of the Site allowed for identification of data gaps and for the development of a sampling plan to fill these data gaps.

The preliminary CSM based on the historic data indicates that the concentrations of metals throughout the Study Area are variable while the VOCs of potential concern are localized along the eastern shore, adjacent to the Site and apparently concentrated around the outfalls (both the historic Site outfalls and the active municipal outfalls). Metals concentrations appear to be highest adjacent to the Site and downstream of the Site; however a fairly strong correlation between metals and sediment type is apparent, which may account for some of the observed variation. Results of a comparison between concentrations of metals observed at the Site with other metals concentrations observed throughout the Hudson River Basin were inconclusive. Higher concentrations of some metals (cadmium, lead, mercury) were observed in Hudson River watershed samples (summarized in Table 2-2); while maximum levels of other metals (chromium, copper, zinc) were observed closer to the Site in the 2004 sediment evaluation (summarized in Table 2-4). However, this comparison was complicated by significant uncertainty associated with the evaluation of near-Site data relative to regional reference conditions due to the methods used to collect background sediment data (surface grabs, not core samples) and the variety of land use regions represented in the regional reference data set (sampling was not

limited to urban areas and therefore may be biased). Furthermore, data are not available to characterize either the lateral or vertical extent of the VOCs, nor are data available to compare with other locations along the Hudson River.

Given the magnitude of water and sediment discharge in the river and the relatively low flux of groundwater and surface runoff from the site, it is anticipated that any Site-related effects should be relatively localized. Few Site-related solids are likely to deposit in the relatively fast water of the main river channel; they are likely to have deposited only in the relatively quiet water along the margins of the river.

2.14 Identification of Data Gaps

Following the data review and the development of the preliminary CSM, several significant data gaps were identified:

- What are the sources of the compounds of potential concern? Possible compound sources on-Site include historic discharge at the location of the outfalls, groundwater leaking through or under the bulkhead along the Site, or overland flow. With regard to the inorganic compounds, there are numerous potential non-Site related sources that likely contribute to anthropogenic background conditions in this urban river. Earlier studies indicated that if any groundwater is leaking through the bulkhead, it is only at a very small flow rate. Most runoff would likely be collected in the storm water system and is not likely a significant source of compounds. Elevated levels of VOCs were observed adjacent to both active and historic outfalls, although utility bedding on the site could provide connections throughout the Site as well as with the property to the north.
- What is the extent (horizontal and vertical) of the VOCs? Too few VOC samples were collected in the previous surveys to map their distribution laterally or with depth in the sediment. The delineation of the extent of VOCs in sediments should help identify a likely source as well as provide insight into the fate and transport of these compounds, including potential migration from the source.
- Are the metals of interest associated with the Site or are they related to ambient urban background conditions in the Hudson River? Sufficient data do not exist to establish if the metals of interest observed adjacent to the Site are related to ambient conditions or are related to the Site, or if the distribution of metals observed in the vicinity of the Site is largely a function of grain size distribution and other geophysical properties of the river.

The Hudson River sediment investigation conducted in 2005 and 2006 was designed to provide additional data to fill the data gaps identified above. The following data were collected to meet this objective:

- A focused geophysical survey was conducted to generate a higher resolution sediment grain size and substrate composition data set. This survey was used to help design the sediment sampling and analysis program. A review of the pre-existing data during work plan development suggested that, given the non-depositional nature of the river, any influence of the Site is likely to be limited to, or at least significantly stronger, along the eastern shore of the river.
- Additional surficial and sub-surficial sediment samples were collected along the property boundary to delineate the vertical and horizontal extent of the VOCs.
- Sediment cores were collected to evaluate changes in concentration with depth as well as potential source locations.
- Additional sediment samples were obtained from reaches representing different grain size regions in the river; these samples were used to further establish the relationship between observed metals concentrations and grain size, and to provide a more extensive set of urban ambient measurements.

- Because of the observed relationships between compound concentrations and other factors (e.g., TOC and grain size), it was necessary to collect these ancillary parameters via additional sampling to be able to properly interpret observed concentration data.

Table 2-1
Hudson River at Green Island Summary Flow Statistics (1946-2003)
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Statistic	Value (cfs)
Annual Mean	13,810
Highest Annual Mean (1976)	22,100
Lowest Annual Mean (1965)	6,386
Highest Daily Mean (3/14/77)	152,000
Lowest Daily Mean (9/2/68)	882
Annual 7-day Minimum (8/23/95)	2,110
10% Exceedance	28,800
50% Exceedance (a)	9,480
90% Exceedance (b)	4,280

(a) Flow that is exceeded 50% of the time

(b) Flow that is exceeded 90% of the time

Table 2-2
Summary of Metals of Interest Results for Hudson River Watershed Sediment Samples
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	NYSDEC (2000)			USGS (1998)	
	Minimum (mg/kg)	Surficial Maximum (mg/kg)	Core Maximum (mg/kg)	Minimum (mg/kg)	Surficial Maximum (mg/kg)
Cadmium	0.59	34.5	170	0.2	6.9
Chromium	29.8	55.8	175	40	160
Copper	33.6	171	171	9	410
Lead	27.8	890	1440	20	450
Mercury	0.15	0.87	3.5	0.03	1.4
Zinc	115	493	493	110	980

Sample locations are presented on Figure 2-7.

Table 2-3
Summary of 2001 Sediment Metals Data
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Screening Value – LEL (a) (mg/kg)	Screening Value – SEL (b) (mg/kg)	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	FOD
Cadmium	0.6	9	0.10	12	3.2	12 : 12
Chromium	26	110	6.5	200	71.3	12 : 12
Copper	16	110	11	150	60.3	12 : 12
Lead	31	110	16	330	124	12 : 12
Mercury	0.15	1.3	0.05	2.6	1.1	11 : 11
Zinc	120	270	47	330	166	12 : 12
TOC (%)	-	-	0.27	4.9	2.2	12 : 12

(a) NYSDEC Lowest Effect Level screening values obtained from NYSDEC (1999)

(b) NYSDEC Severe Effect Level screening values obtained from NYSDEC (1999)

FOD = Frequency of Detection (Number of detected samples : Number of total samples)

Sample locations are presented on Figure 2-8.

Table 2-4
Summary of 2004 Sediment Metals Data
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Screening Value – LEL (a) (mg/kg)	Screening Value – SEL (b) (mg/kg)	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	FOD
Cadmium	0.6	9	1.8	14	3.7	11 : 20
Chromium	26	110	6.5	260	105.7	18 : 20
Copper	16	110	7.5	230	82.0	17 : 20
Lead	31	110	16	1400	187.0	17 : 20
Mercury	0.15	1.3	0.12	1.8	0.6	14 : 20
Zinc	120	270	42	520	248.6	20 : 20
TOC (%)	-	-	0.029	2.3	1.2	16 : 18

(a) NYSDEC Lowest Effect Level screening values obtained from NYSDEC (1999)

(b) NYSDEC Severe Effect Level screening values obtained from NYSDEC (1999)

FOD = Frequency of Detection (Number of detected samples : Number of total samples)

Sample Locations are presented on Figure 2-8.

Table 2-5
Range of Metals Concentrations Measured in 2004 Study in the Near-Site River Reach
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Screening Value – LEL (a) (mg/kg)	Screening Value – SEL (b) (mg/kg)	Range of Metals Concentrations (mg/kg)			
			Site Vicinity	Downstream	Upstream	Western Shore
Cadmium	0.6	9	0.2 - 14	4.1 - 7.9	0.69 - 0.72	0.1 - 0.71
Chromium	26	110	15 - 260	180 - 260	5.7 - 6.5	6.5 - 11
Copper	16	110	24 - 230	130 - 170	5.7 - 6	7.5 - 19
Lead	31	110	18 - 330	210 - 1400	5.7 - 6	16 - 55
Mercury	0.15	1.3	0.06 - 2.6	0.74 - 0.93	0.096 - 0.1	0.05 - 0.1
Zinc	120	270	63 - 440	360 - 520	42 - 53	47 - 73

(a) NYSDEC Lowest Effect Level screening values obtained from NYSDEC (1999)

(b) NYSDEC Severe Effect Level screening values obtained from NYSDEC (1999)

Sample locations are presented on Figure 2-8.

Table 2-6
Summary of 2004 Sediment VOC Data
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

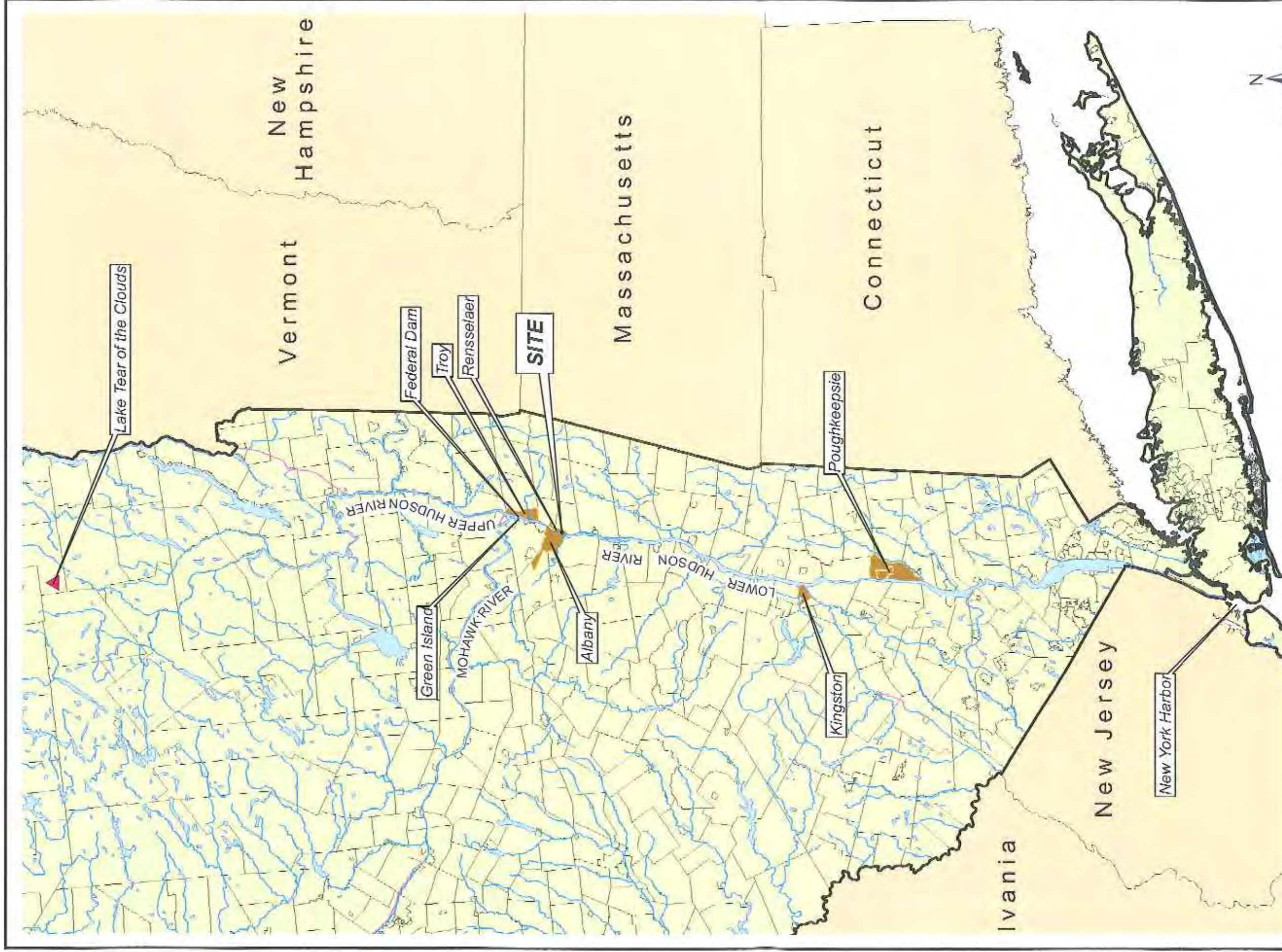
Analyte	Screening Value – Chronic (a) (µg/gOC)	Screening Value – Acute (b) (µg/gOC)	Minimum Detection (µg/gOC)	Maximum Detection (µg/gOC)	Mean (µg/gOC)	FOD
1,2-Dichlorobenzene	12	120	6.5	5263	304	5 : 18
1,3-Dichlorobenzene	12	120	1.3	484	36.5	2 : 18
1,4-Dichlorobenzene	12	120	11	363	30.3	2 : 18
Benzene	28	103	2.1	323	50.2	8 : 18
Chlorobenzene	3.5	34.6	0.7	4789	494	10 : 18
TOC (%)	-	-	0.036	2.3	1.2	16 : 18

(a) NYSDEC Benthic Aquatic Life Chronic Toxicity Criteria obtained from NYSDEC (1999)

(b) NYSDEC Benthic Aquatic Life Acute Toxicity Criteria obtained from NYSDEC (1999)

FOD = Frequency of Detection (Number of detected samples : Number of total samples)

Sample locations are presented on Figure 2-8.



Legend

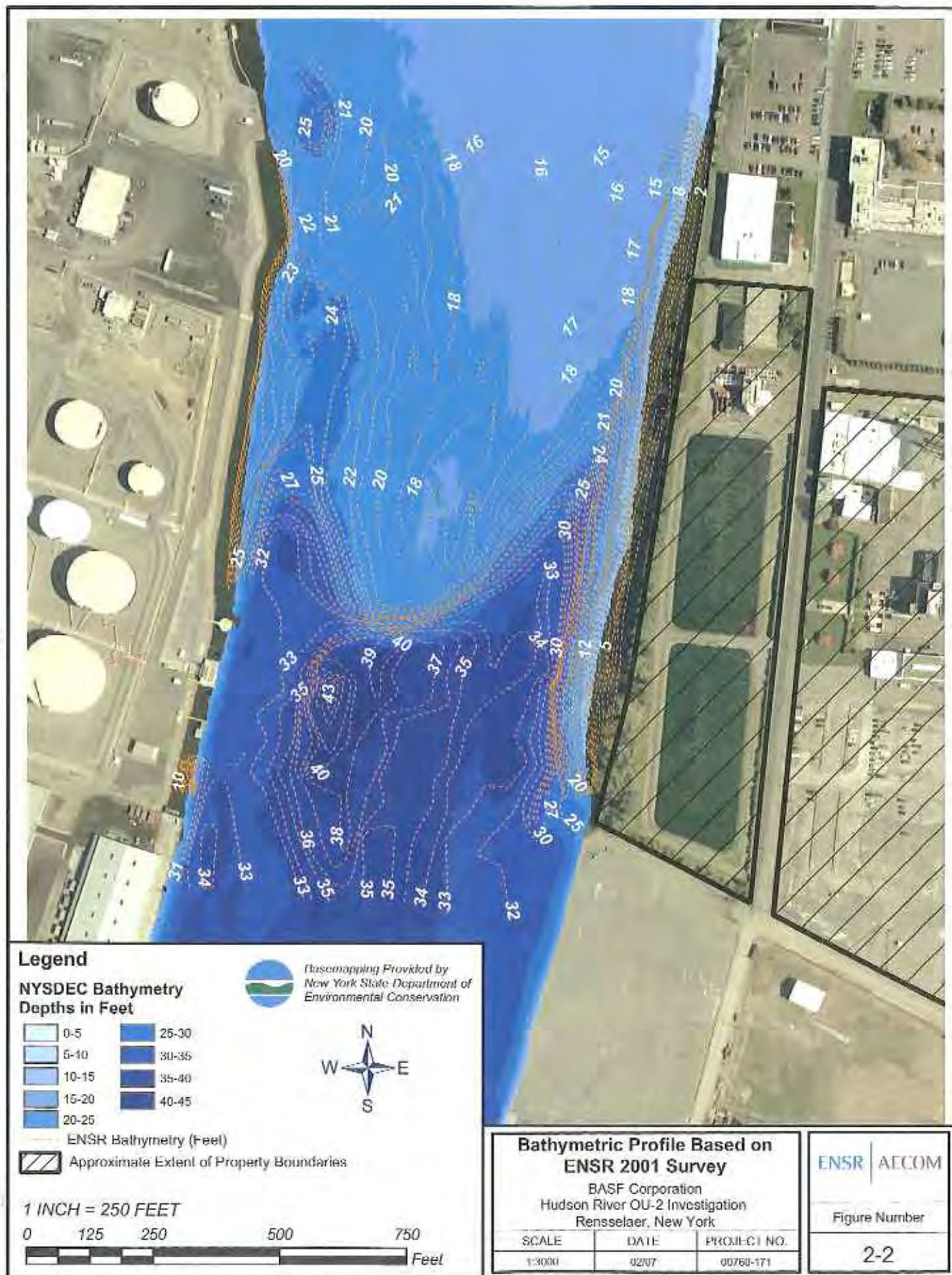
- ▲ Lake Tear of the Clouds
- NYS Town Boundaries
- Statewide Hydrography

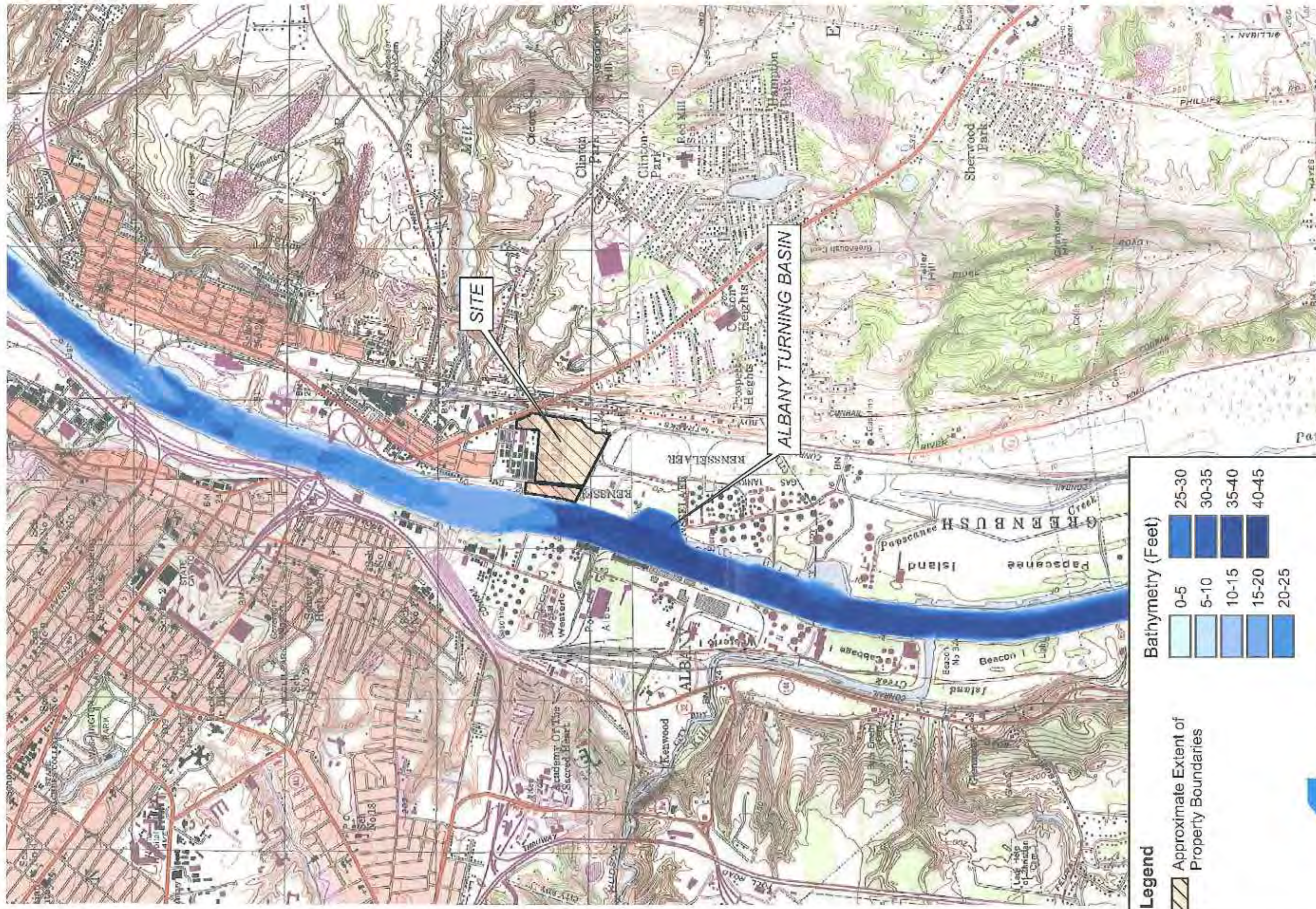


Overview of the Hudson River
 BASF Corporation
 Hudson River OU-2 Investigation
 Rensselaer, New York

SCALE	DATE	PROJECT NO.
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ENSR	AECOM
Figure Number	
2-1	





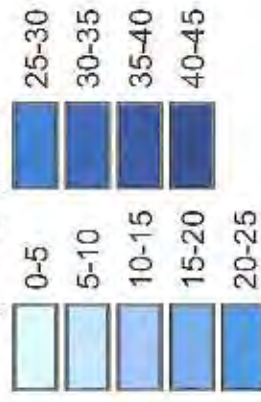
SITE

ALBANY TURNING BASIN

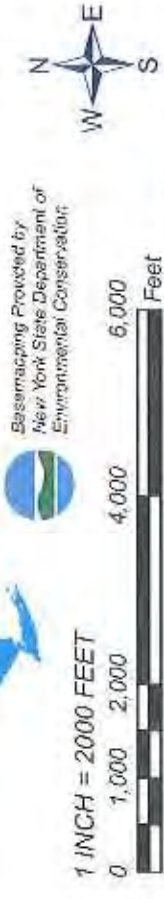
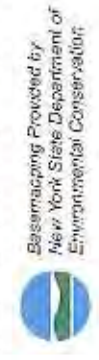
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 Approximate Extent of Property Boundaries

Bathymetry (Feet)



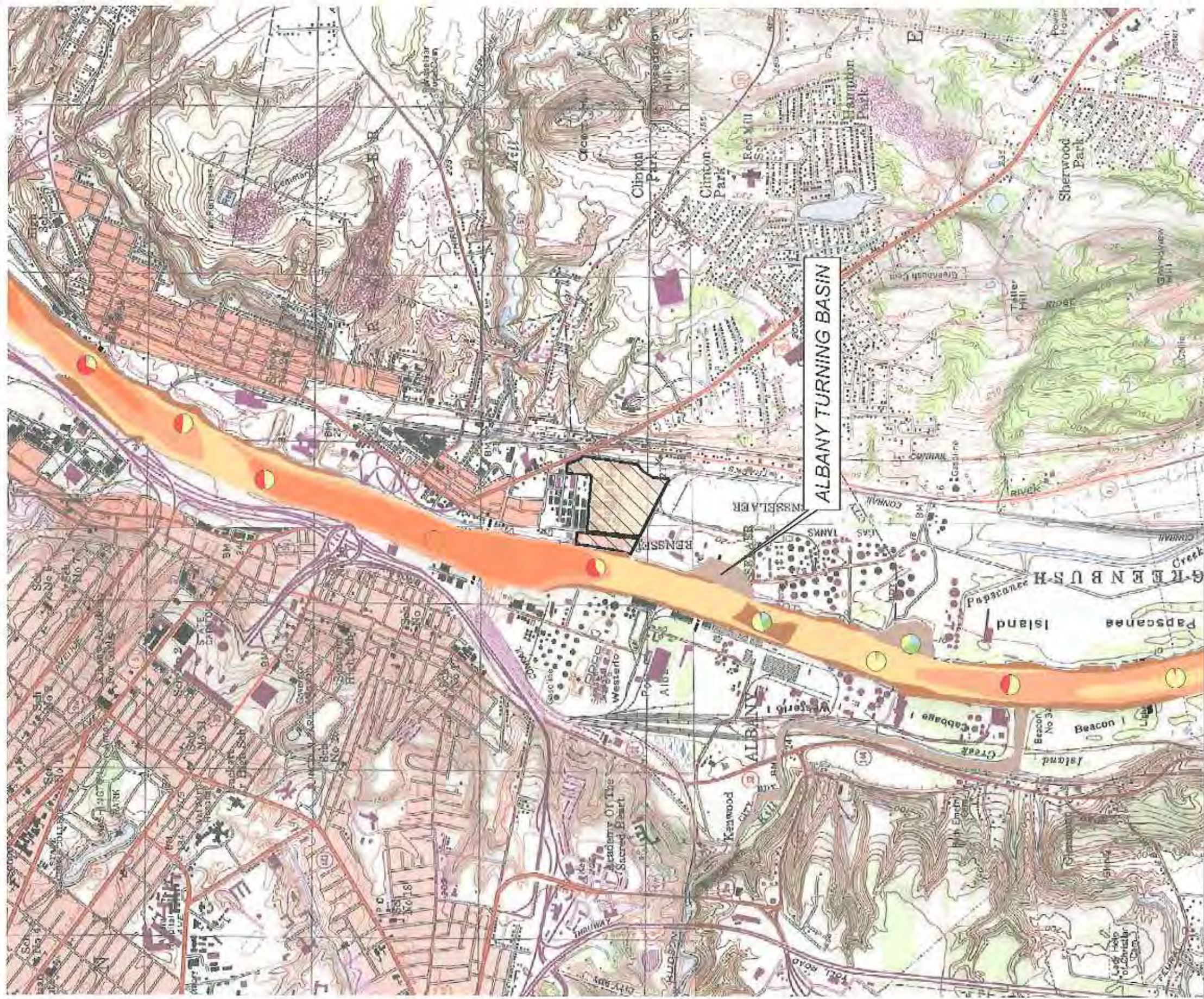
USGS 7.5 MINUTE TOPOGRAPHIC
QUADRANGLES ALBANY, EAST
GREENBUSH, TROY SOUTH AND DELMAR



**Bathymetric Profile Based on
NYSDEC 2003 Survey**
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

ENSR	AECOM
Figure Number	
2-3	

SCALE	DATE	PROJECT NO.
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ALBANY TURNING BASIN

Sediment Type

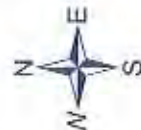
- sandy gravel
- gravelly sand
- sand
- muddy sand
- sandy mud

Cores and Grabs

- gravel
- sand
- silt
- clay
- No Data

Legend

- Approximate Extent of Property Boundaries
- Study Reach (distance from site)**
- 1500 Linear Feet
- 2 Linear Miles



USGS 7.5 MINUTE TOPOGRAPHIC
QUADRANGLES ALBANY, EAST
GREENBUSH, TROY SOUTH AND DELMAR

1 INCH = 2000 FEET



Basemapping Provided by
New York State Department of
Environmental Conservation

NOTES:

- 1) THIS FIGURE DEPICTS THE HISTORIC NYSDEC GEOPHYSICAL DATA, NOT THE DATA GATHERED AS PART OF THIS CURRENT STUDY.

Grain Size Samples and Sediment Type from the NYSDEC 2003 Survey

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

ENSR | AECOM

Figure Number

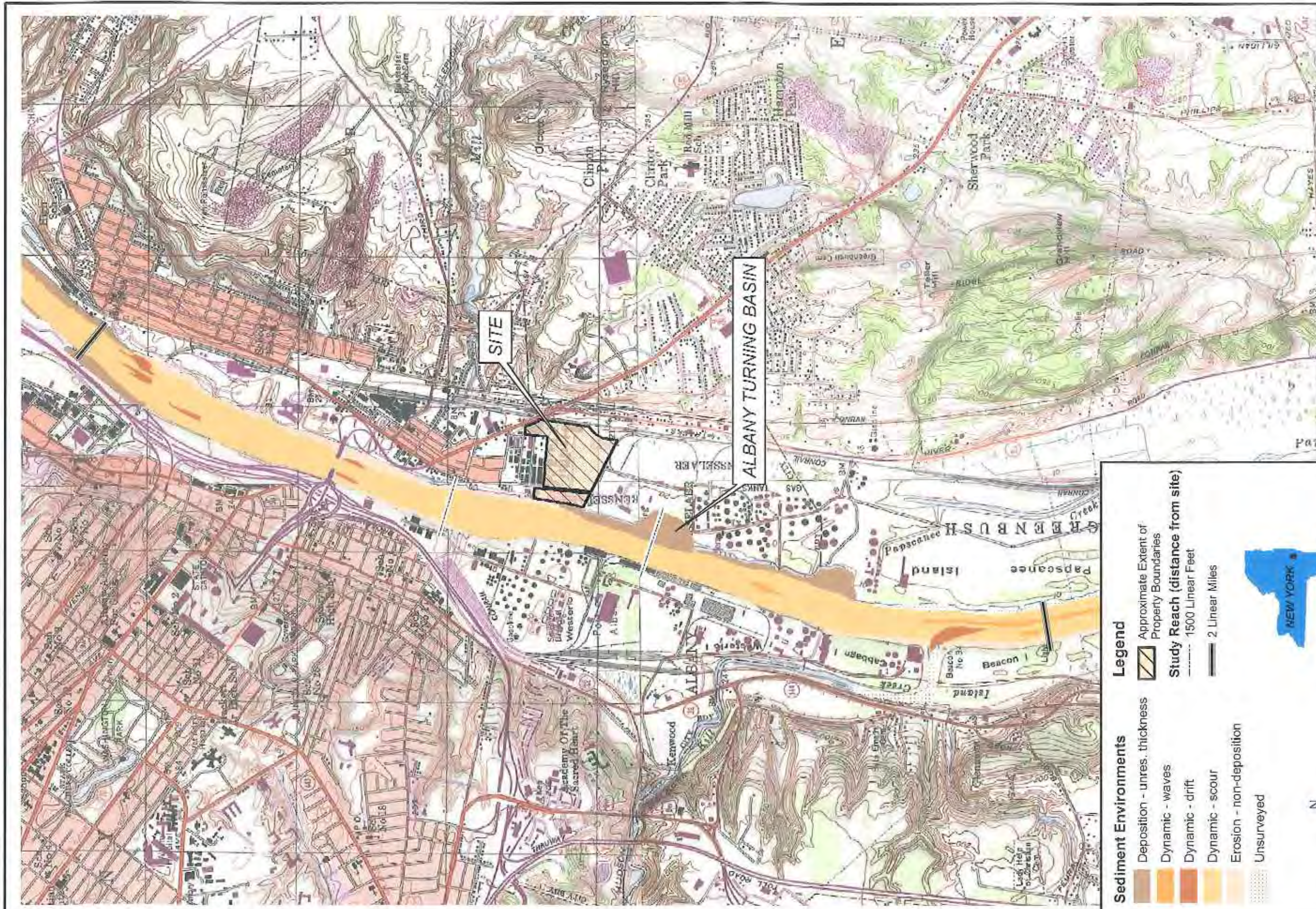
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DATE 02/07

PROJECT NO.

03760-171

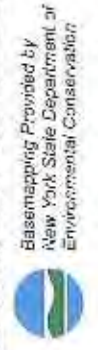


- Sediment Environments**
- Deposition - unres. thickness
 - Dynamic - waves
 - Dynamic - drift
 - Dynamic - scour
 - Erosion - non-deposition
 - Unsurveyed

- Legend**
- Approximate Extent of Property Boundaries
 - Study Reach (distance from site)
 - 1500 Linear Feet
 - 2 Linear Miles



USGS 7.5 MINUTE TOPOGRAPHIC
QUADRANGLES ALBANY, EAST
GREENBUSH, TROY SOUTH AND DELMAR



Basemapping Provided by
New York State Department of
Environmental Conservation

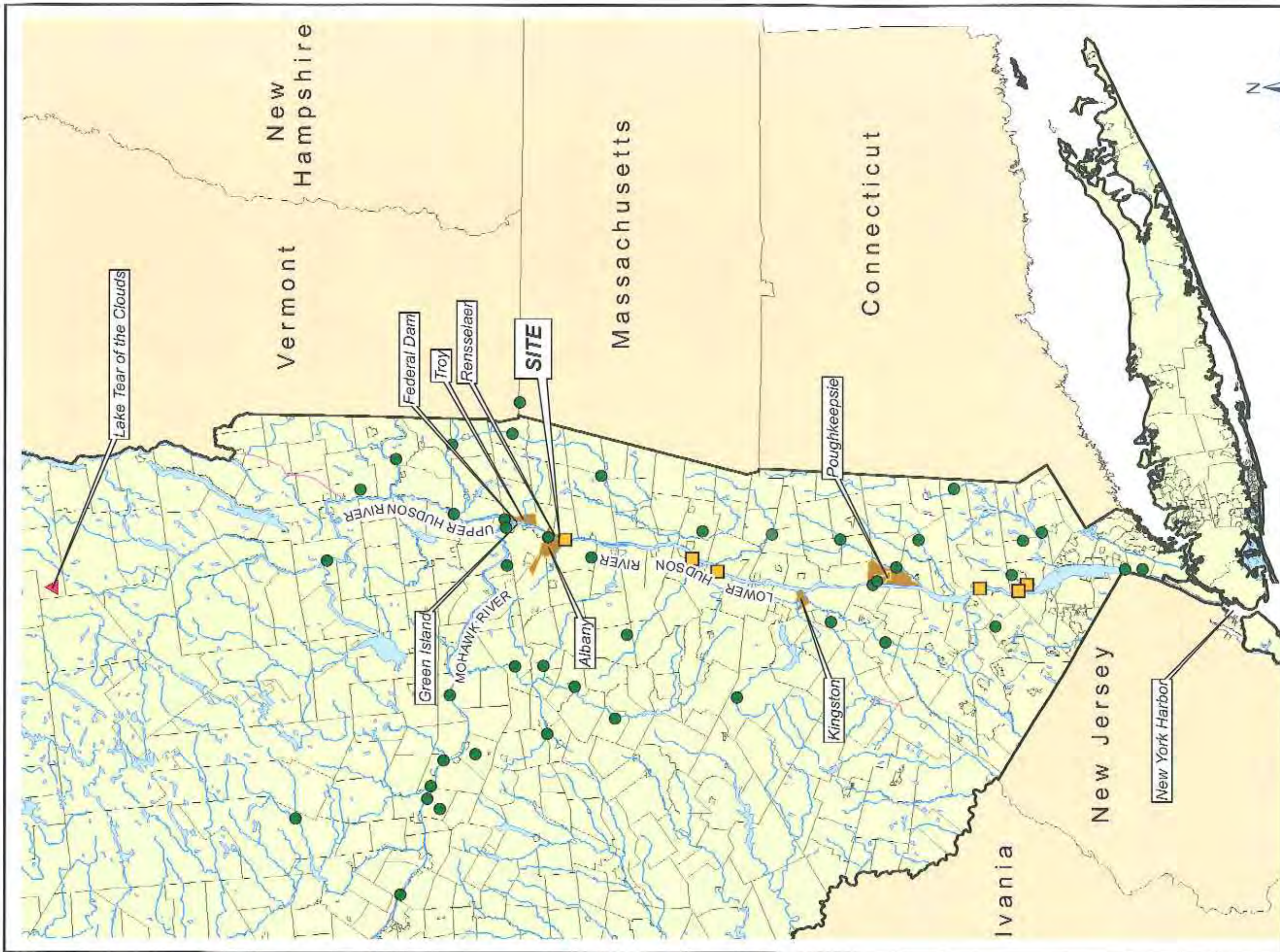
**Sediment Environments Based on
the NYSDEC 2003 Survey**

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

ENSR | AECOM

Figure Number
2-6

SCALE	DATE	PROJECT NO.
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Legend

- ▲ Lake Tear of the Clouds
- NYS Town Boundaries
- NYSDEC
- Statewide Hydrography
- USGS



NYSDEC and USGS Historic Sampling Locations			
BASF Corporation Hudson River OU-2 Investigation Rensselaer, New York			
SCALE	DATE	PROJECT NO.	
1:1,200,000	02/07	00760-171	

ENSR	AECOM
Figure Number	
2-7	

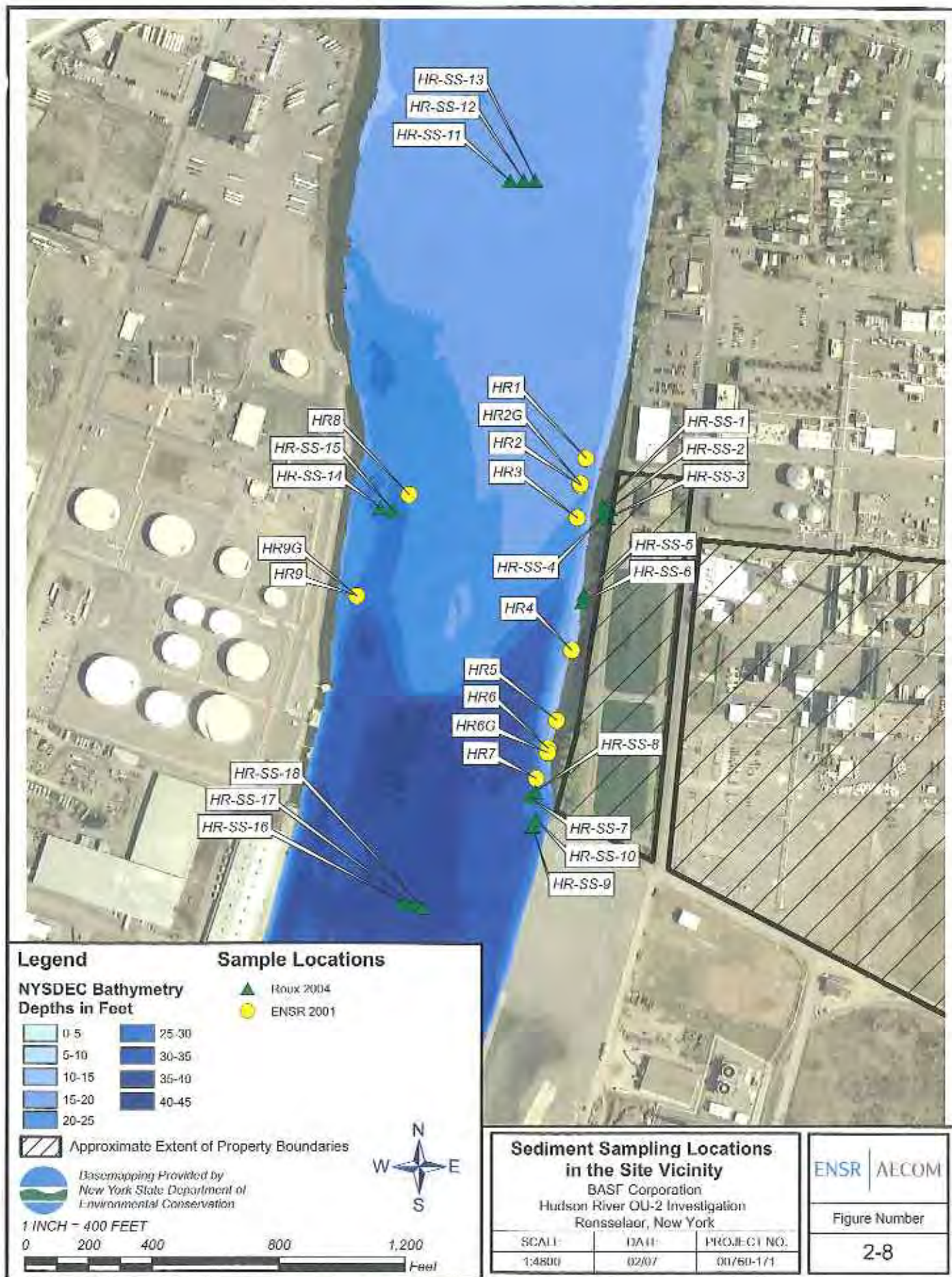
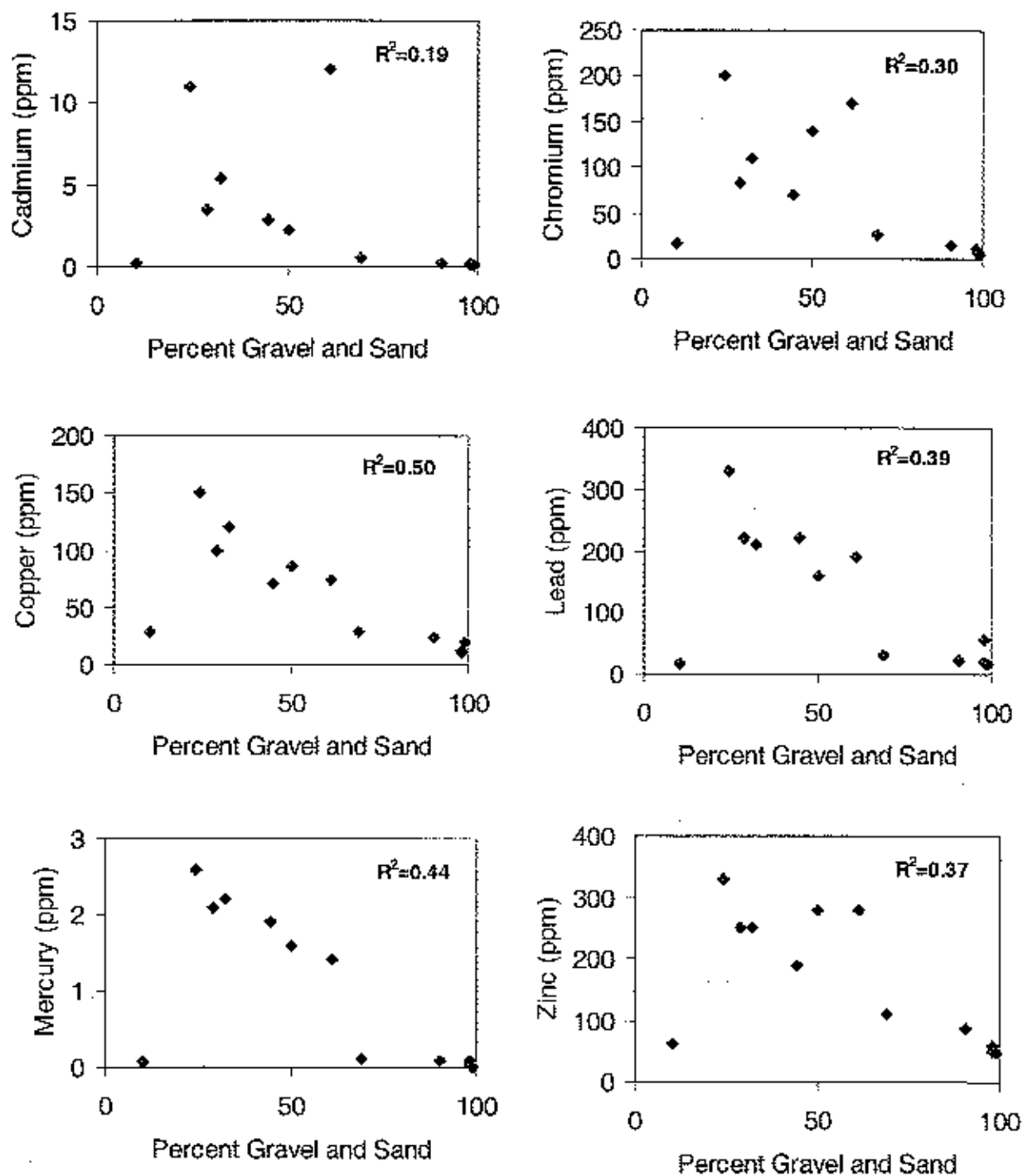


Figure 2-9
Correlation of Metals with Grain Size
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York



3.0 Field Sampling Materials and Methods

To fill existing data gaps, an additional investigation was conducted between November 2005 and May 2006, in accordance with the scope of work outlined in the Work Plan and Quality Assurance Project Plan (QAPP; ENSR, 2005). Appendix A provides additional details regarding the field sampling and analysis methodologies, and Figure 3-1 depicts the surface water, sediment, and biota sampling locations. Table 3-1 presents a summary of the sediment and surface water samples and associated analyses.

This field work included the following activities:

Task	Objectives	Sampling Effort	Reference
Geophysical Study	Characterize surficial and sub-surficial sediments. Identify anthropogenic anomalies on the river bottom which could potentially be sources of COPCs.	Side scan sonar and sub-bottom profile sonar of study area.	Appendix C presents the results of the geophysical survey conducted by CR Environmental, of Falmouth, MA.
Surficial Sediment Sampling and Analysis	Identify the presence and extent of potential Site-related compounds. Characterize the horizontal distribution of compounds. Evaluate the potential influence of non-Site-related anthropogenic background conditions. Provide data for screening level risk analysis.	Collect samples from the top 6 inches of sediment using a modified Ted Young dredge. Analyze for VOCs, inorganic compounds, Simultaneously Extracted Metals and Acid Volatile Sulfides (SEM and AVS), grain size, and TOC.	Appendix B provides a discussion of the surficial sediment data and Appendix D presents the analytical data and supporting documentation.
Sub-Surficial Sediment Sampling and Analysis	Identify the presence and extent of potential Site-related compounds. Characterize the vertical distribution of contaminants. Evaluate the potential influence of non-Site-related anthropogenic background conditions.	Collect samples from a sub-set of sampling locations using a 10- to 12-foot vibracore sampling device. Depending on sediment compositions, penetrate sub-surficial cores to 10 ft. Analyze for VOCs, inorganic compounds, grain size, and TOC.	Appendix B provides a discussion of the sub-surficial sediment data and Appendix D presents the analytical data and supporting documentation. Sediment boring logs are provided in Appendix F.
Surface Water Sampling and Analysis	Identify the presence and extent of potential Site-related compounds. Evaluate the potential influence of non-Site-related anthropogenic background condition. Provide data for screening level risk analysis.	Collect samples at mid-depth using a flow-through pump with Teflon-lined tubing. Analyze for VOCs, inorganic compounds (total and dissolved), total suspended solids, and hardness.	Appendix B provides a discussion of the surface water data and Appendix D presents the analytical data and supporting documentation.

Task	Objectives	Sampling Effort	Reference
Benthic Macroinvertebrate Community Characterization	Provide a reconnaissance level evaluation of the direct integrity of the benthic community adjacent to the Site relative to background or reference conditions.	Collect 18 surficial sediment samples for analysis of the benthic invertebrate community. Benthic invertebrate community samples were spatially and temporally co-located with a sub-set of the analytical sediment chemistry samples.	Appendix E presents the results of the benthic macroinvertebrate survey (report provided by Rapid Watershed Assessment Associates, of Albany, NY).

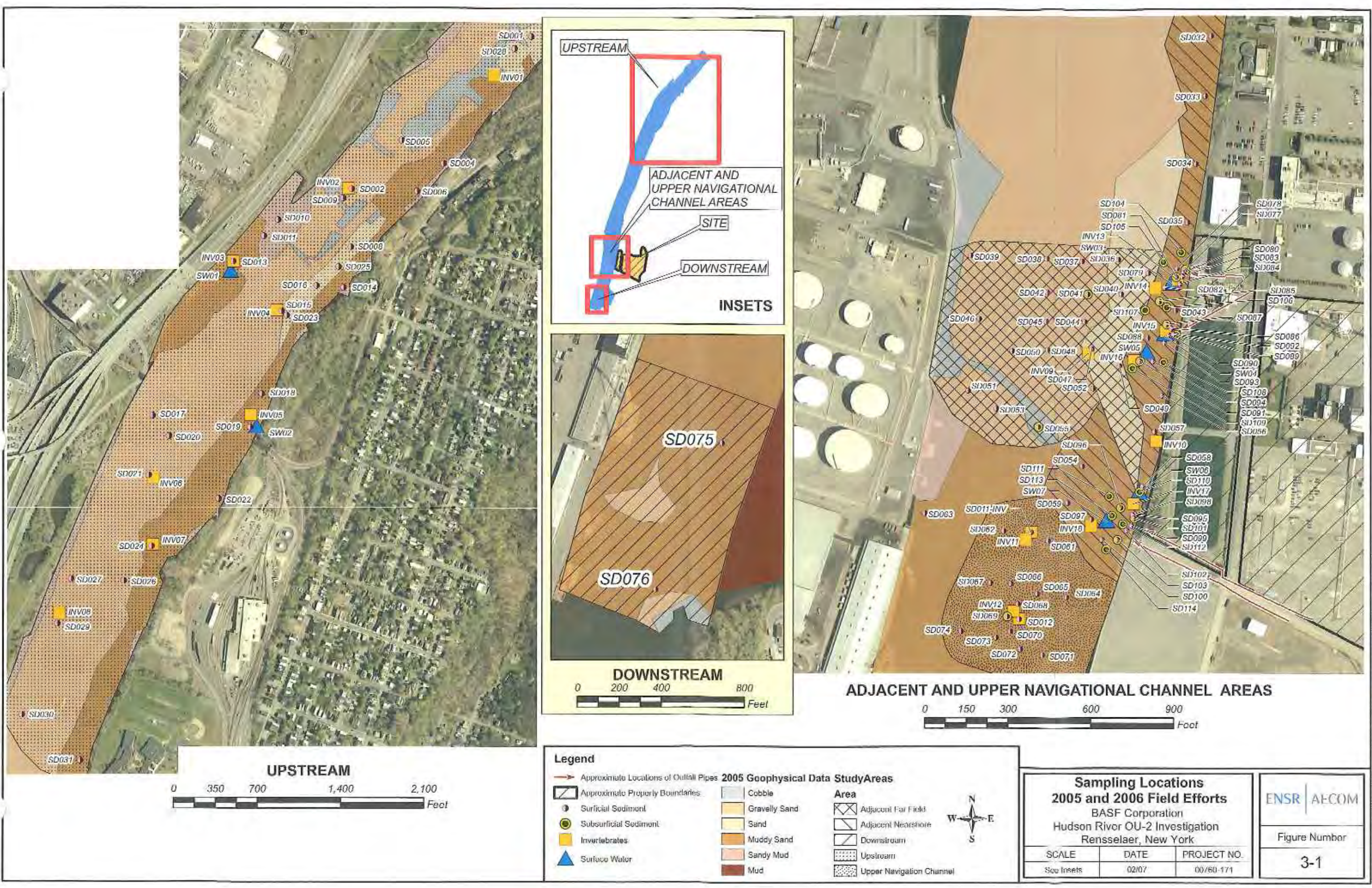
As described in Section 1.5, the data gathered from the various sampling and analysis activities have been segregated into discrete groupings based on proximity to the Site. Much of the remainder of this Report discusses the data within the context the five reaches of the river displayed in Figure 1-4.

Table 3-1
Sediment and Surface Water Sample and Analyses
BASF Corporation
Hudson River OU-2 Investigation
Hempstead, New York

Sample Location ID	River Reach	Geophysical Substrate Type(s)	Top Depth Interval (Feet)	Bottom Depth Interval (Feet)	Sample Date	TAL Inorganic	TCL VOCs	SEM and AYS	TOC	Grain Size
SD001	UPSTREAM	Sand	0	0.5	May-05	X		X	X	X
SD002	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD003	UPSTREAM	Sandy Mud	0	0.5	May-05	X				X
SD004	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD005	UPSTREAM	Muddy Sand	0	0.5	May-05	X				X
SD006	UPSTREAM	Sand	0	0.5	May-05	X				X
SD007	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD008	UPSTREAM	Sandy Mud	0	0.5	May-05	X				X
SD009	UPSTREAM	Muddy Sand	0	0.5	December-05	X				X
SD010	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD011	UPSTREAM	Sand	0	0.5	May-05	X				X
SD012	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD013	UPSTREAM	Sandy Mud	0	0.5	May-05	X				X
SD014	UPSTREAM	Muddy Sand	0	0.5	December-05	X				X
SD015	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD016	UPSTREAM	Sand	0	0.5	May-05	X				X
SD017	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD018	UPSTREAM	Muddy Sand	0	0.5	May-05	X				X
SD019	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD020	UPSTREAM	Muddy Sand	0	0.5	May-05	X				X
SD021	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD022	UPSTREAM	Sand	0	0.5	May-05	X				X
SD023	UPSTREAM	Muddy Sand	0	0.5	May-05	X				X
SD024	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD025	UPSTREAM	Sand	0	0.5	May-05	X				X
SD026	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD027	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD028	UPSTREAM	Sand	0	0.5	May-05	X				X
SD029	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD030	UPSTREAM	Muddy Sand	0	0.5	May-05	X				X
SD031	UPSTREAM	Sand	0	0.5	May-05	X				X
SD032	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD033	UPSTREAM	Sand	0	0.5	May-05	X				X
SD034	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD035	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD036	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD037	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD038	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD039	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD040	UPSTREAM	Sand	0	0.5	May-05	X				X
SD041	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD042	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD043	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD044	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD045	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD046	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD047	UPSTREAM	Sand	0	0.5	May-05	X				X
SD048	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD049	UPSTREAM	Sand	0	0.5	May-05	X				X
SD050	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD051	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD052	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X
SD053	UPSTREAM	Gravelly Sand	0	0.5	May-05	X				X

Table 3-1
Sediment and Surface Water Samples and Analyses
BASF Corporation
Hudson River O&G Investigation
Patuxent, New York

Sample Location ID	River Reach	Geophysical Substrate Type ⁽¹⁾	Top Depth Interval (Feet)	Bottom Depth Interval (Feet)	Sample Date	TAL Inorganics	TCL VOCs	SEM and AVS	TDC	Grain Size
S0055	ADJACENT FAR FIELD	Cobble	0	0.5	May-06	X		X	X	X
S0056	ADJACENT FAR FIELD	Cobble	2	4	December-05	X		X	X	X
S0079	ADJACENT FAR FIELD	Sand	0	0.5	May-06	X	X	X	X	X
S0032	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0033	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0034	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0035	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0043	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0054	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0056	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0057	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0058	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0059	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0077	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0077	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0077	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0078	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0080	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0081	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0081	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0081	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0082	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0083	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0084	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0085	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0085	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0085	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0086	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0087	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0087	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0087	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0088	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0089	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0089	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0089	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0090	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0091	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0091	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0091	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0092	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0093	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
S0094	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0095	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0096	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
S0096	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
S0096	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
S0097	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X



4.0 Field Program Results

This section summarizes the results of the 2005-2006 surface water and sediment sampling field program. A more detailed discussion of the data is presented in Appendix B. The geophysical survey report is presented in Appendix C, the complete analytical data set and data validation documentation are presented in Appendix D, sediment boring logs are presented in Appendix F, and the macroinvertebrate report is presented in Appendix E.

The analytical data collected in support of this program are valid and considered usable for decision-making purposes. Selected data points were qualified as estimated due to QC non-conformances or were negated due to blank contamination. In addition, a few data points were rejected due to more severe QC non-conformances. Qualification of the data is discussed in the validation memoranda included in Appendix D.

4.1 Geophysical Survey

The side-scan sonar surveys, discussed in detail in Appendix C, produced a 30-cm resolution mosaic which allows for the determination of sediment classifications on a broad scale. These data were used to help focus the sediment sampling effort on depositional environments.

Using the classification system employed by NYSDEC (2000b), the primary substrate categories observed during the 2005 geophysical survey conducted by CER Environmental (Appendix C) included cobble, sandy gravel (or gravelly sand), sand, muddy sand, sandy mud, and mud. As indicated in Figure 4-1, the results of the survey indicate that sandy gravel (or gravelly sand) is the dominant substrate throughout the Study Area. However, in the Adjacent Nearshore reach, muddy sand and sandy mud comprise the majority of the substrate observed. In the Adjacent Far Field reach, immediately to the west of the muddy sand/sandy mud complex, a lobe of sand bounds the muddy sand. Immediately downstream of the Site, in the Upper Navigational Channel and in the Downstream reach adjacent to the turning basin, much of the substrate consists of muddy sand. Approximately three miles upstream of the Site, at the reference area, the river is dominated by sandy gravels and gravelly sands, with areas of muddy sand on both the eastern and western edges of the river.

The sub-bottom profiling measured sub-surficial conditions from 1 to 40 ft below the sediment surface. The sub-bottom profiles show approximately 6 ft of coarse sediment in a typical Upstream sample, 12 to 26 ft of sediment in an Adjacent Nearshore sample, and up to 25 ft of stratified sediments located in the Downstream reach near the southern edge of the turning basin.

4.2 Sediment Grain Size

The results of the sediment grain size analysis (Table 4-1) indicate that several different substrate types exist within the Study Area, and generally confirm the results of the geophysical survey presented in Appendix C. Sediments downstream of the Site and along the eastern bank of the Hudson River, including those within the Adjacent Nearshore reach and the Upper Navigational Channel downstream of the Site, are dominated by fine sand, silt, and clay (i.e., fine-grained materials). These depositional materials comprise the muddy sands identified in the geophysical survey conducted in 2005 (Figure 4-1). In the Adjacent Far Field reach to the west of the Site, the grain size data confirmed that this lobe is dominated by coarser materials such as medium sand, with significant amounts of coarse and fine sand. Further west, the grain size data are dominated by gravel and sands, characterized as gravelly sand in the geophysical survey.

The grain size data within the Upstream reach are generally consistent with the 2005 geophysical survey characterization of the upstream locations. These sediments are primarily dominated by gravel and sand in the central portion of the channel, fine sand, silt, and clay along the eastern bank, and a mix of silt, clay, and fine sand along the west bank. Lobes of sediments dominated by either cobble or sand also occur in the upper

portion of the Study Area. In nearshore environments in the Upstream reach, evidence of bank failure was noted (much of the Upstream reach is characterized by an earthen bank, whereas the river bank in the vicinity of the Site is armored). To the extent that the nearshore fine-grained sediments in the Upstream reach are derived from recent bank failure, and not long-term depositional processes, these samples may not be an ideal representation of urban background.

Sub-surficial grain size data from multiple depths were available at 15 sampling stations, primarily located in the Adjacent Nearshore reach. While all 15 stations were classified as muddy sand in the geophysical survey, in general, the grain size data identified the materials as primarily dominated by silt with fewer samples dominated by fine sand or medium sand. In general, when there were materials with different grain sizes present within a core, the finer material was located in the deeper samples. These results indicate that in general, the vertical stratigraphy in the Adjacent Nearshore reach is relatively homogenous and is dominated by fine-grained materials.

4.3 Inorganic Compounds in Sediment

Based on previous studies of the Hudson River in the vicinity of the Site and a review of the historic source area data, the following metals have been identified as potentially Site-related compounds of concern: cadmium, chromium, copper, lead, mercury, and zinc. Figures 4-2 and 4-3 present the inorganic summary data for several of the metals of potential concern at the Site. A sample-by-sample summary of the detected inorganic compounds in sediment is provided in Appendix B, and Appendix D provides all of the analytical data and data validation memoranda.

A total of 101 surficial and 56 sub-surficial sediment samples were analyzed for inorganic compounds as part of this study. These sampling stations were collected from the following strata and locations (excluding field duplicates and other QA/QC samples):

Sampling Horizon (ft)	Number of Sampling Stations Evaluated					Sum
	Upstream	Adjacent Nearshore	Adjacent Far Field	Upper Navigational Channel	Downstream	
0 to 0.5	28	36	19	15	2	101 ^[1]
2 to 4	--	20	2	1	--	23
4 to 6	--	20	--	1	--	21
6 to 8	--	8	--	--	--	8
8 to 10	--	4	--	--	--	4
Sum	28	88	21	17	2	157
[1] A single surficial sample was collected from the muddy sand along western shore of Hudson River. This sample (SD063) is not included in other evaluated reaches.						

With regard to the inorganic compounds, a few trends are apparent relative to the data summarized in this section:

- While levels of inorganic compounds occur within the Upstream reach, which is not influenced by Site-related compounds, concentrations in the Adjacent Nearshore area appear to generally be elevated relative to urban background (i.e., relative to the Upstream data set). Consistency with background conditions is explored further in Section 5 of this Report.

- In the muddy sand located in the immediate vicinity of the Site (i.e., Adjacent Nearshore), concentrations of metals in surficial and sub-surficial sediment are elevated relative to the concentrations in the main channel.
- In the Adjacent Nearshore, concentrations of metals are generally elevated in deeper sediments when compared to surficial sediments at individual sampling locations. The areas of higher metals concentrations typically correspond to depositional sediments (i.e., muddy sand) with finer grain sizes, and appear to be co-located with the locations of historic outfalls from the Site.
- In the Adjacent Far Field located to the west of the muddy sand in the Adjacent Nearshore, inorganic compound concentrations decrease markedly and are generally consistent with concentrations upstream of the Site and further downstream, adjacent to the turning basin.
- Surficial metals levels are slightly elevated in the muddy sand found in the Upper Navigational Channel, just downstream of the Site.

The potential significance of these (and other) trends is further discussed in Sections 5 through 9 of this Report.

4.4 Organic Compounds in Sediment

Previous studies of the Hudson River in the vicinity of the Site identified a sub-set of VOCs of potential concern in sediments adjacent to the Site which exceed NYSDEC guidelines. These VOCs included benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1-4-dichlorobenzene. A sample-by-sample summary of the detected VOCs in sediment is provided in Appendix B. Appendix D provides all of the analytical data and data validation memoranda. A total of 37 surficial and 56 sub-surficial sediment samples were analyzed for organic compounds (specifically VOCs) as part of this study. These sampling stations were collected from the following strata and locations:

Sampling Horizon (ft)	Number of Sampling Stations Evaluated					Sum
	Upstream	Adjacent Nearshore	Adjacent Far Field	Upper Navigational Channel	Downstream	
0 to 0.5	2	34	1	--	--	37
2 to 4	--	20	2	1	--	23
4 to 6	--	20	--	1	--	21
6 to 8	--	8	--	--	--	8
8 to 10	--	4	--	--	--	4
Sum	2	86	3	2	--	93

With regard to VOCs, a few trends are apparent relative to the data summarized in this section:

- VOCs were detected most frequently and at the highest concentrations in the Adjacent Nearshore area, at sampling stations that are located immediately adjacent to the Site bulkhead. Outside of this nearshore environment, VOC concentrations were markedly lower or not detected.
- Concentrations of VOCs in the Adjacent Nearshore area were generally highest in sub-surficial sediments in areas containing muddy sand substrates near the historic outfalls. The band of potentially impacted muddy sand extends from 90 to 185 ft west of the Site bulkhead prior to transitioning to coarser-grained material in the Adjacent Far Field.

- Adjacent to the Site, the upstream extent of surficial VOCs lies between SD035 and SD034, sampling locations situated immediately to the north of the northern Site boundary. It is likely that the sub-surficial extent lies between SD035 and SD104, just upstream of the inactive stormwater outfall.
- Adjacent to the Site, elevated VOC concentrations in surficial and sub-surficial sediments are bound by the extent of muddy sand, which extends 90 to 185 ft west of the bulkhead before transitioning to sandy substrate (i.e., the Adjacent Far Field).
- Within the Adjacent Nearshore environment, the downstream extent of potential VOC impacts is in the vicinity of SD114. Concentrations at this location range from slightly elevated to non-detect, with concentrations generally decreasing with sediment depth.

4.5 Simultaneously Extracted Metals, Acid Volatile Sulfides and TOC in Sediment

Although analysis of SEM, AVS, and TOC data alone is not a completely comprehensive metric of bioavailability, an evaluation of these data is useful as a preliminary indicator of whether or not selected inorganic substances (divalent metals) are likely to be bioavailable in sediments. Therefore, SEM, AVS, and TOC data were collected and analyzed at nearly 50% of the surface sediment locations. These stations were broadly distributed and included nine Upstream, 10 Adjacent Far Field, 19 Adjacent Nearshore, nine Upper Navigational Channel, and one Downstream sampling locations. Appendix B provides additional detail regarding the collection of the samples and the theory behind the equilibrium partitioning ("EqP") approach for establishing sediment quality criteria. Sulfides were not detected in more than half of the samples (29 of 48 samples) so comparisons could not be conducted with these samples.

Results of the SEM, AVS, and TOC analysis (summarized in Table 4-2) indicate that the levels of AVS alone may not be sufficient to bind the divalent metals. However, increasing levels of organic carbon, particularly in the Adjacent Nearshore area, may help to decrease the bioavailability of the metals.

Seven locations from within the Upstream, Adjacent Nearshore, and Upper Navigational Channel reaches had $(\Sigma\text{SEM-AVS})/f_{oc}$ values of less than $130 \mu\text{mol/g}_{oc}$ where the sediments are presumed to "not likely" be toxic (USEPA, 2005). None of the samples had an $(\Sigma\text{SEM-AVS})/f_{oc}$ value above $3,000 \mu\text{mol/g}_{oc}$ where the sediments are presumed to "likely" be toxic (USEPA, 2005). The remaining samples were between these two thresholds in a range where the prediction of effects is uncertain.

These results indicate that, while the presence of AVS and TOC may play a role in modifying the bioavailability of divalent metals at a sub-set of the Hudson River sediment sampling locations, the results are uncertain, and AVS alone is not sufficient to bind divalent metals at a number of stations. In addition, at 29 sampling locations, AVS was not detected, and therefore binding of metals to AVS at these stations is not a significant factor.

4.6 Benthic Macroinvertebrate Community Analysis

As detailed in the benthic macroinvertebrate study report presented in Appendix E, the benthic macroinvertebrate communities analyzed upstream, adjacent to, and downstream of the Site are ecologically similar to one-another, regardless of proximity to the Site or compound concentration levels in co-located surficial sediment samples. Invertebrate diversity and abundance in the sediment were comparable across all samples and sampling reaches evaluated. Similarity analyses indicate that the observed differences (in terms of taxa observed, diversity, abundance, and habitat) throughout the Study Area were small and not significant.

Additional analysis of the macroinvertebrate survey data in the context of the analytical chemistry data is provided in Section 7 and Appendix I (screening level risk ecological assessment).

4.7 Surface Water VOCs and Inorganic Compounds

A sample-by-sample summary of the total recoverable and dissolved inorganic compounds and VOCs in surface water is provided in Appendix B and Table 4-3. Appendix D provides all of the analytical data and data validation memoranda.

A review of the concentration ranges and mean concentrations indicates that there is little difference in inorganic compound concentrations in the Upstream and Adjacent Nearshore reaches. For many compounds, concentrations were slightly higher upstream of the Site than adjacent to the Site. With the exception of acetone and toluene, VOCs were not detected in all surface water samples. However, the low levels of acetone and toluene detected in surface water samples may be due to laboratory contamination, are likely not Site-related, and were not present in either sediment or groundwater at the Site.

As discussed further in the risk assessments (Sections 6 and 7 and Appendices I and J), a review of the surface water data indicates that it is not a medium of concern at this Site.

Table 4-1
Sediment Grain Size Results
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, New York

Location ID	Depth Interval (ft)	Grain Size (%)							
		Gravel	Coarse Sand	Medium Sand	Fine Sand	Total Silt	Total Clay	Total Sand	Total Fines
UPSTREAM									
SD001	0 - 0.5	44.4	21.2	23.5	6.5	1	1.4	53.2	2.4
SD002	0 - 0.5	29.3	20	41.6	7.7	0.9	0.5	69.3	1.4
SD004	0 - 0.5	28.9	11.9	13.6	20	18	7.6	45.5	25.8
SD005	0 - 0.5	47.8	14	29.7	6.9	0.8	0.8	50.6	1.6
SD006	0 - 0.5	1.5	3.3	9	96	38.2	12	48.3	50.2
SD008	0 - 0.5	48.15	8.25	20.95	15.35	4.8	2.5	44.6	7.3
SD009	0 - 0.5	22.05	23.6	43.85	5.45	1.25	3.8	72.9	5.1
SD010	0 - 0.5	2.1	3.5	10.1	69.5	9.8	5	83.1	14.8
SD011	0 - 0.5	0.7	1.9	13.1	86.8	12.7	4.8	81.8	17.5
SD013	0 - 0.5	0.2	0	1.2	65.2	27.7	5.7	66.4	33.4
SD014	0 - 0.5	0	0.3	1.8	45.9	43.4	8.6	48.0	52.0
SD015	0 - 0.5	24.4	18.5	21.8	25.8	1.6	7.9	66.1	9.5
SD016	0 - 0.5	50.8	13.5	23.1	10.2	1.7	0.7	46.8	2.4
SD017	0 - 0.5	32.1	21.4	38.8	6.7	0.6	0.4	66.9	1.0
SD018	0 - 0.5	0	0.2	2.4	41.3	46	10.1	43.9	56.1
SD019	0 - 0.5	13.3	6.5	14.8	26.6	36.9	1.9	47.9	38.8
SD020	0 - 0.5	32.8	19.7	38.3	7.5	0.7	1	65.5	1.7
SD021	0 - 0.5	34.7	21.4	34.2	8	1.3	0.4	63.6	1.7
SD022	0 - 0.5	0.6	0.3	1.7	35.5	46.6	12.3	38.5	60.9
SD023	0 - 0.5	50.6	10.6	15	21.2	1.8	0.8	46.8	2.6
SD024	0 - 0.5	0.7	2.7	21.4	48.2	19.3	7.7	72.3	27.0
SD025	0 - 0.5	27.2	10.9	17.9	34.5	7	2.5	83.3	9.5
SD026	0 - 0.5	1.4	5.5	53.6	37.6	1.4	0.5	96.7	1.9
SD027	0 - 0.5	41.4	9	29.5	16.4	1.4	2.3	54.9	3.7
SD028	0 - 0.5	47.1	14.2	19.4	13.7	3.8	2	47.3	5.6
SD029	0 - 0.5	10	10.6	37.4	36.2	3.3	2.5	84.2	5.6
SD030	0 - 0.5	25.7	17.4	41.5	10.8	2.8	1.7	69.7	4.6
SD031	0 - 0.5	5.8	2.4	4.8	35.7	39.8	12.1	42.7	51.7
ADJACENT FAR FIELD									
SD038	0 - 0.5	28.7	15.1	27	27	1.7	0.5	69.1	2.2
SD037	0 - 0.5	12.7	41.8	44	0.9	0.2	0.4	86.7	0.6
SD038	0 - 0.5	44.9	16.4	32.8	5.1	0.4	0.4	54.3	0.8
SD039	0 - 0.5	46.6	19.5	26.4	4.5	1.9	1.1	50.4	3.0
SD040	0 - 0.5	11.7	23.3	40.2	23	1.2	0.8	86.5	1.8
SD041	2 - 4	15.5	18.8	58.4	6	1.2	0.1	83.2	1.3
SD047	0 - 0.5	4.2	9.9	66.2	17.3	1.8	0.8	93.4	2.4
SD055	2 - 4	21.7	30	41.6	5.5	1.1	0.1	77.1	1.2
SD079	0 - 0.5	4.7	3.1	63.3	21.4	0.5	2	92.8	2.5
ADJACENT NEARSHORE									
SD032	0 - 0.5	18.5	15.5	14.2	19.2	27.3	7.3	48.9	34.6
SD033	0 - 0.5	5	4.8	6.5	31.9	38.7	13.1	43.2	51.8
SD034	0 - 0.5	1.1	1.8	10.4	41.4	35.3	9	53.6	45.3
SD035	0 - 0.5	0.6	1	3.2	28.6	49.7	16.9	32.8	66.6
SD057	0 - 0.5	0.3	0.1	3	29.5	60.6	6.5	32.6	67.1
SD059	0 - 0.5	1	1.7	21.2	52.4	15.8	7.9	75.3	23.7
SD077	0 - 0.5	7.3	3.9	10.9	30.3	37.1	10.5	45.1	47.6
SD077	2 - 4	2	2.5	54.1	12.5	28.2	0.7	69.1	28.9
SD077	4 - 6	0.1	0.4	71.2	9.8	18.1	2.4	81.4	18.5
SD078	0 - 0.5	0	0.3	10.5	31.1	42	16.1	41.9	58.1
SD080	0 - 0.5	17.4	9.4	17.6	28.5	20.1	7	55.5	27.1
SD081	0 - 0.5	0	0.3	1.6	32.9	46.6	18.6	34.8	65.2
SD081	2 - 4	0	0.1	10.8	30.5	57.4	1.2	41.4	58.6
SD081	4 - 6	0.7	1.5	20.6	26.2	41.6	7.4	50.3	49.0
SD082	0 - 0.5	2.1	0.8	14.3	24.3	56.6	1.9	39.4	58.5
SD083	0 - 0.5	0.9	1.3	6.9	42.3	37.4	11.2	50.5	48.6
SD084	0 - 0.5	0	0.5	4.4	40	42.3	12.8	44.9	55.1
SD085	0 - 0.5	0	0.3	18.1	20.5	58	3.1	38.9	61.1
SD085	2 - 4	0	1.2	18	26.7	48.8	4.3	46.9	53.1
SD085	4 - 6	0.6	1.3	11	24.5	51.3	11.3	36.8	82.6
SD086	0 - 0.5	0.2	0.8	5.8	58.9	33.9	0.4	65.5	34.3
SD087	0 - 0.5	2.6	2.1	9.6	23.3	62.1	0.3	35.0	62.4
SD087	2 - 4	4.1	12.4	29.7	28.1	24.8	0.9	70.2	25.7
SD087	4 - 6	1.2	11.1	27.1	36.5	24	0.1	74.7	24.1
SD088	0 - 0.5	0	0	7.2	16.3	66	10.5	23.5	75.5
SD089	0 - 0.5	1.4	1.5	7.4	85.4	18.2	8.1	74.3	24.3
SD089	2 - 4	1	5.3	18.3	39.7	34.7	1	83.3	35.7
SD089	4 - 6	0	1.8	20.4	41.7	35.8	0.2	63.9	38.1

Table 4-1
Sediment Grain Size Results
BASF Corporation
Hudson River OU-2 Investigation
Hensselaer, New York

Location ID	Depth Interval (ft)	Grain Size (%)							
		Graves	Coarse Sand	Medium Sand	Fine Sand	Total Silt	Total Clay	Total Sand	Total Fines
ADJACENT NEARSHORE									
SD090	0 - 0.5	0.1	0.2	2	49.5	47	1.2	51.7	48.2
SD091	0 - 0.5	2.3	3.3	10.1	65.8	17.9	0.6	79.2	18.5
SD093	0 - 0.5	0.8	1.6	7.5	40.9	48.1	1.1	50.0	49.2
SD095	0 - 0.5	0.2	0.5	2	51.9	45.3	0.1	54.4	45.4
SD096	0 - 0.5	3.9	2.8	6.4	68.9	16.7	7.3	78.1	18.0
SD096	2 - 4	5.5	1.7	7.3	27.9	56.5	1.1	56.9	57.6
SD096	4 - 6	0.1	1.3	4.8	28.8	60.8	4.2	34.9	65.0
SD097	0 - 0.5	6.7	4.9	6.8	64.6	7.7	9.4	76.2	17.1
SD098	0 - 0.5	0	0.1	2.2	93.6	60.1	4	35.9	64.1
SD099	0 - 0.5	0.1	0.4	3.2	68.1	12.2	1.5	72.7	27.2
SD100	0 - 0.5	0.1	0.2	8.4	69.2	17	5.1	77.8	22.1
SD101	2 - 4	0.9	1.1	15.6	21.3	56.8	4.3	38.0	61.1
SD101	4 - 6	2.9	0	30.5	27.2	38.8	0.6	57.7	39.4
SD103	0 - 0.5	0	0.1	2.9	53.2	36.2	7.6	58.2	43.8
SD103	2 - 4	0	0.7	20.6	29.7	34.6	14.4	51.0	49.0
SD103	4 - 6	0	0.1	21.3	2.1	44.5	32	23.5	78.5
SD104	2 - 4	0	0	10.9	20.4	55.4	13.3	31.3	68.7
SD104	4 - 6	1.15	1.45	11.25	27.35	45.6	13	40.1	58.8
SD104	6 - 8	2.6	2.7	27.4	30.8	29.1	7.4	60.9	36.5
SD105	2 - 4	0.5	0.5	7	21	52.4	18.8	28.5	71.0
SD105	4 - 6	0	0	10.3	23.2	51.2	15.3	39.5	88.5
SD105	6 - 8	0	0.1	8.7	31.4	45.6	14	40.2	59.8
SD108	2 - 4	0	0	16.4	15.1	63.7	4.8	31.5	68.5
SD108	4 - 6	1.2	0.9	13.8	18.4	51	16.7	31.1	87.7
SD108	2 - 4	0	0	4.6	26.1	62.2	17.1	30.7	69.3
SD108	4 - 6	0	0	5.9	13.7	78.3	2.1	19.6	80.4
SD108	6 - 8	1	0.1	11.4	16.5	62.8	8.2	28.0	71.0
SD108	8 - 10	0.1	0.3	7.2	14.1	62.2	15.1	21.8	78.3
SD110	2 - 4	2.6	1.1	11.7	19.2	46.9	18.5	32.0	65.4
SD110	4 - 6	10.7	7.7	22.9	25.8	25.2	7.7	56.4	32.9
SD110	6 - 8	7	2.75	18.05	20.15	39.55	13.9	39.6	53.5
SD112	2 - 4	0	0	8.3	15.7	58.5	17.5	24.0	76.0
SD112	4 - 6	0	0	9.7	12.5	59.7	18.1	22.2	77.8
SD112	6 - 8	0	0.3	9.7	15.7	54.4	19.9	25.7	74.3
SD112	8 - 10	1.5	1.7	16.4	25	43.4	12	43.1	55.4
UPPER NAVIGATIONAL CHANNEL									
SD011-INV	0 - 0.5	0	0.4	4	68.8	24.4	2.4	73.2	26.8
SD012	0 - 0.5	0.9	3.1	11.8	58.5	25.1	0.8	73.4	25.7
SD061	0 - 0.5	3.7	3.6	38.2	43.5	8.9	2.1	85.3	11.0
SD062	0 - 0.5	0	7.6	8.9	10.7	56.6	16	27.4	72.6
SD064	0 - 0.5	0.2	0.3	15.7	74	9.7	0.1	90.0	9.8
SD065	0 - 0.5	0.4	0.9	33.5	61.3	3.8	0.1	65.7	3.9
SD066	0 - 0.5	17.4	5.5	38.9	31.8	5.9	0.5	76.2	6.4
SD067	0 - 0.5	9.8	5.5	36.5	33.8	7.7	8.7	75.8	14.4
SD068	0 - 0.5	0	0	5.3	36.7	43.6	14.4	42.0	58.0
SD069	0 - 0.5	1.7	1	8.1	41.7	38.1	9.4	50.8	47.5
SD069	2 - 4	2.9	2.9	5.4	47.3	16.9	24.2	56.0	41.1
SD069	4 - 6	1	9.2	14.9	7.2	39.9	33.8	31.3	67.7
SD070	0 - 0.5	7.1	7.8	10.1	35.1	29.4	10.5	53.0	39.9
SD071	0 - 0.5	0.2	1.3	11.3	52.5	27.6	7.1	66.1	34.7
SD072	0 - 0.5	2	2.3	34.3	42.4	18.1	0.9	79.0	19.0
SD073	0 - 0.5	4.2	2.8	35.1	43.8	9.3	4.8	81.7	14.1
SD074	0 - 0.5	18.3	13.5	43.9	19	3.2	2.1	76.4	5.3
DOWNSTREAM									
SD076	0 - 0.5	0.9	0.8	56.4	38.2	1.5	2.7	94.9	4.2
SD076	0 - 0.5	0.7	0.6	41.2	31.7	17	8.8	73.5	25.8

Total Sand represents the sum of the Coarse, Medium, and Fine Sand Fractions.
Total Fines represents the sum of the Total Silt and Total Clay Fractions.

Table 4-2
Summary of SEM and AVS Data Evaluation
BASF Corporation
Hudson River CU-2 Investigation
Rensselaer, New York

Location ID	Sum SEM/AVS	(Sum SEM- AVS)/ f_{oc} ($\mu\text{mol/g}_{oc}$)
UPSTREAM	11.7	548
SD001	2.6	86.9
SD008	0.9	-16.9
SD011	NC	NC
SD015	NC	NC
SD017	NC	NC
SD021	NC	NC
SD022	6.0	101
SD026	NC	NC
SD030	19.2	277
Location ID	Sum SEM/AVS	(Sum SEM- AVS)/ f_{oc} ($\mu\text{mol/g}_{oc}$)
ADJACENT FAR FIELD	NC	NC
SD038	NC	NC
SD039	NC	NC
SD041	NC	NC
SD042	NC	NC
SD045	21.5	857
SD048	NC	NC
SD050	NC	NC
SD052	NC	NC
SD056	NC	NC
SD079	NC	NC
Location ID	Sum SEM/AVS	(Sum SEM- AVS)/ f_{oc} ($\mu\text{mol/g}_{oc}$)
ADJACENT NEARSHORE	19.3	181
SD056	NC	NC
SD057	0.8	-28.8
SD077	13.9	230
SD080	NC	NC
SD081	1.7	190
SD082	1.4	57.2
SD084	NC	NC
SD085	NC	NC
SD086	1.6	54.4
SD088	NC	NC
SD089	NC	NC
SD091	4.3	155
SD092	11.8	189
SD094	NC	NC
SD095	NC	NC
SD097	NC	NC
SD099	NC	NC
SD100	7.5	257
SD103	21.9	131
Location ID	Sum SEM/AVS	(Sum SEM- AVS)/ f_{oc} ($\mu\text{mol/g}_{oc}$)
UPPER NAVIGATIONAL CHANNEL	1.1	24.9
SD011-INV	NC	NC
SD061	33.5	238
SD064	NC	NC
SD066	NC	NC
SD067	NC	NC
SD068	16.7	244
SD071	NC	NC
SD073	NC	NC
SD074	NC	NC
Location ID	Sum SEM/AVS	(Sum SEM- AVS)/ f_{oc} ($\mu\text{mol/g}_{oc}$)
DOWNSTREAM	NC	NC
SD075	NC	NC

Calculations not completed if AVS was not detected.
One-half detection limit used in calculation for non-detect SEM analyses.
Bold text indicates Sum SEM / AVS is greater than 1.
Italic bold text indicates (Sum SEM-AVS)/ f_{oc} > 130 $\mu\text{mol/g}_{oc}$ (below this value the sediments are presumed to "not likely" be toxic (USEPA, 2005)).

AVS - Acid Volatile Sulfides
NC - Not Calculated
SEM - Simultaneously Extracted Metals
TOC - Total Organic Carbon
 f_{oc} - fraction organic carbon
 Q_{oc} - gram organic carbon

According to USEPA guidance (2005):
(Sum SEM-AVS)/ f_{oc} > 3000 $\mu\text{mol/g}_{oc}$, the sediments are presumed to be "likely to be toxic";
(Sum SEM-AVS)/ f_{oc} between 130 and 3,000 $\mu\text{mol/g}_{oc}$, predictions of effects are uncertain; and
(Sum SEM-AVS)/ f_{oc} < 130 $\mu\text{mol/g}_{oc}$, the sediments are presumed to "not likely" be toxic.

Table 4-3
Surface Water Analytical Results
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	UPSTREAM SW01	UPSTREAM SW01 (F)	UPSTREAM SW02	UPSTREAM SW02 (F)	ADJACENT NEARSHORE SW03	ADJACENT NEARSHORE SW03 (F)	ADJACENT NEARSHORE SW04	ADJACENT NEARSHORE SW04 (F)	ADJACENT NEARSHORE SW05	ADJACENT NEARSHORE SW05 (F)	ADJACENT NEARSHORE SW06	ADJACENT NEARSHORE SW06 (F)	ADJACENT NEARSHORE SW07	ADJACENT NEARSHORE SW07 (F)
Inorganics (ug/L)														
ALUMINUM	8892	2880	13050	1195	8770	170	9150	765	11700	47.5	11400	95.2	12100	752
ARSENIC	1.5	0.898	2.15	0.429	1.6	0.28	1.7	0.424	2	0.269	2	0.245	2.2	0.359
BARIUM	93.1	42.4	126	23.6	89.7	24.6	103	30.2	119	17.3	114	17.6	117	24.4
BERYLLIUM	0.239	0.118	0.3205	0.0575	0.239	0.0575	0.266	0.0575	0.328	0.0575	0.312	0.0575	0.353	0.0575
CADMIUM	0.134	0.055	0.1695	0.025	0.124	0.025	0.112	0.025	0.367	0.025	0.168	0.025	0.19	0.025
CALCIUM METAL	50100	26700	20350	18460	21000	18400	20400	16700	22100	16900	22900	20300	22400	20100
CHROMIUM, TOTAL	7.0	3	13.8	2.1	8.6	0.85	9.6	0.85	12.4	0.85	10.4	0.85	10.7	0.85
COBALT	3	0.945	4.15	0.407	2.8	0.143	3	0.323	3.7	0.163	3.8	0.146	4	0.303
COPPER	7.5	3.2	9.7	1.65	8	1.2	8.8	1.8	9.1	1.1	9.2	1.1	9.7	2.1
IRON, TOTAL	8620	2840	12460	1048	8230	210	8940	785	11700	80.3	11800	126	11900	877
LEAD	5.5	1.6	6.36	0.635	5.8	0.307	6.7	0.699	7.2	0.344	8.1	0.13	6.6	0.431
MAGNESIUM	7220	5850	6735	3975	6860	9780	5800	4040	6790	3410	6850	4070	6830	4190
MANGANESE	230	70.5	300.5	40.83	286	34.2	292	80	388	25.5	267	24.8	304	32.3
MERCURY	0.00473	0.00353	0.007955	0.001655	0.00346	0.0034	0.00903	0.00228	0.00218	0.00211	0.00807	0.00259	0.00234	0.00249
NICKEL	14.8	7.1	20.25	3.45	31.6	3.45	12.8	7.3	15	3.48	15.9	3.45	15.2	6.9
POTASSIUM	4030	2190	5005	1490	3910	1200	4050	1580	4810	1010	4640	1340	4840	1470
SELENIUM	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.8	0.8	0.8	0.8
SILVER	0.035	0.0135	0.042	0.0135	0.04	0.0135	0.034	0.0135	0.043	0.0135	0.052	0.0135	0.075	0.0135
SODIUM	18200	18700	11500	10750	13900	17700	13100	12500	12900	10100	13900	12900	13800	12400
THALLIUM	0.035	0.03	0.1055	0.03	0.075	0.03	0.078	0.03	0.097	0.03	0.093	0.03	0.105	0.03
VANADIUM	8.4	4	12	1.85	9.3	0	9.9	1.5	11.4	0	11.6	0	12.5	1.8
ZINC	23.6	11.3	38.95	9.45	31	7.8	32.2	23.4	40.9	9.7	36.9	3.45	38.7	35.1
VOCs (ug/L)														
ACETONE	2.2	--	2.8	--	2.8	--	2.9	--	1.9	--	2.3	--	3.8	--
TOLUENE	0.5	--	0.5	--	0.43	--	0.43	--	0.39	--	0.5	--	0.5	--

-- VOCs not analyzed in filtered samples

Only compounds detected at least once are presented.

Half the detection limit is presented for non-detects. Duplicate samples have been averaged.

Results are Total Recoverable phase unless otherwise noted

Dissolved phase results are indicated by F in location ID (sample was filtered in the field)



Legend

 Approximate Extent of Property Boundaries

2005 Geophysical Data

 Cobble
 Gravelly Sand
 Sand
 Muddy Sand
 Sandy Mud
 Mud

0 1,000 2,000 4,000
 Feet



Sediment Textural Classification

2005 Geophysical Survey

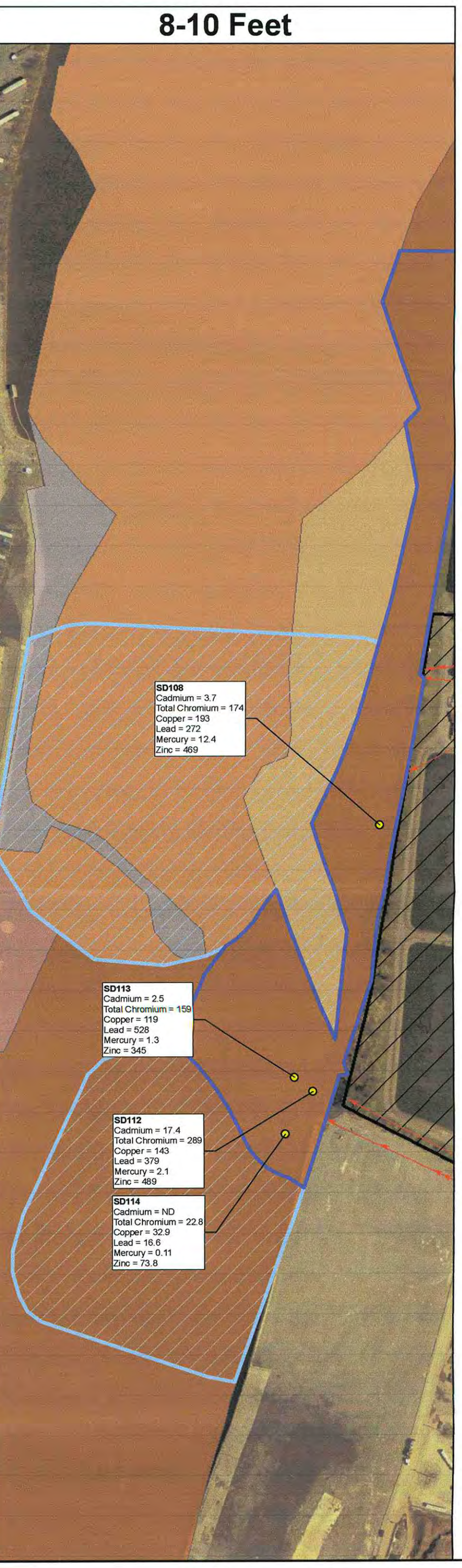
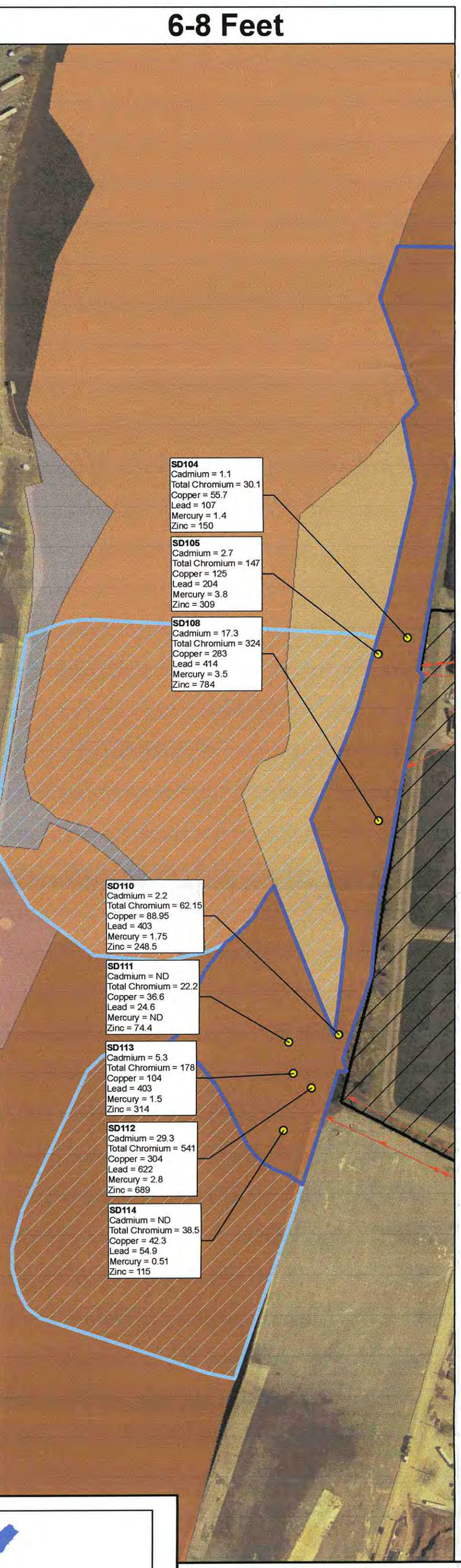
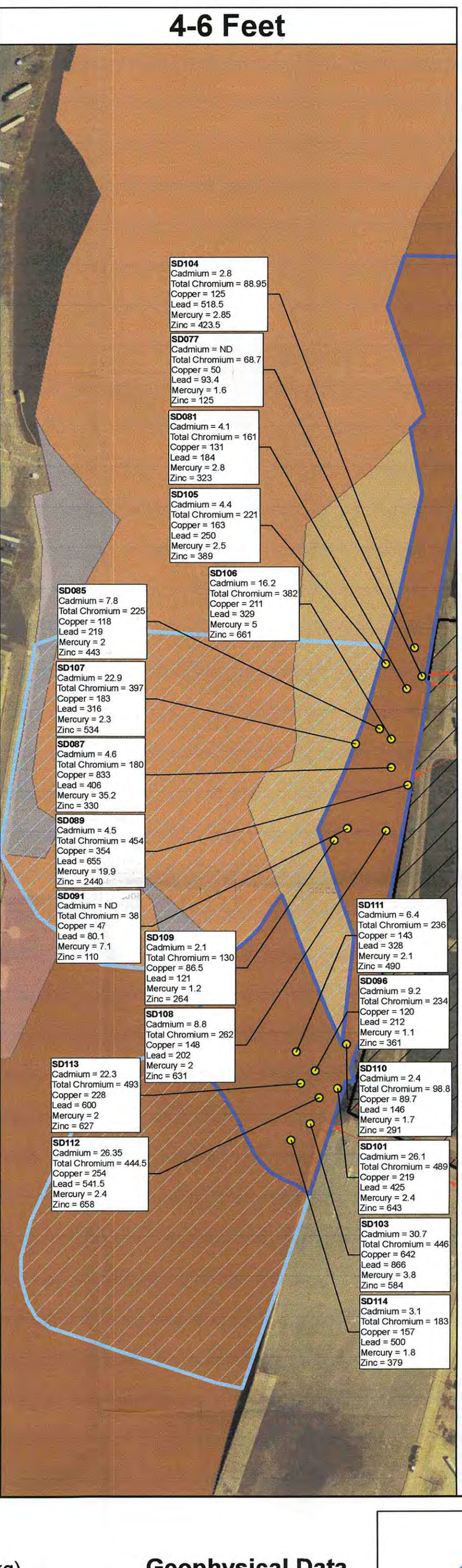
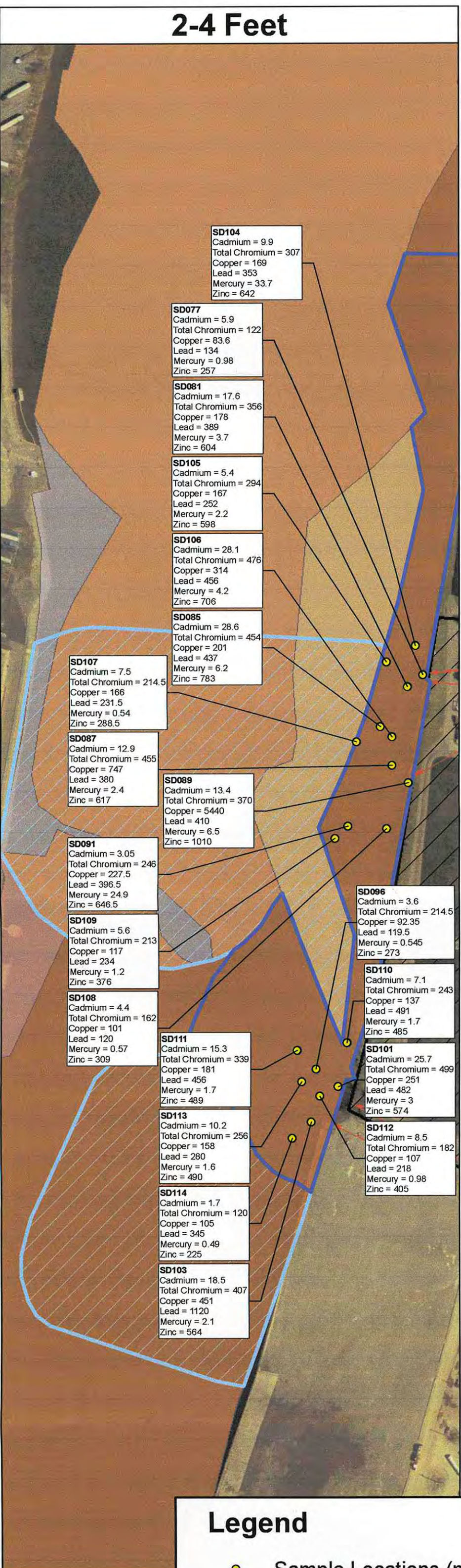
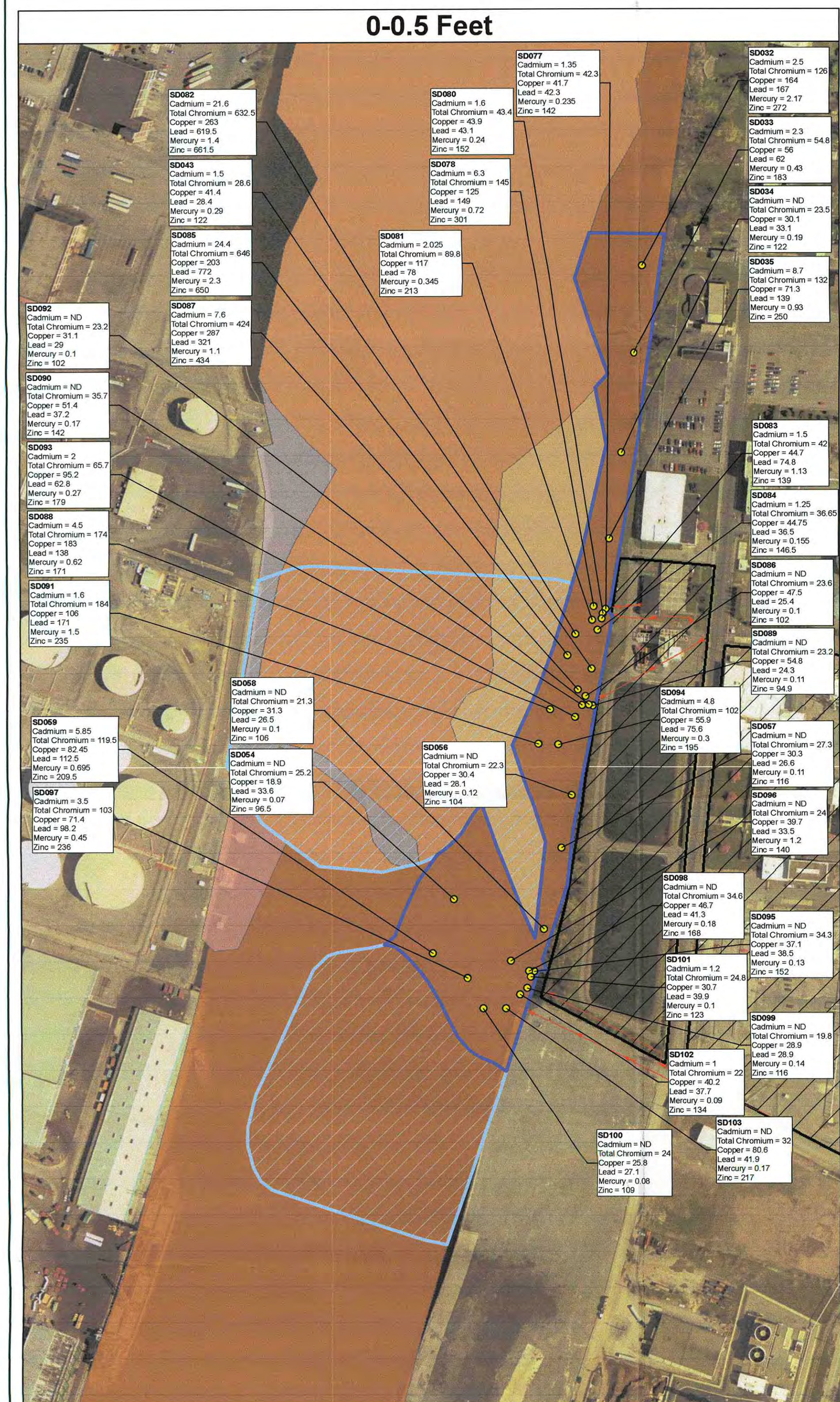
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
1:24000	02/07	00700-171

ENSR | AECOM

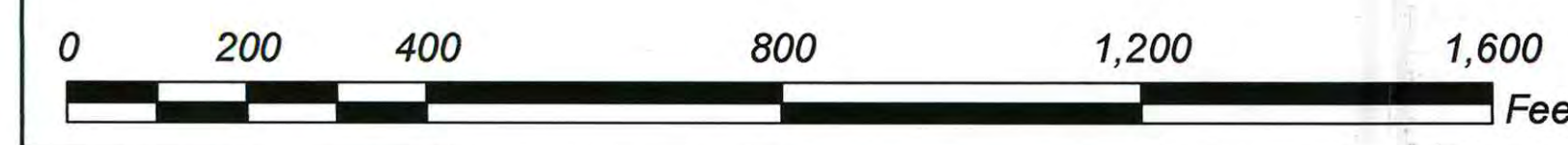
Figure Number

4-1



Notes:

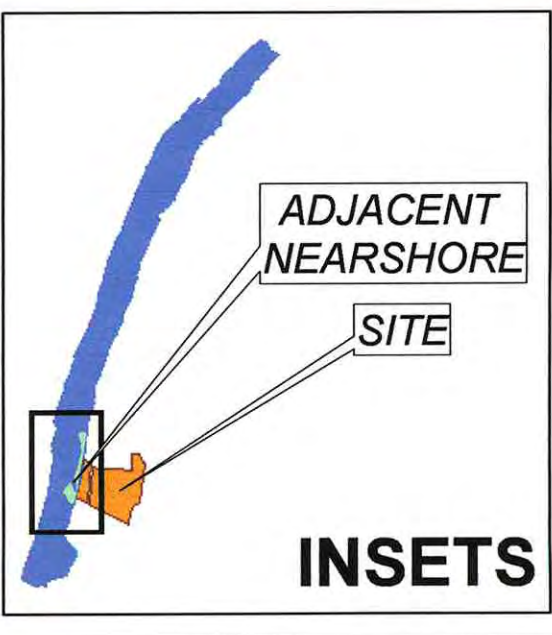
- 1) Duplicates are averaged.
- 2) Units are mg/kg



Legend

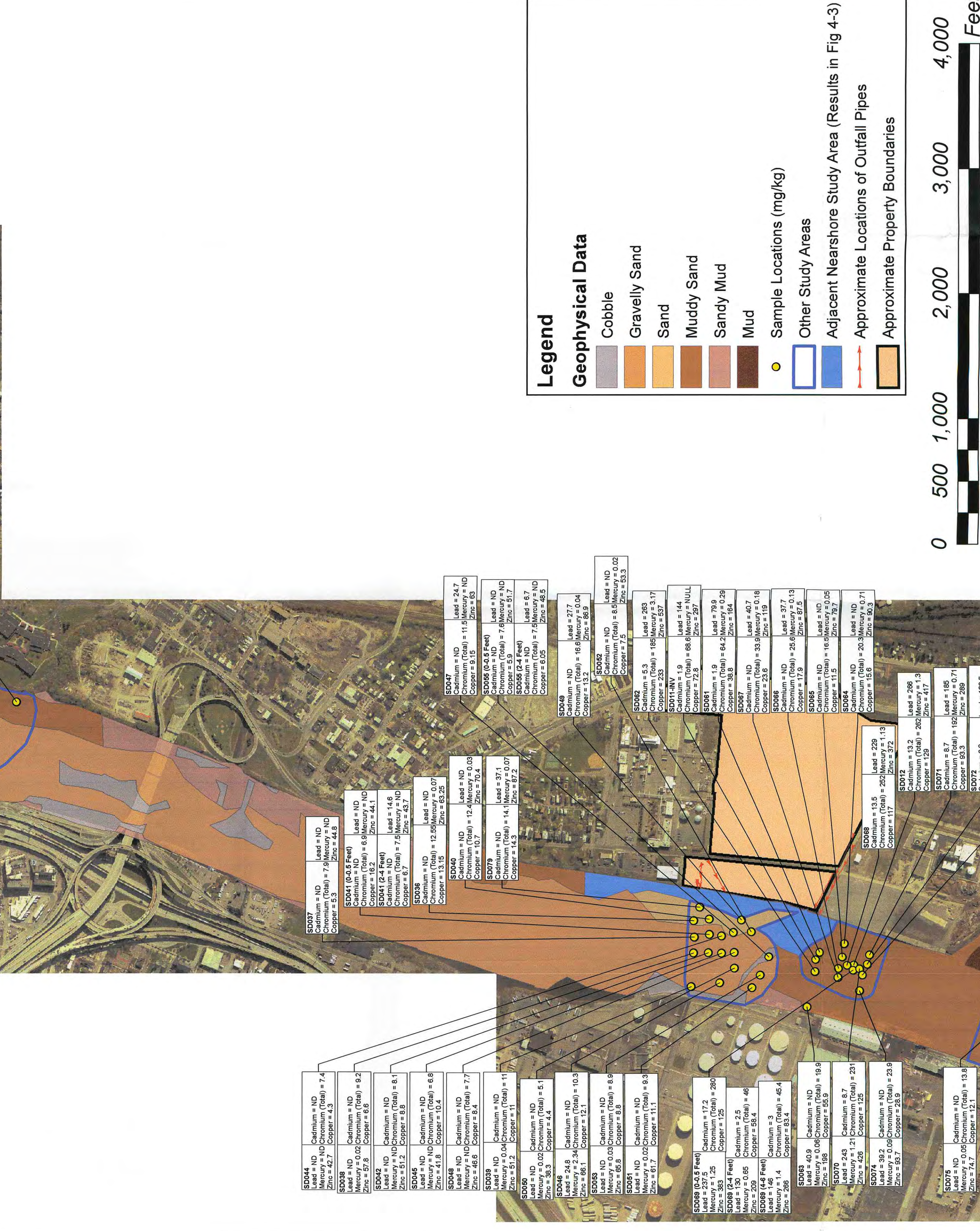
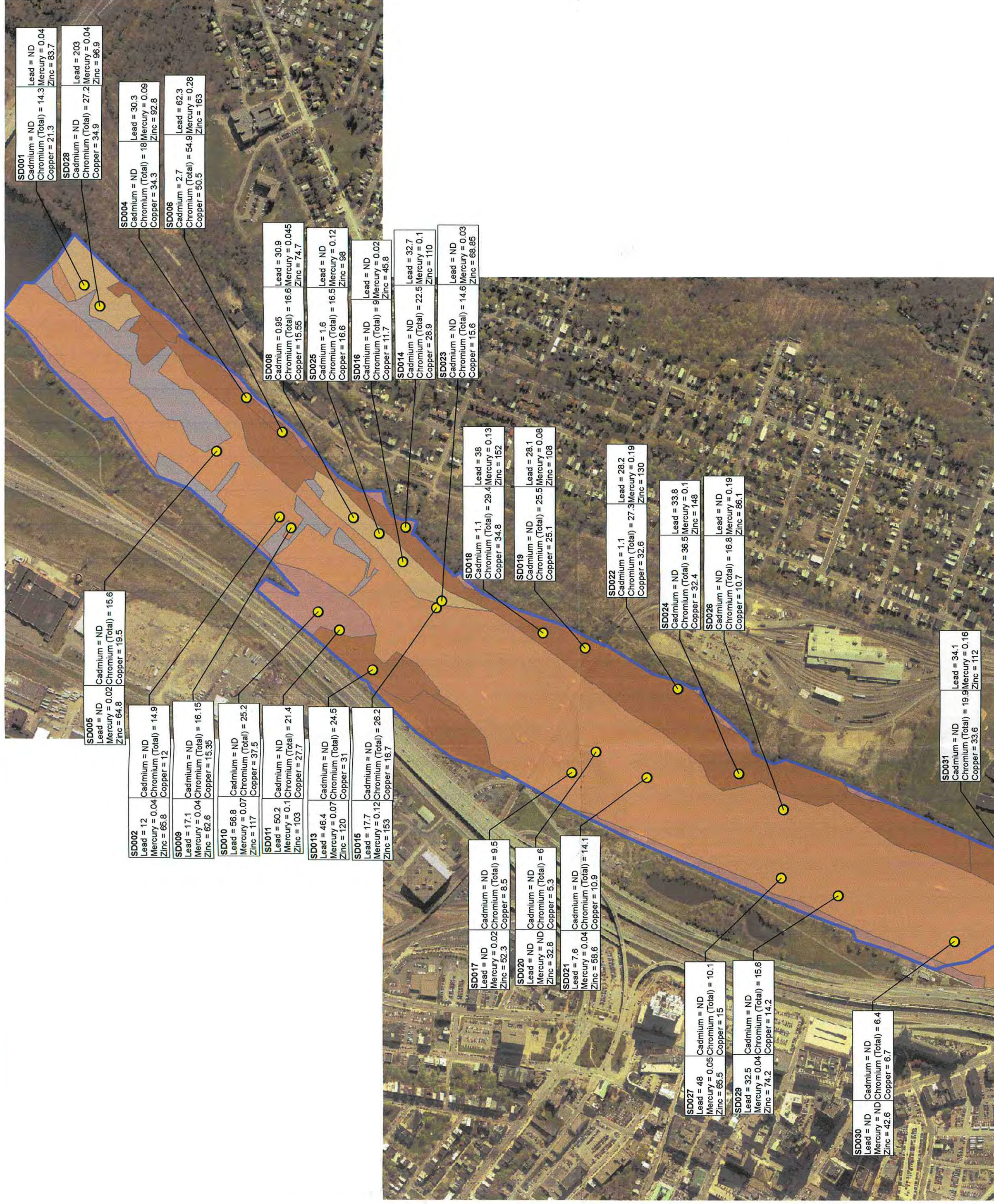
- Sample Locations (mg/kg)
- Approximate Locations of Outfall Pipes
- Approximate Property Boundaries
- Study Areas
 - Adjacent Nearshore Study Area
 - Other Study Areas

- Geophysical Data
- Cobble
 - Gravelly Sand
 - Sand
 - Muddy Sand
 - Sandy Mud
 - Mud



Metals of Potential Interest in Surficial and Subsurface Sediment Adjacent Nearshore Samples		
BASF Corporation Hudson River OU-2 Investigation Rensselaer, New York		
SCALE	DATE	PROJECT NO.
1:2400	02/07	00760-171

ENSR AECOM
Figure Number
4-3



Metals of Potential Interest in Surficial and Subsurficial Sediment in the Hudson River Far Field, Dredge Area and Downstream Regions	
BASF Corporation Hudson River OU-2 Investigation Rensselaer, New York	
SCALE	DATE
1:6000	02/07
PROJECT NO.	
00760-171	
Figure Number	
4-2	

5.0 Statistical Analysis of Upstream/Downstream Sediment Quality

Statistical analyses of the surficial sediment data were conducted to determine if concentrations of inorganic compounds in the sediments in the vicinity of the Site are consistent (or inconsistent) with concentrations of compounds upstream of the Site. Where concentrations among Upstream and Adjacent sediment data sets were determined to be similar, the presence of the inorganic compounds in sediments may be due to an upstream or regionally distributed source. The statistical testing was conducted in accordance with the USEPA Guidance for *Characterizing Background Chemicals in Soil at Superfund Sites* (USEPA, 2001a).

The results of the statistical analysis indicate that the metals-impacted sediments in the Study Area are generally located near the Site, in the Adjacent Nearshore muddy sand sediments. The statistical evaluation of the Upper Navigational Channel samples indicates that the concentrations of metals in these sediments are more consistent with the Adjacent Nearshore, and inconsistent with Adjacent Far Field and Upstream sediments. Based on this observation, the Adjacent Nearshore sediments may be impacting the Upper Navigational Channel sediments, although interpretation of the data in the Upper Navigational Channel also needs to consider the dredging and depositional history of the river. The statistical analysis is presented in Appendix G and summarized below.

5.1 Data Selection and Treatment

The data evaluation process used in the statistical analysis focused on surficial sediment samples from 101 surficial sediment sampling locations, including 28 upstream samples and 83 samples from the reaches in the general vicinity of the Site. Analyses were conducted in accordance with the NYSDEC-approved Work Plan (ENSR, 2005) and according to USEPA methodology (USEPA, 2001a). Field sampling locations were selected following a "Targeted Sampling Design" where prior knowledge of Site-related factors is incorporated into the process of station location.

The concentration data were grouped by location as described in Section 1.5. Another data set, referred to in this section as the Adjacent data set, was generated for the statistical analysis by combining the data in the Adjacent Nearshore, Adjacent Far Field, and Upper Navigational Channel reaches. There was not a sufficient number of samples in the Downstream data set for a statistical analysis to be completed using this reach.

The number of surficial sediments samples from each sampling area included in the statistical analysis is presented below:

Sampling Region	Upstream	Adjacent Nearshore	Adjacent Far Field	Upper Navigational Channel	Adjacent
Number of Samples	28	36	19	15	70

These groupings were compared to determine differences in sediment chemistry according to:

- Upstream vs. Adjacent: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of all samples collected in the Hudson River reach in the general vicinity of the Site.

- Upstream vs. Adjacent Nearshore: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of nearshore muddy sand samples collected from immediately adjacent to and downstream from the Site.
- Upstream vs. Adjacent Far Field: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of samples collected from more coarse-grained sediments which may or may not be potentially influenced by the Site.
- Adjacent Far Field vs. Adjacent Nearshore: this evaluation was conducted to compare samples that were collected in the same river reach as the Site but are not immediately adjacent to the Site bulkhead to a data set comprised of nearshore muddy sand samples collected from immediately adjacent to and downstream from the Site.
- Upper Navigational Channel vs. Adjacent Nearshore: this evaluation was conducted to compare samples from the area maintained for navigation (i.e., periodically dredged) to the nearshore muddy sediments to determine if sediments from the nearshore may be impacting the area maintained for navigation.
- Upstream vs. Upper Navigational Channel: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of samples collected from the area maintained for navigation.
- Adjacent Far Field vs. Upper Navigational Channel: this evaluation was conducted to compare samples that were collected in the same river reach as the Site, but outside the influence of the Adjacent Nearshore sediments, to samples collected from the area maintained for navigation.

5.2 Statistical Methods

The statistical software Stata 8.2 was used to perform statistical calculations. The results of the distribution tests, the statistical analyses, and the raw results from the Stata 8.2 program are discussed in more detail in Appendix G.

The surficial sediment chemistry data from the Hudson River were evaluated using statistical Background Test Form 2 from the USEPA Guidance for Characterizing Background Chemicals in Soil at Superfund Sites (USEPA, 2001a). Background Test Form 2 requires a strict burden of proof by selecting the null hypothesis that the chemical concentration in potentially contaminated areas exceeds background (Reference Reach) by more than a substantial difference S ($\Delta > S$). This approach favors the protection of the environment (USEPA, 2001a). A significant difference (S) of one standard deviation ($1s$) of the Reference Reach data set was used to provide a reasonable ability to distinguish differences between data sets.

Comparisons were made to test the null and alternate hypotheses:

H_0 : The mean of the compound concentration in the Test Reach data set is greater than the mean of the Reference Reach data set by S ($\Delta > S$) where, $S = 1s$ of the Reference Reach data set ($U_{\text{Test Reach}} \geq U_{\text{Reference Reach}} + S$).

H_A : The mean of the compound concentration in the Test Reach data set does not exceed the mean of the Reference Reach data set by S ($\Delta \leq S$) ($U_{\text{Test Reach}} < U_{\text{Reference Reach}} + S$).

If the null hypothesis H_0 is rejected, it can be concluded with statistical significance that the mean of the Test Reach surficial sediment data set is not significantly greater than the mean of the Reference Reach surficial sediment data set, or that, in general, concentrations downstream are not significantly greater than relative upstream concentrations. If the null hypothesis is not rejected, it was assumed that the mean from the Test Reach surficial sediment data set may be greater than the mean of the Reference Reach surficial sediment data set, although this is not a statistically significant conclusion.

5.3 Results of Statistical Analyses

The statistical evaluation, summarized in Table 5-1 and described in detail in Appendix G, resulted in the following findings:

- **Upstream vs. Adjacent** - Concentrations of five of the 11 evaluated inorganic compounds in the combined Adjacent (Adjacent Nearshore, Adjacent Far Field, and Upper Navigational Channel) sediments (cadmium not considered due to low frequency of detection (FOD) in the Upstream data set) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, mercury, and zinc). These results are largely due to the contribution of the Adjacent Nearshore sediments in the combined data set.
- **Upstream vs. Adjacent Nearshore** - Concentrations of nine of the 11 evaluated inorganic compounds in the Adjacent Nearshore sediments (cadmium not considered due to low FOD) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, iron, lead, mercury, nickel, silver, and zinc). Therefore, the majority of the evaluated Adjacent Nearshore inorganic compounds are inconsistent with Upstream reference conditions.
- **Upstream vs. Adjacent Far Field** - Concentrations of all of the 10 evaluated inorganic compounds in the Adjacent Far Field sediments (cadmium and lead not considered due to low FOD) are consistent with the concentrations in the Upstream data set (i.e., antimony, arsenic, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). This indicates that the Adjacent Far Field inorganic compound concentrations are consistent with Upstream reference conditions.
- **Adjacent Far Field vs. Adjacent Nearshore** - Concentrations of nine of the 10 evaluated inorganic compounds in Adjacent Nearshore sediments (cadmium and lead not considered due to low FOD) are inconsistent with the concentrations in the Adjacent Far Field data set (i.e., antimony, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). Since more elevated concentrations are observed within the Adjacent Nearshore samples, this suggests that the Adjacent Nearshore muddy sands are inconsistent with, and more impacted than, the Adjacent Far Field coarse-grained materials.
- **Upper Navigational Channel vs. Adjacent Nearshore** - Concentrations of nine of the 12 evaluated inorganic compounds in the Adjacent Nearshore sediments are consistent with the concentrations in the Upper Navigational Channel data set (i.e., cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc). This indicates that concentrations of the majority of the evaluated inorganic compounds in the Adjacent Nearshore samples are consistent with the Upper Navigational Channel samples.
- **Upstream vs. Upper Navigational Channel** - Concentrations of eight of the 11 evaluated inorganic compounds in Upper Navigational Channel sediments (cadmium not considered due to low FOD) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc). Since more elevated concentrations are observed within the Upper Navigational Channel samples, this suggests that the Upper Navigational Channel samples are inconsistent with, and more impacted than, the Upstream samples.
- **Adjacent Far Field vs. Upper Navigational Channel** - Concentrations of nine of the 10 evaluated inorganic compounds in Adjacent Far Field sediments (cadmium and lead not considered due to low FOD) are inconsistent with the concentrations in the Upper Navigational Channel data set (i.e., antimony, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). Since more elevated inorganic concentrations are observed within the Upper Navigational Channel samples, this suggests that the Upper Navigational Channel samples are inconsistent with, and more impacted than, the Adjacent Far Field samples.

These results indicate that the metals-impacted sediments in the study area are generally located near the Site, in the Adjacent Nearshore muddy sand and in the Upper Navigational Channel sediments. It is important

to recognize that the statistical analysis is not intended to assign attribution or define sources. Given the dynamics in the river, with coarse-grained material located upstream of the Site, and fine muddy sediments located in the nearshore environment, it is possible that the fine-grained sediments in this reach of the river are impacted by the Site; alternatively, it is possible that at least some of the inorganic compounds observed in this nearshore depositional environment are attributable to sources other than the Site.

Table 5-1
Summary of Statistical Results
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Analyte Concentrations in Test Reach Consistent With Reference Reach ?						
	Upstream vs. Adjacent	Upstream vs. Adjacent Nearshore	Upstream vs. Adjacent Far Field	Adjacent Far Field vs. Adjacent Nearshore	Upper Navigational Channel vs. Adjacent Nearshore	Upstream vs. Upper Navigational Channel	Adjacent Far Field vs. Upper Navigational Channel
Antimony	Yes	Yes	Yes	No	No	Yes	No
Arsenic	No	No	Yes	Yes	No	No	Yes
Cadmium	NA	NA	NA	NA	Yes	NA	NA
Chromium	No	No	Yes	No	Yes	No	No
Copper	No	No	Yes	No	Yes	No	No
Iron	Yes	No	Yes	No	Yes	Yes	No
Lead	Yes	No	NA	NA	Yes	No	NA
Manganese	Yes	Yes	Yes	No	No	Yes	No
Mercury	No	No	Yes	No	Yes	No	No
Nickel	Yes	No	Yes	No	Yes	No	No
Silver	Yes	No	Yes	No	Yes	No	No
Zinc	No	No	Yes	No	Yes	No	No

NA = Not applicable. Frequency of detection of one dataset <50% and statistical evaluation not conducted.

6.0 Analysis of Potential Risks to Human Health

A screening level analysis was conducted to evaluate the potential for risk of harm to human health due to exposure to sediment or surface water adjacent to the Site. Appendix H presents the full text of the human health risk assessment ("HHRA"), which is summarized in the following sub-sections. The results of this screening level analysis indicate that there is no potential current risk to human health associated with exposure to sediment or surface water adjacent to the Site.

This screening level analysis goes beyond the qualitative assessment described in NYSDEC site investigation guidance (NYSDEC, 2002) by including a quantitative assessment of the data (i.e., comparison to risk-based screening criteria) as well as evaluation of current and future potential exposure pathways. The summary presented in the following sub-sections discusses potential exposure pathways at the Site under current and potential future conditions and evaluates the comparison of sediment and surface water data to conservative risk-based screening levels for the protection of human health.

The results of the screening-level analysis indicate that: (1) surface water is not a medium of concern at the Site, and (2) the potential for human exposure to sediments adjacent to the Site is minimal given the limited access to the Site and the adjacent sediments, therefore there is no potential current risk to human health associated with exposure to sediment or surface water adjacent to the Site.

6.1 Potential Exposure Pathways Evaluated in the Human Health Risk Assessment

Section 2 of this report presents a description of the environmental setting and site characteristics, which are critical for understanding the potential for human exposure to sediment and surface water at the Site. As noted in Section 2, a steel bulkhead runs the length of the shoreline along the Site. Access to the river from the Site is limited by the bulkhead, and there is a tidally-dependent drop of five to ten ft from the top of the bulkhead to the water surface. Site access is further limited by the locked chain link fence surrounding the Site.

6.1.1 Potential Exposure Pathways for Sediment

Sediments adjacent to the Site are submerged beneath at least five or more feet of tidally influenced surface water. Boring logs from the December 2005 and May 2006 sampling events showed five to nine ft of overlying water for samples collected closest to the shoreline, and the visual observations from the field program indicated that significant rubble (e.g., old pilings) is present in the immediate vicinity of the Site. Therefore, the potential for human exposure to sediments is minimal. Direct contact with the sediment was assumed to be an incomplete exposure pathway due to the depth of the water and the inaccessibility of the sediments. Inhalation of VOCs in sediment is also expected to be negligible due to the presence of the overlying water column. Nevertheless, the HHRA conservatively evaluated potential exposure to sediment adjacent to the Site as a result of consumption of fish exposed to sediments.

6.1.2 Potential Exposure Pathways for Surface Water

Given the fast-moving water and use of the river for commercial ship traffic, recreational swimming is unlikely to occur within this reach of the Hudson River. However, the river is used for boating and fishing and exposure to surface water adjacent to the Site could occur during these activities. Therefore, the HHRA conservatively evaluated potential exposure to surface water, including incidental ingestion and dermal contact with surface water. Inhalation of VOCs in surface water is expected to be negligible due to dispersion and dilution of any VOCs that may volatilize from the water column into ambient air. The evaluation of the surface water pathway also included a comparison to surface water quality criteria derived to be protective of potential fish consumption.

6.2 Human Health Risk Screening Results

Compounds in surface water and sediment were evaluated by comparing analytical results to NYSDEC human health screening values. For sediments, data were compared against NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) normalized to organic carbon content. The NYSDEC sediment criteria have been derived for a limited suite of organics (52 non-polar organic compounds) using an EqP methodology (NYSDEC, 1999). The derivation procedure is the same as that recommended by USEPA, except that New York State water quality standards and guidance values are used instead of USEPA ambient water quality criteria (except in the absence of state water quality criteria). The New York State water quality criteria are from the Department of Water Technical and Operational Guidance Series ("TOGS") 1.1.1 (NYSDEC, 1998). Since the water quality criteria are based on potential bioaccumulation into fish, the NYSDEC sediment criteria are by default protective of potential fish consumption. It should be noted that there are limitations to the EqP methodology and its application in derivation of sediment criteria. The EqP methodology is uncertain and variable depending on factors including the value of the K_{ow} used, the organic content of the sediment sample, whether the sediment and pore water are at an equilibrium (which may not be the case for sites that are dredged). For compounds with a K_{ow} less than 100 ($\log_{10}K_{ow} \leq 2$), the methodology may underestimate acceptable sediment concentrations (NYSDEC, 1999). Thus, the NYSDEC sediment criteria for human health bioaccumulation should be used with awareness of their inherent uncertainties and conservatism. The NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) are limited to organic compounds and do not include criteria for metals. Therefore, the metals data are not evaluated in the human health risk screening due to a lack of applicable criteria.

The hierarchy of surface water screening values included NYSDEC water quality standards (NYSDEC, 1998), federal ambient water quality criteria for consumption of water and organisms ("AWQC"; USEPA, 2006), and the lower of the Maximum Contaminant Level ("MCL"; USEPA, 2003), and the Region 9 PRG for tapwater (USEPA, 2004). It is recognized that the comparison to drinking water-based human health screening values is conservative for the Class C Hudson River.

Tables 6-1 and 6-2 summarize the surficial and sub-surficial sediment screening results, respectively. Table 6-3 summarizes the surface water screening results. Sample by sample screening tables are presented in Appendix I.

6.2.1 Sediment

Surficial Sediments

As shown in Table 6-1, organic carbon normalized NYSDEC Human Health Bioaccumulation Criteria are available for four of the detected VOCs in surficial sediment (benzene, 1,2-dichloroethane, tetrachloroethene, and trichloroethylene). The NYSDEC bioaccumulation criteria were not exceeded in the two upstream surficial samples. Organic carbon normalized concentrations of benzene in 11 of the 34 Adjacent Nearshore area surficial sediment samples exceed the NYSDEC criterion for benzene. However, the benzene sediment criterion of $0.6 \mu\text{g/g}_{OC}$ is likely to be conservative. As previously noted, the EqP methodology likely underestimates acceptable sediment concentrations for organic compounds with $\log_{10}K_{ow} \leq 2$. Further, available information indicates that nonaqueous exposure (e.g., bioaccumulation in fish) is not likely to be important for compounds with low hydrophobicity ($\log_{10}K_{ow}$ values less than 4) (USEPA, 2003). Since the $\log_{10}K_{ow}$ for benzene is approximately 2 (NYSDEC, 1999), the sediment criterion for benzene is likely overly conservative, and it is unlikely that fish bioaccumulation pathways are significant. As discussed below, the exceedance of the NYSDEC benzene sediment criterion should also be considered in the context of surface water data for benzene.

Sub-Surficial Sediments

Exposure pathways to sub-surficial sediment are currently incomplete at this Site. However, given the dynamic nature of the Hudson River sediment environment, it is conceivable that these sub-surficial sediments may become exposed under future foreseeable conditions. Therefore, the sub-surficial sediments were also compared to the human health screening values to help place these data in context.

As shown in Table 6-2, all four of the available NYSDEC Human Health Bioaccumulation Criteria were exceeded in the sub-surficial samples collected in the Adjacent Nearshore area. The majority of the NYSDEC sediment criteria exceedances in the sub-surficial sediments were for benzene with 40 of the 52 sub-surficial samples exceeding the NYSDEC criteria. The most elevated benzene levels were detected in the 2 – 4 ft horizon. As described above for benzene, the $\log_{10}K_{ow}$ values are well below 4 for 1,2-dichloroethane, tetrachloroethene, and trichloroethylene, indicating that bioaccumulation in fish is not likely to be important. Therefore, this sediment screening is likely to be conservative, particularly for sub-surficial sediments to which exposure is limited.

6.2.2 Surface Water

Surface water samples were collected from within the Upstream and Adjacent Nearshore reaches of the river. Table 6-3 presents the results of the comparison to screening criteria for the surface water samples. Concentrations of iron, manganese, and mercury exceeded their screening levels in both Upstream and Adjacent Nearshore sampling locations. The Upstream locations (SW-01 and SW-02) had exceedances for all three of these compounds and had the highest concentration of iron in the surface water. Filtered samples within the Adjacent Nearshore had fewer exceedances of the iron and manganese screening levels indicating that a significant fraction of the metals may be present within the solids found in the water. All samples exceeded the fish consumption-based mercury screening value; however, mercury concentrations in all samples are below the NYSDEC water supply-based surface water screening level of 0.7 $\mu\text{g/L}$ (NYSDEC, 1998). Although insufficient data are available for a robust statistical analysis, it is apparent that concentrations of inorganic compounds in surface water adjacent to the Site are generally consistent with upstream surface water concentrations.

Only two VOCs, acetone and toluene, were detected in the surface water. Upstream and Adjacent Nearshore concentrations of these possible laboratory contaminants were generally similar and were all below the NYSDEC public water supply standards. Benzene was not detected in any surface water samples at a detection limit of 1 $\mu\text{g/L}$, which is below the NYSDEC human health water quality criterion of 6 $\mu\text{g/L}$ used in the derivation of the sediment criterion (NYSDEC, 1999). Because benzene was not detected in the surface water, there is some uncertainty as to whether levels of benzene in sediment are likely to bioaccumulate into fish.

6.3 Conclusions

The results of this screening level analysis indicate that there is no potential current risk to human health associated with exposure to sediment or surface water adjacent to the Site.

Adjacent surface water concentrations of potentially Site-related compounds were generally similar to upstream concentrations. Further, no Site-related VOCs were detected in surface water, indicating that the Site is not adversely impacting surface water quality in the river.

The potential for human exposure to sediments adjacent to the Site is minimal given the limited access to the Site and the adjacent sediments. The Site itself is securely fenced and guarded making access to the river from the Site unlikely. In addition, access to river sediments is limited by the metal bulkhead along the shoreline of the Site and the five to ten ft drop from the top of the bulkhead to the water surface. Further, water adjacent to the Site is too deep for wading, there is considerable submerged debris in the region, and surficial

sediments are under at least 5 ft of water. In short, direct contact with potentially impacted sediments is highly unlikely.

In the unlikely event that someone did contact surficial sediments adjacent to the Site, such limited exposure is not expected to pose an unacceptable risk to human health. While benzene in sediment exceeded its NYSDEC sediment criterion for bioaccumulation into fish, benzene was not detected in surface water at detection limits that achieve the NYSDEC water quality criterion set for protection of fish consumption. In addition, the remaining three VOCs with NYSDEC sediment criterion (1,2-dichloroethane, tetrachloroethene, and trichloroethylene) and sub-surficial sediment exceedances were also not detected in surface water. Given these results, the uncertainty in the EqP methodology used to derive the NYSDEC sediment criterion, and the likelihood that the method over-predicts for organic compounds with low hydrophobicity such as benzene, there is some uncertainty as to whether levels of benzene or other VOCs present in sediment are likely to bioaccumulate into fish.

Since NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) are limited to organic compounds and do not include criteria for metals, there is also some uncertainty related to potential risks due to bioaccumulation of inorganic compounds into fish.

If conditions change in the future and sub-surficial sediments (which are characterized by higher levels of several compounds) become exposed, additional risk analysis may be required.

Table E-1
Summary of Human Health Risk Based Critical Sediment Screening
BASF Corporation
Tribal River OU-2 Investigation
Barnesville, New York

Analyte	Human Health Sediment Screening Values	Number of Exceedances	FQD	Concentration (mg/kg OC)			Location of Maximum Detection
				Minimum	Maximum	Mean	
UPSTREAM (0 - 0.5 ft)							
VOCs	NC	-	1:1:2	0.089	0.089	0.066	SD019
1,4-DICHLOROBENZENE	NC	-	1:2:2	0.75	0.75	0.67	SD011
2-BUTANONE (MEK)	NC	-	1:1:2	3.075	3.075	0.076	SD013
BENZENE	NC	0	2:2:2	0.073	0.073	0.065	SD018
CARBON DISULFIDE	NC	-	1:1:2	0.089	0.089	0.069	SD019
CHLOROBENZENE	NC	-	1:1:2	0.089	0.089	0.069	SD011
ETHYLENE	NC	-	1:1:2	0.089	0.089	0.069	SD011
SOPROPYLBENZENE	NC	-	1:1:2	0.089	0.089	0.069	SD011
NAPHTHALENES	NC	-	1:2:2	0.46	0.46	0.28	SD018
METHYL ACETATE	NC	-	1:2:2	0.3	0.3	0.3	SD018
C-XYLENE	NC	-	1:2:2	0.17	0.17	0.14	SD018
STYRENE	NC	-	2:2:2	0.089	0.089	0.095	SD018
TOLUENE	NC	-	2:2:2	0.23	0.23	0.33	SD018
TOTAL XYLENES	NC	-	1:2:2	0.61	0.61	0.62	SD018
Analyte	Human Health Sediment Screening Values	Number of Exceedances	FQD	Concentration (mg/kg OC)			Location of Maximum Detection
				Minimum	Maximum	Mean	
ADJACENT NEARSHORE (0 - 0.5 ft)							
VOCs							
1,1,1-TRICHLOROETHYLENE (TCE)	NC	-	1:1:2	0.014	0.014	0.014	SD037
1,2,4-TRICHLOROETHYLENE	NC	-	6:54:54	0.10	500	24.0	SD037
1,2-DICHLOROBENZENE	NC	-	58:54:54	0.026	7523	231	SD037
1,2-DICHLOROETHANE	0.7	0	1:1:2	0.20	0.20	0.14	SD037
1,3-DICHLOROBENZENE	NC	-	20:54:54	0.026	980	37.1	SD037
1,4-DICHLOROBENZENE	NC	-	25:54:54	0.026	1500	55.9	SD037
2-BUTANONE (MEK)	NC	-	20:25:54	0.40	4.6	0.36	SD035
ACETONE	NC	-	25:26:54	0.3	15.4	3.7	SD035
BENZENE	0.8	11	19:34:54	0.076	900	84.4	SD030
CARBON DISULFIDE	NC	-	24:25:34	0.067	0.25	0.11	SD032
CHLOROBENZENE	NC	-	34:34:34	0.068	45000	1466	SD037
CHLOROBENZENE	NC	-	1:1:2	0.068	0.068	0.068	SD031
CYCLOHEXANE	NC	-	13:34:34	0.067	0.48	0.23	SD032
ETHYLENE	NC	-	13:34:34	0.064	100	7.6	SD037
ISOPROPYLBENZENE	NC	-	4:23:34	0.064	0.38	0.33	SD032
M-P-XYLENES	NC	-	17:34:34	0.068	400	17.2	SD037
MET-HYDROXYLACETATE	NC	-	15:33:34	0.068	75	6.6	SD030
MET-HYDROXYLACETATE	NC	-	13:23:34	0.063	5.0	0.55	SD035
MET-HYDROXYLACETATE	NC	-	1:25:34	0.063	4.1	0.4	SD030
STYRENE	NC	-	19:34:34	0.043	100	7.6	SD037
TOLUENE	NC	-	1:1:2	0.21	0.21	0.15	SD037
TOLUENE	NC	-	14:34:34	0.064	750	35.8	SD037
TOTAL XYLENES	NC	-	19:34:34	0.13	500	24.8	SD037
TRICHLOROETHYLENE	2.2	-	1:1:2	0.063	0.063	0.063	SD030
TRICHLOROETHYLENE	NC	-	4:13:34	0.063	0.060	0.064	SD035

FQD = Frequency of Detection. Number of detection samples. Number of samples used to calculate statistics. Number of total samples.
Human Health Sediment Screening Values Source: WSD-EC, 1999. Technical Guidelines for Assessing Contaminant Status. Color of Fish, Wildlife and Marine Resources.

NC=No

Shaded cell indicates exceedance of human health screening value.

NC = No Contaminant

Only detected compounds with each result are reported and presented.

Table 6-2
Summary of Human Health Risk Based Sub-Surface Sediment Screening
BASF Corporation
Hudson River OUS Investigator
Bardonia, New York

Analyte	Human Health Sediment Screening Values	Number of Exceedances	EQD	Concentration (mg/kg OC)			Location of Maximum Detection
				Minimum	Maximum	Mean	
UPPER NAVIGATIONAL CHANNEL (2 - 4 ft) VOCs METHYL ACETATE	NC	0	0:1:1	2.9	2.9	2.9	SD289
UPPER NAVIGATIONAL CHANNEL (4 - 6 ft) VOCs METHYL ACETATE	NC	0	0:1:1	1.2	11.2	11.2	SD289

EQD = Frequency of Detection, Number of detected samples, Number of samples used to calculate statistics, Number of total samples
Human Health Sediment Screening Values Source: NYSED 1999, Technical Guidance for Screening Contaminated Sediments, Division of Fish, Wildlife and Marine Resources.
Notes:
Shaded cell indicates exceedance of human health screening value.
NC = No Criteria.
Only detected compounds within each reach and depth are presented.

Table 6-3
Summary of Human Health Risk Based Surface Water Screening
BASI Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Surface Water		Number of Exceedances	FOD	Concentration (ug/L)			Location of Maximum Detection
	Screening Value (ug/L)				Minimum	Maximum	Mean	
UPSTREAM								
Dissolved Inorganics								
ALUMINUM	36499	[3]	0	2:2:2	1195	2990	2093	SW01
ARSENIC	50	[1]	0	2:2:2	0.43	0.70	0.56	SW01
BARIUM	1000	[1]	0	2:2:2	25.6	42.4	34	SW01
BERYLLIUM	3	[1]	0	1:2:2	0.12	0.12	0.088	SW01
CADMIUM	5	[1]	0	1:2:2	0.055	0.055	0.040	SW01
CALCIUM METAL	EN	--	--	2:2:2	18450	28700	23575	SW01
CHROMIUM, TOTAL	50	[1]	0	2:2:2	2.1	3	2.55	SW01
COBALT	730	[3]	0	2:2:2	0.41	0.95	0.68	SW01
COPPER	200	[1]	0	2:2:2	1.9	3.2	2.5	SW01
IRON, TOTAL	300	[2]	2	2:2:2	1048	2640	1844	SW01
LEAD	50	[1]	0	2:2:2	0.64	1.6	1.1	SW01
MAGNESIUM	35000	[1]	0	2:2:2	3975	5850	4913	SW01
MANGANESE	50	[2]	1	2:2:2	40.85	70.5	55.7	SW01
MERCURY	0.0007	[1,4]	2	2:2:2	0.0017	0.0035	0.0026	SW01
NICKEL	100	[1]	0	1:2:2	7.1	7.1	5.275	SW01
POTASSIUM	FN	--	--	2:2:2	1490	2190	1840	SW01
SODIUM	FN	--	--	2:2:2	10750	18700	14725	SW01
VANADIUM	36	[3]	0	2:2:2	1.85	4	2.925	SW01
ZINC	2000	[1]	0	2:2:2	9.45	11.3	10.375	SW01
Total Recoverable Inorganics								
ALUMINUM	36499	[3]	0	2:2:2	8930	13050	10980	SW02
ARSENIC	50	[1]	0	2:2:2	1.5	2.2	1.8	SW02
BARIUM	1000	[1]	0	2:2:2	99.1	126	110	SW02
BERYLLIUM	3	[1]	0	2:2:2	0.24	0.32	0.28	SW02
CADMIUM	5	[1]	0	2:2:2	0.13	0.17	0.15	SW02
CALCIUM METAL	EN	--	--	2:2:2	20350	30100	25225	SW01
CHROMIUM, TOTAL	50	[1]	0	2:2:2	7.9	13.8	10.9	SW02
COBALT	730	[3]	0	2:2:2	3.0	4.2	3.6	SW02
COPPER	200	[1]	0	2:2:2	7.5	9.7	8.6	SW02
IRON, TOTAL	300	[2]	2	2:2:2	8620	12450	10535	SW02
LEAD	50	[1]	0	2:2:2	5.5	6.35	5.925	SW02
MAGNESIUM	35000	[1]	0	2:2:2	6735	7220	6977.5	SW01
MANGANESE	50	[2]	2	2:2:2	230	301	265	SW02
MERCURY	0.0007	[1,4]	2	2:2:2	0.0047	0.0080	0.0064	SW02
NICKEL	100	[1]	0	2:2:2	14.9	20.3	17.6	SW02
POTASSIUM	FN	--	--	2:2:2	4030	5005	4518	SW02
SILICON	50	[1]	0	2:2:2	0.033	0.042	0.038	SW02
SODIUM	FN	--	--	2:2:2	11500	19200	15350	SW01
THALLIUM	0.5	[1]	0	2:2:2	0.083	0.110	0.096	SW02
VANADIUM	36	[3]	0	2:2:2	9.4	12	10.7	SW02
ZINC	2000	[1]	0	2:2:2	28.6	37.0	32.8	SW02
VOCs								
ACETONE	50	[1]	0	2:2:2	2.2	2.8	2.5	SW02

Table 6-3
Summary of Human Health Risk Based Surface Water Screening
UASI Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Surface Water		Number of Exceedances	FOD	Concentration (ug/L)			Location of Maximum Detection
	Screening Value (ug/L)				Minimum	Maximum	Mean	
ADJACENT NEARSHORE								
Dissolved Inorganics								
ALUMINUM	36499	[3]	0	5:5:5	47.5	765	365	SW04
ARSENIC	50	[1]	0	5:5:5	0.25	0.42	0.32	SW04
BARIUM	1000	[1]	0	5:5:5	17.3	30.2	22.86	SW04
CALCIUM METAL	FN	--	--	5:5:5	16900	20300	18880	SW06
COBALT	730	[3]	0	5:5:5	0.11	0.32	0.21	SW04
COPPER	200	[1]	0	5:5:5	1.1	2.1	1.46	SW07
IRON, TOTAL	300	[2]	2	5:5:5	90.3	765	374	SW04
LEAD	50	[1]	0	5:5:5	0.13	0.70	0.34	SW04
MAGNESIUM	35000	[1]	0	5:5:5	3410	4180	3898	SW07
MANGANESE	50	[2]	1	5:5:5	24.8	60.0	35.6	SW04
MERCURY	0.0007	[1,4]	5	5:5:5	0.0021	0.0034	0.0026	SW03
NICKEL	100	[1]	0	5:5:5	6.9	7.5	5.0	SW04
POTASSIUM	FN	--	--	5:5:5	1010	1580	1300	SW04
SODIUM	LN	--	--	5:5:5	10100	12500	11800	SW04
VANADIUM	36	[3]	0	2:2:5	1.3	1.5	1.4	SW04
ZINC	2000	[1]	0	4:5:5	7.8	35.1	15.9	SW07
Total Recoverable Inorganics								
ALUMINUM	36499	[3]	0	5:5:5	8770	12100	10624	SW07
ARSENIC	50	[1]	0	5:5:5	1.6	2.2	1.9	SW07
BARIUM	1000	[1]	0	5:5:5	99.7	119	111.14	SW05
BERYLLIUM	3	[1]	0	5:5:5	0.24	0.35	0.30	SW07
CADMIUM	5	[1]	0	5:5:5	0.11	0.17	0.19	SW05
CALCIUM METAL	FN	--	--	5:5:5	20400	22900	21780	SW06
CHROMIUM, TOTAL	50	[1]	0	5:5:5	8.6	12.4	10.3	SW05
COBALT	730	[3]	0	5:5:5	2.8	4.0	3.46	SW07
COPPER	200	[1]	0	5:5:5	8	9.7	8.96	SW07
IRON, TOTAL	300	[2]	5	5:5:5	8290	11900	10426	SW07
LEAD	50	[1]	0	5:5:5	6.1	7.2	6.7	SW05
MAGNESIUM	35000	[1]	0	5:5:5	5900	6950	6512	SW06
MANGANESE	50	[2]	5	5:5:5	286	336	301	SW05
MERCURY	0.0007	[1,4]	5	5:5:5	0.0052	0.0090	0.0068	SW04
NICKEL	100	[1]	0	5:5:5	12.8	31.6	18.1	SW03
POTASSIUM	FN	--	--	5:5:5	3910	4840	4392	SW07
SELENIUM	10	[1]	0	1:5:5	1.8	1.8	1.0	SW06
SILVER	50	[1]	0	5:5:5	0.034	0.075	0.049	SW07
SODIUM	LN	--	--	5:5:5	12000	13800	13280	SW07
THALLIUM	0.5	[1]	0	5:5:5	0.075	0.11	0.090	SW07
VANADIUM	36	[3]	0	5:5:5	9.3	12.5	10.9	SW07
ZINC	2000	[1]	0	5:5:5	31	40.9	35.5	SW05
VOCs								
ACETONE	50	[1]	0	5:5:5	1.9	3.6	2.7	SW07
TOLUENE	5	[1]	0	3:3:5	0.33	0.43	0.40	SW03, SW04

FOD - Frequency of Detection, Number of detected samples: Number of samples used to calculate statistics: Number of total samples.

Human Health Surface Water Screening Value Sources (in order of preference):

- 1 - NYSDEC ambient water quality standard (value for public water supply unless otherwise noted)(NYSDEC, 1998)
- 2 - Federal ambient water quality criteria (value for water + organism)(USEPA, 2002)
- 3 - USLPA Region 9 Tapwater PRG (USEPA, 2004)
- 4 - Fish consumption based value which applies to dissolved phase

Notes:

FN = Essential Nutrient [no screening value available]

Shaded cell indicates exceedance of human health screening value.

Only detected compounds within each reach are presented.

7.0 Analysis of Potential Risks to the Environment

A screening level analysis was conducted to evaluate the potential for risks to the environment due to exposure to sediment or surface water adjacent to the Site. Appendix I presents the full text of the screening level ecological risk assessment (ERA) which is summarized in the following sub-sections. The analysis identifies potential Site-related compounds in sediment and surface water which may pose a potential risk to ecological receptors. The analysis is not intended to serve as a comprehensive evaluation of potential risks to ecological receptors, but rather to help frame the need for and scope of any future evaluation of potential ecological risks.

The summary presented in the following sub-sections focuses on the evaluation of potentially complete exposure pathways for ecological receptors within the Hudson River adjacent to the Site. The screening level ERA includes a comparison of surface water and sediment data to risk-based benchmarks, an evaluation of analytical data designed to assess bioavailability of metals (i.e., SEM and AVS), and an evaluation of the results of the recent macroinvertebrate survey presented in Appendix E.

The results of the screening level ERA indicate that: (1) surface water is not a medium of concern at the Site, and (2) despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments (0 – 0.5 ft), there is no difference in the abundance or diversity of the macroinvertebrate community adjacent to the Site, relative to upstream locations.

7.1 Potential Exposure Pathways

The primary objective of the screening level ERA is to determine whether or not there is the potential for current or future risks to the environment due to exposure to chemical stressors in surface water and/or surficial sediment in the Study Area. Potentially complete exposure pathways for ecological receptors were identified through a review of historic Site information, including the site description presented in Section 2. This screening level ERA focuses on impacts to lower trophic level receptors in the river and does not evaluate all potentially complete exposure pathways. Impacts to higher trophic level wildlife receptors may be evaluated if additional assessment is recommended at the conclusion of the screening level ERA. This analysis has identified and evaluated the following potentially complete ecological exposure pathways, the details of which are set forth in Appendix I:

- Direct contact and ingestion of surface water by aquatic receptors (i.e., fish and invertebrates) exposed to surface water; and
- Direct contact with surficial sediment by benthic receptors (i.e., benthic macroinvertebrates).

Although benthic receptors are not currently exposed to the sub-surficial sediments, this exposure pathway has been conservatively included in the ERA in the event that future mixing events or remedial response actions expose these receptors to sub-surficial sediments.

7.2 Ecological Risk Analysis

In order to evaluate the potential for risks to the benthic macroinvertebrate community, bulk sediment analytical chemistry results were compared to sediment quality benchmarks, SEM/AVS relationships were used as preliminary indicators of sediment metals bioavailability, and the results of a recent field survey of the benthic macroinvertebrate community (presented in Appendix E) were reviewed. Bulk surficial sediment concentrations in excess of sediment quality benchmarks were considered to be indicative of a potential for ecological risks. SEM/AVS ratios greater than one may be considered an indicator of potential bioavailability for divalent cationic metals. Various macroinvertebrate community metrics have been used to evaluate the potential risks associated with exposure to sediment *in situ*; these metrics have been compared against

macroinvertebrate communities identified in the urbanized, upstream background reach of the Hudson River (i.e., the Upstream reach).

To evaluate the potential for risks to the fish community in the Hudson River adjacent to the Site, surface water analytical chemistry results were compared to surface water quality benchmarks. Surface water concentrations in excess of surface water quality benchmarks were considered indicative of a potential for ecological risks.

7.2.1 Ecological Risk Screening Results

Potential adverse ecological effects to benthic and aquatic receptors were evaluated based on comparisons of near-Site surficial sediment and surface water data to literature-derived screening values. The presence of compounds in environmental media at concentrations which exceed benchmark screening values does not necessarily constitute ecological risk. For instance, certain compounds may not be bioavailable, may not be absorbed into an organism's system following ingestion, or may not be absorbed through direct contact due to the chemical form of the compounds.

To identify screening level chemicals of potential concern (SLCOPCs) in the surficial sediment data set, concentrations of each compound were compared against their respective NYSDEC sediment quality risk-based benchmarks (NYSDEC, 1999). Surface water screening values were selected from the NYSDEC water quality standards (WQS) for the protection of aquatic life (NYSDEC, 1998). When appropriate, surface water screening criteria were adjusted to the average hardness value for the river. Both total recoverable and dissolved phase surface water data were evaluated for inorganic compounds.

Tables 7-1 through 7-2 summarize the surficial sediment screening results. In order to help place the sub-surficial data in perspective, these data were also screened against the NYSDEC criteria (Tables 7-3 and 7-4). It is recognized that potential exposure pathways to sub-surficial sediment are currently incomplete since ecological receptors are not currently exposed to the horizons represented by the core samples; however, if conditions were to change and these sediments were to become exposed, developing an understanding of the compound levels relative to screening values may be relevant. Table 7-5 summarizes the surface water screening results. Sample by sample screening results are presented and discussed in Appendix I.

7.2.1.1 Sediment

Inorganic Compounds

As discussed in Appendix I, the inorganic sediment data from the Study Area were evaluated relative to NYSDEC sediment quality risk-based screening benchmarks.

- Within the Upstream data set (comprised of 28 surficial samples), the low effect screening value was exceeded for 11 compounds and the severe effect screening value was exceeded for one compound (lead).
- The Adjacent Far Field data set included 19 surficial samples and two core samples. The low effect screening value was exceeded for arsenic, copper, iron, lead, and mercury within the surficial data set. The arsenic concentration at SD039 and the mercury concentration at SD046 also exceeded the severe effects screening value.
- The Adjacent Nearshore data set included 36 surficial samples and 20 core samples collected from the muddy sand area located directly adjacent to the Site. Many of the samples were located in close proximity to the historic sewer outfalls. Concentrations in excess of low and severe effect screening values were noted at least once for all 12 of the compounds with NYSDEC screening values.

- The Upper Navigational Channel data set included 15 surficial samples and one core sample collected from the muddy sand area located directly downstream of the Site, in the vicinity of what is understood to be the northern extreme of navigational dredging in this portion of the river. Low effect screening value exceedances were noted at least once for the following compounds: arsenic, iron, manganese, and nickel. Concentrations of the following compounds exceeded both low and severe effect screening values: cadmium, chromium, copper, lead, mercury, silver, and zinc.
- The Downstream data set contains two surficial samples located downstream of the Site in the vicinity of the turning basin. Analytical results from the sample located in the muddy sand directly to the west of the turning basin (SD075) did not exceed any of the low or severe effect sediment benchmarks. However, the sample located in the muddy sand downstream of the turning basin (SD076) exceeded the low effect screening values for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc. Chromium and zinc also exceed the severe effect screening value.

For many locations, concentrations in the sub-surficial samples, generally the 2 to 4 ft and 4 to 6 ft strata, were higher than those observed in the surficial samples. In three of the four cores that penetrated to the 8 to 10 ft depth (SD108, SD112, and SD113), severe effect screening value exceedances were observed for many of the inorganic compounds at multiple depths. In many cases, the deeper samples had higher concentrations of many compounds than the 0 to 0.5 ft layer. The surficial samples (0 to 0.5 ft) represent the horizon at which ecological receptors are most likely to be exposed to chemical stressors. Ecological receptors are not currently exposed to the horizons represented by the core samples (2 to 10 ft); however these samples have been included in this assessment to provide additional perspective relative to sub-surficial conditions.

VOCs

A total of 37 surficial samples and 23 core samples were analyzed for VOCs. The majority of these samples were located in the muddy sand of the Adjacent Nearshore area.

- The organic carbon-normalized NYSDEC benthic aquatic life chronic sediment toxicity criteria were not exceeded in the two Upstream surficial samples. Few exceedances were noted in the three Adjacent Far Field sample locations. These results indicate that the more coarse substrate located to the west of the Site (i.e., the Adjacent Far Field data set) is generally not impacted by Site-related VOCs.
- Within the Adjacent Nearshore data set, screening values for all of the VOCs with NYSDEC screening values were exceeded in at least some samples. Chlorobenzene concentrations exceeded the NYSDEC screening value most frequently and generally had the highest magnitude of the exceedances. Many of these chlorobenzene exceedances are clustered around the middle outfall location closest to the North Lagoon (an inactive production sewer). Concentrations of VOCs are generally much lower at the southerly outfall owned by the City of Rensselaer.
- Surficial samples within the Upper Navigational Channel and the two Downstream sample locations near the turning basin were not analyzed for VOCs; however, VOCs were undetected in several sampling stations located between the southerly outfall owned by the City of Rensselaer and these Downstream stations, indicating that downstream impacts from VOCs are unlikely (i.e., the VOC-impacted sediment is generally in the nearshore environment in the vicinity of the Site).

As was observed for the inorganic compounds, in many cases, the deeper samples contained higher levels of VOCs than did the surficial sediments. For instance, at station SD089, the surficial sample had low levels of VOCs, but the 2 to 4 ft and 4 to 6 ft samples had exceedances of all NYSDEC screening values and had the highest observed chlorobenzene concentration. As stated previously, the surficial sediments represent the horizon at which ecological receptors are most likely to be exposed to chemical stressors. The higher concentrations present in the deeper sediments are below the depth of most ecological receptor activities;

therefore exposure to these elevated VOCs is not likely. However these samples have conservatively been included in this assessment to help place these data into perspective relative to the NYSDEC criteria.

7.2.1.2 Surface Water

Surface water samples were collected from two Upstream locations and five Adjacent Nearshore locations. Criteria for total recoverable and dissolved inorganic compounds were exceeded in both the Upstream and Adjacent Nearshore reaches for aluminum, copper, iron, lead, and manganese. Because inorganic compounds occurred at similar concentrations within the Upstream and Adjacent Nearshore reaches, there is no indication that potential risk from these compounds is related to the Site.

With the exception of two likely laboratory contaminants (acetone and toluene), VOCs were non-detect in all samples. Acetone concentrations were low and similar upstream and adjacent to the Site. Toluene was non-detect upstream of the Site and low adjacent to the Site. No NYSDEC aquatic life criterion was available for acetone; although all concentrations were well below the NYSDEC drinking water value (50 µg/L presented in the human health assessment). Toluene was well below the NYSDEC aquatic life criterion. These low levels of acetone and toluene could potentially be due to laboratory contamination. These results indicate that surface water is not a medium of concern at this Site.

7.2.2 SEM and AVS Analysis

The SEM and AVS samples were collected from the top four cm of sediment in order to help assess whether or not selected divalent metals are likely to be bioavailable, and therefore potentially toxic, to benthic receptors. Sulfides were not detected in more than half of the samples (29 of 48 locations) so comparisons could not be conducted with these samples. Analysis of results of the SEM and AVS analysis (presented in Table 4-2) indicate that the levels of AVS alone may not be sufficient to bind the divalent metals. However, increasing levels of organic carbon, particularly in the Adjacent Nearshore area, may help to decrease the bioavailability of the metals.

Seven locations from within the Upstream and Adjacent Nearshore, and Upper Navigational Channel reaches had (ΣSEM-AVS)/ f_{oc} values of less than 130 µmol/g_{oc} where the sediments are presumed to "not likely" be toxic (USEPA, 2005). None of the samples had an (ΣSEM-AVS)/ f_{oc} value above 3,000 µmol/g_{oc} where the sediments are presumed to "likely" be toxic (USEPA, 2005). The remaining samples were between these two thresholds in a range where the prediction of effects is uncertain.

These results indicate that, while the presence of AVS and TOC may play a role in modifying the bioavailability of divalent metals at a sub-set of the Hudson River sediment sampling locations, the results are uncertain, and AVS alone is not sufficient to bind divalent metals at a number of stations. In addition, at 29 sampling locations, AVS was not detected, and therefore binding of metals to AVS at these stations is not a significant factor.

7.2.3 Benthic Macroinvertebrate Community Assessment

A site-specific macroinvertebrate community survey was conducted to provide a direct assessment of the integrity of the benthic community near the Site. Appendix E provides the benthic macroinvertebrate survey report provided by Rapid Watershed Assessment Associates of Albany, New York. Sampling locations were located in the Upstream, Adjacent Far Field, Adjacent Nearshore, and Upper Navigational Channel reaches. The macroinvertebrate survey indicated that the more pollution-tolerant oligochaetes (i.e., *Limnodrilus hoffmeisteri*) and chironomids (i.e., *Chironomus* sp., *Cryptochironomus* sp., *Procladius* sp.) were the dominant types of organisms found throughout the Study Area (including the Upstream reach, outside of Site-related influence).

The benthic macroinvertebrate communities analyzed upstream, adjacent to, and downstream of the Site all show signs of impairment. Biological impairment is determined by comparing indices of community structure

and function at upstream and downstream sites using application of the student t-test. Although several macroinvertebrate sampling stations were located within the Adjacent Nearshore reach, immediately adjacent to the Site bulkhead, no relationship between proximity to the Site and a decrease in macroinvertebrate community fitness was observed. Likewise, no relationship between increased VOC and/or inorganic compound concentrations and a decrease in macroinvertebrate community fitness was observed. Invertebrate diversity and abundance in the sediment were low across all samples and many of the taxa present are typically associated with high stress environments. These conditions were expected given the daily shifts in flow direction (due to tidal influence) and the historical urban/industrial setting of this part of the Hudson River. Similarity analyses (Figure 7-1) indicate that the differences (in terms of taxa observed, diversity, abundance, and habitat) observed upstream, adjacent to, and downstream of the Site were minimal and not significant. These results indicate that the observed biological impairment of the macroinvertebrate community reflects conditions throughout the Study Area (i.e., from the Upstream reach to the most downstream sampling location in the Upper Navigational Channel).

7.3 Conclusions

Based on the comparison of surface water concentrations to NYSDEC surface water screening values and consistency of concentrations throughout the Study Area, surface water is not a medium of concern at the Site, and there are unlikely to be unacceptable risks to fish in the vicinity of the Site from exposure to surface water.

NYSDEC sediment screening criteria were exceeded in surficial sediments through the entire Study Area. Concentrations of inorganics and VOCs in surficial sediment were highest in the muddy sand adjacent to the Site (i.e., the Adjacent Nearshore reach), and metals from at least some sampling locations may be bioavailable to benthic receptors. There is some uncertainty as to whether compounds in sediment, particularly those with low $\log_{10} K_{ow}$ values (e.g., benzene and other VOCs), are likely to bioaccumulate into fish. Metals concentrations were also elevated above screening criteria in surficial sediments within the muddy sand of the Upper Navigational Channel just downstream of the Site and in the Upstream and Adjacent Far Field reaches.

The highest observed concentrations of inorganics and VOCs were in the Adjacent Nearshore reach in the deeper sediments, two ft or more below the sediment surface. However, exposure to these sub-surficial sediments is not likely to be a complete ecological exposure pathway for ecological receptors as the sediments are situated well below the bioactive zone for most benthic organisms. There is some uncertainty as to whether re-suspension of sub-surficial sediments could pose a risk to the environment. Sediments in the 0.5 - 2 ft sediment horizon have not yet been fully characterized.

The macroinvertebrate survey indicates that there is a similar benthic macroinvertebrate community throughout the entire Study Area (including the Upstream reach). Although several macroinvertebrate sampling stations were located within the Adjacent Nearshore reach, immediately adjacent to the Site bulkhead, no relationship between proximity to the Site and a decrease in macroinvertebrate community fitness was observed. Likewise, no relationship between increased VOC and/or inorganic compound concentrations and a decrease in macroinvertebrate community fitness was observed. It is likely that the observed macroinvertebrate community integrates exposures to a number of stressors present in the Hudson River in the vicinity of Albany.

Despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments, there is no difference in the abundance or diversity of the macroinvertebrate community adjacent to the Site, relative to upstream locations. Similarly, no relationship between elevated levels of compounds in the sediment and the macroinvertebrate community health was observed. However, due to a lack of existing sediment data in the 0.5 - 2 ft horizon, there is some uncertainty as to the potential for risks to deep burrowing benthic receptors adjacent to the Site. Additional ecological risk analysis and evaluation of the preponderance of evidence from multiple measurement endpoints would be required to more definitively evaluate the potential for ecological risks due to exposure to stressors of concern.

Table 7-1
Summary of Ecological Risk Based Surficial Sediment Screening - Inorganics
BASF Corporation
Hudson River C.U-2 Investigation
Hersselaer, New York

Analyte	Ecological Sediment Screening Values		Number of Low Effect Exceedances [1,2]	FOD	Concentration (mg/kg)			Location of Maximum Detection
					Minimum	Maximum	Mean	
UPSTREAM (0 - 0.5 ft)								
Inorganics	LEL NC	SEL NC	--	28 : 28 : 28	3550	15700	84.5	SD024
ALUMINUM	2	25	8	20 : 28 : 28	0.08	7.2	1.8	SD016
ANTIMONY	6	33	1	26 : 28 : 28	1.1	8.7	2.9	SD001
ARSENIC	NC	NC	--	28 : 28 : 28	14	117	57.2	SD022
BARIUM	0.6	9	5	5 : 26 : 28	0.95	2.7	0.66	SD006
CADMIUM	NC	NC	--	28 : 28 : 28	390	16900	7585	SD005
CALCIUM/METAL	26	110	6	26 : 28 : 28	6	54.9	19.6	SD006
CHROMIUM, TOTAL	NC	NC	--	28 : 28 : 28	3.1	13	7.5	SD024
COBALT	16	110	16	28 : 28 : 28	5.3	50.5	22.1	SD006
COPPER	20000	40000	14	28 : 28 : 28	9970	30800	20715	SD024
IRON, TOTAL	31	110	11	19 : 28 : 28	7.6	203	32.6	SD028
LEAD	NC	NC	--	28 : 28 : 28	1940	8130	4895	SD022
MAGNESIUM	480	100	3	28 : 28 : 28	156	988	467	SD022
MANGANESE	0.16	1.3	4	26 : 28 : 28	0.02	0.28	0.08	SD006
MERCURY	16	50	18	28 : 28 : 28	6.3	30.5	17.1	SD024
NICKEL	NC	NC	--	26 : 28 : 28	508	2420	1055	SD024
POTASSIUM	1	2.2	0	17 : 20 : 28	0.03	0.31	0.09	SD006
SILVER	NC	NC	--	28 : 28 : 28	35.4	160	95.1	SD021
SODIUM	NC	NC	--	22 : 28 : 28	0.02	25.6	0.75	SD015
THALLIUM	NC	NC	--	28 : 28 : 28	3.2	163	14.3	SD024
VANADIUM	120	270	6	28 : 28 : 28	32.6		92.2	SD006
ZINC								
ADJACENT FAR FIELD (0 - 0.5 ft)								
Inorganics	LEL NC	SEL NC	--	19 : 19 : 19	3370	8250	6899	SD049
ALUMINUM	2	25	1	12 : 18 : 19	0.05	0.15	0.07	SD079
ANTIMONY	6	33	4	18 : 18 : 18	0.8	34.6	6.2	SD039
ARSENIC	NC	NC	--	19 : 19 : 19	11.4	178	39.4	SD046
BARIUM	NC	NC	--	19 : 19 : 19	823	13680	4746	SD036
CALCIUM/METAL	26	110	0	19 : 19 : 19	5.1	16.5	9.6	SD049
CHROMIUM, TOTAL	NC	NC	--	18 : 19 : 19	4	7.5	5.1	SD041
COBALT	19	110	1	19 : 19 : 19	4.3	16.2	8.5	SD039
COPPER	20000	40000	3	19 : 19 : 19	10930	38500	17008	SD079
IRON, TOTAL	31	110	1	4 : 19 : 19	24.7	37.1	14.5	SD079
LEAD	NC	NC	--	19 : 19 : 19	2390	4490	3344	SD042
MAGNESIUM	480	1100	0	19 : 19 : 19	117	451	279	SD046
MANGANESE	0.16	1.3	1	11 : 19 : 19	0.02	2.34	0.15	SD049
MERCURY	16	50	0	19 : 19 : 19	7.1	15	10.7	SD049
NICKEL	NC	NC	--	13 : 19 : 19	427	1200	584	SD045
POTASSIUM	NC	NC	--	1 : 15 : 18	1.7	1.7	0.59	SD045
SELENIUM	NC	NC	0	9 : 13 : 19	0.02	0.31	0.038	SD046
SILVER	1	2.2	--	19 : 19 : 19	22.7	221	72.6	SD079
SODIUM	NC	NC	--	15 : 17 : 18	0.02	0.06	0.031	SD079
THALLIUM	NC	NC	--	19 : 19 : 19	5.1	12.8	8.7	SD079
VANADIUM	NC	NC	0	19 : 19 : 19	38.3	87.2	57.3	SD079
ZINC	120	270						

Table 7-1
Summary of Ecological Risk Based Surficial Sediment Screening - Inorganics
BASF Corporation
Hudson River O & A Investigation
Rensselaer, New York

Analyte	Ecological Sediment Screening Values		Number of Low Effect Exceedances [1,2]	FOD	Concentration (mg/kg)			Location of Maximum Detection
					Minimum	Maximum	Mean	
ADJACENT NEARSHORE (0 - 0.5 ft)								
Inorganics	LEL	SEL		36 : 36 : 36	8140	23500	12913	SD085
ALUMINUM	NC	NC	-	20 : 20 : 36	0.120	1.3	0.44	SD035
ANTIMONY	2	25	0	36 : 36 : 36	2.1	115	10.2	SD080
ARSENIC	9	33	22 (1)	36 : 36 : 36	59.1	376	115	SD085
BARIUM	NC	NC	-	21 : 36 : 36	1.0	24.4	3.2	SD035
CADMIUM	0.6	9	21 (2)	36 : 36 : 36	2660	63700	13407	SD099
CALCIUM METAL	NC	NC	-	36 : 36 : 36	19.8	646	101	SD035
CHROMIUM, TOTAL	26	110	24 (9)	36 : 36 : 36	6.7	19.4	10.7	SD087
COBALT	NC	NC	-	36 : 36 : 36	18.9	297	76	SD087
COPPER	16	110	36 (7)	36 : 36 : 36	7900	42700	24799	SD087
IRON, TOTAL	20000	40000	33 (1)	36 : 36 : 36	24.3	772	104	SD085
LEAD	31	110	27 (9)	36 : 36 : 36	3790	8190	5242	SD085
MAGNESIUM	NC	NC	-	36 : 36 : 36	259	7590	616	SD086
MANGANESE	460	1100	27 (1)	36 : 36 : 36	0.07	2.3	0.51	SD085
MERCURY	0.15	1.3	24 (42)	36 : 36 : 36	15.6	44.1	24	SD085
NICKEL	16	50	35	36 : 36 : 36	779	2990	1536	SD082
POTASSIUM	NC	NC	-	36 : 36 : 36	0.11	2.95	0.73	SD082
SILVER	1	2.2	1 (1)	20 : 36 : 36	85.9	238.0	141.39	SD085
SODIUM	NC	NC	-	36 : 36 : 36	0.07	0.16	0	SD032
THALLIUM	NC	NC	-	20 : 20 : 36	13.5	54.3	24.71	SD085
VANADIUM	NC	NC	-	36 : 36 : 36	94.9	661.5	195.4	SD085
ZINC	120	270	27 (5)	36 : 36 : 36				SD082
UPPER NAVIGATIONAL CHANNEL (0 - 0.5 ft)								
Inorganics	LEL	SEL		15 : 15 : 15	8800	20300	12583	SD082
ALUMINUM	NC	NC	-	12 : 15 : 15	0.050	1.1	0.44	SD089
ANTIMONY	2	25	0	15 : 15 : 15	1.5	19	5.3	SD082
ARSENIC	6	33	4	15 : 15 : 15	43.9	262	135	SD082
BARIUM	NC	NC	-	10 : 15 : 15	1.9	17.2	5.8	SD089
CADMIUM	0.6	9	10 (3)	15 : 15 : 15	2630	9030	5880	SD082
CALCIUM METAL	NC	NC	-	15 : 15 : 15	15.5	280	127	SD082
CHROMIUM, TOTAL	26	110	11 (8)	15 : 15 : 15	4.8	12.5	8.2	SD082
COBALT	NC	NC	-	15 : 15 : 15	11.5	233	77	SD082
COPPER	13 (5)	110	13 (9)	15 : 15 : 15	13400	34700	21847	SD082
IRON, TOTAL	8	40000	5	15 : 15 : 15	37.7	266	137	SD082
LEAD	31	110	11 (1)	15 : 15 : 15	2850	5240	5021	SD082
MAGNESIUM	NC	NC	-	15 : 15 : 15	139	670	399	SD082
MANGANESE	460	1100	11 (1)	14 : 14 : 14	0.05	3.2	0.80	SD082
MERCURY	0.15	1.3	-	15 : 15 : 15	11.6	34.8	22	SD082
NICKEL	16	50	-	15 : 15 : 15	1270	4020	2215	SD088
POTASSIUM	NC	NC	-	15 : 15 : 15	0.75	1.4	0.63	SD082
SELENIUM	NC	NC	-	2 : 15 : 15	0.07	2.2	0.78	SD082
SILVER	1	2.2	4 (1)	13 : 15 : 15	83.7	165	116	SD082
SODIUM	NC	NC	-	14 : 15 : 15	0.04	0.27	0.10	SD082
THALLIUM	NC	NC	-	13 : 13 : 15	12.5	44.1	25.6	SD032
VANADIUM	NC	NC	-	15 : 15 : 15	79.7	557	251	SD088
ZINC	120	270	10 (7)	15 : 15 : 15				SD032

Table 7-1
Summary of Ecological Risk Based Surficial Sediment Screening - Inorganics
BASF Corporation
Hudson River CU-2 Investigation
Hempstead, New York

Analyte	Ecological Sediment Screening Values		Number of Low Effect Exceedances [1,2]	FOD	Concentration (mg/kg)			Location of Maximum Detection
					Minimum	Maximum	Mean	
DOWNSTREAM (0 - 0.5 ft)								
Inorganics								
ALUMINUM	LEL NC	SEL NC	--	2:2:2	8540	9590	8035	SD076
ANTIMONY	2	25	0	2:2:2	0.09	0.32	0.21	SD076
ARSENIC	6	33	1	2:2:2	1.2	7.0	4.1	SD076
BARIUM	NC	NC	--	2:2:2	31.8	103	70.4	SD076
CADMIUM	0.8	9	1	1:2:2	2.1	2.1	1.3	SD076
CALCIUM METAL	NC	NC	--	2:2:2	-920	3530	2925	SD076
CHROMIUM, TOTAL	25	110	1 (1)	2:2:2	13.8	128	70.9	SD076
COBALT	NC	NC	--	2:2:2	5.2	8.6	7.4	SD076
COPPER	15	110	1	2:2:2	12.1	94.2	53.2	SD076
IRON, TOTAL	20000	40000	1	2:2:2	14800	20500	17700	SD076
LEAD	31	110	0	1:2:2	20	20	15.3	SD076
MAGNESIUM	NC	NC	--	2:2:2	3300	4200	3750	SD076
MANGANESE	460	1100	0	2:2:2	275	325	300	SD076
MERCURY	0.15	1.3	1	2:2:2	0.03	1.2	0.64	SD076
NICKEL	15	50	1	2:2:2	13.1	20.7	16.9	SD076
POTASSIUM	NC	NC	--	2:2:2	911	1010	961	SD076
SILVER	1	2.2	0	2:2:2	0.03	0.77	0.41	SD076
SODIUM	NC	NC	--	2:2:2	58.8	96.1	78.5	SD076
THALLIUM	NC	NC	--	2:2:2	0.05	0.21	0.13	SD076
VANADIUM	NC	NC	--	2:2:2	-0	-9.9	14.5	SD076
ZINC	120	270	1 (1)	2:2:2	74.7	333	204	SD076

FOD - Frequency of Detection. Number of detected samples. Number of samples used to calculate statistics. Number of total samples.

NYSDEC, 1999, Technical Guidance for Screening Contaminated Sediments. Division of Fish, Wildlife and Marine Resources.

Yellow shaded cell indicates exceedance of low effect level (LEL).

Green shaded cell indicates exceedance of LEL and severe effect level (SEL).

1 - Counts indicate exceedances by detected concentrations

2 - Number in parentheses indicates number of SEL exceedances

NC = No NYSDEC Criteria

Only detected compounds within each reach and depth are presented.

Table 7-2
Summary of Ecological Risk Basic Sediment Screening - VOCs
BASF Corporation
Hudson River QJ2 Investigation
Hempstead, New York

Analyte	Chronic Benthic Life Criteria	Number of Chronic Exceedances [1]	FOD	Concentration (mg/kg OC)			Location of Maximum Detection
				Minimum	Maximum	Mean	
ADJACENT NEARSHORE (0 - 0.5 ft)							
VOCs							
1,1,1-TRICHLOROETHANE (TCA)	NC	--	1 : 1 : 34	0.014	0.014	0.014	SD087
1,2,4-TRICHLOROBENZENE	91.0	1	8 : 34 : 34	0.10	500	24.0	SD087
1,2-DICHLOROBENZENE	12.0	5	32 : 34 : 34	0.025	7500	231	SD087
1,2-DICHLOROETHANE	NC	--	1 : 1 : 34	0.20	0.23	0.14	SD080
1,3-DICHLOROBENZENE	12.0	1	20 : 34 : 34	0.026	980	37.1	SD087
1,4-DICHLOROBENZENE	12.0	4	25 : 34 : 34	0.028	1500	55.9	SD087
2-BUTANONE (MEK)	NC	--	20 : 25 : 34	0.40	4.6	1.0	SD085
ACETONE	NC	--	25 : 26 : 34	0.13	5.4	3.7	SD085
BENZENE	26.0	6	19 : 34 : 34	0.016	800	84.4	SD090
CARBON D SULFIDE	NC	--	24 : 25 : 34	0.027	0.35	0.11	SD092
CHLOROBENZENE	3.5	18	34 : 34 : 34	0.052	45000	1846	SD087
CHLOROMETHANE	NC	--	1 : 1 : 34	0.059	0.08	0.06	SD081
CYCLOHEXANE	NC	--	9 : 24 : 34	0.027	0.42	0.23	SD082
ETHYLBENZENE	24.0	2	13 : 34 : 34	0.034	100	7.5	SD087
ISOPROPYLBENZENE	12.0	0	4 : 22 : 34	0.064	0.32	0.23	SD082
M,P-XYLENES	NC	--	17 : 34 : 34	0.068	400	17.2	SD087
METHYL ACETATE	NC	--	15 : 33 : 34	0.068	75.0	6.6	SD090
METHYLCYCLOHEXANE	NC	--	10 : 28 : 34	0.035	5.0	1.0	SD085
METHYLENE CHLORIDE	NC	--	1 : 25 : 34	4.1	4.1	4.1	SD086
O-XYLENE	NC	--	18 : 34 : 34	0.043	190.0	7.6	SD087
STYRENE	NC	--	1 : 11 : 34	0.21	0.21	0.2	SD057
TOLUENE	49.0	2	14 : 34 : 34	0.064	730	29.8	SD087
TOTAL XYLENES	82.0	2	19 : 34 : 34	0.13	530	24.8	SD087
TRICHLOROETHYLENE	NC	--	1 : 4 : 34	0.096	0.385	0.081	SD086
TRICHLOROFLUOROMETHANE	NC	--	4 : 5 : 34	0.048	0.380	0.064	SD088

FOD - Frequency of Detection. Number of detected samples. Number of samples used to calculate statistics. Number of total samples, 85.
NYSDEC, 1999. Technical Guidance for Screening Contaminated Sediments. Division of Fish, Wildlife and Marine Resources.

Shaded cell indicates exceedance of chronic screening criteria

1 - Counts indicate exceedances by detected concentrations

NC = No NYSDC Criteria

Only detected compounds within each reach and depth are presented.

Table Y-3
Summary of Ecological Risk Based Sub-Sediment Screening - Inorganics
Hudson River CO-2 - Westkill
Parasitoid New York

Analyte	Ecological Sediment Screening Values		Number of Low Effect Exceedances [1,2]	FOQ	Concentration (mg/kg)		Mean	Location of Maximum Detection
	LEL	SEL			Minimum	Maximum		
ADJACENT NEARSHORE (4 - 6 ft)								
Inorganics								
ALUMINUM	NC	NC	—	20:20:20	5150	21600	15937	SD089
ANTIMONY	2	25	5 (1)	5:20:20	9.5	29.7	8.2	SD089
ARSENIC	6	53	19 (3)	20:20:20	6	57.6	19.3	SD089
BARIUM	NC	NC	—	20:20:20	46.7	512.5	210	SD134
BERYLLIUM	NC	NC	—	1:20:20	1.0	1.0	0.46	SD127
CADMIUM	2.6	9	15 (7)	15:20:20	2.1	30.7	10.3	SD138
CALCIUM METAL	NC	NC	—	20:20:20	3090	14300	8005	SD085
CHROMIUM TOTAL	28	110	20 (11)	20:20:20	38	493	262	SD118
COBALT	NC	NC	—	15:20:20	7.9	20.0	11.4	SD126
COPPER	16	110	20 (11)	20:20:20	47	833	215	SD087
POM, TOTAL	20000	42000	15 (1)	20:20:20	9320	73400	25511	SD087
LEAD	31	110	20 (11)	20:20:20	80.1	665	350	SD103
MAGNESIUM	NC	NC	—	20:20:20	2000	18430	5158	SD107
MANGANESE	480	110	3	15:15:20	267	861	533	SD107
MERCURY	0.3	1.3	20 (10)	20:20:20	1.1	35.2	5.1	SD087
NICKEL	16	50	15 (2)	20:20:20	17.8	92.7	36.1	SD086
POTASSIUM	NC	NC	—	20:20:20	763	3125	2139	SD112
SELENIUM	NC	NC	—	3:20:20	2.74	2.93	2.50	SD112
SILVER	1	2.2	5 (6)	3:20:20	1.8	3.45	1.5	SD112
SODIUM	NC	NC	—	14:20:20	127	442	186	SD082
THALLIUM	NC	NC	—	20:20:20	10.7	51.5	33.5	SD112
ZINC	130	270	15 (17)	20:20:20	112	2440	335	SD082
ADJACENT NEARSHORE (6 - 8 ft)								
Inorganics								
ALUMINUM	NC	SEL	—	5:8:5	10800	22700	14700	SD112
ANTIMONY	2	25	2	2:8:5	15.7	23.1	8.2	SD112
ARSENIC	6	53	7	5:8:5	4.3	14	10.1	SD105
BARIUM	NC	NC	—	5:8:5	95	542	161.6	SD112
BERYLLIUM	NC	NC	—	2:8:5	2.76	2.9	2.53	SD112
CADMIUM	2.6	9	8 (2)	5:8:5	1.1	26.3	7.3	SD112
CALCIUM METAL	NC	NC	—	5:8:5	5130	33200	11656	SD112
CHROMIUM TOTAL	28	110	7 (6)	5:8:5	22.2	547	168	SD112
COBALT	NC	NC	—	5:8:5	2.75	15.7	11.7	SD112
COPPER	16	110	5 (3)	5:8:5	36.6	304	130	SD112
POM, TOTAL	20000	42000	5	5:8:5	23500	34900	27519	SD112
LEAD	31	110	7 (5)	5:8:5	24.6	623	273	SD112
MAGNESIUM	NC	NC	—	5:8:5	5350	12700	7261	SD112
MANGANESE	480	110	3	5:8:5	422	763	559	SD105
MERCURY	0.3	1.3	7 (6)	7:8:5	0.31	3.8	1.3	SD105
NICKEL	16	50	5	5:8:5	20.3	411	28.0	SD112
POTASSIUM	NC	NC	—	5:8:5	1705	3000	2297	SD111
SELENIUM	NC	NC	—	4:8:5	2.82	0.955	0.7	SD112
SILVER	1	2.2	4 (2)	4:8:5	1.65	3.9	1.6	SD112
SODIUM	NC	NC	—	4:8:5	143	297	154	SD105
THALLIUM	NC	NC	—	5:8:5	19.5	56.6	30.5	SD112
ZINC	130	270	5 (4)	5:8:5	74.4	764	335	SD103

UPPER NAVIGATIONAL CHANNEL (2 - 4 ft)

Table 7-3
Summary of Ecological Risk Assessment Sediment Screening - Progress
BASF Corporation
Hudson River DRUG Investigation
Parsippany, New York

Analyte	Ecological Sediment Screening Values	Number of Low Effect Exceedances (1,2)	FOD	Concentration (mg/kg)			Location of Maximum Detection
				Minimum	Maximum	Mean	
UPPER NAVIGATIONAL CHANNEL (4 - 6 ft)							
Inorganics	LEL						
ALUMINUM	NC	0	1:1:1	9220	9220	9220	SD039
ANTIMONY	2	1	1:1:1	15.6	15.6	16	SD039
ARSENIC	5	1	1:1:1	9.7	9.7	10	SD039
BARIUM	NC	0	1:1:1	118	118	116	SD039
CADMIUM	0.6	1	1:1:1	3	3	3	SD039
CALCIUM METAL	NC	0	1:1:1	8450	8450	8450	SD039
CHROMIUM, TOTAL	26	1	1:1:1	45.4	45.4	45	SD039
COPPER	16	1	1:1:1	83.4	83.4	83	SD039
COPPER, TOTAL	20000	0	1:1:1	14600	14600	14600	SD039
LEAD	31	1 (1)	1:1:1	146	146	146	SD039
MAGNESIUM	NC	0	1:1:1	4550	4550	4550	SD039
MANGANESE	480	0	1:1:1	229	229	229	SD039
MERCURY	0.5	1 (1)	1:1:1	1.4	1.4	1	SD039
NICKEL	16	0	1:1:1	15.7	15.7	15	SD039
POTASSIUM	NC	0	1:1:1	1630	1630	1630	SD039
SODIUM	NC	0	1:1:1	513	513	513	SD039
WAXES, TOTAL	NC	0	1:1:1	17.8	17.8	18	SD039
ZINC	120	1	1:1:1	266	266	266	SD039

FOD - Frequency of Detection, Number of detected samples, Number of samples used to calculate statistics, Number of total samples.

NYSDDEC 1999 Technical Guidance for Screening Concentrated Sediments, Division of Fish, Wildlife and Marine Resources.

Yellow shaded cell indicates exceedance of low effect level (LEL).

Green shaded cell indicates exceedance of LEL and severe affect level (SEL).

1 - Counts indicate exceedances by detected concentration.

2 - Number in parentheses indicates number of SEL exceedances.

NC = No NYSDDEC Criteria.

Only detected compounds within each asset and depth are presented.

Table 2-4

2

Table 7-5
Summary of Ecological Risk Based Surface Water Screening
BASF Corporation
Hudson River OII-2 Investigation
Honnolaer, New York

Analyte	Surface Water Screening Value (ug/L)		Number of Exceedances	FOD	Concentration (ug/L)			Location of Maximum Detection
					Minimum	Maximum	Mean	
UPSTREAM								
Dissolved Inorganics								
ALUMINUM	100		2	2:2:2	1195	2990	2093	SW01
ARSENIC	150		0	2:2:2	0.43	0.70	0.56	SW01
BARIUM	NC		--	2:2:2	25.6	42.4	34	SW01
BERYLLIUM	1100	[1]	0	1:2:2	0.12	0.12	0.1291	SW01
CADMIUM	2	[1]	0	1:2:2	0.055	0.055	0.040	SW01
CALCIUM METAL	NC		--	2:2:2	18450	28700	23575	SW01
CHROMIUM, TOTAL	60	[1]	0	2:2:2	2.1	3.0	2.6	SW01
CORAL T	5		0	2:2:2	0.41	0.95	0.68	SW01
COPPER	8	[1]	0	2:2:2	1.9	3.2	2.5	SW01
IRON, TOTAL	300		2	2:2:2	1048	2640	1844	SW01
LEAD	3	[1]	0	2:2:2	0.64	1.6	1.1	SW01
MAGNESIUM	35000	[1]	0	2:2:2	3975	5850	4912.5	SW01
MANGANESE	300	[2]	0	2:2:2	40.9	70.5	55.7	SW01
MERCURY	1	[3]	0	2:2:2	0.0017	0.0035	0.0026	SW01
NICKEL	46	[1]	0	1:2:2	7.1	7.1	5.3	SW01
POTASSIUM	NC		--	2:2:2	1490	2190	1840	SW01
SODIUM	NC		--	2:2:2	10750	18700	14725	SW01
VANADIUM	14		0	2:2:2	1.9	4.0	2.9	SW01
ZINC	73	[1]	0	2:2:2	9.5	11.3	10.4	SW01
Total Recoverable Inorganics								
ALUMINUM	100		2	2:2:2	8930	13050	10990	SW02
ARSENIC	150		0	2:2:2	1.5	2.2	1.8	SW02
BARIUM	NC		--	2:2:2	93.1	126	110	SW02
BERYLLIUM	1100	[1]	0	2:2:2	0.24	0.32	0.28	SW02
CADMIUM	2	[1]	0	2:2:2	0.13	0.17	0.15	SW02
CALCIUM METAL	NC		--	2:2:2	20350	30100	25225	SW01
CHROMIUM, TOTAL	60	[1]	0	2:2:2	7.9	13.8	10.85	SW02
CORAL T	5		0	2:2:2	3.0	4.2	3.6	SW02
COPPER	8	[1]	1	2:2:2	7.5	9.7	8.6	SW02
IRON, TOTAL	300		2	2:2:2	8620	12450	10535	SW02
LEAD	3	[1]	2	2:2:2	5.5	6.4	5.9	SW02
MAGNESIUM	35000	[1]	0	2:2:2	6735	7220	6977.5	SW01
MANGANESE	300	[2]	1	2:2:2	230	301	265	SW02
MERCURY	1	[3]	0	2:2:2	0.0047	0.0080	0.0064	SW02
NICKEL	46	[1]	0	2:2:2	14.9	20.3	17.6	SW02
POTASSIUM	NC		--	2:2:2	4030	5005	4518	SW02
SILVER	0		0	2:2:2	0.033	0.042	0.038	SW02
SODIUM	NC		--	2:2:2	11500	19200	15350	SW01
THALLIUM	8		0	2:2:2	0.093	0.11	0.10	SW02
VANADIUM	14		0	2:2:2	9.4	12.0	10.7	SW02
ZINC	73	[1]	0	2:2:2	28.6	37.0	32.8	SW02
VOCs								
ACETONE	NC		--	2:2:2	2.2	2.8	2.5	SW02

Table 7-5
Summary of Ecological Risk Based Surface Water Screening
BASF Corporation
Hudson River OU 2 Investigation
Rensselaer, New York

Analyte	Surface Water	Number of Exceedances	FOD	Concentration (ug/L)			Location of Maximum Detection
	Screening Value (ug/L)			Minimum	Maximum	Mean	
ADJACENT NEARSHORE							
Dissolved Inorganics							
ALUMINUM	100	3	5:5:5	47.5	765	366	SW04
ARSENIC	150	0	5:5:5	0.25	0.42	0.32	SW04
BARIUM	NC	--	5:5:5	17.3	30.2	22.9	SW04
CALCIUM METAL	NC	--	5:5:5	16900	20300	18600	SW06
COBALT	5	0	5:5:5	0.11	0.32	0.21	SW04
COPPER	8 [1]	0	5:5:5	1.1	2.1	1.46	SW07
IRON, TOTAL	300	2	5:5:5	90.3	765	374	SW04
LEAD	3 [1]	0	5:5:5	0.13	0.70	0.34	SW04
MAGNESIUM	35000 [1]	0	5:5:5	3410	4180	3898	SW07
MANGANESE	300 [2]	0	5:5:5	24.8	60.0	35.6	SW04
MERCURY	1 [3]	0	5:5:5	0.00211	0.0034	0.002574	SW03
NICKEL	46 [1]	0	5:5:5	6.9	7.5	5.0	SW04
POTASSIUM	NC	--	5:5:5	1010	1580	1300	SW04
SODIUM	NC	--	5:5:5	10100	12500	11800	SW04
VANADIUM	14	0	2:2:5	1.3	1.5	1.4	SW04
ZINC	73 [1]	0	4:5:5	7.8	35.1	15.9	SW07
Total Recoverable Inorganics							
ALUMINUM	100	5	5:5:5	8770	12100	10624	SW07
ARSENIC	150	0	5:5:5	1.0	2.2	1.9	SW07
BARIUM	NC	--	5:5:5	99.7	119	111	SW05
BERYLLIUM	1100 [1]	0	5:5:5	0.24	0.35	0.30	SW07
CADMIUM	2 [1]	0	5:5:5	0.11	0.37	0.19	SW05
CALCIUM METAL	NC	--	5:5:5	20400	22900	21760	SW06
CHROMIUM, TOTAL	66 [1]	0	5:5:5	8.6	12.4	10.3	SW05
COBALT	5	0	5:5:5	2.8	4.0	3.5	SW07
COPPER	8 [1]	5	5:5:5	6.0	9.7	9.0	SW07
IRON, TOTAL	300	5	5:5:5	8290	11900	10426	SW07
LEAD	3 [1]	5	5:5:5	6.1	7.2	6.68	SW05
MAGNESIUM	35000 [1]	0	5:5:5	5900	6950	6512	SW06
MANGANESE	300 [2]	2	5:5:5	286	336	301	SW05
MERCURY	1 [3]	0	5:5:5	0.0052	0.0090	0.0068	SW04
NICKEL	46 [1]	0	5:5:5	12.8	31.6	18.1	SW03
POTASSIUM	NC	--	5:5:5	3910	4840	4392	SW07
SILICON	5 [3]	0	1:5:5	1.8	1.8	1.0	SW06
SILVER	0	0	5:5:5	0.004	0.075	0.049	SW07
SODIUM	NC	--	5:5:5	12900	13800	13280	SW07
THALLIUM	8	0	5:5:5	0.075	0.11	0.09	SW07
VANADIUM	14	0	5:5:5	9.3	12.5	10.94	SW07
ZINC	73 [1]	0	5:5:5	31.0	40.9	35.5	SW05
VOCs							
ACETONE	NC	--	5:5:5	1.9	3.6	2.7	SW07
TOLUENE	100	0	3:3:5	0.33	0.43	0.40	SW03, SW04

FOD - Frequency of Detection, Number of detected samples; Number of samples used to calculate statistics; Number of total samples.

Criteria Source:

NYSDEC 1998. New York State Ambient Water Quality Standards and Guidance Values.

Notes:

1 - Criterion adjusted to mean hardness concentration of 86.1 mg/L.

2 - Manganese criterion available for Acute only.

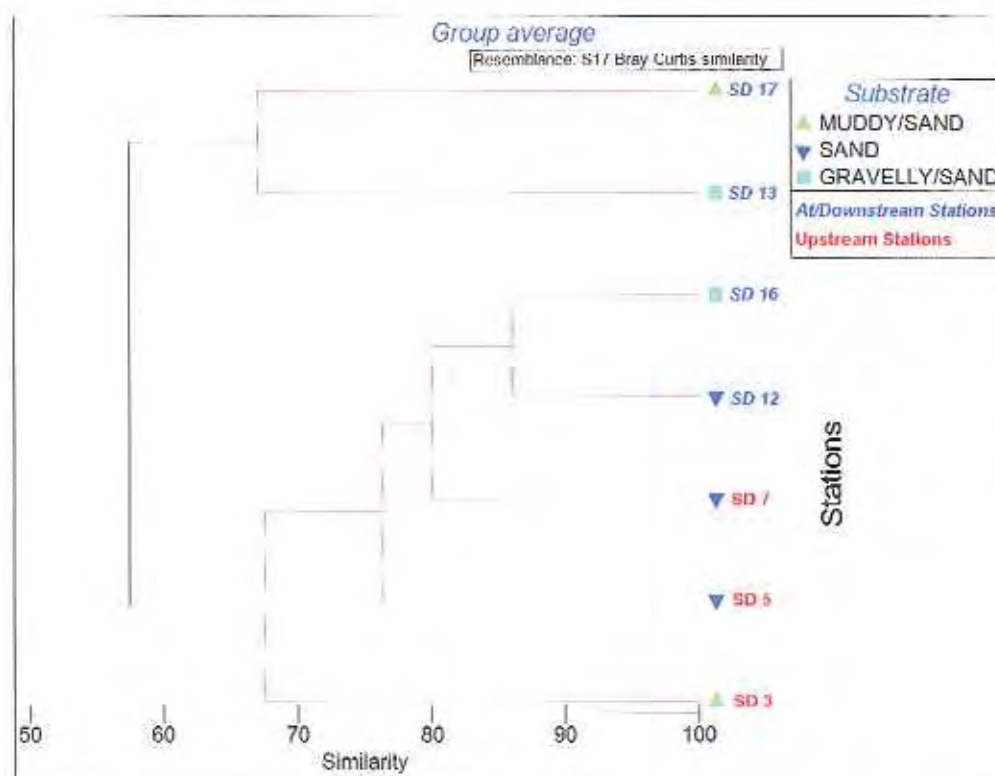
3 - Criterion available for dissolved phase only.

NC = No NYSDEC Criteria

Shaded cell indicates screening value exceedance.

Only detected compounds within each reach are presented.

Figure 7-1 Benthic Macroinvertebrate Community Similarity Analysis



Notes: Bray Curtis similarity values of taxa from Upstream samples SD-3, SD-5, and SD-7 and Adjacent/Downstream samples SD-12, SD-13, SD-16, and SD-17. See Appendix E for additional details.

8.0 Conceptual Site Model

A preliminary CSM was presented in the work plan (ENSR, 2005) and is summarized briefly in Section 2.13. The sediment investigation was designed to address the data gaps and refine the CSM for the Hudson River adjacent to the Site.

The OU-2 CSM describes the origin (sources) of COPCs, as well as potential transport pathways, exposure pathways, and receptors. This CSM is presented as a series of working hypotheses considering how chemical stressors in the river might interact with human and ecological receptors within the Study Area (Figure 8-1).

8.1 Primary Sources of Compounds in the River

The long history of industrial use in the vicinity of the Site has resulted in elevated levels of compounds in sediment in the river. This section describes: (1) potential Site-related sources of sediment-associated compounds; (2) potential near-Site sources of compounds other than the Site (i.e., storm sewers); and (3) potential anthropogenic sources of compounds in this urban system other than the Site (e.g., urban background sources of sediment-associated compounds).

8.1.1 Site Primary Sources

Several primary sources of compounds historically existed at the Site.

8.1.1.1 Production Sewers

As part of an earlier phase of work (Roux, 2004b), historical maps and records were reviewed to identify all outfall locations to determine selection of river sediment sampling stations. Through this program, two inactive outfalls to the Hudson River in the vicinity of the Site were identified (see Figure 1-3). These outfalls were former production sewers located in the northern part of the Lagoon Area.

The two inactive production outfalls related to past Site operations were used until 1975, when the North and South Lagoons were constructed and the effluent from the GAF and Sterling wastewater treatment plants were discharged to the lagoons. One of the outfalls is an abandoned 30-inch tile sewer that was used before lagoon construction, and the other is a 30-inch diameter cast iron temporary effluent line that was apparently used only during lagoon construction. The abandoned 30-inch tile sewer was also used by Sterling a prior owner of the Albany Molecular Research site.

The active Town of East Greenbush and City of Rensselaer storm sewers described below in Section 8.1.2 are not related to past Site operations, but the bedding surrounding these sewers was identified during earlier investigations as a potential migration route for dissolved VOCs in groundwater.

8.1.1.2 Overland Flow

It is possible that, prior to the upland (OU-1) remediation, overland runoff could have carried soils from the Site into the Hudson River. However, all industrial operations were conducted inside buildings, the majority of the Site is covered with buildings, roadways and parking structures, and the on-Site landfill was closed – with a soil cover – in 1982. Therefore, there was little opportunity for surface water transport of Site-related compounds; this potential pathway would not be expected to continue to contribute to current risk in the Hudson River.

8.1.1.3 Groundwater

Groundwater generally flows across the Site from east to west, toward the Hudson River. During the OU-1 investigation, observed perturbations in this pattern were assumed to be the influence of subsurface sewers. In the vicinity of the sewers, groundwater flow is toward the sewers, and potentially discharges to the bedding of the utilities.

To the north of the Site, water level measurements indicated that an east-west groundwater divide runs through the center of the Albany Molecular property. South of this divide, groundwater flows towards the sewers on the BASF Site. Groundwater level data indicated that groundwater from both the Albany Molecular property and the BASF Site discharge to the bedding of the Site sanitary sewer and subsequently to the bedding of the Town of East Greenbush and City of Rensselaer storm sewers. A steel bulkhead runs the length of the Site along the shoreline. This bulkhead is driven into underlying silt and clay, and likely prevents on-Site groundwater from seeping into the river.

Based on observations made during the OU-1 and OU-2 investigations, the relatively low transmissivity of the saturated fill, fluctuating tidal levels (i.e., minimal net flux toward the river) and the presence of the bulkhead preclude Site groundwater as a significant source of contaminants to the Hudson River. VOCs have not been detected significantly in groundwater beneath the Lagoon Area, which is adjacent to the river. The only compound present in high concentrations in groundwater beneath the Lagoon Area was arsenic, which was not observed in high concentrations in the river sediment immediately adjacent to the Site.

Moreover, the Site has an operational perimeter groundwater containment system that is currently preventing any ongoing discharge of Site-related compounds to the river.

8.1.2 Near-Site Storm Sewers

As part of an earlier phase of work (Roux, 2004b), historical maps and records were reviewed to identify all outfall locations to determine selection of river sediment sampling locations. Through this program, BASF identified the following storm sewer outfalls to the Hudson River in the vicinity of the Site (see Figure 1-3).

- One inactive 8-inch cast iron sewer in the northern part of the Lagoon Area, probably related to storm water;
- The Town of East Greenbush Storm Sewer; and
- The City of Rensselaer Storm Sewer.

The Town of East Greenbush and City of Rensselaer storm sewers are currently active and may serve as an ongoing source of urban compounds. The City of Rensselaer storm sewer originates east of the Site's Main Plant, and may represent a conduit for compounds originating east of the Site to be transported to the Hudson River. These storm sewers may contribute "urban background" compounds (e.g., metals) to the river.

8.1.3 Urban River Anthropogenic Contributions

It is generally recognized that elevated concentrations of various inorganic and organic compounds are ubiquitous in freshwater and marine sediments throughout the nation's urban aquatic systems. Some of the more common sources of anthropogenic pollution in rivers include urban and agricultural wastes, which can contain heavy metals and other trace elements, pesticides and herbicides, fertilizers, hydrocarbons, organic materials, sediments, and numerous artificial compounds (Hynes 1960; Cole 1994). The amount of anthropogenic pollution entering water bodies has sharply increased in the last two centuries as a result of the industrial revolution (Cole 1994) and the associated burning of fossil fuels. Rivers draining urban areas, where industry and human populations are often concentrated, receive large volumes of anthropogenic pollution through runoff, atmospheric deposition, spills, and discharge of industrial wastes. Anthropogenic pollutants in rivers are eventually deposited in fine-grained, depositional sediments such as clay and silt. Both clay and silt

have enormous surface areas and a slight electrical charge, two properties which attract and bind many pollutants. The deposition of pollution-containing sediments over time forms a "sink" of pollutants in depositional areas of rivers. It is now recognized that the sediments in urban rivers are typically contaminated to varying degrees, depending on location, by a host of pollutants. Contamination is so ubiquitous in urban rivers that it has been accepted that urban background, or baseline, is represented by some state of contamination, rather than pristine (Stout et al., 2004).

As summarized in Section 2, many of the inorganic compounds under evaluation in this sediment investigation are present in Hudson River sediment due to a variety of historic and current activities. These sources include releases and discharges from industry, the surrounding urban community, and recreational and commercial activities on the Hudson River. Other potential sources of contaminants include overland runoff from land surfaces, roadways, parking lots, roofs and structures, and snow melt. In addition, there may be instream sources of contaminants associated with maintenance and operation of boats, marinas, and wooden structures in the river. Many of these potential sources are likely to have affected sediment quality in the sampling reaches evaluated in this investigation.

Contaminants from a multitude of sources can migrate to the Hudson River surface water and sediments by direct discharge, overland runoff, bank erosion, and groundwater migration. In the Albany area, a number of factors, including discharges from contaminated environmental sites, urban runoff, atmospheric deposition, inadvertent spills, and combined sewer overflows (CSOs) have contributed fine-grained sediment, inorganic, and organic compounds to the upper Hudson River over the past hundred years.

It is a common and significant quality of these background sources that they can be multiple, intermittent, relatively low level, and diffuse. For this reason, it is often impossible to identify a specific source or sources contributing to anthropogenic background conditions but, instead, it is often necessary to evaluate their cumulative impact by characterization of an appropriate and relevant "background" or upstream "reference" location.

8.2 Secondary Sources of Compounds

Once chemical stressors have been discharged or released to the river from the primary source(s), deposition in the bedded sediment (surficial and sub-surficial) may occur. Section 2 of this Report describes in detail the complex hydrogeologic and geomorphological conditions of the river in the vicinity of the Site which may affect sediment transport and stability in the nearshore environment. In addition, the re-suspension of deposited compounds from the sediments into the water column represents a potential secondary source of compounds.

Existing compound concentrations in sediments at and adjacent to the Site were evaluated in the context of five study areas: Upstream, Adjacent Nearshore, Adjacent Far Field, Upper Navigational Channel, and Downstream. Each of these study areas is discussed in detail in Section 8.2.1 (Distribution of VOCs) and Section 8.2.2. (Distribution of Metals).

As indicated by the sub-bottom surveys and the sediment grain size analyses (see Sections 2 and 4), sediments downstream of the Site and along the eastern bank of the Hudson River, including those within the Adjacent Nearshore reach and the Upper Navigational Channel, are dominated by depositional materials. In the Adjacent Far Field and the central channel in the Upstream area, observed sands indicated an erosional or non-depositional area. In depositional areas (e.g., the Adjacent Nearshore area), potentially impacted sediments have been buried since their original deposition, and in many locations appear to remain below the surface sediments, and are therefore likely not readily available for resuspension. Nonetheless, there may be hydrodynamic or bioturbation conditions that destabilize these depositional areas, potentially introducing these buried sub-surficial materials, as a secondary source into the water column and/or the surficial sediment.

Water column samples indicated that compounds in the water column are largely non-detect and/or consistent with background or upstream conditions. This suggests that re-suspension of particulate phase sediment and partitioning between sediment and surface water may not be major concerns at the Site.

8.2.1 Distribution of VOCs

The VOCs of potential concern are localized in the Adjacent Nearshore area, adjacent to the Site and apparently concentrated around the outfalls (both the historic Site outfalls and the active municipal outfalls).

The concentrations of VOCs were highest adjacent to the Site within the muddy sand near the historic outfalls. The sediment chemistry at the five outfalls is not entirely consistent, suggesting that several temporal or spatial primary sources may have contributed.

VOC concentrations are variable in the sediments, both horizontally and vertically. A sharp transition exists between cleaner coarse-grained sediments in the Adjacent Far Field and Adjacent Nearshore muddy sands relative to VOC concentrations. Downstream transport of VOCs as well as transport to the west (across-river transport) appears to be very limited. The band of potentially-impacted Adjacent Nearshore muddy sand extends from 90 to 185 linear ft west of the Site bulkhead prior to transitioning to coarser-grained material in the Adjacent Far Field. Outside of the depositional sediments adjacent to the Site, VOC concentrations were lower or not detected. In general, higher VOC concentrations were observed in the sub-surficial sediments with some of the highest concentrations in the 4 to 6 ft horizon (e.g., samples SD089 and SD106).

Several cross-sections were prepared in order to help understand the relationship between sub-surficial stratigraphy and VOC concentrations in the Adjacent Nearshore environment. Figure 8-2 presents an index to these cross-sections, and Figures 8-3, 8-4, 8-5, and 8-6 represent the specific cross-sections. The VOC data presented in the cross-sections were organic carbon-normalized using sample-specific TOC data. Samples collected from SD087 and SD096 did not have sample-specific TOC data so the TOC level was conservatively assumed to be 1% in these samples.

These cross-sections indicate that the sediment in the Adjacent Nearshore environment is relatively consistent fine-grained material, with some clay and silty clay at depth, and even coarser grained materials in some areas. A review of these cross-sections indicates that the horizontal extent of VOC-impacted sediments is generally well-delineated, and that the VOC-impacted sediments are primarily an Adjacent Nearshore phenomenon, primarily in the muddy sand immediately to the west of the Site bulkhead. However, the deepest sediment deposits in several areas of the Adjacent Nearshore environment are impacted and while the vertical extent of VOC-impacted sediment has largely been delineated in this study, there are several areas where a potential data gap exists relative to the extent of VOCs in the deeper sediment horizons.

8.2.2 Distribution of Metals

The distribution of metals throughout the Study Area is variable. Metals concentrations appear to be highest in the Adjacent Nearshore and the Upper Navigational Channel areas; however a fairly strong correlation between metals, sediment type, and TOC is apparent, which may account for some of the observed variation. Comparison with other metals concentrations observed throughout the Hudson River Basin (e.g., NYSDEC, 2000; Wall et al., 1998) generally indicates that the concentrations observed near the Site could be typical of urban ambient concentrations.

In the Upstream reach, metals occur in surficial sediments at concentrations typical of urban/industrial areas (e.g., watershed sediment samples presented in Table 2-2), and at times occur at concentrations in excess of NYSDEC guidelines (see screening in Table 7-1). In the immediate vicinity of the Site, concentrations are elevated relative to the main channel and exceed NYSDEC guidelines.

The areas of higher concentrations correspond to depositional sediments (i.e., muddy sand) with finer grain sizes. The highest concentrations also correspond with the locations of historic outfalls; in general, more elevated concentrations are found in deeper strata, rather than in surficial sediment samples. In addition to the vertical trends, there is considerable horizontal variability in concentrations of several metals. It is possible that some of the observed heterogeneity is related to factors such as TOC and/or grain size. The western extent of potentially Site-associated inorganic compounds in sediments is clearly marked by the interface with the sandier substrate in the Adjacent Far Field where inorganic compounds were either not detected or were consistent with background samples in the Upstream reach.

Elevated levels of metals are apparent in the vicinity of several sampling stations within the Upper Navigational Channel, immediately downstream of the southerly Site outfall owned by the City of Rensselaer. Although it is possible that metals in the Upper Navigational Channel originated at the Site, this area represents the northern extent of navigational dredging, and these sampling locations are associated with a dramatic change in riverine bathymetry (see Figure 2-2) as well as increases in sediment TOC and decreases in grain size, all consistent with a depositional zone. Therefore, it is unclear if the moderately elevated levels of inorganic compounds present in this area are related to the Site or are potentially associated with a change in sediment texture associated with the dredge-related depositional zone immediately downstream from the Site.

Metals concentrations appear to be highest adjacent to and slightly downstream of the Site (i.e., proximity to the Site appears to be related to increased metals concentrations); however, a fairly strong relationship between metals and sediment type is apparent, which may also account for some of the observed spatial variation in metals concentrations. As depicted in Figure 8-7, grain size (as represented by the percent fines data) and TOC appear to relate well with one-another (that is, sediments with higher TOC tend to be finer grained). Furthermore, the data tend to cluster according to the relative reach of the river evaluated. For instance, as depicted in Figure 8-7, virtually all of the Upstream and Adjacent Far Field data are located in the lower left hand portion of the chart, indicating that both the TOC concentration and the grain size fractions are at the lower end of the evaluated range (i.e., the Upstream and Adjacent Far Field data sets are dominated by coarser grained sediment relative to the other data sets). Conversely, much of the Adjacent Nearshore data are located in the upper right hand portion of the chart, indicating that the Adjacent Nearshore environment is characterized by higher TOC and finer grain size.

The evaluation of the distribution of metals is complicated by the apparent different origins of the fine-grained depositional sediments. Adjacent to the Site, a review of the data suggests that the sediment is depositional in origin, and contains elevated levels of several inorganic compounds which may reflect decades of urban deposition. While some of these same compounds were also observed in the fine-grained sediments upstream of the Site (at the reference area), based on field observations, it is likely that these upstream sediments are at least partially derived from more recent bank failure, which has resulted in slumping of the earthen bank into the nearshore environment. This difference in origin may contribute to contrasting physical properties (e.g., percent fines, TOC) as well as variations in metals concentrations.

To further evaluate the potential influence of grain size on metals concentrations, an evaluation of total metals toxic units (TU) relative to grain size was conducted. For this evaluation, the following 11 inorganic compounds with NYSDEC low effect screening values were evaluated in surficial sediment: antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, silver, zinc. A metal TU was defined as the ratio of an individual metal concentration to its NYSDEC low effect sediment screening value. On a sampling-station-by-sampling-station basis, the individual metal TUs were summed, and then divided by the number of individual metals considered in the analysis to obtain a mean TU per sampling station (Table 8-1). Mean TUs were plotted relative to percent fines (Figure 8-8). Although this evaluation does not show a high degree of correlation between percent fines and TUs (largely due to the relatively low overall mean TUs in the data set), the distribution of metals was found to be largely related to the sediment grain size, with higher levels of percent fines frequently corresponding to higher mean TUs. Furthermore, a relative lack of differences was observed between Upstream, Adjacent Far Field, and Downstream reaches of the river. Much of these data

sets are clustered together, and contrast with the Adjacent Nearshore and Upper Navigational Channel sampling stations, which have higher levels of percent fines and slightly higher mean TUs.

These results indicate that the distribution of inorganic compounds in the sediment are likely a function of grain size distribution and other geophysical properties of the river, as well as proximity to the Site. The most elevated levels appear to be generally limited to the more depositional areas where grain size is finer (i.e., the muddy sand areas) adjacent to and immediately downstream of the Site. It is possible that some of the inorganic compound concentrations in the Adjacent Nearshore area and the Upper Navigational Channel are elevated due to the potential influence of historic Site activities. Metals enrichment in the Upper Navigational Channel may be associated, at least in part, with the relative metals enrichment associated with the changes in bathymetry that have led to deposition of fine-grained sediments.

8.3 Summary of Primary and Secondary Sources

A review of the sediment data collected in the recent investigation supports earlier observations and conclusions concerning potential sources of compounds. Based on location and distribution, there is evidence to suggest that the VOCs observed in sediment adjacent to the Site originated at the Site. Available data presented in this Report suggests that the presence of VOCs in sediment in the Adjacent Nearshore environment is likely the result of historic Site discharges, rather than a groundwater discharge or overland runoff. The inorganic compounds found adjacent to the Site are similar in makeup to those found in the on-Site lagoons and landfill, which suggests that at least some of the metals located in the sediments adjacent to the Site may have historically been released from the Site. In addition, it is likely that some portion of the inorganic compounds adjacent to the Site may reflect urban anthropogenic background conditions in the river.

Evaluation of data collected in this sediment investigation did not suggest any primary compound sources that were previously unidentified. Additionally, it was not possible to identify from the data if all compounds found in the Adjacent Nearshore environment and in the Upper Navigational Channel originated from the Site, or if they originated upstream from other anthropogenic sources. Much of the Adjacent Nearshore area is depositional or non-erosional, evidenced by fine-grained sediments. This area has likely been receiving sediments over a long period of time, which may contain compounds originating from other sources, consistent with sediment contamination found in urban environments.

Given the magnitude of water and sediment discharge in the river and the relatively low flux of groundwater and surface runoff from the Site, it is anticipated that any Site-related effects should be relatively localized. Few Site-related solids are likely to deposit in the relatively fast water of the main river channel; they are likely to have deposited only in the relatively quiet water along the margins of the river. These predictions are illustrated by the pattern of sediment type deposited in the various portions of the river as well as the restriction of Site-related VOCs to the depositional sediments adjacent to the shoreline.

8.4 Compound Transport Mechanisms

Compound transport can occur via a number of mechanisms, some responsible for the introduction of compounds into the river (e.g., runoff, bank erosion, and groundwater transport) and others that move compounds once in the river (e.g., bed erosion, surface water transport, bioturbation and food chain accumulation). Based on review of historical and recent data, and as described above, runoff, bank erosion and groundwater transport are not currently significant mechanisms for compound transport from the Site to the river.

Within the river, compounds are likely to move with the sediments if the sediments become resuspended (rather than dissolved in the water column). Concentrations of contaminants in sediments have often been observed to be closely correlated to sediment type and sediment organic carbon content (Michelson and Bragdon-Cook, 1993). Organic contaminants, such as VOCs and polycyclic aromatic hydrocarbons (PAHs) are hydrophobic, and have limited solubility in water, but preferentially partition to oils, fats, non-polar organic

solvents and organic material in sediments (Hemond and Fechner, 1994). The toxicity of organic contaminants has also been correlated to organic carbon fraction of sediments, while it is poorly correlated to overall dry weight concentration. Because hydrophobic organic contaminants are well correlated to organic content, sediment concentrations of these contaminants are often normalized to organic carbon content. Normalization to organic carbon can help discern patterns in chemical concentrations when sediments with varying physical properties are present.

Metals do not partition as strongly to organic material as hydrophobic organic compounds. However, the covariance of many inorganic compounds to sediment grain size has been well documented and is generally accepted by the scientific community (Klamer et al., 1990, SSC, 2003, Dshalakis and O'Connor, 1995). Coarse-grained sediments tend to have lower metals concentrations due to relatively low surface area available for metals sorption. Conversely, many compounds will tend to sorb to fine-grained sediment particles (Power and Chapman, 1992; USEPA, 2001a). Additionally, when weathering breaks down minerals into clay particles, this fine fraction has higher metals concentrations in mineral matrices associated with naturally occurring background concentrations. The state of Wisconsin Department of Natural Resources (WDNR) recently published guidance for sediment quality guidelines (WDNR, 2003) which integrates the effects of grain size on the distribution of metals.

While a significant amount of sediment transport occurs in the Study Area, evidence suggests little net deposition and scour beyond the immediate vicinity of the Site bulkhead (Adjacent Nearshore area). Observed downstream velocities (0.85 to 2.0 ft/s) are indicative of an erosional regime for sand grain size (>0.1 mm) (Graf, 1971), suggesting that sediments move through the river reach in the vicinity of the Site (rather than being eroded from or deposited on the reach bed). Along the shoreline of the river there is evidence of at least periodic deposition, both from the eddies in the flow and possibly from episodic landslide events. These data suggest that there is not significant ongoing transport of the buried sediments from the Adjacent Nearshore area.

The flows in the Hudson River are generally dominated by tidal influence, with a four-foot tidal range at the Site, 148 miles upriver from the mouth. Net flow is in the downstream direction the majority of the time, with periodic flow reversals, depending on the tide and the freshwater inflow. A hydrographic survey at the Site (ENSR, 2001) indicated upstream flow for less than one hour during a 12-hour tidal cycle, with upstream flow velocities lower than those observed in the downstream direction over the survey. During this survey, when freshwater inflow was above average, the upstream tidal excursion was approximately 0.6 miles. Although this survey represents only one set of flow conditions, flows are predominantly in the downstream direction and the maximum upstream excursion under certain flow conditions is likely on the order of one to two miles and peak downstream velocities are generally always higher than upstream velocities. Because of the dominance of downstream flows, and the higher downstream flow velocities, it is likely that there is little, if any, sediment transport in the upstream direction.

The evaluation of surface water indicates that very little dissolved phase transport of potentially Site-related compounds is occurring from the Site. With the exception of two relatively common laboratory contaminants, no VOCs were detected in surface water samples collected in the water column immediately adjacent to the Site and overlying some of the most VOC-impacted sediment. Dissolved phase metal concentrations in the water column (as well as concentrations of total recoverable metals) were generally consistent with upstream conditions.

The biological processes which may potentially affect the fate and transport of compounds from near-site environments are highly variable and likely somewhat site-specific (USEPA, 2005). For instance, biodegradation of organic compounds, which is facilitated by both aerobic and anaerobic microorganisms living in the sediment environment, may be a factor governing VOC dynamics at this Site. Biodegradation typically is most prevalent in surficial sediments, but may also occur in the sub-surficial, depending upon site-specific conditions. Aging of compounds in sediment (i.e., longer residence time) may also limit biodegradation by reducing the availability of compounds to microorganisms (Luthy et al., 1997). This

phenomenon may also limit or reduce the bioavailability of the chemical stressors to other receptors in contact with the sediment, as well as to higher trophic level receptors (USEPA, 2005). Given the elevated concentrations of VOCs and the historic nature of the discharge, it is unlikely that biodegradation plays a significant role in overall mass reduction of compounds in the near-site environment.

In many quiescent systems, bioturbation is one of the primary factors affecting sediment stability (USEPA, 2005). Many bottom feeding organisms physically move sediment during feeding, locomotion, nesting, and shelter building; however, with regard to sediment stability analysis, the most significant concern is "mixing zone" movement of sediment in the top 5 to 15 cm. Although bioturbation has the potential to be a significant factor affecting nearshore Hudson River sediment stability, the results of the macroinvertebrate surveys suggest that the macroinvertebrate community in the river upstream and adjacent to the Site is limited; in fact, the majority of organisms found in Hudson River sediment (worms and oligochaetes) typically only bioturbate the top 2 to 3 cm of sediment (USEPA, 2005). Given the site-specific knowledge of the biological community, it is unlikely that bioturbation will play a major role in modifying sediment stability in the Hudson River at or near the Site.

The potential for food chain accumulation of chemical stressors in the vicinity of the Site is discussed further in the following two sections.

8.5 Human Receptors and Exposure Pathways

As described in the HHRA (Appendix H), potential human exposure to sediment at the Site is expected to be minimal, given the limited access to the Site and the adjacent sediments. Sediments adjacent to the Site are submerged beneath at least five or more ft of water. Boring logs from the sampling program show five to nine ft of water overlying samples collected closest to the shoreline, and the visual observations from the field program indicate that significant rubble (e.g., old pilings) is present in the immediate vicinity of the Site. Given the fast-moving water and use of the river for commercial ship traffic, recreational swimming is unlikely to occur within this reach of the Hudson River, and the water depth likely precludes any potential wading exposure scenarios. Therefore, the potential for human exposure to surface water and sediments is minimal.

In the unlikely event that someone did contact surficial sediments adjacent to the Site, such limited exposure is not expected to pose an unacceptable risk to human health. The HHRA presented in Section 6 conservatively evaluated potential exposures to COPC in surface water and sediment. The evaluation of the surface water pathway also included a comparison to surface water quality criteria derived to be protective of potential fish consumption.

The results of the HHRA analysis indicate that there is no potential current risk to human health due to exposure to sediment or surface water adjacent to the Site. While concentrations of several of the Site-related VOCs in individual surficial sediment samples exceed the screening benchmarks considered in the HHRA, many of the sediment samples do not contain concentrations of any compounds in excess of these benchmarks. Adjacent surface water concentrations were generally similar to upstream concentrations.

Ultimately, it is extremely unlikely that exposure to sediments poses a threat to human health, and it is unlikely that humans would come into contact with Hudson River sediments in the vicinity of the Site.

8.6 Ecological Receptors and Exposure Pathways

The biological resources of the Hudson River have been studied by a variety of government agencies, industries, academic institutions, and interest groups. The information presented in the following sub-sections summarizes some of the data currently available to describe aquatic vegetation, fish, and benthic communities within the Hudson River adjacent to the Site.

8.6.1 Aquatic Vegetation

Submerged aquatic vegetation has been mapped in a joint effort by NYSDEC, Cornell University, the Institute for Ecosystem Studies, New York SeaGrant, and others. Beds of vegetation were identified and mapped using true color aerial photographs from 1997 (NYSDEC, 2000b), then large-scale maps were created, and data verified with sampling and visual observation vegetation. According to this study, submerged aquatic vegetation beds in the vicinity of the Site tend to be limited, and are dominated by water celery (*Vallisneria spiralis*). Lesser amounts of pondweed (*Potamogeton* sp.) are also found throughout the beds. Distribution of plants is light-limited, with the highest abundance in water less than 3 ft deep at low-tide (NYSDEC, 2000b). The area where water depth is less than 3 ft at low tide is very limited adjacent to the Site, thus limiting the development of submerged aquatic vegetation.

Little to no submerged aquatic vegetation was observed in the vicinity of the Site during the OU-2 field investigation, and it is likely that the geometry of the river in this region precludes development of such a community. Therefore, aquatic vegetation exposure pathways are assumed to be incomplete.

8.6.2 Fish Community

The Hudson River in the vicinity of the Site is designated as a Class C water. NYSDEC regulations indicate that the best usage of Class C waters is fishing and that Class C waters shall be suitable for fish propagation and survival, as well as primary and secondary contact recreation.

Due to the tidal nature of the Hudson River adjacent to the Site, the fish community is composed of estuarine species, diadromous species (those that migrate from the sea), and a few euryhaline species (those able to travel between freshwater and saltwater environments) (Odum, 1971). Additional detail regarding the Hudson River fish community is presented in Section 2 of this Report.

As discussed in the ERA (Appendix I), surface water is not a medium of concern at this Site, and therefore exposure pathways to fish are likely to be incomplete for the following reasons: (1) inorganic compounds occur at similar concentrations within the Upstream and Adjacent Nearshore reaches, and there is no indication that potential risk from these compounds is related to the Site; (2) with the exception of two likely non-Site-related laboratory contaminants (acetone and toluene), VOCs were non-detect in all surface water samples.

Non-aqueous exposure (e.g., bioaccumulation in fish) is not likely to be important for compounds like VOCs with low hydrophobicity ($\log_{10}K_{ow}$ values less than 4) (USEPA, 2003). However, based on the current evaluation, there is some uncertainty as to whether compounds in sediment are likely to bioaccumulate into bottom-feeding fish that may disturb the sediment surface and feed on benthic organisms.

8.6.3 Vertebrate Wildlife

Although upper trophic level species, including predatory and piscivorous avian and mammalian receptors, have the potential to be exposed to compounds in surficial sediments in the Study Area through food chain uptake and incidental ingestion of surface water and/or sediment, these exposure pathways are assumed to be largely incomplete for the following reasons:

- The Site and the immediate vicinity of the Site are heavily urbanized. The bank at the Site is armored and the complete lack of any palustrine wetland or floodplain corridor for wading birds or predatory mammals to forage in likely precludes any significant use of the Site by these receptors.
- As described above, surface water is not a medium of concern at this Site and therefore surface water exposure pathways are assumed to be incomplete. Inorganic compounds occur at similar concentrations within the Upstream and Adjacent Nearshore reaches, and there is no indication that potential risk from these compounds is related to the Site. With the exception of two likely non-Site-related laboratory contaminants (acetone and toluene), VOCs were non-detect in all surface water

samples. Neither of these compounds is likely Site-related, and neither is classified as a Persistent Bioaccumulative and Toxic (PBT) chemical by USEPA under its PBT program (www.epa.gov/pbt).

- Dermal contact and incidental ingestion by wildlife of potentially impacted sediment is very unlikely. Access to the sediments in the vicinity of the Site is very limited due to the metal bulkhead that forms the shoreline between the Site and the river. The water adjacent to the Site is too deep for wading so sediment exposure by wading birds such as herons and egrets would not be likely. The surficial sediments are under at least 5 to 6 ft of water and the more contaminated deeper sediments are located 2 to 8 ft below the sediment surface. Therefore, contact with contaminated sediments is highly unlikely by any vertebrate receptors.
- Although piscivorous avifauna such as kingfishers and osprey may occasionally forage in the vicinity of the Site, piscivorous exposure pathways are largely incomplete because: (1) the urban nature of the Nearshore area likely precludes significant foraging activity; (2) the footprint of the potentially impacted Nearshore area is finite and likely would serve as only a small fraction of the foraging area of any piscivorous wildlife; and (3) with the exception of mercury, none of the potentially Site-related compounds evaluated in this Site investigation are classified as PBT chemicals by USEPA under its PBT program (www.epa.gov/pbt). Concentrations of mercury in the surficial sediments in the vicinity of the Site were generally low (the 95th upper confidence limit (UCL) in the Adjacent Nearshore area was approximately 0.5 mg/kg).

8.6.4 Benthic Community

Based on the elevated levels of potentially Site-related compounds in surficial sediments (especially in the Adjacent Nearshore area), it is assumed that potential benthic macroinvertebrate exposure pathways are complete.

The benthic macroinvertebrate community associated with the Hudson River near the Site was investigated in 2001 (ENSR, 2001) and as part of the current OU-2 investigation. The results of these investigations, as well as literature-reviewed studies such as work conducted by Simpson et al. (1986) indicate that the benthic community in the reach nearest the Site is generally dominated by oligochaetes (primarily tubificid worms) and chironomid midge larvae. The results of qualitative sampling of the benthic macroinvertebrate community near the Site document a community dominated primarily by oligochaetes and chironomids. These results are typical for benthic communities in a large river system. Based on the available data, the benthic community in the Hudson River near the Site is characterized by low diversity.

A review of the existing data presented in the ERA (Appendix I) suggests that no relationship exists between proximity to the Site and a decrease in macroinvertebrate community fitness, and likewise, no relationship between increased VOC and/or inorganic compound concentrations and a decrease in macroinvertebrate community fitness. Similarity analyses indicate that the differences (in terms of taxa observed, diversity, abundance, and habitat) observed upstream, adjacent to, and downstream of the Site were minimal and not significant.

8.7 CSM Update Summary

The recently completed sediment investigation was designed in part to address data gaps identified in the preliminary CSM, which was developed from previously collected data and presented in the Work Plan (ENSR, 2005). An analysis of the newly collected data generally supports the preliminary CSM, confirming and refining the distribution of metals and VOCs, and supporting the earlier observation that grain size, which is highly variable in the vicinity of the Site, strongly impacts the concentration distribution of the compounds. The additional sediment data allows for the following refinements to the preliminary CSM:

- The geophysical survey generally confirms (and refines) the grain size distribution throughout the Study Area.

- The nature and extent of potentially VOC-impacted sediment is more completely characterized, and well delineated along most of the Site, with the possible exception of the deeper sediment horizons at the southern end of the Adjacent Nearshore area. The available data suggest a historic discharge of VOCs, rather than a diffuse or ongoing source. The VOCs appear to be limited to the muddy sand in the immediate vicinity of the outfalls; no evidence of downstream transport of the VOCs exists.
- Higher inorganic compound concentrations are found in areas of fine-grained sediments indicative of depositional areas, including those adjacent to the Site. The inorganic compounds immediately adjacent to the Site are similar in makeup to those previously observed in upland areas at the Site, suggesting that at least some of the metals may have originated on the Site. Inorganic compound concentrations upstream of and adjacent to the Site (in the Adjacent Far Field) are generally consistent with one-another, suggesting that the Site is not the source of these metals, but rather they are likely indicative of anthropogenic urban background concentrations in the river.
- The source of the metals downstream of the Site, in the depositional Upper Navigational Channel, can not be determined with the existing data. It is possible that some of the detected metals in this area originated at the Site; however, it is possible that some of these metals are representative of anthropogenic background.
- Human exposure pathways to sediment and surface water are largely incomplete. Potential human exposure to sediment at the Site is expected to be minimal, given the limited access to the Site and the adjacent sediments. Surface water is not a medium of concern at this Site and therefore surface water exposure pathways are assumed to be incomplete.
- The majority of potential ecological exposure pathways also appear to be incomplete. However, benthic macroinvertebrate receptors may be exposed to surficial sediments adjacent to the Site. The benthic community in this reach of the river is largely comprised of worms and midge larvae – a review of preliminary data suggests that upstream and near-Site ecological communities are similar, and that neither proximity to the Site nor compound concentrations relate to macroinvertebrate community fitness. However, additional risk analysis is needed in order to better evaluate the potential risks to these receptors associated with exposure to surficial sediments. Based on the current study, there is also some uncertainty as to whether compounds in sediment are likely to bioaccumulate into bottom-feeding fish. In addition, further analysis is required to determine whether re-suspension of sub-surficial sediments could pose a risk to the environment. Lastly, sediments in the 0.5 – 2 ft sediment horizon have not yet been fully characterized.

Table 8-1
Inorganic Toxic Units in Sediment
BASF Corporation
Hudson River CU-2 Investigation
Rensselaer, NY

Analyst Toxic Units	UPSTREAM SD001 Sand 0 - 0.5'	UPSTREAM SD002 Gravelly Sand 0 - 0.5'	UPSTREAM SD004 Sandy Mud 0 - 0.5'	UPSTREAM SD005 Gravelly Sand 0 - 0.5'	UPSTREAM SD006 Muddy Sand 0 - 0.5'	UPSTREAM SD008 Sand 0 - 0.5'	UPSTREAM SD009 Gravelly Sand 0 - 0.5'	UPSTREAM SD010 Sandy Mud 0 - 0.5'	UPSTREAM SD011 Sandy Mud 0 - 0.5'
ANTIMONY	0.04	1.73	0.15	0.05	0.20	0.07	1.64	0.19	0.21
ARSENIC	1.45	0.47	0.52	0.40	0.62	0.27	0.43	0.50	0.50
CADMIUM	0.92	0.48	0.75	1.00	4.50	1.55	0.45	0.82	1.00
COPPER	1.33	0.76	2.14	1.22	3.16	0.97	0.96	1.73	1.73
IRON	1.24	0.90	0.99	0.90	1.33	1.02	0.74	0.94	0.84
LEAD	0.35	0.39	0.98	0.40	2.01	1.00	0.65	1.33	1.63
MANGANESE	1.80	0.59	0.87	0.83	1.06	0.73	0.63	1.44	1.20
MERCURY	0.27	0.27	0.60	0.13	1.87	0.30	0.27	0.47	0.67
NICKEL	1.18	1.09	0.91	1.06	1.45	1.07	0.73	1.09	1.04
SILVER	0.03	0.55	0.11	0.09	0.31	0.05	0.55	0.12	0.18
ZINC	0.70	0.55	0.77	0.54	1.35	0.82	0.52	0.88	0.86
Sum Toxic Units	9.31	7.67	8.78	8.38	17.85	7.67	7.47	10.92	9.84
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	0.85	0.70	0.80	0.59	1.62	0.70	0.68	0.99	0.89
Percent Fines	2.4	1.4	25.6	1.8	50.2	7.3	5.1	14.8	17.5
TOC (mg/kg)	1700	ND	ND	ND	ND	7830	ND	ND	15900

ND = No data available.
*Depth intervals are in Feet.

Average Upstream TU 0.85
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

Table B-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, NY

Analyte Toxic Units	UPSTREAM SD013 Muddy Sand 0 - 0.5	UPSTREAM SD014 Muddy Sand 0 - 0.5	UPSTREAM SD015 Gravelly Sand 0 - 0.5	UPSTREAM SD016 Sand 0 - 0.5	UPSTREAM SD017 Gravelly Sand 0 - 0.5	UPSTREAM SD018 Muddy Sand 0 - 0.5	UPSTREAM SD019 Muddy Sand 0 - 0.5	UPSTREAM SD020 Gravelly Sand 0 - 0.5	UPSTREAM SD021 Gravelly Sand 0 - 0.5
ANTIMONY	2.38	0.17	3.50	0.21	0.01	0.20	2.13	0.02	1.75
ARSENIC	0.67	0.47	0.66	0.23	0.18	0.53	0.85	0.22	0.42
CADMIUM	0.86	0.75	0.90	1.00	0.92	1.83	0.59	0.92	0.48
COPPER	1.94	1.81	1.04	0.73	0.53	2.16	1.57	0.33	0.68
IRON	1.01	1.11	1.48	0.74	0.80	1.39	1.22	0.50	0.85
LEAD	1.80	1.05	0.57	0.87	0.35	1.23	0.91	0.35	0.25
MANGANESE	1.35	1.44	1.03	0.42	0.45	2.10	1.27	0.34	0.70
MERCURY	0.47	0.67	0.80	0.19	0.13	0.87	0.63	0.07	0.27
NICKEL	1.25	1.26	1.89	0.72	0.84	1.43	1.21	0.38	1.11
SILVER	0.80	0.15	0.60	0.04	0.01	0.21	0.70	0.01	0.80
ZINC	1.00	0.82	1.28	0.36	0.44	1.87	0.80	0.27	0.49
Sum Toxic Units	13.00	8.79	13.24	4.97	4.66	13.22	11.88	3.42	7.69
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	1.18	0.89	1.20	0.45	0.42	1.20	1.08	0.31	0.70
Percent Fines	32.4	52.0	9.6	2.4	1.0	53.1	38.8	1.7	1.7
TOC (mg/kg)	ND	ND	1480	ND	555	ND	11970	ND	1460

ND = No data available.

*Depth Intervals are in Feet.

Average Upstream TU 0.86
Average Far Field TU 0.61
Average Nearshore TU 2.89
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

Table B-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River CU-2 Investigation
Rensselaer, NY

Analysis Toxic Units	UPSTREAM SD031 Muddy Sand 0 - 0.5	ADJACENT FAR FIELD SD036 Sand 0 - 0.5	ADJACENT FAR FIELD SD037 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD038 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD039 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD040 Sand 0 - 0.5	ADJACENT FAR FIELD SD041 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD042 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD044 Gravelly Sand 0 - 0.5
ANTIMONY	0.29	0.07	0.01	0.01	0.05	0.04	0.01	0.03	0.01
ARSENIC	0.38	0.24	0.22	0.25	0.77	0.93	0.29	0.13	0.25
CADMIUM	0.55	0.92	0.92	0.92	1.00	1.00	0.83	0.93	0.92
COPPER	2.10	0.82	0.93	0.41	0.69	0.67	1.01	0.56	0.27
IRON	1.09	0.68	0.70	0.75	1.93	0.99	0.89	1.01	0.88
LEAD	1.10	0.34	0.34	0.36	0.39	0.39	0.32	0.34	0.35
MANGANESE	0.64	0.68	0.52	0.53	0.90	0.79	0.54	0.98	0.56
MERCURY	1.07	0.47	0.07	0.13	0.27	0.20	0.07	0.07	0.07
NICKEL	1.08	0.73	0.59	0.89	0.62	0.90	0.86	0.87	0.59
SILVER	0.22	0.03	0.01	0.02	0.01	0.04	0.01	0.01	0.01
ZINC	0.93	0.59	0.37	0.48	0.43	0.59	0.37	0.43	0.36
Sum Toxic Units	9.57	5.39	4.07	4.55	12.04	5.61	4.67	5.04	4.05
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	0.88	0.49	0.37	0.41	1.09	0.53	0.42	0.46	0.37
Percent Fines	51.7	2.2	0.6	0.8	3.0	1.8	1.3	ND	ND
TOC (mg/kg)	ND	ND	ND	1620	ND	ND	538	ND	ND

ND = No data available.
*Depth intervals are in Feet.

Average Upstream TU 0.88
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

Table 8-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River OII-2 Investigation
Rensselaer, NY

Analyte Toxic Units	ADJACENT FAR FIELD SD045 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD046 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD047 Sand 0 - 0.5	ADJACENT FAR FIELD SD048 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD049 Sand 0 - 0.5	ADJACENT FAR FIELD SD050 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD051 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD052 Gravelly Sand 0 - 0.5	ADJACENT FAR FIELD SD053 Gravelly Sand 0 - 0.5
ANTIMONY	0.04	0.06	1.80	0.01	0.04	0.01	0.04	0.05	0.04
ARSENIC	4.58	2.82	0.57	0.22	0.33	0.13	1.60	0.17	0.28
CADMIUM	0.89	0.62	0.50	0.83	0.92	0.88	0.92	1.00	0.83
COPPER	0.65	0.76	0.67	0.53	0.83	0.28	0.69	0.47	0.55
IRON	0.58	1.15	0.74	0.74	0.96	0.63	0.89	0.71	0.75
LEAD	0.34	0.60	0.80	0.32	0.89	0.32	0.34	0.37	0.32
MANGANESE	0.44	0.67	0.68	0.47	0.80	0.25	0.51	0.62	0.43
MERCURY	0.07	15.60	0.13	0.07	0.27	0.13	0.13	0.13	0.20
NICKEL	0.44	0.66	0.73	0.61	1.00	0.53	0.63	0.51	0.66
SILVER	0.31	0.05	0.60	0.01	0.03	0.01	0.04	0.01	0.04
ZINC	0.95	0.55	0.53	0.39	0.72	0.32	0.51	0.44	0.55
Sum Toxic Units	9.63	24.02	7.64	4.19	6.79	3.35	6.41	4.47	4.65
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	0.78	2.16	0.69	0.38	0.62	0.30	0.58	0.41	0.42
Percent Fine	ND	ND	2.4	ND	ND	ND	ND	ND	ND
TCC (mg/kg)	B28	ND	ND	ND	ND	ND	ND	1493	ND

ND = No data available.
*Depth intervals are in Feet.

Average Upstream TU 0.93
Average Far Field TU 0.51
Average Nearshore TU 2.59
Average Upper Navigational Channel TU 2.85
Average Downstream TU 1.53

Table B-1
Inorganic Toxic Units in Surficial Sediment
GASF Corporation
Hudson River DU-2 Investigation
Hesselaer, NY

Analyte Toxic Units	ADJACENT FAR FIELD SD065 Cobble 0 - 0.5	ADJACENT FAR FIELD SD078 Sand 0 - 0.5	ADJACENT NEARSHORE SD032 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD033 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD034 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD035 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD043 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD054 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD058 Muddy Sand 0 - 0.5
ANTIMONY	0.06	0.08	0.41	0.29	0.18	0.49	0.16	0.06	0.12
ARSENIC	0.00	0.37	1.80	1.27	0.60	0.92	0.78	0.36	1.00
CADMIUM	0.92	0.92	4.17	3.63	0.75	14.60	2.50	0.92	0.93
COPPER	0.37	0.89	10.25	3.60	1.88	4.46	2.59	1.18	1.80
IRON	0.70	0.97	1.29	1.15	1.00	1.30	1.12	0.90	1.08
LEAD	0.34	1.20	5.39	2.00	1.07	4.48	0.92	1.08	0.81
MANGANESE	0.46	0.88	0.96	1.27	0.83	1.34	1.25	0.68	1.36
MERCURY	0.07	0.47	14.47	2.67	1.27	6.20	1.89	0.47	0.80
NICKEL	0.63	0.93	1.87	1.36	1.05	1.66	1.29	0.88	1.14
SILVER	0.01	0.04	2.85	0.92	0.32	0.86	0.33	0.11	0.27
ZINC	0.43	0.73	2.27	1.53	1.02	2.06	1.02	0.80	0.87
Sum Toxic Units	3.97	7.46	45.87	19.57	10.07	98.27	13.81	7.59	10.27
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	0.36	0.68	4.17	1.78	0.92	9.48	1.26	0.69	0.93
Percent Fines	1.2	2.5	34.6	51.8	45.3	68.6	ND	ND	ND
TOC (mg/kg)	985	2460	50100	12800	13700	26400	16200	ND	14200

ND = No data available.

*Depth intervals are in Feet.

Average Upstream TU 0.86
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

Table B-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, NY

Analyte Toxic Units	ADJACENT NEARSHORE SD057 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD063 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD059 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD077 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD078 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD080 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD081 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD082 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD083 Muddy Sand 0 - 0.5
ANTIMONY	2.60	0.21	0.27	0.23	0.36	0.26	3.04	3.68	0.26
ARSENIC	1.78	1.10	0.72	2.69	1.53	19.17	1.28	1.19	1.57
CADMIUM	0.73	0.83	9.75	2.25	10.50	2.67	3.38	36.00	2.50
COPPER	1.89	1.95	5.15	2.61	7.81	2.74	7.31	16.44	2.79
IRON	1.25	1.07	1.10	1.35	1.08	1.48	1.48	1.49	1.42
LEAD	0.86	0.85	3.63	1.56	4.81	1.39	2.62	19.98	2.41
MANGANESE	1.48	1.25	0.83	1.36	0.78	1.74	1.62	1.34	1.00
MERCURY	0.73	0.87	4.63	1.57	4.90	1.60	2.30	9.33	7.53
NICKEL	1.53	1.21	1.30	1.45	2.09	1.41	1.66	2.42	1.31
SILVER	0.86	0.81	0.44	0.28	0.85	0.31	1.03	1.23	0.35
ZINC	0.97	0.88	1.75	1.18	2.51	1.27	1.78	5.51	1.16
Sum Toxic Units	14.84	10.36	29.61	16.29	97.11	34.00	27.67	96.59	22.30
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	1.35	0.94	2.69	1.48	8.83	3.09	2.51	8.78	2.03
Percent Excess	87.1	ND	23.7	47.6	58.1	27.1	65.2	56.5	48.6
TOC (ppm)	18200	18500	ND	22800	17700	10000	15600	14400	15400

ND = No data available.
*Depth intervals are in Feet.

Average Upstream TU 0.65
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.85
Average Downstream TU 1.53

Table 2-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, NY

ANALYTE TOXIC UNITS	ADJACENT NEARSHORE SD084 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD085 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD086 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD087 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD088 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD089 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD090 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD091 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD092 Muddy Sand 0 - 0.5
ANTIMONY	0.23	3.78	2.20	3.75	2.73	2.15	2.36	2.20	0.10
ARSENIC	1.08	1.57	1.22	2.87	1.27	1.25	0.88	2.32	0.90
CADMIUM	2.08	40.67	0.61	12.87	7.50	0.59	0.65	2.67	1.00
COPPER	2.80	12.69	2.97	17.94	11.44	3.43	3.21	6.63	1.94
IRON	1.90	1.69	1.08	2.14	1.42	1.19	1.11	1.01	1.07
LEAD	1.18	24.90	0.82	10.38	4.45	0.78	1.20	5.52	0.94
MANGANESE	1.43	1.82	0.94	2.37	1.80	0.85	1.00	0.58	1.02
MERCURY	1.03	15.33	0.67	2.33	4.13	0.73	1.13	10.00	0.87
NICKEL	1.42	2.75	1.16	2.66	1.98	1.12	1.48	1.54	1.23
SILVER	0.58	1.25	0.75	1.25	0.90	0.70	0.80	0.78	0.17
ZINC	1.22	5.42	0.85	3.62	1.43	0.79	1.18	1.96	0.85
Sum Toxic Units	14.37	111.85	13.25	66.78	39.03	13.58	15.10	35.16	9.88
Total Analytes	11	11	11	11	11	11	11	11	11
Average TU	1.31	10.17	1.20	6.07	3.55	1.23	1.37	3.20	0.90
Percent Fines	55.1	61.1	34.9	82.4	76.5	24.3	48.2	18.5	ND
TOC (mg/kg)	14200	48200	8330	ND	97900	5250	ND	15100	10900

ND = No data available.

*Depth intervals are in Feet.

Average Upstream TU 0.86
Average Far Field TU 0.61
Average Nearshore TU 2.38
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.59

Table B-1
Inorganic Toxic Units in Sulfidic Sediment
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, NY

Analyte Toxic Units	ADJACENT NEARSHORE SD003 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD004 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD005 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD006 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD007 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD008 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD009 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD010 Muddy Sand 0 - 0.5
ANTIMONY	2.58	0.22	2.85	2.18	2.83	3.35	2.55	0.09
ARSENIC	1.17	0.62	1.47	0.57	1.17	1.37	0.86	0.42
CADMIUM	3.33	8.00	0.79	0.61	5.89	0.92	0.64	1.50
COPPER	5.95	3.48	2.32	2.48	4.46	2.92	1.81	0.92
IRON	1.10	1.20	1.28	1.21	1.28	1.65	1.00	1.52
LEAD	2.03	2.44	1.24	1.06	3.17	1.33	0.93	1.07
MANGANESE	1.36	1.35	1.69	1.15	1.61	3.46	1.12	0.87
MERCURY	1.80	2.00	0.97	8.00	3.00	1.20	0.93	1.12
NICKEL	1.58	1.98	1.54	1.98	1.70	1.73	1.10	0.53
SILVER	0.85	0.58	0.95	0.75	0.95	1.10	0.75	1.15
ZINC	1.48	1.83	1.27	1.17	1.97	1.40	0.97	0.25
Sunt Toxic Units	23.21	22.50	16.25	20.55	26.17	25.42	12.42	0.94
Total Analyses	11	11	11	11	11	11	11	11
Average TU	2.11	2.06	1.48	1.87	2.56	1.86	1.13	0.81
Percent Fines	49.3	ND	45.4	57.6	17.1	64.1	27.2	22.1
TOC (mg/kg)	ND	15700	14000	ND	23200	ND	8980	7240

ND = No data available.
*Depth intervals are in Feet.

Average Upstream TU 0.86
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.63

Table 8-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River Q1-2 Investigation
Hempstead, NY

Analyte Toxic Units	ADJACENT NEARSHORE SD102 Muddy Sand 0 - 0.5	ADJACENT NEARSHORE SD103 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD011-INV Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD011-INV Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD012 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD061 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD082 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD064 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD065 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD086 Muddy Sand 0 - 0.5
ANTIMONY	0.14	0.18	2.28	2.70	0.15	0.35	0.08	0.01	0.01	0.04
ARSENIC	0.57	0.65	1.27	0.77	0.62	3.17	0.37	0.27	0.27	0.32
CADMIUM	1.87	0.83	3.17	22.00	3.17	8.83	0.82	0.83	0.83	0.92
COPPER	2.51	5.04	4.55	8.05	2.43	14.56	0.88	0.72	0.72	1.12
IRON	1.03	1.27	1.10	1.15	0.86	1.74	0.97	0.89	0.89	0.88
LEAD	1.22	1.35	4.65	8.58	2.58	8.48	0.37	0.34	0.34	1.22
MANGANESE	1.14	1.80	0.67	0.98	0.68	1.46	0.77	0.64	0.64	0.52
MERCURY	0.50	1.13	0.00	8.87	1.83	21.13	4.73	0.53	0.53	0.87
NICKEL	1.29	1.39	1.30	1.89	1.09	2.18	1.01	0.91	0.91	0.84
SILVER	0.23	0.42	0.75	0.90	0.34	2.23	0.18	0.07	0.07	0.25
ZINC	1.12	1.51	2.48	3.48	1.37	4.48	0.75	0.65	0.65	0.73
Sum Toxic Units	11.51	15.87	22.39	58.87	15.31	88.60	11.08	5.88	5.88	7.70
Total Analytes	11	11	11	11	11	11	11	11	11	11
Average TU	1.05	1.44	2.04	5.35	1.39	8.05	1.01	0.53	0.53	0.70
Percent Fines	ND	43.8	28.8	ND	11.0	72.8	9.8	3.9	3.9	8.4
TOC (mg/kg)	12300	19300	7260	ND	7630	ND	6960	ND	ND	6920

ND = No data available.

*Depth Intervals are in Feet.

Average Upstream TU 0.66
Average Far Field TU 0.61
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.85
Average Downstream TU 1.53

Table 8-1
Inorganic Toxic Units in Surficial Sediment
BASF Corporation
Hudson River OU-2 Investigation
Pensacola, NY

Analyte Toxic Units	UPPER NAVIGATIONAL CHANNEL SD067 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD068 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD069 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD070 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD071 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD072 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD073 Muddy Sand 0 - 0.5	UPPER NAVIGATIONAL CHANNEL SD074 Muddy Sand 0 - 0.5
ANTIMONY	0.06	0.42	0.54	0.39	0.32	0.28	0.22	0.05
ARSENIC	0.49	1.20	0.95	1.22	0.87	0.61	0.68	0.43
CADMIUM	1.00	22.50	28.67	14.50	14.50	11.50	11.83	0.83
COPPER	1.48	7.31	7.81	7.81	5.83	3.50	4.01	1.81
IRON	0.87	1.36	1.25	1.31	1.20	1.08	0.90	0.67
LEAD	1.31	7.39	7.86	7.84	5.87	4.08	4.42	1.26
MANGANESE	0.70	1.18	1.00	1.08	1.13	0.86	0.88	0.43
MERCURY	1.20	7.53	8.35	8.07	4.73	3.30	3.80	0.60
NICKEL	0.97	1.84	1.71	1.71	1.86	1.31	1.28	0.73
SILVER	0.31	1.95	1.22	1.46	0.86	0.81	0.85	0.28
ZINC	0.99	3.10	3.19	3.55	2.41	1.86	1.81	0.78
Sum Toxic Units	8.45	55.28	62.33	45.83	39.57	28.78	30.23	7.87
Total Analytes	11	11	11	11	11	11	11	11
Average TU	0.85	5.03	5.67	4.45	3.60	2.61	2.75	0.72
Percent Fines	14.4	58.0	ND	39.8	34.7	19.0	14.1	5.3
TOC (mg/kg)	6000	28100	ND	23200	14600	ND	11000	21200

ND = No data available.
*Depth Intervals are in Feet.

Average Upstream TU 0.86
Average Far Field TU 0.81
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

Table B-1
Inorganic Toxic Units in Surficial Sediment
EASZ Corporation
Hudson River QJ-2 Investigation
Rensselaer, NY

Analyte Toxic Units	OTHER SD063 Muddy Sand 0 - 0.5	DOWNSTREAM SD075 Muddy Sand 0 - 0.5	DOWNSTREAM SD075 Muddy Sand 0 - 0.5
ANTIMONY	0.09	0.05	0.16
ARSENIC	0.45	0.20	1.17
CADMIUM	0.83	0.92	3.50
COPPER	3.48	0.76	5.88
IRON	1.10	0.75	1.03
LEAD	1.32	ND	ND
MANGANESE	0.89	0.60	0.71
MERCURY	0.40	0.33	8.13
NICKEL	2.14	0.82	1.28
SILVER	0.17	0.05	0.77
ZINC	1.85	0.62	2.78
Sum Toxic Units	12.29	5.09	25.42
Total Analyses	11	10	10
Average TU	1.12	0.51	2.54
Percent Fines	ND	4.9	25.8
TOC (mg/kg)	ND	1660	ND

ND = No data available.

*Depth Intervals are in Feet.

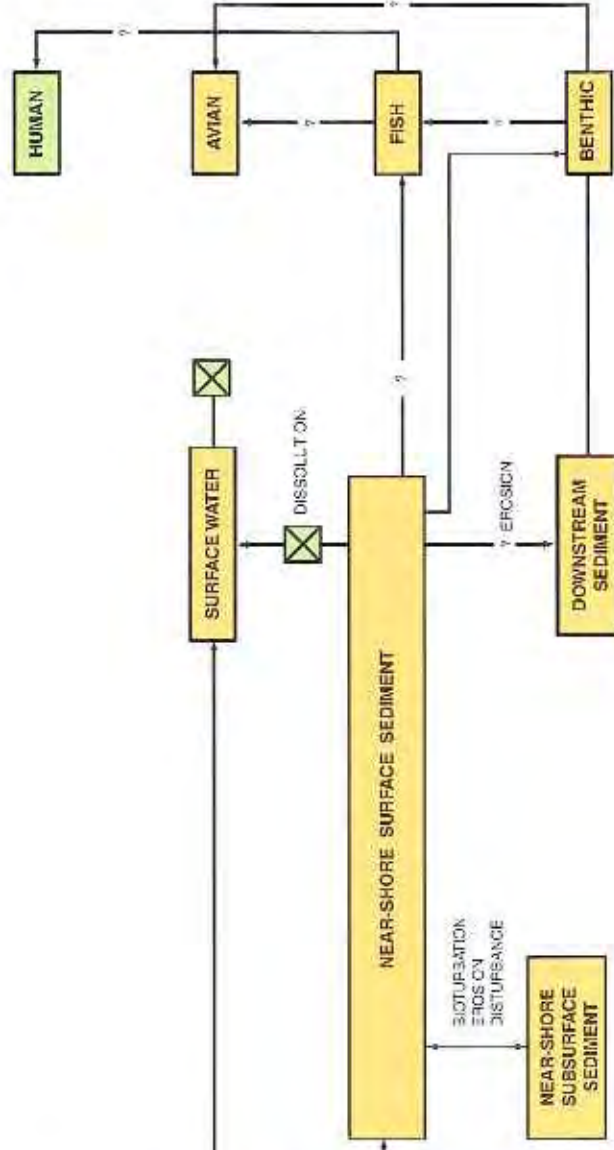
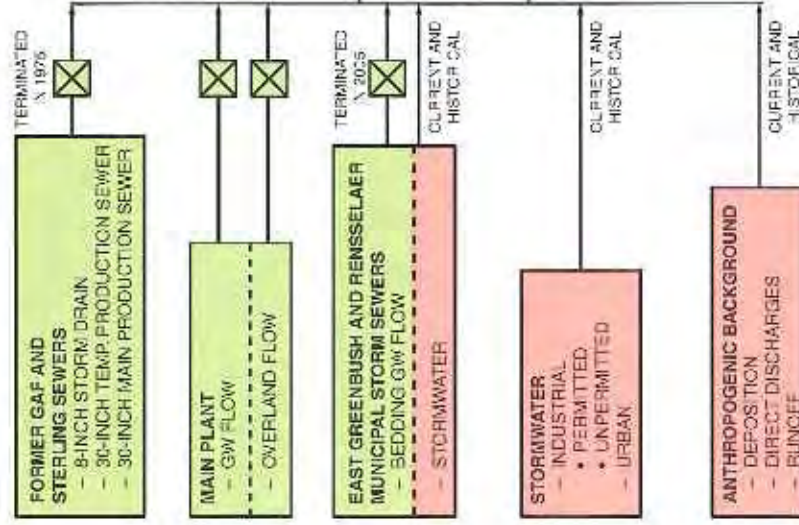
Average Upstream TU 0.86
Average Far Field TU 0.81
Average Nearshore TU 2.39
Average Upper Navigational Channel TU 2.86
Average Downstream TU 1.53

PRIMARY SOURCES

SECONDARY SOURCES

EXPOSURE MEDIUM

RECEPTORS



LEGEND

→ Transport/Exposure Pathway

⊗ Pathway incomplete or terminated

Green shading indicates inactive sources and/or incomplete pathways.

Yellow shading indicates uncertain receptors and pathways

Red shading indicates active sources.

FIGURE 8-1
 Generalized Conceptual Site Model
 BASF Corporation
 Hudson River OU-2 Investigation
 Rensselaer, New York

NYCDEP

ENSR | AECOM



Legend

- 2005-2006 Coro Sampling Locations
- Cross-Section Locations
- Bathymetry (NAVD88)
- Approximate Locations of Outfall Pipes
- Approximate Property Boundaries



0 70 140 280 420 560
Feet

Cross-Section Index Coring Locations in Downstream and Adjacent Regions

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

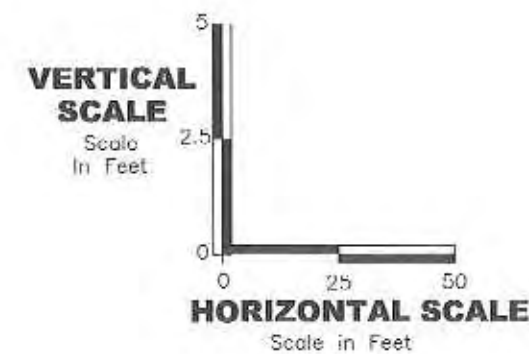
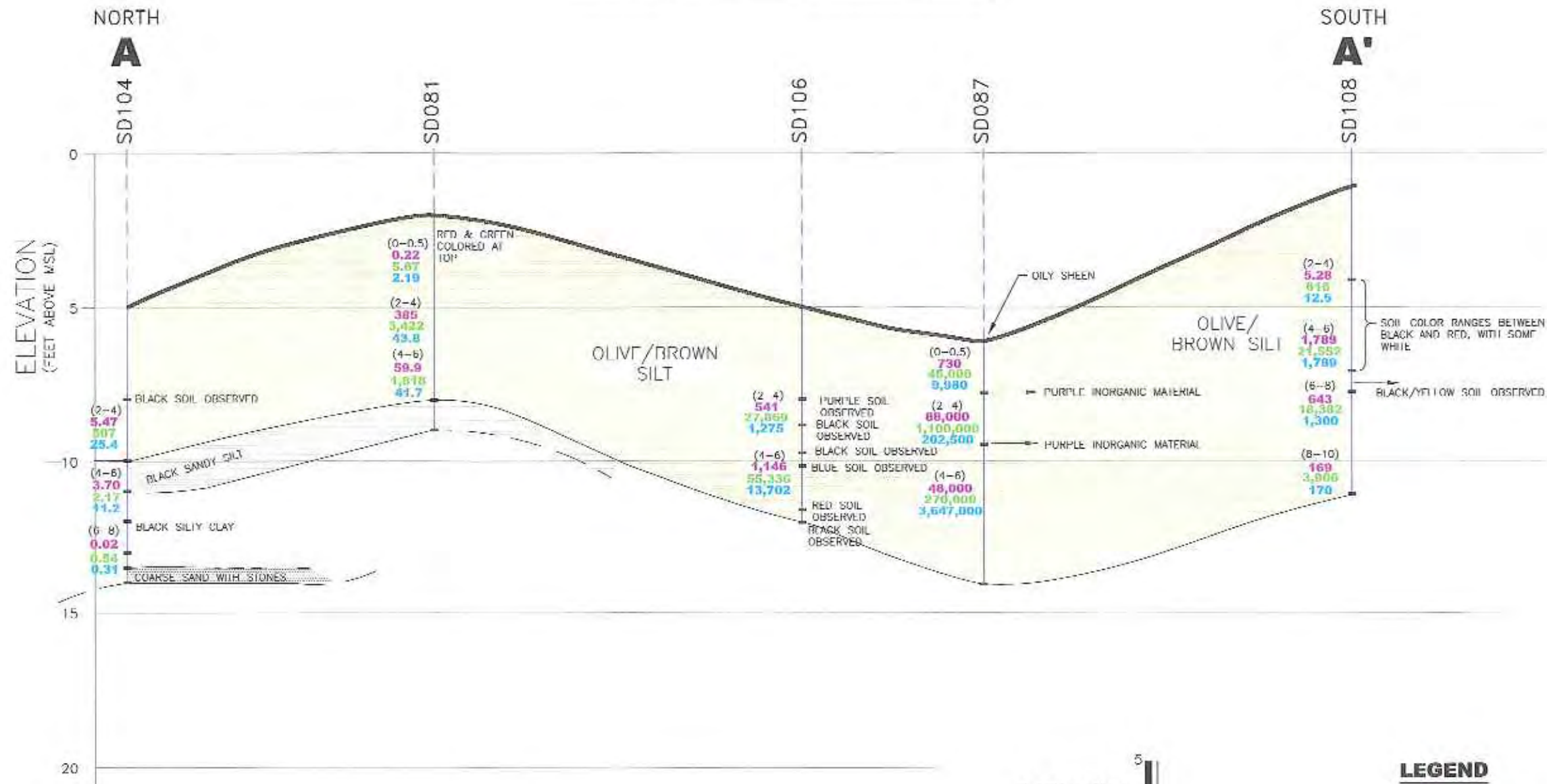
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1:2400	02/07	00760-171

ENSR | AECOM

Figure Number

8-2

CROSS SECTION A-A'



LEGEND

0.00 Benzene
0.00 Chlorobenzene
0.00 Dichlorobenzene
(0-0.5) Depth in feet below soil sediment surface
NOTE: All units shown are in mg/kg OC (milligrams per kilogram organic carbon).

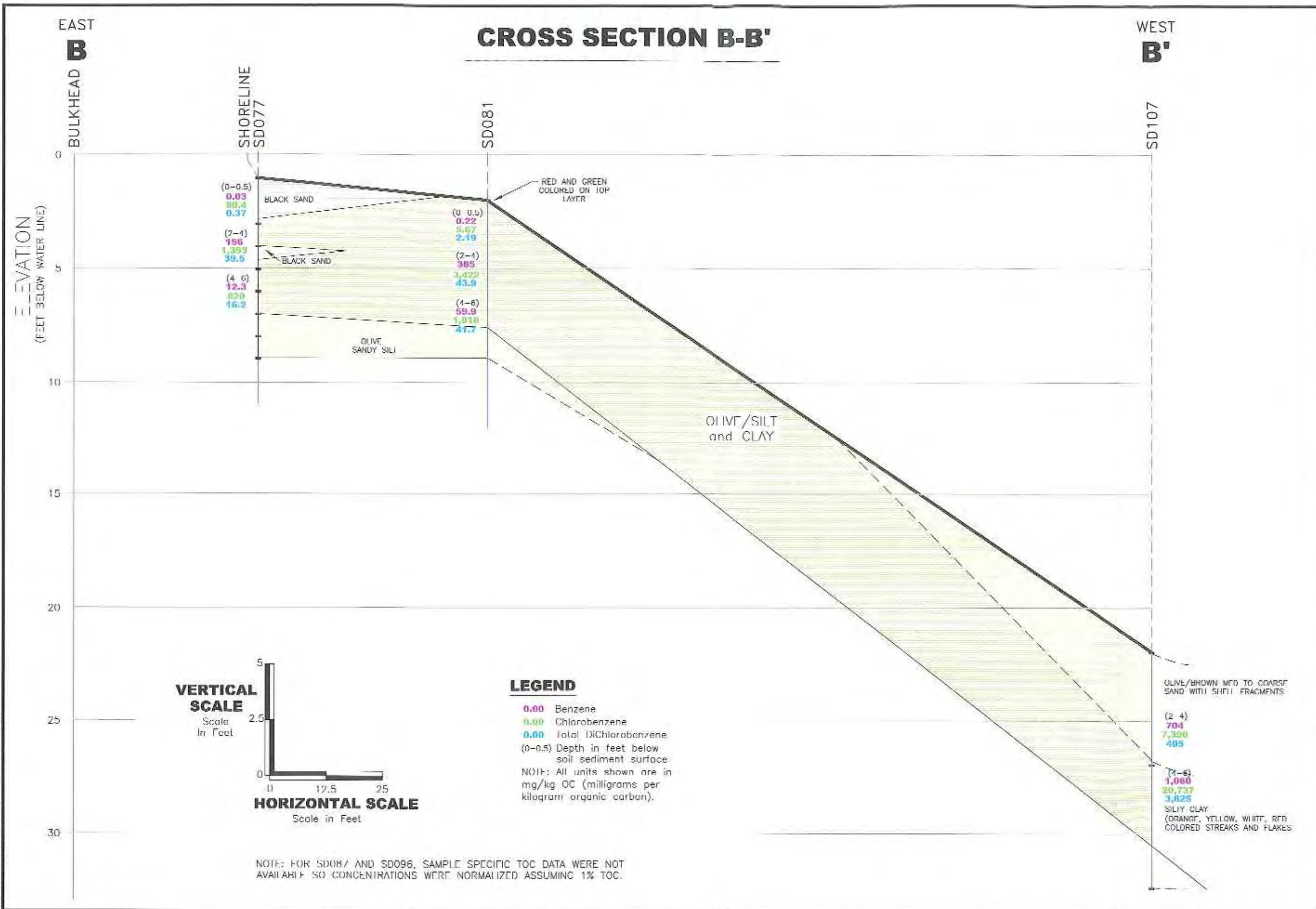
NOTE: FOR SD087 AND SD096, SAMPLE SPECIFIC TOC DATA WERE NOT AVAILABLE SO CONCENTRATIONS WERE NORMALIZED ASSUMING 1% TOC.

DESIGNED BY:	NO.:	DESCRIPTION:	DATE:	BY:
	1	MISCELLANEOUS	10/05/2006	ANH
DRAWN BY:				
CHECKED BY:				
APPROVED BY:				

ENSUR	AECOM
ENSUR CORPORATION	2 TECNOLOGY PARK DRIVE
WESTFORD, MASSACHUSETTS 01886	PHONE: (978) 589-3000
FAX: (978) 589-3100	WEB: HTTP://WWW.ENSUR.COM

SEDIMENT CROSS SECTION	SCALE:	DATE:	PROJECT NUMBER:
BASF CORPORATION	AS SHOWN	10/05/2006	00760-171-250
HUDSON RIVER OU-2 INVESTIGATION			
RENSSELAIR, NEW YORK			

FIGURE NUMBER:
8-3
SHEET NUMBER:
1 of 1



DESIGNED BY:	NO.	DESCRIPTION:	DATE:	BY:
	1	MISCELLANEOUS	10/06	AVH
CHECKED BY:				
APPROVED BY:				

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BASF CORPORATION
HUDSON RIVER CL-2 INVESTIGATION
RENSSELAIR, NEW YORK

SCALE: AS SHOWN

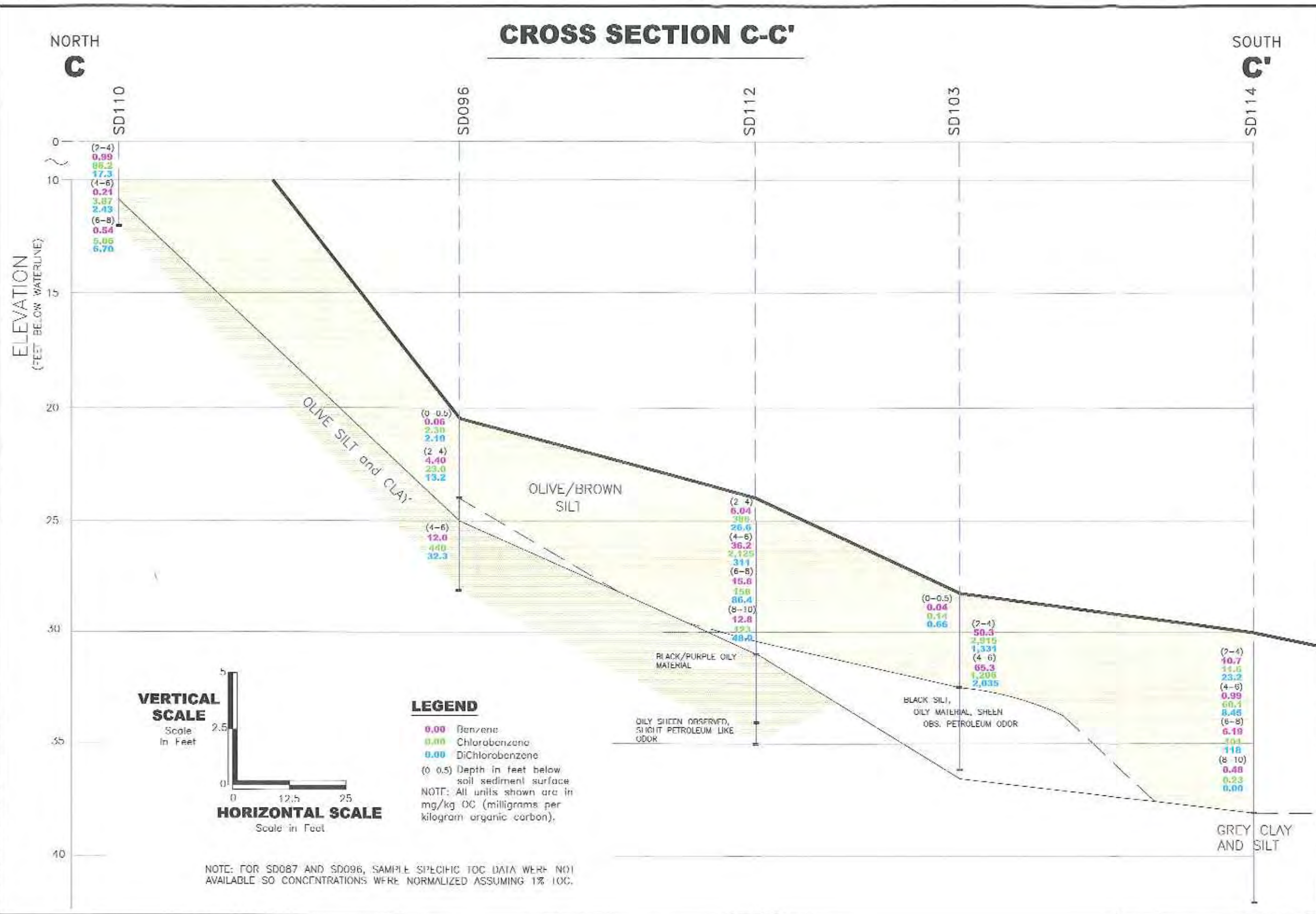
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PROJECT NUMBER: 00760-17'-250'

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8-4

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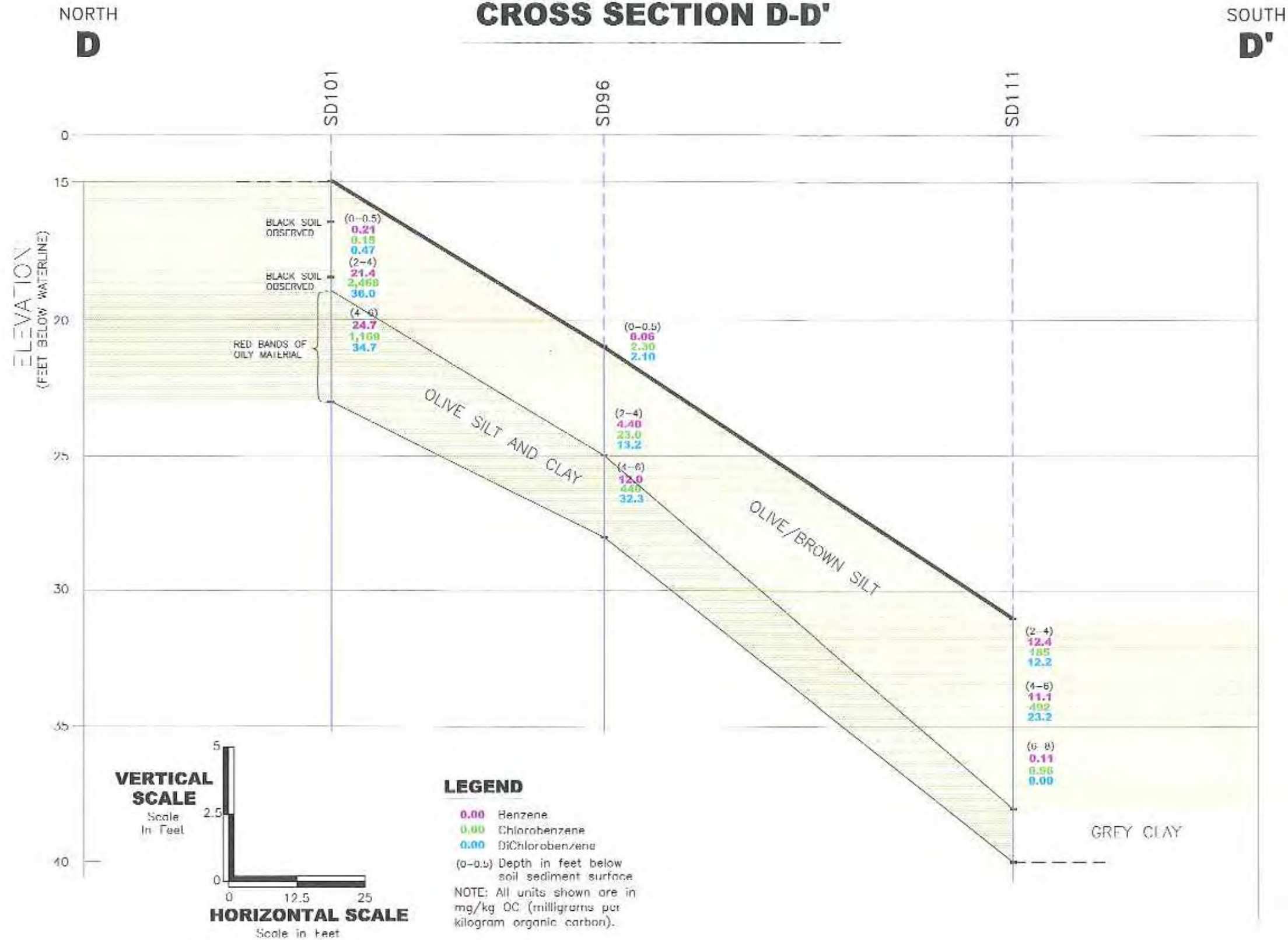
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				NO.	DESCRIPTION	DATE	BY
				1	MISC. LANE CHANGES	10/05/06	AMH

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SEDIMENT CROSS SECTION		
BASF CORPORATION HUDSON RIVER OJ-2 INVESTIGATION RENSSELAIR, NEW YORK		
SCALE:	DATE:	PROJECT NUMBER:
AS SHOWN	10/05/2006	00760-171-25C

FIGURE NUMBER: 8-5
SHEET NUMBER: 1 of 1

CROSS SECTION D-D'



NOTE: FOR SD087 AND SD096, SAMPLE SPECIFIC TOC DATA WERE NOT AVAILABLE SO CONCENTRATIONS WERE NORMALIZED ASSUMING 1% TOC.

REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	MISC. ANNOTS.	10/20	AM
DESIGNED BY:			
DRAWN BY:			
CHECKED BY:			
APPROVED BY:			

ENSR AECOM

ENSR CORPORATION
2 TECHNOLOGY PARK DRIVE
WESTFORD, MASSACHUSETTS 01885
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SEDIMENT CROSS SECTION
BASF CORPORATION
HUDSON RIVER OJ-2 INVESTIGATION
RENSSELAIR, NEW YORK

SCALE: AS SHOWN
DATE: 10/05/2006
PROJECT NUMBER: 00760-171-250

FIGURE NUMBER:
8-6

SHEET NUMBER:
1 of 1

Figure 8-7
TOC versus Percent Fines in Surficial Sediment
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

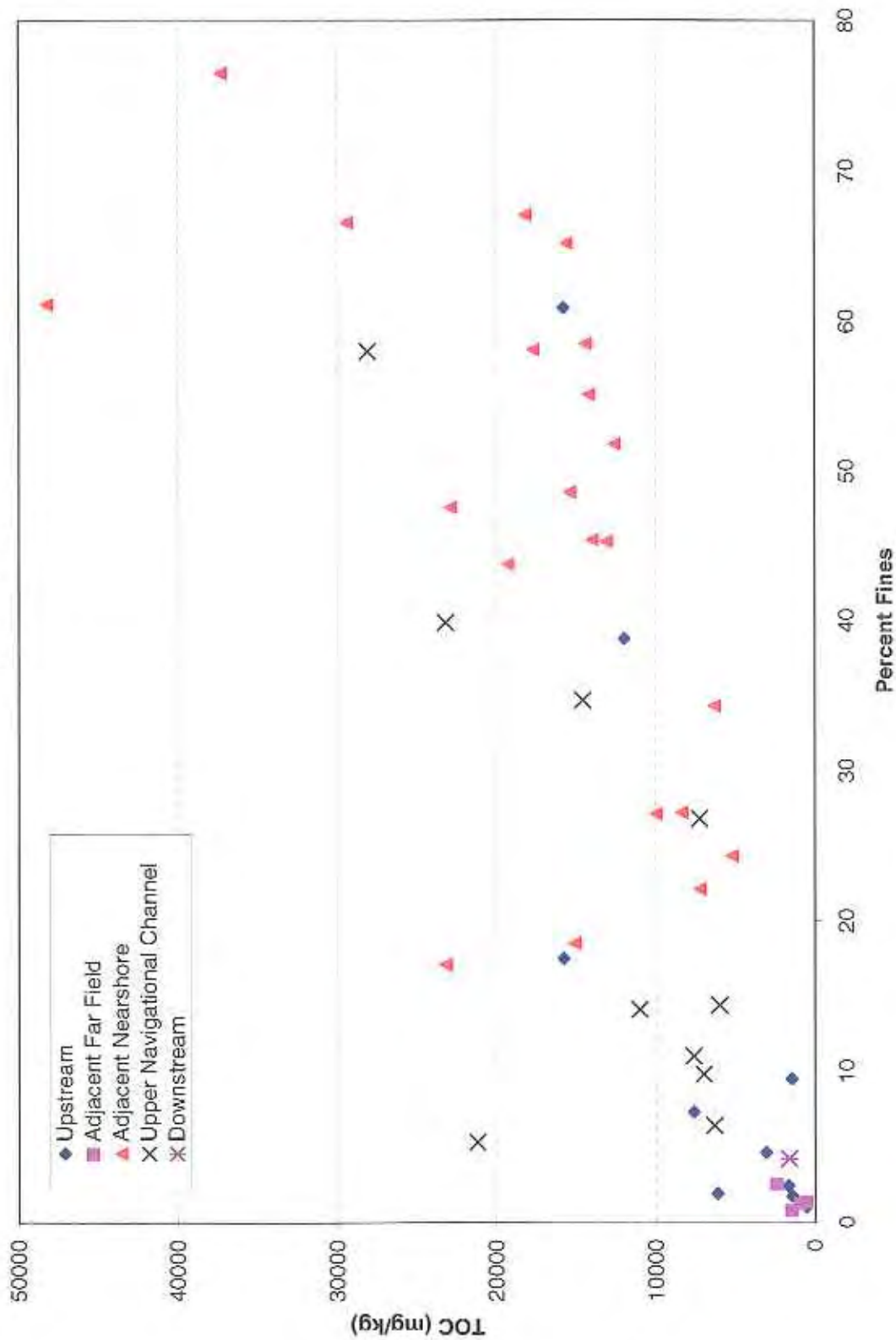
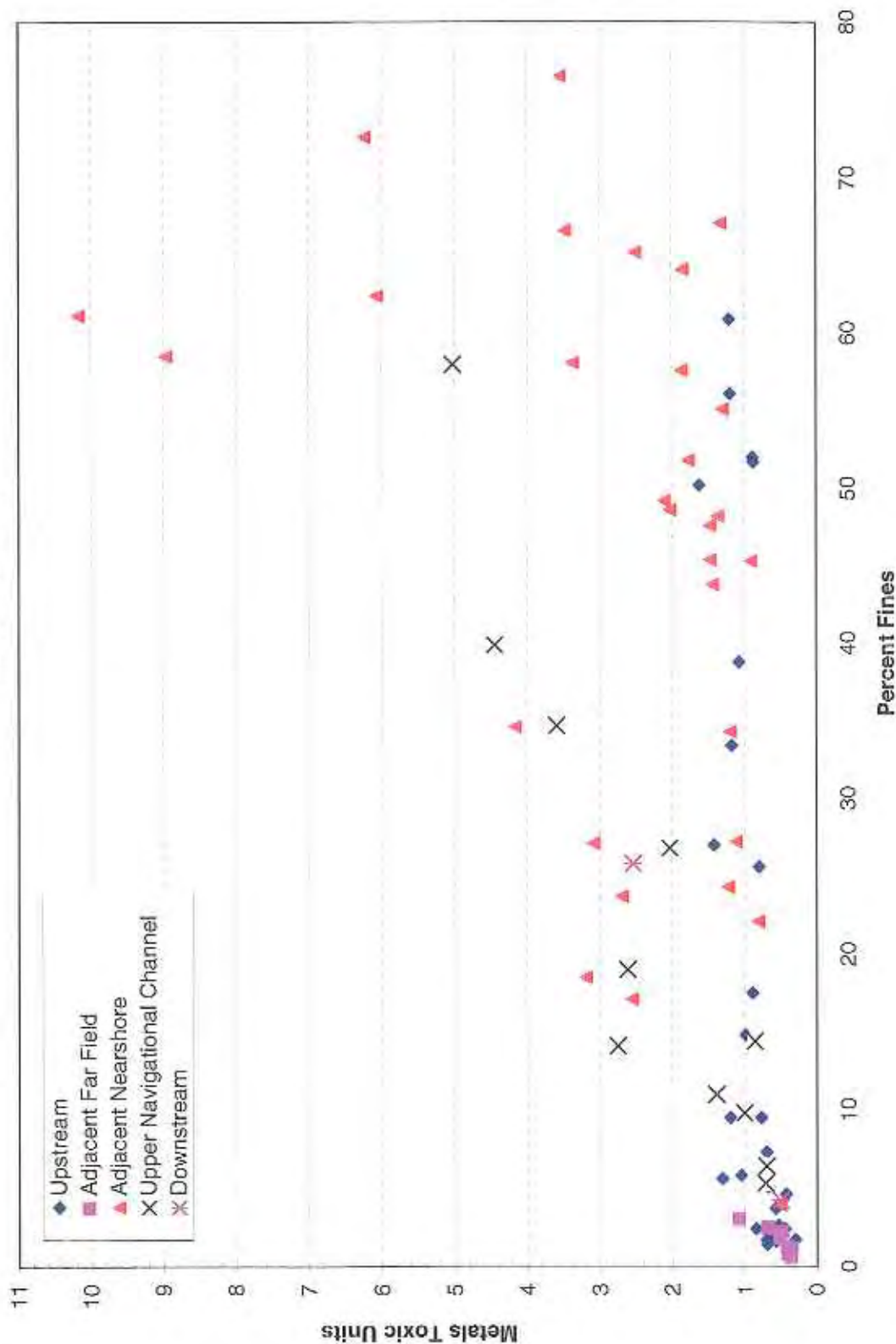


Figure 8-8
Mean Toxic Units versus Percent Fines in Surficial Sediment
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York



9.0 Summary and Conclusions

This Site Investigation provides: (1) a preliminary analysis of the nature and extent of potentially impacted sediment and surface water in the Hudson River adjacent to the Site, (2) a preliminary evaluation of the potential for risks to human health and the environment associated with exposure to these media, and (3) a conceptual model describing the origins (sources) of COPCs, transport processes, and receptors in the river adjacent to the Site.

9.1 Sediment Summary

The evaluation of the nature and extent of compounds in the surficial and sub-surficial sediments indicates that potentially Site-related compounds are present at elevated levels in the Adjacent Nearshore area along the Site bulkhead. These compounds include selected VOCs and inorganic compounds, which are present at depths of up to 10 to 12 ft below the sediment surface. The impacted sediment generally appears to be a nearshore phenomenon, with elevated levels of VOCs and inorganic compounds present in the sub-surficial (and to a lesser extent in the surficial) muddy sand substrate adjacent to and downstream of the Site's historic outfalls. In addition to proximity to the Site, elevated concentrations of compounds also appear to be related to the grain size and organic carbon composition of the sediment. The more coarse-grained sediments upstream of the Site are generally not as impacted as the more fine-grained nearshore sediments with higher levels of organic carbon.

As described throughout this Report, based on the sediment bulk chemistry results and the geophysical survey conducted during this investigation, the main Study Area was sub-divided into five study areas: Upstream, Adjacent Nearshore, Adjacent Far Field, Upper Navigational Channel, and Downstream:

- **Upstream:** The Upstream area contains low to moderate levels of a number of inorganic compounds but is well upstream of the potential impact zone from the Site. The sediment grain size in this area ranges from muddy sand through more coarse-grained sands and gravel. In general, the more upstream sediments are more coarse-grained than the nearshore, near bulkhead sediments. No VOCs were detected in the Upstream area. The inorganic compounds in this area are likely derived from upland and upstream sources and are assumed to represent ambient urban background conditions. To the extent that the nearshore fine-grained sediments in the Upstream area are derived from recent bank failure, and not long-term depositional processes, these samples may not be an ideal representation of urban background.
- **Adjacent Far Field:** A second area is located to the west of the muddy sand samples directly adjacent to the Site. This area runs in a north-south direction, starts immediately upstream of the Site, and extends nearly to the downstream boundary of the Site. This area is characterized by moderately coarse-grained materials (sand and gravelly sand) which show little evidence of any Site-related impacts in surficial and sub-surficial sediments. The analytical results from within this area are generally consistent with those results obtained from the Upstream area, suggesting that the extent of Site-related impact does not extend far beyond the Site to the west and to the south.
- **Adjacent Nearshore:** A third area is located in the muddy sand immediately adjacent to the bulkhead, as well as immediately downstream from the southerly outfall. This area contains a number of inorganic compounds and VOCs. The inorganic compounds of interest include cadmium, chromium, copper, lead, mercury, and zinc, whereas the VOCs include several chlorinated benzenes, benzene, ethylbenzene, toluene, and total xylenes. The VOCs appear to be limited to the muddy sand in the immediate vicinity of the outfalls – no evidence of downstream transport of the VOCs exists. Inorganic compounds are found at elevated levels in the muddy sand adjacent to the outfalls. Elevated levels of several compounds in this area occur both in surficial sediments as well as sub-surficial sediments, with the highest concentrations typically occurring several feet below

the sediment surface. It is possible that the elevated levels of compounds in this area originated from a combination of sources, including the Site, Town of East Greenbush and City of Rensselaer storm sewers, and/or other urban sources.

- **Upper Navigational Channel:** A fourth area is located in the muddy sand in the central portion of the river downstream from the Site's southerly outfall. This area contains a number of inorganic compounds which may have at least partially originated at the Site. The inorganic compounds include cadmium, chromium, copper, lead, mercury, and zinc. It is possible that the elevated levels of metals in this the dredged area originated from a combination of sources, including the Site, Town of East Greenbush and City of Rensselaer storm sewers, and/or other urban sources. In addition, this area represents a depositional environment associated with the northern extent of the routine navigational dredging in the river. It is therefore possible that the elevated metals concentrations in this region reflect the dredging history of the river.
- **Downstream:** The downstream area is represented by two sampling locations collected approximately 1,800 ft downstream of the Site. Concentrations of inorganic compounds in this dredged depositional environment are generally consistent with upstream conditions, indicating that the extent of Site-related impacts does not extend far beyond the southerly Site boundary.

The results of this study suggest that the area of potentially Site-impacted sediment is generally limited: concentrations of compounds decrease markedly (i.e., approach background levels) immediately to the west of the nearshore muddy sand. Although moderately elevated levels of several inorganic compounds are present in an area to the south of and downstream of the southernmost outfall, these results need to be interpreted with caution: this potentially impacted area represents the northern extreme of the routine maintenance dredged area in the river channel, and the metals present may be related to the Site, or alternatively, may be related to the hydraulic effects of dredging (i.e., deepening of the channel has created a depositional zone for fine-grained sediments which typically are metals-enriched relative to coarser grained materials). Furthermore, with regard to Site attribution, the presence of inorganic compounds in the nearshore environment in excess of screening values needs to be interpreted with caution. Concentrations of the inorganic compounds appear to be highest in fine-grained sediments, which are predominantly located in the nearshore environment. Given that much of the river upstream of the Site is scoured, the relatively finite nearshore fine-grained depositional environment may represent a number of sources.

9.2 Surface Water Summary

The results of the surface water investigation indicate that surface water is not a medium of concern at the Site. Concentrations of all detected compounds in surface water adjacent to the Site are generally consistent with upstream surface water concentrations or below risk-based thresholds.

9.3 Summary of Preliminary Risk Analysis

The screening level HHRA and ERA evaluated potential risks to human health and the environment due to exposure to surface water and sediment within the river adjacent to the Site. In accordance with USEPA and NYSDEC guidance, the presence of compounds in excess of screening level risk benchmarks does not necessarily indicate an actual risk of harm to human health or the environment. Rather, this information simply suggests that additional risk analysis or investigation may be warranted.

9.3.1 Human Health Risk Screening

The results of this analysis indicate that there is no potential current risk to human health due to exposure to sediment or surface water adjacent to the Site. Adjacent surface water concentrations were generally similar to upstream concentrations. Further, no Site-related VOCs were detected in surface water, indicating that the Site is not adversely impacting surface water quality in the river. It is unlikely that exposure to sediments poses a threat to human health, and it is unlikely that humans would come into contact with Hudson River sediments in the vicinity of the Site. While concentrations of several of the Site-related VOCs exceed the

screening benchmarks considered in this evaluation, many of the sediment samples do not contain concentrations of any compounds in excess of these benchmarks. Furthermore, access to the sediments in the vicinity of the Site is very limited due to the metal bulkhead that forms the shoreline between the Site and the river. The Site itself is securely fenced and guarded so access to the river from the Site is unlikely. The water adjacent to the Site is too deep for wading so sediment exposure would not be likely. The surficial sediments are under at least 6 ft of water and the more contaminated deeper sediments are located 2 to 8 ft below the sediment surface. Therefore, contact with contaminated sediments is highly unlikely. However, if conditions change in the future and sub-surficial sediments (which are characterized by higher levels of several compounds) become exposed, additional risk analysis may be required.

There is some uncertainty as to whether levels of benzene or other VOCs present in sediment are likely to bioaccumulate into fish since they were generally not detected in the surface water. While benzene in sediment exceeded its NYSDEC sediment criterion for bioaccumulation into fish, benzene was not detected in surface water at detection limits that achieve the NYSDEC water quality criterion set for protection of fish consumption. In addition, the remaining three VOCs with NYSDEC sediment criterion (1,2-dichloroethane, tetrachloroethene, and trichloroethylene) and sub-surficial sediment exceedances were also not detected in surface water. Given these results, the uncertainty in the EqP methodology used to derive the NYSDEC sediment criterion, and the likelihood that the method over-predicts for organics with low hydrophobicity such as benzene, there is some uncertainty as to whether levels of VOCs present in sediment are likely to bioaccumulate into fish.

9.3.2 Ecological Risk Screening

Elevated levels of several inorganic and organic compounds were present in the surficial sediment adjacent to the Site. Although concentrations of inorganic and organic compounds exceed benchmark screening values, many of the highest concentrations of these compounds are located in sub-surficial sediment, well below the presumed bioactive zone for most benthic organisms. Results from the screening level macroinvertebrate survey indicate that there is a similar benthic macroinvertebrate community throughout the entire study area (including the upstream exposure area). Although several invertebrate sampling stations were located in the nearshore environment, immediately adjacent to the Site bulkhead, no relationship between proximity to the Site and a decrease in macroinvertebrate community fitness was observed. Likewise, no relationship between increased VOC and/or inorganic compound concentrations and a decrease in macroinvertebrate community fitness was observed. It is likely that the observed macroinvertebrate community integrates exposures to a number of stressors, including chemical and physical stressors present as a result of the long industrial, municipal, and navigational uses of the Hudson River in the vicinity of Albany.

Therefore, despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments, review of the available macroinvertebrate biology data indicates that the diversity and abundance of the macroinvertebrate communities observed upstream of, adjacent to, and downstream of the Site are similar. Similarly, no relationship between elevated levels of compounds in the sediment and the macroinvertebrate community health was observed. There is some uncertainty as to whether compounds in sediment are likely to bioaccumulate into fish and additional data collection may be warranted to address the lack of analytical data in the 0.5 – 2 ft sediment horizon.

9.4 Recommendation

Based on results of this investigation, BASF recommends additional studies to further characterize conditions in river sediments. BASF will discuss the results and conclusions contained in this Report with NYSDEC and subsequently prepare and submit to the Agency a work plan detailing additional data collection activities and risk assessment analysis that are needed to complete the investigation.

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Appendix A
Summary of Site Investigation Field
Program Methods

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

Contents

1.0 Introduction	1-1
2.0 Geophysical Survey	2-1
3.0 Sediment Characterization.....	3-1
3.1 Sediment Sampling	3-1
3.2 Sediment Analysis.....	3-1
4.0 Benthic Macroinvertebrate Community Characterization	4-1
5.0 Surface Water Characterization	5-1
6.0 Literature Cited	6-1

List of Tables

Table 3-1 Field Measurements

Table 3-2 Sediment and Surface Water Samples and Analyses

List of Figures

Figure 3-1 Sampling Locations 2005 and 2006 Sampling Field Efforts

1.0 Introduction

This appendix to the Site Investigation Report (Report) discusses the BASF OU-2 SI field program that was conducted between November 2005 and May 2006. The field work was conducted in accordance with the scope of work outlined in the Work Plan and QAPP (ENSR, 2005) and included activities which are summarized in the following sections:

- Geophysical Survey
- Sediment Characterization
- Benthic Macroinvertebrate Community Characterization
- Surface Water Characterization

For the sediment, surface water, and macroinvertebrate survey sampling efforts a differential global positioning system (DGPS) was used to navigate to pre-determined sampling locations. After arriving at a sampling location, the location was fixed by setting a bow anchor and one or two stern anchors. Once the sampling vessel was anchored in position and a sample was being taken, a second DGPS location was recorded.

2.0 Geophysical Survey

Geophysical surveys of the Study Area were performed in November 2005 to characterize surficial and sub-surficial sediments and to identify any anthropogenic anomalies on the river bottom which could potentially be sources of chemicals of potential concern (COPCs). The Study Area consisted of a 3.2 mile reach of the Hudson River, extending from the turning basin located south of the Site to a point approximately 600 ft south of the Interstate 90 Bridge. The surveys were performed by CR Environmental; its report (Hudson River Geophysical Surveys Methods and Results) is appended to the Report (Appendix C). The sediment characterization was conducted to provide bathymetric information in the vicinity of the Site and to gather information regarding substrate type and depositional characteristics to help focus the sample collection program. Side-scan sonar and sub-bottom profiling sonar were used for the survey.

Side-scan sonar was used to characterize the surficial features of the sediment. Side-scan sonar transects were conducted parallel to the river's course, with the towfish pulled as near the bottom as possible. The side-scan system was operated using a 50 meter recording range at 500 kHz. Several transects adjacent to the Site were surveyed at a 25 meter recording range to provide higher resolution. Side-scan data were georeferenced using DGPS data collected during the survey. DGPS accuracy during the survey was below 1.0 meter.

Sub-bottom profiling sonar transects were performed to measure the geologic and depositional characteristics of the riverbed. Sub-bottom data were collected simultaneously with the side-scan data and along several transects running perpendicular to the river's course.

Additional detail regarding geophysical survey methodology is included in Appendix C of the Report.

3.0 Sediment Characterization

Sediment sampling and analysis was conducted to obtain a comprehensive set of physical, chemical, and biological data for the Hudson River adjacent to the Site. Additional sediment sampling was conducted upstream of the Site to evaluate anthropogenic background conditions in the Albany area.

3.1 Sediment Sampling

Sediment sampling in the Hudson River was conducted to identify the presence and extent of potential Site-related compounds, as well as to evaluate the potential influence of non-Site-related anthropogenic background conditions. Sediment sampling locations are presented in Figure 3-1. As indicated in the figure, sampling to delineate the extent of volatile organic compounds (VOCs) in sediment was focused on the near-shore Study Area near the historic Site outfalls. Sampling for metals included the nearshore area as well as additional samples collected from the upstream, downstream, and adjacent areas. Surficial and sub-surficial sediment samples were collected to evaluate both the horizontal and vertical distribution of compounds in riverine sediment.

Surficial sediment samples were collected using a modified Ted Young dredge. Surficial sediments were collected from the upper 0 to 0.5 ft (approximately 0 to 15 cm) horizon. Generally, this sediment horizon contains the most recently deposited sediments and is the bioactive zone (i.e., the site of most biological activity). Once the top 0.5 ft horizon was removed from the dredge sampler, the sediment was sampled for VOCs and, at selected locations, simultaneously extracted metals (SEM) and acid volatile sulfides (AVS). After sampling for those parameters, the sediment was placed in a clean stainless steel bowl and homogenized. Homogenized sediment was then sampled for metals, grain size, and total organic carbon (TOC).

Sub-surficial sediment samples were collected from a sub-set of sampling locations using a 10 to 12 ft vibracore sampling device. Sub-surficial samples allow a characterization of the vertical distribution of contaminants. Sub-surficial samples initially targeted cores from the 2 to 4 ft and 4 to 6 ft horizon at each station. When sediment composition allowed, deeper cores were taken at the 6 to 8 ft and 8 to 10 ft horizons. All of these depth horizons are well below the bioactive zone, but were selected to provide data on the vertical distribution of VOCs and metals. Sediment cores were transported to an on-shore processing station where they were opened, characterized, measured, divided into horizons, and sampled.

Water quality field measurements were taken at each sediment sampling station. Measurements were taken 2 ft off the sediment surface, mid-depth, and 1 ft below the water surface and included temperature, conductivity, dissolved oxygen saturation and concentration, and pH. These data are tabulated in Table 3-1.

All equipment which comes into contact with sediment samples was decontaminated prior to sampling and between each sample station. Decontamination was performed to prevent cross-contamination between samples and to maintain a clean working environment for all personnel. The decontamination procedure consisted of a station river water rinse to remove gross contamination, followed by a non-phosphate detergent scrub, and a final deionized water rinse.

3.2 Sediment Analysis

Sediment samples were analyzed for the following parameters:

- Target Compound List (TCL) VOCs;
- Target Analyte List (TAL) metals (Inorganics);
- SEM and AVS;

- Grain size; and
- TOC.

Not all samples were analyzed for the full list of parameters. Table 3-2 presents a summary of the sediment samples and associated analyses.

Table 3-1
Field Measurements
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Sample Location ID	Date	Depth (ft)	Temperature (C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
2005 SURFACE WATER SAMPLING EFFORT							
SWD1	11/30/2005	1	6.03	251	99	12.21	8.07
SWD1	11/30/2005	2	6.03	251	98.9	12.31	8.05
SWD1	11/30/2005	3	6.05	257	99.3	12.34	8.04
SWD1	11/30/2005	4	6.16	266	99.4	12.32	8.04
SWD1	11/30/2005	5	6.15	267	99.3	12.31	8.03
SWD1	11/30/2005	6	6.15	267	99.2	12.3	8.03
SWD1	11/30/2005	8	5.98	251	99.4	12.37	8.03
SWD1	11/30/2005	10	5.97	251	99.2	12.37	8.01
SWD1	11/30/2005	12	5.99	252	99.3	12.36	8.01
SWD1	11/30/2005	14	5.99	251	99.3	12.35	7.98
SWD1	11/30/2005	16	5.95	248	99.3	12.37	7.97
SWD1	11/30/2005	18	5.94	248	99.3	12.37	7.96
SWD2	11/30/2005	1	6.86	185	99.2	12.09	8.06
SWD2	11/30/2005	2	6.84	164	99.5	12.13	8.07
SWD2	11/30/2005	3	6.84	165	99.7	12.15	8.06
SWD2	11/30/2005	4	6.83	165	99.7	12.15	8.04
SWD2	11/30/2005	5	6.83	165	99.8	12.16	8.04
SWD3	11/30/2005	1	7.01	176	98.6	12.01	7.99
SWD3	11/30/2005	2	7.3	178	101.5	12.22	7.6
SWD3	11/30/2005	3	7.33	178	101.2	12.17	7.42
SWD3	11/30/2005	4	7.12	177	101	12.18	7.35
SWD3	11/30/2005	5	7.3	176	101.1	12.21	7.35
SWD3	11/30/2005	6	7.34	177	101	12.18	7.34
SWD3	11/30/2005	7	7.19	177	100.9	12.2	7.34
SWD3	11/30/2005	8	7.3	177	100.9	12.16	7.34
SWD3	11/30/2005	9	7.2	177	100.9	12.18	7.34
SWD3	11/30/2005	10	7.19	177	100.9	12.18	7.31
SWD3	11/30/2005	11	7.2	177	100.9	12.17	7.32
SWD4	11/30/2005	1	7.48	174	99.1	11.9	7.74
SWD4	11/30/2005	2	7.47	175	99.5	11.94	7.74
SWD4	11/30/2005	3	7.4	174	99.7	11.98	7.74
SWD4	11/30/2005	4	7.45	175	99.8	11.96	7.73
SWD4	11/30/2005	5	7.48	176	99.7	11.95	7.73
SWD5	11/30/2005	1	7.06	174	99.3	12.05	7.93
SWD5	11/30/2005	2	6.93	174	100.1	12.10	7.93
SWD5	11/30/2005	4	6.9	174	100.3	12.24	7.93
SWD5	11/30/2005	6	6.86	174	100.4	12.23	7.94
SWD5	11/30/2005	8	6.91	174	100.2	12.22	7.93
SWD5	11/30/2005	10	6.9	174	100.2	12.18	7.94
SWD5	11/30/2005	12	6.85	174	100.3	12.21	7.94
SWD5	11/30/2005	14	6.81	174	100.3	12.24	7.94
SWD5	11/30/2005	16	6.76	174	100.4	12.23	7.95
SWD5	11/30/2005	18	6.71	174	100.3	12.26	7.94
SWD5	11/30/2005	20	6.72	174	100.4	12.26	7.94
SWD5	11/30/2005	22	6.76	174	100.4	12.27	7.93
SWD6	11/30/2005	1	6.77	177	99.4	12.12	8.01
SWD6	11/30/2005	2	6.79	177	99.5	12.13	8.01
SWD6	11/30/2005	3	6.79	183	99.5	12.12	8.01
SWD6	11/30/2005	4	6.93	196	99.5	12.09	8.00
SWD6	11/30/2005	5	6.73	183	99.4	12.13	8.01
SWD6	11/30/2005	6	6.88	180	99.7	12.18	8.00
SWD6	11/30/2005	8	6.69	180	99.6	12.18	8.03
SWD6	11/30/2005	10	6.69	180	99.6	12.18	8.03
SWD7	11/30/2005	1	6.83	171	99.1	12.08	8.02
SWD7	11/30/2005	2	6.84	171	99.4	12.1	8.03
SWD7	11/30/2005	4	6.86	172	99.5	12.11	8.05
SWD7	11/30/2005	5	6.85	171	99.4	12.11	8.05
SWD7	11/30/2005	6	6.85	172	99.4	12.11	8.06
SWD7	11/30/2005	10	6.85	172	99.5	12.11	8.06
SWD7	11/30/2005	12	6.85	172	99.4	12.11	8.07
SWD7	11/30/2005	14	6.84	172	99.4	12.11	8.06
SWD7	11/30/2005	16	6.83	172	99.4	12.12	8.06
SWD7	11/30/2005	18	6.8	172	99.4	12.14	8.07
SWD7	11/30/2005	20	6.75	177	99.5	12.14	8.07
SWD7	11/30/2005	22	6.75	174	99.4	12.15	8.08

Table 3-1
Field Measurements
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, New York

Sample Location ID	Date	Depth (ft)	Temperature (C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
2005 SEDIMENT SAMPLING EFFORT							
SD089	12/1/2005	1	7.25	174	85.2	10.25	7.36
SD089	12/1/2005	2.5	7.15	174	83.7	10.12	7.32
SD089	12/1/2005	5	7.12	174	83	10.04	7.31
SD077	12/1/2005	1	7.15	173	80.6	9.77	7.85
SD077	12/1/2005	4.5	7.11	173	81.7	9.89	7.6
SD077	12/1/2005	8.5	7.1	174	82.2	9.95	7.74
SD081	12/1/2005	1	7.14	172	79.5	9.68	7.92
SD081	12/1/2005	6	7.12	171	81.2	9.83	7.85
SD081	12/1/2005	11.5	7.11	171	82.4	9.97	7.81
SD085	12/1/2005	1	7.1	171	88.2	10.55	7.97
SD085	12/1/2005	8	7.11	170	84.3	10.2	7.93
SD085	12/1/2005	19	7.11	170	83.4	10.1	7.89
SD087	12/1/2005	1	7.08	170	91.2	11.09	7.96
SD087	12/1/2005	7	7.11	170	88	10.65	7.93
SD087	12/1/2005	15	7.11	170	87.4	10.57	7.82
SD091	12/1/2005	1	7.11	167	85.9	10.9	7.95
SD091	12/1/2005	14	7.13	168	84.3	10.21	7.96
SD091	12/1/2005	23	7.13	168	84.8	10.25	7.96
SD087	12/2/2005	1	6.24	145	100	12.51	8.19
SD087	12/2/2005	6	6.24	144	104	12.9	7.97
SD087	12/2/2005	12	6.25	147	106	13.13	7.91
SD041	12/2/2005	1	6.17	143	101.8	12.7	7.85
SD041	12/2/2005	12	6.18	149	106.1	13.19	7.9
SD041	12/2/2005	24	6.18	149	108.5	13.47	7.92
SD046	12/2/2005	1	6.18	152	102.1	12.76	7.99
SD096	12/2/2005	12	6.22	148	106.4	13.22	7.95
SD096	12/2/2005	24	6.25	148	105.1	13.4	7.89
SD101	12/2/2005	1	6.14	144	103.3	13.09	8
SD101	12/2/2005	10	6.18	144	108.6	13.49	7.94
SD101	12/2/2005	19	6.18	143	108.7	13.61	7.92
SD103	12/2/2005	1	6.07	144	102	12.68	8.04
SD103	12/2/2005	18	6.24	158	106	13.22	7.95
SD103	12/2/2005	23	6.19	145	108	13.43	7.95
SD089	12/2/2005	1	6.05	152	105	13.2	8.05
SD089	12/2/2005	20	6.09	152	109	13.64	7.98
SD055	12/2/2005	1	6.08	155	108.8	13.31	8.07
SD055	12/2/2005	8	6.07	155	108.5	13.5	8.05
SD055	12/2/2005	15	6.07	154	109	13.6	8.05
SD055	12/2/2005	22	6.07	154	110	13.7	8.04
SD091	12/2/2005	1	5.91	138	104.2	12.95	8.13
SD091	12/2/2005	15	6.07	138	106	13.26	8.04
SD091	12/2/2005	23	6.07	138	107.4	13.36	8.02
SD070	12/7/2005	1	2	178	95.8	13.23	8.1
SD070	12/7/2005	20	1.98	178	94.2	13	7.91
SD090	12/7/2005	1	1.86	181	93.8	13.05	7.86
SD090	12/7/2005	20	1.84	182	94.5	13.15	7.84
SD013	12/12/2005	1	0.71	243	103.8	14.79	7.93
SD013	12/12/2005	10	0.71	250	109.7	14.41	7.83
SD057	12/12/2005	1	1.02	195	103.6	14.71	7.98
SD057	12/12/2005	7.5	1.02	195	101.4	14.39	7.86
SD081	12/12/2005	1	0.97	206	105	14.79	7.9
SD081	12/12/2005	10	0.96	208	101.2	14.39	7.85
2006 SEDIMENT SAMPLING EFFORT							
SD114	5/9/2006	1	14.46	135	100	10.20	8.07
SD114	5/9/2006	17	14.44	139	101	10.29	8.00
SD114	5/9/2006	32	14.42	139	99.5	10.18	7.98
SD113	5/9/2006	1	14.73	139	101.7	10.32	8.11
SD113	5/9/2006	15	14.56	135	101.7	10.35	8.00
SD113	5/9/2006	29	14.87	135	100.6	10.26	7.98
SD111	5/9/2006	1	14.72	138	101.5	10.29	8.11
SD111	5/9/2006	17	14.5	139	101.6	10.34	8.06
SD111	5/9/2006	33	14.55	141	98.9	10.1	7.86
SD109	5/9/2006	1	14.66	136	101.4	10.27	8.19
SD109	5/9/2006	8	14.67	137	101.4	10.28	8.11
SD109	5/9/2006	15	14.61	137	101	10.25	8.05

Table 3-1
Field Measurements
BASF Corporation
Hudson River QJ-2 Investigation
Rensselaer, New York

Sample Location ID	Date	Depth (ft)	Temperature (C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
2006 SEDIMENT SAMPLING EFFORT							
SD091	5/9/2006	1	14.97	138	102.3	10.32	8.13
SD091	5/9/2006	12	14.55	138	101.1	10.27	8.05
SD091	5/9/2006	22	14.54	138	96.7	9.91	7.97
SD107	5/9/2006	1	14.89	140	101.4	10.25	8.03
SD107	5/9/2006	13	14.73	142	100.9	10.23	8.06
SD107	5/9/2006	24	14.68	145	100.7	10.22	8.11
SD112	5/10/2006	1	15.11	165	98.8	9.94	7.82
SD112	5/10/2006	13	15.11	161	98.7	9.92	7.86
SD112	5/10/2006	25	15.13	187	98.2	9.87	7.82
SD110	5/10/2006	1	15.1	164	98.4	9.80	7.84
SD110	5/10/2006	5.5	15.1	162	98.2	9.88	7.84
SD110	5/10/2006	9	15.1	169	98.3	9.89	7.85
SD108	5/10/2006	1	15.14	162	97.1	9.78	7.85
SD108	5/10/2006	6	15.14	162	97.0	9.75	7.85
SD108	5/10/2006	10	15.13	163	97.1	9.76	7.89
SD108	5/10/2006	1	15.07	162	96.3	9.70	7.85
SD104	5/10/2006	1	15.25	162	96.8	9.72	7.86
SD104	5/10/2006	4	15.19	163	91.7	9.31	7.87
SD104	5/10/2006	6.5	15.17	184	89.1	8.42	7.9
SD105	5/10/2006	1	15.37	158	93.1	9.82	7.8
SD105	5/10/2006	12	15.14	157	98.6	9.81	7.92
SD105	5/10/2006	21	15.11	156	98.9	9.94	7.96
SD073	5/2/2006	1	12.4	148	148	18	7.87
SD073	5/2/2006	12	12.4	149	9.0	0.95	8.12
SD073	5/2/2006	25	12.4	150	3.2	0.34	8.39
SD069	5/2/2006	1	12.85	148	NA	NA	8.05
SD069	5/2/2006	12	12.84	148	NA	NA	8.21
SD069	5/2/2006	25	12.83	148	NA	NA	8.30
SD064	5/2/2006	1	12.86	149	NA	NA	8.01
SD064	5/2/2006	12	12.86	148	NA	NA	7.97
SD064	5/2/2006	25	12.86	148	NA	NA	8.21
SD103	5/2/2006	1	12.83	151	NA	NA	8.20
SD103	5/2/2006	12	12.81	151	NA	NA	8.09
SD103	5/2/2006	25	12.8	150	NA	NA	8.38
SD102	5/3/2006	1	12.44	145	99.3	10.6	8.07
SD102	5/3/2006	12	12.44	143	100.2	10.7	8.04
SD102	5/3/2006	25	12.45	146	100.4	10.7	8.06
SD094	5/3/2006	1	12.52	136	102.9	10.96	8.05
SD094	5/3/2006	8	12.51	136	102.5	10.91	8.03
SD094	5/3/2006	14	12.51	136	102.4	10.9	8.01
SD055	5/3/2006	1	12.7	150	100.6	10.67	8.02
SD055	5/3/2006	14	12.7	150	100.3	10.63	8.02
SD055	5/3/2006	26	12.65	150	100.1	10.62	8.01
SD045	5/3/2006	1	12.68	145	100.6	10.67	8.01
SD045	5/3/2006	11.5	12.68	149	99.8	10.58	7.99
SD045	5/3/2006	21	12.68	148	99.7	10.58	7.99
SD040	5/4/2006	1	12.33	107	99.0	10.67	7.99
SD040	5/4/2006	13	12.3	108	99.1	10.6	7.94
SD040	5/4/2006	24	12.3	108	98.8	10.57	7.92
SD036	5/4/2006	1	12.53	115	98.5	10.58	7.97
SD036	5/4/2006	12	12.39	113	98.9	10.58	7.98
SD036	5/4/2006	22	12.34	112	98.2	10.6	7.94
SD077	5/4/2006	1	12.57	114	101.4	10.78	8.00
SD077	5/4/2006	13	12.58	114	101	10.74	7.98
SD077	5/4/2006	24	12.56	115	100.7	10.7	7.96
SD032	5/4/2006	1	12.72	111	101.6	10.75	8.02
SD032	5/4/2006	9	12.69	111	100.8	10.68	7.98
SD032	5/4/2006	16	12.68	111	101.3	10.72	7.95
SD058	5/4/2006	2.5	13.2	167	107.3	11.19	8.08
SD076	5/5/2006	1	13.39	165	101.5	10.58	7.89
SD076	5/5/2006	13	13.34	163	100.2	10.47	7.96
SD076	5/5/2006	22	13.3	163	99.9	10.45	7.83
SD017	5/5/2006	1	13.8	133	102	10.57	8.02
SD017	5/5/2006	15	13.42	133	100.6	10.49	7.95
SD017	5/5/2006	39	13.4	144	99.8	10.40	7.93
SD006	5/5/2006	1	13.8	137	103.9	10.69	8.03
SD006	5/5/2006	10	13.71	135	101.9	10.55	7.99
SD006	5/5/2006	20	13.69	133	101.5	10.52	7.97
SD028	5/5/2006	1	14.05	136	104.2	10.69	8.07
SD028	5/5/2006	17	13.92	132	101.2	10.43	8.03
SD028	5/5/2006	30	13.92	136	100.7	10.30	7.95
SD016	5/5/2006	1	14.29	136	101.5	10.39	8.02
SD016	5/5/2006	17	14.15	135	100.8	10.35	7.98
SD016	5/5/2006	32	14.12	135	100.5	10.32	7.95

Table 3-2
Sediment and Surface Water Samples and Analyses
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Sample Location ID	River Reach	Geophysical Substrate Type ¹⁾	Top Depth Interval (Feet)	Bottom Depth Interval (Feet)	Sample Date	TAL Inorganics	TCL VOCs	SEM and AMS	TOC	Grain Size
SD001	UPSTREAM	Sand	0	0.5	May-06	X		X	X	X
SD002	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD004	UPSTREAM	Sandy Mud	0	0.5	May-06	X				X
SD005	UPSTREAM	Gravelly Sand	0	0.5	May-06	X				X
SD006	UPSTREAM	Muddy Sand	0	0.5	May-06	X				X
SD008	UPSTREAM	Sand	0	0.5	May-06	X		X	X	X
SD009	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD010	UPSTREAM	Sandy Mud	0	0.5	May-06	X		X	X	X
SD011	UPSTREAM	Sandy Mud	0	0.5	May-06	X	X			X
SD013	UPSTREAM	Muddy Sand	0	0.5	December-05	X				X
SD014	UPSTREAM	Muddy Sand	0	0.5	May-06	X		X	X	X
SD015	UPSTREAM	Gravelly Sand	0	0.5	December-05	X				X
SD016	UPSTREAM	Sand	0	0.5	May-06	X		X	X	X
SD017	UPSTREAM	Gravelly Sand	0	0.5	May-06	X				X
SD018	UPSTREAM	Muddy Sand	0	0.5	May-06	X				X
SD019	UPSTREAM	Muddy Sand	0	0.5	December-05	X	X		X	X
SD020	UPSTREAM	Gravelly Sand	0	0.5	May-06	X				X
SD021	UPSTREAM	Gravelly Sand	0	0.5	December-05	X		X	X	X
SD022	UPSTREAM	Muddy Sand	0	0.5	May-06	X		X	X	X
SD023	UPSTREAM	Sand	0	0.5	May-06	X				X
SD024	UPSTREAM	Muddy Sand	0	0.5	December-05	X				X
SD025	UPSTREAM	Sand	0	0.5	May-06	X				X
SD026	UPSTREAM	Gravelly Sand	0	0.5	May-06	X		X	X	X
SD027	UPSTREAM	Gravelly Sand	0	0.5	May-06	X				X
SD028	UPSTREAM	Sand	0	0.5	May-06	X				X
SD029	UPSTREAM	Gravelly Sand	0	0.5	December-05	X		X	X	X
SD030	UPSTREAM	Muddy Sand	0	0.5	May-06	X				X
SD031	UPSTREAM	Sand	0	0.5	May-06	X		X	X	X
SD036	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X		X
SD037	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				X
SD038	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	X
SD039	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				X
SD040	ADJACENT FAR FIELD	Sand	0	0.5	May-06	X		X	X	X
SD041	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				X
SD042	ADJACENT FAR FIELD	Gravelly Sand	2	4	December-05	X	X	X	X	X
SD043	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				
SD044	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	
SD045	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	
SD046	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				X
SD047	ADJACENT FAR FIELD	Sand	0	0.5	December-05	X		X	X	
SD048	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				
SD049	ADJACENT FAR FIELD	Sand	0	0.5	May-06	X		X	X	
SD050	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	
SD051	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	
SD052	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X		X	X	
SD053	ADJACENT FAR FIELD	Gravelly Sand	0	0.5	May-06	X				

Table 3-2
Sediment and Surface Water Samples and Analyses
EASF Corporation
Hudson River OUG Investigation
Rensselaer, New York

Sample Location ID	River Reach	Geophysical Substrate Type ¹	Top Depth Interval ² (Feet)	Bottom Depth Interval ² (Feet)	Sample Date	TAL Inorganics ³	TCL VOCs	SEM and AVS	TDC	Grain Size
SD055	ADJACENT FAR FIELD	Cobble	0	0.5	May-06	X		X	X	X
SD079	ADJACENT FAR FIELD	Sand	2	4	December-05			X	X	X
SD032	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD033	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD034	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD035	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD043	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD054	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD056	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD057	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X
SD058	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD059	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD077	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD078	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05		X	X	X	X
SD079	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05		X	X	X	X
SD080	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD081	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X
SD082	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05		X	X	X	X
SD083	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05		X	X	X	X
SD084	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD085	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X
SD086	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05		X	X	X	X
SD087	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05		X	X	X	X
SD088	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06		X	X	X	X
SD089	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05		X	X	X	X
SD090	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05		X	X	X	X
SD091	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X
SD092	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06		X	X	X	X
SD093	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06		X	X	X	X
SD094	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X
SD095	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05		X	X	X	X
SD096	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05		X	X	X	X
SD097	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05		X	X	X	X

Table 3-2
Sediment and Surface Water Samples and Analyses
BASF Corporation
Hudson River Q1-Q2 Investigation
Rensselaer, New York

Sample Location ID	River Reach	Geophysical Substrate Type ¹⁾	Top Depth Interval (Feet)	Bottom Depth Interval (Feet)	Sample Date	TAL Inorganics ²⁾	TCL VOCs	SEM and AVE	TOC	Grain Size
SD008	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
SD009	ADJACENT NEARSHORE	Muddy Sand	0	0.5	December-05	X	X	X	X	X
SD010	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD011	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
SD012	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
SD013	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD014	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD015	ADJACENT NEARSHORE	Muddy Sand	2	4	December-05	X	X	X	X	X
SD016	ADJACENT NEARSHORE	Muddy Sand	4	6	December-05	X	X	X	X	X
SD017	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD018	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD019	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD020	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD021	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD022	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD023	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD024	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD025	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD026	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD027	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD028	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD029	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD030	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD031	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD032	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD033	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD034	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD035	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD036	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD037	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD038	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD039	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD040	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD041	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD042	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD043	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD044	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD045	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD046	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD047	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD048	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD049	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD050	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD051	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD052	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD053	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD054	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD055	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD056	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD057	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD058	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD059	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD060	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD061	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD062	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD063	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD064	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD065	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD066	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD067	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD068	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD069	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD070	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD071	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD072	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD073	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD074	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD075	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD076	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD077	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD078	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD079	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD080	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD081	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD082	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD083	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD084	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD085	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD086	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD087	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD088	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD089	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD090	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD091	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD092	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD093	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD094	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD095	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD096	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD097	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD098	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD099	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD100	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD101	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD102	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD103	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD104	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD105	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD106	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD107	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD108	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD109	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD110	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD111	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD112	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD113	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD114	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD115	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD116	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD117	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD118	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD119	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD120	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD121	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD122	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD123	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD124	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD125	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD126	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD127	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD128	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD129	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD130	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD131	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD132	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD133	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD134	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD135	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD136	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD137	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD138	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD139	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD140	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD141	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD142	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD143	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD144	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD145	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD146	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD147	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD148	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD149	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD150	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD151	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD152	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD153	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD154	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD155	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD156	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD157	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD158	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X
SD159	ADJACENT NEARSHORE	Muddy Sand	2	4	May-06	X	X	X	X	X
SD160	ADJACENT NEARSHORE	Muddy Sand	4	6	May-06	X	X	X	X	X
SD161	ADJACENT NEARSHORE	Muddy Sand	0	0.5	May-06	X	X	X	X	X

Table 3-2
Sediment and Surface Water Samples and Analyses
BASF Corporation
Hudson River Q0-2 Investigation
Hempstead, New York

Sample Location ID	River Reach	Geophysical Substrate Type ¹⁾	Top Depth Interval (Feet)	Bottom Depth Interval (Feet)	Sample Date	1AL Inorganics	TCL VOCs	SEM and AYS	TOC	Grain Size
SD113	ADJACENT NEARSHORE	Muddy Sand	0	10	May-05	X	X		X	
SD114	ADJACENT NEARSHORE	Muddy Sand	2	4	May-05	X	X		X	
SD114	ADJACENT NEARSHORE	Muddy Sand	4	8	May-05	X	X		X	
SD114	ADJACENT NEARSHORE	Muddy Sand	5	8	May-05	X	X		X	
SD114	ADJACENT NEARSHORE	Muddy Sand	8	12	May-05	X	X		X	
SD011-IN7	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	December-05	X		X		X
SD012	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	December-05	X				
SD012-INW	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	December-05	X				
SD081	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD082	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X				
SD084	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD085	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X				
SD086	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD067	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD068	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD069	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD088	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD089	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	2	4	December-05	X	X		X	X
SD090	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	4	8	December-05	X	X		X	X
SD071	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD072	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD073	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD074	UPPER NAVIGATIONAL CHANNEL	Muddy Sand	0	0.5	May-06	X		X		X
SD083	OTHER ²⁾	Muddy Sand	0	0.5	May-06	X				
SD075	DOWNSTREAM	Muddy Sand	0	0.5	May-06	X		X		X
SD076	DOWNSTREAM	Muddy Sand	0	0.5	May-06	X				
SW01	UPSTREAM	Muddy Sand	NA	NA	November-05	X	X			
SW02	UPSTREAM	Muddy Sand	NA	NA	November-05	X	X			
SW03	ADJACENT NEARSHORE	Muddy Sand	NA	NA	November-05	X	X			
SW04	ADJACENT NEARSHORE	Muddy Sand	NA	NA	November-05	X	X			
SW05	ADJACENT NEARSHORE	Muddy Sand	NA	NA	November-05	X	X			
SW06	ADJACENT NEARSHORE	Muddy Sand	NA	NA	November-05	X	X			
SW07	ADJACENT NEARSHORE	Muddy Sand	NA	NA	November-05	X	X			

1 - Substrate type determined using TOCS geophysical survey.

2 - Surface water samples also analyzed for hardness and total suspended solids.

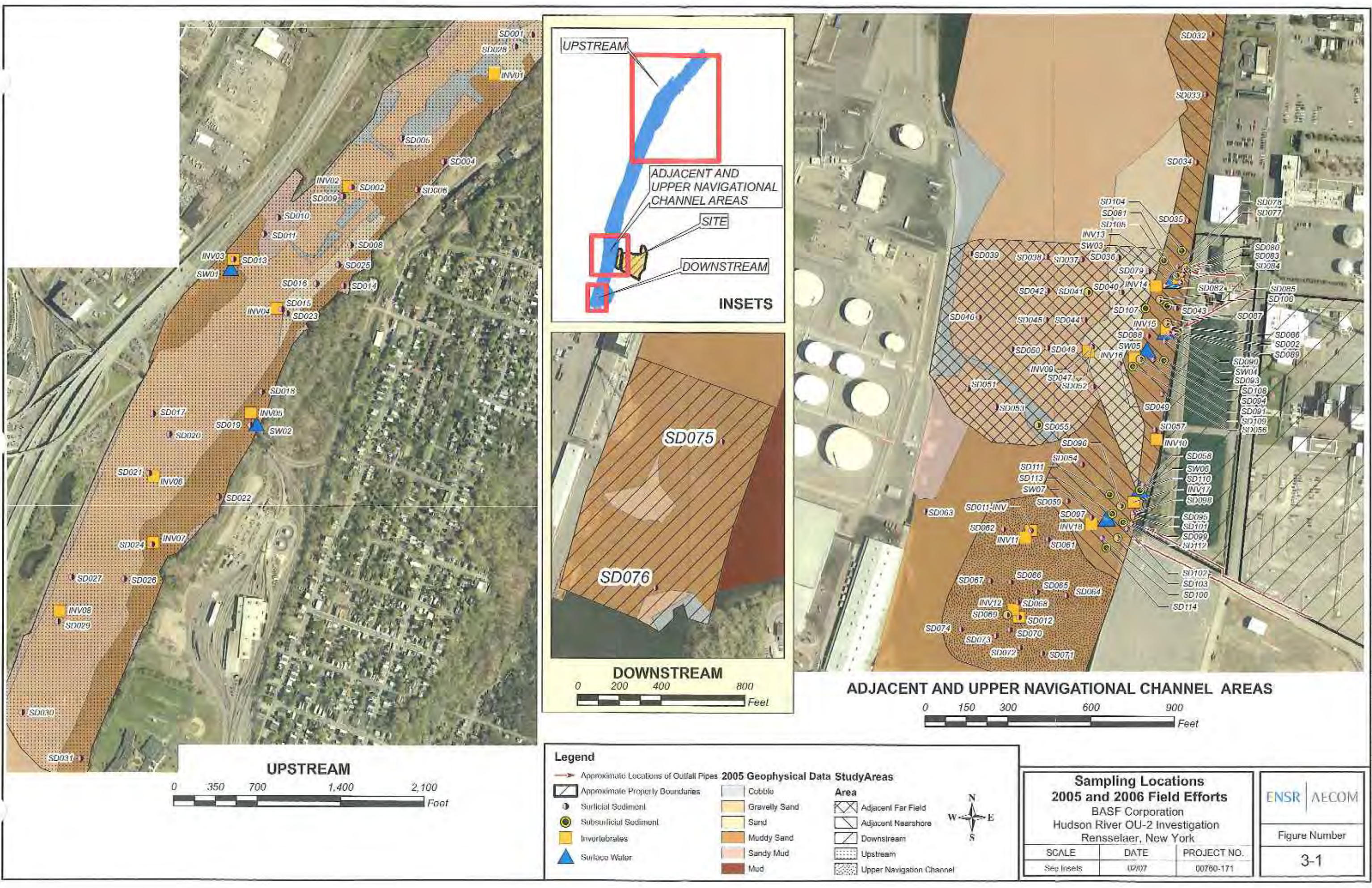
3 - Sample located in muddy sand along western shore of Hudson River. Not included in other evaluated reaches.

AVS - Acid Volatile Sulfides

NA - Not Applicable

SEM - Simultaneously Extracted Metals

TCL - Target Analyte List



4.0 Benthic Macroinvertebrate Community Characterization

In order to evaluate the health of the macroinvertebrate community and to provide a direct assessment of the integrity of the benthic community, a reconnaissance level macroinvertebrate community survey was conducted. The full report on this survey is presented in Appendix E of the Report. Benthic macroinvertebrate sampling stations were co-located with a sub-set of the surficial sediment analytical chemistry sampling stations, thereby allowing for detailed evaluation of the co-occurring data in the ecological risk assessment. The results of the macroinvertebrate community survey program provide a direct measure of the sustainability of the site-specific benthic invertebrate community in support of the ecological risk assessment.

Eighteen surficial sediment samples were taken for analysis of the benthic invertebrate community using a Ted Young grab sampler. Figure 3-1 shows the benthic invertebrate community sampling locations, which are indicated by "INV". Benthic invertebrate community samples were spatially and temporally co-located with a sub-set of the analytical sediment chemistry samples to relate observed community characteristics with measured concentrations of inorganic compounds and VOCs, as well as non-chemical parameters such as grain size. Duplicate benthic samples were collected at each sampling station.

Once the sediment sample was retrieved, the top of the grab sampler was opened to determine whether the sample collected was acceptable for analysis. In accordance with USEPA (2001) guidance, an acceptable grab is one having relatively level, intact sediment over the entire area of the grab, and a sediment depth at the center of at least 7 centimeters. Samples deemed unacceptable may result from inadequate penetration, angle of closure, completeness of closure of the jaws, and potential loss of sample material during retrieval.

Duplicate samples were collected at each sampling location (one for analysis and one for archival purposes). Samples were emptied into a collection bucket and any sediment remaining in the grab was washed directly into the bucket. The bucket was transferred to a sample-processing table where it was sieved through a 500 micron sieve bucket to remove fine material. Large debris (e.g., rocks) were removed from the sample; however, no attempt was made to remove small debris. All matter retained on the sieve was transferred to labeled storage bottles and preserved in 95 percent ethanol to cover the sample. Sample bottles were labeled with the site name, the station number, a unique sample identification number, date and time of collection, depth of collection, preservative use, and name of collectors.

The preserved samples were sent to a contract laboratory (J. Kelly Nolan, Rapid Watershed Assessment Associates, Albany, NY) under chain-of-custody for sub-sampling, identification, enumeration, statistical analysis, and reporting (see Appendix E). Sub-sampled organisms were identified to the lowest possible taxonomic level and the number of taxa and number of individuals in each sample were tabulated. Several community indices were calculated for each sample or group of samples: taxa richness, biotic index, percent model affinity, dominance-3, and taxa diversity. These indices allowed for a comparison of the invertebrate communities upstream of the Site and adjacent to the Site. The macroinvertebrate data were evaluated in the context of proximity to the Site and substrate grain size data. Similarity cluster analyses were performed to determine the similarity of benthic communities and substrate habitats between samples taken upstream of the Site and samples taken adjacent to the Site. Results were also pooled according to sampling location (i.e. upstream, adjacent, or downstream of the Site) to allow for a comparison of the benthic community in each of these areas.

5.0 Surface Water Characterization

Surface water samples were collected at mid-depth using a flow-through pump with Teflon-lined tubing. Figure 3-1 shows the surface water sampling locations and Table 3-2 presents a summary of the surface water samples and associated analyses. All surface water samples were analyzed for the following parameters:

- TCL VOCs;
- TAL Inorganics;
- Total Suspended Solids (TSS); and
- Hardness.

Samples for dissolved inorganic compounds were filtered in the lab. The following water quality parameters were measured at each location: depth, dissolved oxygen, temperature, conductivity, and pH. All surface water samples were collected prior to sediment sampling.

6.0 Literature Cited

ENSR. 2005. Work Plan Hudson River Operable Unit 2 Investigation. BASF Corporation, Rensselaer, New York. Document No. 00760-171-202. September 2005.

USEPA, 2001. Method for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual. EPA-823-B-01-002. October 2001.

Appendix B
Field Program Results
Site Investigation Report
Hudson River Operable Unit 2
BASF Rensselaer
Rensselaer, New York

Contents

1.0	Introduction.....	1-1
1.1	Data Quality.....	1-1
2.0	Geophysical Survey and Grain Size Assessment	2-1
2.1	Geophysical Survey	2-1
2.2	Sediment Grain Size	2-1
3.0	Sediment and Surface Water Analytical Data.....	3-1
3.1	Inorganic Compounds in Sediment	3-1
3.2	Organic Compounds in Sediment	3-3
3.3	Simultaneously Extracted Metals, Acid Volatile Sulfides and TOC in Sediment	3-4
3.4	Surface Water VOCs and Inorganic Compounds	3-5
4.0	Literature Cited	4-1

List of Tables

Table 2-1 Sediment Grain Size Results

Table 3-1 Sediment Analytical Results for Inorganic Compounds – Upstream

Table 3-2 Sediment Analytical Results for Inorganic Compounds – Adjacent Far Field

Table 3-3 Sediment Analytical Results for Inorganic Compounds – Adjacent Nearshore, Upper Navigational Channel and Downstream

Table 3-4 Sediment Summary Statistics – Upstream

Table 3-5 Sediment Summary Statistics – Adjacent Far Field

Table 3-6 Sediment Summary Statistics – Adjacent Nearshore

Table 3-7 Sediment Summary Statistics – Upper Navigational Channel

Table 3-8 Sediment Summary Statistics – Downstream

Table 3-9 Sediment Analytical Results for Volatile Organic Compounds

Table 3-10 Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds

Table 3-11 SEM and AVS Sediment Analytical Results

Table 3-12 Surface Water Analytical Results

Table 3-13 Surface Water Summary Statistics

List of Figures

Figure 2-1 Sediment Textural Classification – 2005 Geophysical Survey

1.0 Introduction

This appendix to the Site Investigation Report (Report) presents the results of the surface water and sediment sampling field program conducted between November 2005 and May 2006. Individual data summary tables are presented in this section, which also includes a series of maps depicting sampling locations and selected analyte concentrations. A summary of these data is presented in Section 4 of the Report. This appendix primarily provides tabular summaries of the data collected in support of the BASF Hudson River OU-2 investigation. Additional graphical (i.e., maps and figures) and tabular presentations of the data, as well as analysis of the significance of the findings, are presented in the following locations:

- Appendix G provides a statistical evaluation of the inorganic surficial sediment data, and includes detailed comparisons of Upstream to Adjacent data sets. This appendix is summarized in Section 5 of the Report.
- Appendices H and I present screening level human health and ecological risk assessments, respectively. These appendices are summarized in Sections 6 and 7 of the Report.
- Section 8 of the SI Report presents an updated Conceptual Site Model (CSM) and provides additional conceptual detail regarding compound fate, transport, and potential impacts.

As described in the Report, the data gathered from the various sampling and analysis activities have been segregated into discrete groupings (Upstream, Downstream, Adjacent Nearshore, Upper Navigational Channel, and Adjacent Far Field) based on proximity to the BASF Rensselaer facility (Site).

1.1 Data Quality

The project data quality objectives (DQOs) for the Hudson River OU-2 investigation were designed to characterize the Hudson River adjacent to the Site relative to compounds which may have emanated from the Site. Therefore, the sampling and analysis program was based on the following:

- A sampling protocol designed to obtain sufficient data to characterize the compounds adjacent to, and upstream and downstream of the Site,
- The use of sample collection and handling procedures to ensure the representativeness and integrity of the samples, and
- An analytical program designed to generate definitive data of sufficient quality and sensitivity to meet the project objectives.

In general, the data collected in support of this program are valid and considered usable for decision making purposes. Selected data points were qualified as estimated due to quality control (QC) non-conformances or were negated due to blank contamination. In addition, some data points were rejected due to more severe QC non-conformances. Qualification of the data is discussed in the validation memoranda included in Appendix D of the Report.

2.0 Geophysical Survey and Grain Size Assessment

As described in the Report, sediment characterization was conducted to provide bathymetric information in the vicinity of the Site and to gather information regarding substrate type and depositional characteristics to help focus the sample collection program. Geophysical surveys of the Study Area were performed in November 2005 to characterize surficial and sub-surficial sediments and to identify any anthropogenic anomalies on the river bottom which could potentially be sources of chemicals of potential concern (COPC). The Study Area consisted of a 3.2 mile reach of the Hudson River, extending from the turning basin located south of the Site to a point approximately 600 ft south of the Interstate 90 Bridge. As part of the sediment sampling program, grain size samples were collected at a sub-set of stations to verify the results of the geophysical survey, help provide context for the macroinvertebrate survey results, and vertically characterize the cores.

2.1 Geophysical Survey

The geophysical survey report authored by CR Environmental is presented as Appendix C of the Report. The side-scan sonar surveys produced a 30-cm resolution mosaic which allows for the determination of sediment classifications on a broad scale. These data were used to help focus the sediment sampling effort on depositional environments.

Using the classification system employed by NYSDEC (2000), the primary substrate categories observed during the 2005 survey included cobble, sandy gravel (or gravelly sand), sand, muddy sand, sandy mud, and mud. Based on a review of the sonar and sediment geotechnical data, a color-coded map of the sediment textural classifications through the entire Study Area was prepared (Figure 2-1). The results of the survey indicate that sandy gravel (or gravelly sand) is the dominant substrate throughout the Study Area; however, in the Adjacent Nearshore area, muddy sand and sandy mud comprise the majority of the substrate observed. Immediately to the west of the muddy sand/sandy mud complex is a lobe of sand. Immediately downstream of the Site in the Upper Navigational Channel and in the Downstream reach adjacent to the turning basin, much of the substrate consists of muddy sand.

Approximately 3 miles upstream of the Site, at the reference area, similar substrates are found. This reach of the river is dominated by sandy gravels and gravelly sands, with areas of muddy sand on both the eastern and western edges of the river.

The sub-bottom profiling measured sub-surficial conditions from 1 to 40 ft below the sediment surface. Penetration was typically less than 10 ft in locations upstream of the Site. Penetration adjacent to and downstream of the Site was greater, with up to 26 ft of sediment penetration. Sonar profiles presented in Appendix A show approximately 6 ft of coarse sediment in a typical upstream location, 12 to 26 ft of sediment adjacent to the southern portion of the Site, and up to 25 ft of stratified sediments located near the southern edge of the turning basin, approximately 2,000 ft downstream of the Site.

2.2 Sediment Grain Size

The results of the sediment grain size analysis (Table 2-1) indicate that several different substrate types exist within the Study Area, and generally confirm the results of the geophysical survey.

Sediments downstream of the Site and along the eastern bank of the Hudson River, including those within the Adjacent Nearshore reach and the Upper Navigational Channel, are dominated by fine sand, silt, and clay (i.e., fine-grained materials). These depositional materials comprise the muddy sands identified in the geophysical survey (Figure 2-1). Moving west from the Site, the geophysical survey indicated a lobe of sand running nearly the entire north/south length of the Site. A review of the grain size data confirmed that this lobe is dominated by more coarse materials like medium sand, with significant amounts of coarse and fine sand. This lobe starts upstream (north) of the Site and ends just upstream of the southern boundary of the Site. To the west of this

lobe, the grain size data are dominated by gravel and sands, characterized as gravelly sand in the geophysical survey. According to the geophysical survey, cobble lines much of the western bank, with a thin lobe of cobble extending towards mid-channel. This substrate type was confirmed during field sampling; however, the grain size techniques used in this project do not physically allow for adequate characterization of grain sizes larger than gravel.

The sediments upstream of the Site (i.e., at the reference area) are dominated by gravel and sand in the central portion of the channel, fine sand, silt, and clay along the eastern bank, and a mix of silt, clay, and fine sand along the west bank. Lobes of sediments dominated by either cobble or sand also occur in the upper portion of the Study Area. These grain size determinations are generally consistent with the geophysical survey characterization of the upstream locations.

In nearshore environments in the Upstream reach, evidence of bank failure was noted (much of the Upstream reach is characterized by an earthen bank, whereas the river bank in the vicinity of the Site is armored). To the extent that the nearshore fine-grained sediments in the upstream reach are derived from recent bank failure, and not long-term depositional processes, these samples may not be an ideal representation of urban background.

Sub-surficial grain size data from multiple depths were available at 15 sampling stations, primarily located in the near-site sampling area. While all 15 stations were classified as muddy sand in the geophysical survey, in general, the grain size data identified the materials as primarily dominated by silt with fewer samples dominated by fine sand or medium sand. In general, when there were materials with different grain sizes present within a core, the finer material was located in the deeper samples. However, at nine of the sampling locations, the core was classified consistently throughout the sampled horizons (not all cores included a surficial sample for grain size analysis). These results indicate that in general, the vertical stratigraphy in the nearshore environment adjacent to the Site (i.e., Adjacent Nearshore data set) is relatively homogenous and is dominated by fine-grained materials; when inconsistencies in grain size were observed with depth, these differences were not dramatic, although the near-surface horizons may be slightly more coarse than the deeper material.

Table 2-1
Sediment Grain Size Results
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Location ID	Depth Interval (ft)	Grain Size (%)							
		Gravel	Coarse Sand	Medium Sand	Fine Sand	Total Silt	Total Clay	Total Sand	Total Fines
UPSTREAM									
SD001	0 - 0.5	44.4	21.2	23.5	8.5	1.0	1.4	53.2	2.4
SD002	0 - 0.5	29.3	20	41.6	7.7	0.8	0.5	69.3	1.4
SD004	0 - 0.5	28.9	11.9	13.6	20	18	7.6	45.5	25.5
SD005	0 - 0.5	47.8	14	29.7	6.9	0.8	0.8	50.6	1.6
SD006	0 - 0.5	1.5	3.3	9	38	38.2	12	48.3	50.2
SD008	0 - 0.6	48.15	8.25	20.95	15.35	4.8	2.5	44.55	7.3
SD009	0 - 0.5	22.05	23.6	43.85	5.45	1.25	3.8	72.9	5.05
SD010	0 - 0.5	2.1	3.5	10.1	69.5	9.8	5	83.1	14.8
SD011	0 - 0.5	0.7	1.9	13.1	68.8	12.7	4.8	81.8	17.5
SD013	0 - 0.5	0.2	0	1.2	85.2	27.7	5.7	86.4	33.4
SD014	0 - 0.6	0	0.3	1.8	45.9	43.4	8.6	48	52
SD015	0 - 0.5	24.4	18.5	21.8	25.8	1.6	7.9	66.1	9.5
SD016	0 - 0.5	50.8	13.5	23.1	10.2	1.7	0.7	46.8	2.4
SD017	0 - 0.5	32.1	21.4	38.8	5.7	0.6	0.4	66.9	1
SD018	0 - 0.5	0	0.2	2.4	41.3	46	10.1	43.9	56.1
SD019	0 - 0.5	13.3	6.5	14.8	26.6	36.9	1.9	47.9	38.8
SD020	0 - 0.5	32.8	19.7	38.3	7.5	0.7	1	65.5	1.7
SD021	0 - 0.5	34.7	21.4	34.2	8	1.3	0.4	63.6	1.7
SD022	0 - 0.5	0.6	0.3	1.7	36.5	48.6	12.3	38.5	80.9
SD023	0 - 0.5	50.6	10.6	15	21.2	1.8	0.8	46.8	2.6
SD024	0 - 0.5	0.7	2.7	21.4	48.2	19.3	7.7	72.3	27
SD025	0 - 0.5	27.2	10.9	17.9	34.5	7.0	2.5	63.3	9.5
SD026	0 - 0.5	1.4	5.5	53.6	37.6	1.4	0.5	96.7	1.9
SD027	0 - 0.5	41.4	9	28.5	16.4	1.4	2.3	54.9	3.7
SD028	0 - 0.5	47.1	14.2	19.4	13.7	3.6	2	47.3	5.6
SD029	0 - 0.5	10	10.6	37.4	36.2	3.3	2.5	84.2	5.8
SD030	0 - 0.5	25.7	17.4	41.5	10.8	2.9	1.7	69.7	4.6
SD031	0 - 0.5	5.6	2.4	4.6	35.7	39.6	12.1	42.7	51.7
ADJACENT FAR FIELD									
SD036	0 - 0.5	28.7	15.1	27	27	1.7	0.5	68.1	2.2
SD037	0 - 0.5	12.7	41.9	44	0.9	0.2	0.4	86.7	0.6
SD038	0 - 0.5	44.9	16.4	32.8	5.1	0.4	0.4	54.3	0.8
SD039	0 - 0.5	48.5	19.5	26.4	4.5	1.9	1.1	50.4	3
SD040	0 - 0.5	11.7	23.3	40.2	23	1.2	0.6	86.5	1.8
SD041	2 - 4	15.5	18.8	58.4	6	1.2	0.1	83.2	1.3
SD047	0 - 0.5	4.2	9.9	66.2	17.3	1.6	0.8	93.4	2.4
SD055	2 - 4	21.7	30	41.6	5.5	1.1	0.1	77.1	1.2
SD079	0 - 0.5	4.7	8.1	63.3	23.4	0.5	2	92.8	2.5
ADJACENT NEARSHORE									
SD032	0 - 0.5	16.5	15.5	14.2	19.2	27.3	7.3	48.9	34.6
SD033	0 - 0.5	5	4.8	6.5	31.9	38.7	13.1	43.2	51.8
SD034	0 - 0.5	1.1	1.8	10.4	41.4	38.3	9	53.6	45.3
SD035	0 - 0.5	0.6	1	3.2	28.6	48.7	16.9	32.9	66.6
SD057	0 - 0.5	0.3	0.1	3	28.5	60.6	6.5	32.6	57.1
SD059	0 - 0.5	1	1.7	21.2	52.4	15.6	7.9	75.3	23.7
SD077	0 - 0.5	7.3	3.9	10.9	30.3	37.1	10.5	45.1	47.6
SD077	2 - 4	2	2.5	54.1	12.5	28.2	0.7	69.1	28.9
SD077	4 - 6	0.1	0.4	71.2	9.8	16.1	2.4	81.4	18.5
SD078	0 - 0.5	0	0.3	10.5	31.1	42	16.1	41.9	58.1
SD080	0 - 0.5	17.4	9.4	17.6	28.5	20.1	7	55.5	27.1
SD081	0 - 0.5	0	0.3	1.6	32.9	46.6	18.6	34.8	65.2
SD081	2 - 4	0	0.1	10.8	30.5	57.4	1.2	41.4	58.6
SD081	4 - 6	0.7	1.5	20.6	28.2	41.6	7.4	50.3	49
SD082	0 - 0.5	2.1	0.8	14.3	24.3	56.6	1.9	30.4	58.5
SD083	0 - 0.5	0.9	1.3	6.9	42.3	37.4	11.2	60.5	48.6
SD084	0 - 0.5	0	0.5	4.4	40	42.3	12.8	44.9	55.1
SD085	0 - 0.5	0	0.3	18.1	20.5	58	3.1	38.9	61.1
SD085	2 - 4	0	1.2	19	26.7	48.8	4.3	46.9	53.1
SD085	4 - 6	0.6	1.3	11	24.5	51.3	11.3	36.8	62.6
SD086	0 - 0.5	0.2	0.8	5.8	58.9	33.9	0.4	85.5	34.3
SD087	0 - 0.5	2.6	2.1	9.6	23.3	62.1	0.3	35	62.4
SD087	2 - 4	4.1	12.4	29.7	28.1	24.8	0.9	70.2	25.7
SD087	4 - 6	1.2	11.1	27.1	36.5	24	0.1	74.7	24.1
SD088	0 - 0.5	0	0	7.2	16.3	66	10.5	23.5	76.5
SD089	0 - 0.5	1.4	1.5	7.4	85.4	18.2	6.1	74.3	24.3
SD089	2 - 4	1	5.3	18.3	39.7	34.7	1	63.3	35.7
SD089	4 - 6	0	1.8	20.4	41.7	35.9	0.2	63.9	38.1

Table 2-1
Sediment Grain Size Results
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Location ID	Depth Interval (ft)	Grain Size (%)							
		Gravel	Coarse Sand	Medium Sand	Fine Sand	Total Silt	Total Clay	Total Sand	Total Fines
ADJACENT NEARSHORE									
SD090	0 - 0.5	0.1	0.2	2	49.5	47	1.2	51.7	48.2
SD091	0 - 0.5	2.3	3.3	10.1	65.8	17.9	0.6	79.2	18.5
SD093	0 - 0.5	0.8	1.6	7.5	40.9	48.1	1.1	50	49.2
SD095	0 - 0.6	0.2	0.5	2	51.9	45.3	0.1	54.4	45.4
SD096	0 - 0.5	3.9	2.8	6.4	68.9	10.7	7.3	78.1	18
SD096	2 - 4	5.5	1.7	7.3	27.9	56.5	1.1	56.9	57.6
SD096	4 - 6	0.1	1.3	4.8	28.8	60.8	4.2	34.9	85
SD097	0 - 0.5	6.7	4.9	6.8	64.5	7.7	9.4	76.2	17.1
SD098	0 - 0.5	0	0.1	2.2	33.6	60.1	4	35.9	64.1
SD099	0 - 0.5	0.1	0.4	3.2	69.1	12.2	15	72.7	27.2
SD100	0 - 0.5	0.1	0.2	9.4	69.2	17	5.1	77.8	22.1
SD101	2 - 4	0.9	1.1	15.6	21.3	56.8	4.3	38	61.1
SD101	4 - 6	2.9	0	30.5	27.2	38.8	0.6	57.7	39.4
SD103	0 - 0.5	0	0.1	2.9	53.2	36.2	7.8	56.2	43.8
SD103	2 - 4	0	0.7	20.6	29.7	34.6	14.4	51	49
SD103	4 - 6	0	0.1	21.3	2.1	44.5	32	23.5	76.5
SD104	2 - 4	0	0	10.9	20.4	55.4	13.3	31.3	68.7
SD104	4 - 6	1.15	1.45	11.25	27.35	45.8	13	40.05	58.8
SD104	6 - 8	2.6	2.7	27.4	30.8	29.1	7.4	60.9	36.5
SD105	2 - 4	0.5	0.5	7	21	52.4	18.6	28.5	71
SD105	4 - 6	0	0	10.3	23.2	51.2	15.3	33.5	66.5
SD105	6 - 8	0	0.1	8.7	31.4	45.8	14	40.2	59.8
SD106	2 - 4	0	0	16.4	15.1	69.7	4.8	31.5	68.5
SD106	4 - 6	1.2	0.9	13.8	16.4	51	16.7	31.1	67.7
SD108	2 - 4	0	0	4.6	26.1	52.2	17.1	30.7	69.3
SD108	4 - 6	0	0	5.9	13.7	78.3	2.1	19.6	80.4
SD108	6 - 8	1	0.1	11.4	16.5	62.8	6.2	28	71
SD108	8 - 10	0.1	0.3	7.2	14.1	62.2	16.1	21.8	78.3
SD110	2 - 4	2.6	1.1	11.7	19.2	46.9	18.5	32	85.4
SD110	4 - 6	10.7	7.7	22.9	25.8	25.2	7.7	56.4	32.9
SD110	6 - 8	7	2.75	16.65	20.15	39.55	13.9	39.55	53.45
SD112	2 - 4	0	0	8.3	15.7	58.5	17.5	24	76
SD112	4 - 6	0	0	9.7	12.5	59.7	18.1	22.2	77.8
SD112	6 - 8	0	0.3	9.7	15.7	54.4	19.9	25.7	74.3
SD112	8 - 10	1.5	1.7	15.4	25	43.4	12	43.1	55.4
UPPER NAVIGATIONAL CHANNEL									
SD011-INV	0 - 0.5	0	0.4	4	68.8	24.4	2.4	73.2	26.8
SD012	0 - 0.5	0.9	3.1	11.8	56.5	25.1	0.6	73.4	25.7
SD061	0 - 0.5	3.7	3.6	38.2	43.5	8.9	2.1	85.3	11
SD062	0 - 0.5	0	7.8	8.9	10.7	56.6	16	27.4	72.6
SD064	0 - 0.5	0.2	0.3	15.7	74	9.7	0.1	90	9.8
SD065	0 - 0.5	0.4	0.9	33.5	61.3	3.8	0.1	95.7	3.9
SD066	0 - 0.5	17.4	5.5	28.9	31.8	5.9	0.5	78.2	6.4
SD067	0 - 0.5	9.8	5.5	36.5	33.8	7.7	6.7	75.9	14.4
SD068	0 - 0.5	0	0	5.3	36.7	43.6	14.4	42	58
SD069	0 - 0.5	1.7	1	8.1	41.7	38.1	9.4	50.8	47.5
SD069	2 - 4	2.9	2.3	6.4	47.3	16.9	24.2	56	41.1
SD069	4 - 6	1	9.2	14.9	7.2	33.9	33.8	31.3	67.7
SD070	0 - 0.5	7.1	7.8	10.1	35.1	29.4	10.5	53	39.9
SD071	0 - 0.5	0.2	1.3	11.3	52.5	27.6	7.1	65.1	34.7
SD072	0 - 0.5	2	2.3	34.3	42.4	18.1	0.9	79	19
SD073	0 - 0.5	4.2	2.8	35.1	43.6	9.3	4.8	81.7	14.1
SD074	0 - 0.5	18.3	13.5	43.9	19	3.2	2.1	76.4	5.3
DOWNSTREAM									
SD075	0 - 0.5	0.9	0.3	56.4	38.2	1.5	2.7	84.9	4.2
SD076	0 - 0.5	0.7	0.8	41.2	31.7	17	8.8	73.5	25.8

Total Sand represents the sum of the Coarse, Medium, and Fine Sand Fractions.
Total Fines represents the sum of the Total Silt and Total Clay Fractions.



Legend

 Approximate Extent of Property Boundaries

2005 Geophysical Data

 Cobble
 Gravelly Sand
 Sand
 Muddy Sand
 Sandy Mud
 Mud

0 1,000 2,000 4,000
 Feet



Sediment Textural Classification 2005 Geophysical Survey

BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
1:24000	02/07	00780-171

ENSUR | AECOM

Figure Number

2-1

3.0 Sediment and Surface Water Analytical Data

Sediment and surface water sampling and analysis was conducted to obtain a comprehensive set of physical and chemical data for the Hudson River adjacent to the Site. Additional sampling was conducted upstream of the Site to evaluate anthropogenic background conditions in the Albany area. At a sub-set of stations, surficial sediment samples were also collected to evaluate the health of the macroinvertebrate community and to provide a direct assessment of the integrity of the benthic community. Benthic macroinvertebrate sampling stations were co-located with a sub-set of the surficial sediment analytical chemistry sampling stations, thereby allowing for detailed evaluation of the co-occurring data in the ecological risk assessment. The analytical results for the sediment and surface water samples are discussed in the following sub-sections and the benthic survey results are presented in Appendix E of the Report.

3.1 Inorganic Compounds in Sediment

Based on previous studies of the Hudson River in the vicinity of the BASF Site and a review of the BASF OU-1 source area data, the following metals have been identified as potentially Site-related stressors of concern: cadmium, chromium, copper, lead, mercury, and zinc. These metals, as well as other inorganic compounds, are also known to occur due to urban anthropogenic background sources and have been previously identified as occurring in depositional environments in urban rivers in the glaciated northeast.

A total of 101 surficial and 56 sub-surficial sediment samples were analyzed for inorganic compounds as part of this study. These sampling stations were collected from the following strata and locations (excluding field duplicates and other QA/QC samples):

Sampling Horizon (ft)	Number of Sampling Stations Evaluated					Sum
	Upstream	Adjacent Nearshore	Adjacent Far Field	Upper Navigational Channel	Downstream	
0 to 0.5	28	36	19	15	2	101 ^[1]
2 to 4	--	20	2	1	--	23
4 to 6	--	20	--	1	--	21
6 to 8	--	8	--	--	--	8
8 to 10	--	4	--	--	--	8
Sum	28	88	21	17	2	157

[1] A single surficial sample was collected from the muddy sand along western shore of Hudson River. This sample (SD063) is not included in other evaluated reaches.

Tables 3-1 through 3-3 present the sample-by-sample summary of the detected inorganic compounds in sediment. The information in this table, which has been organized to present the sampling data by sampling location (upstream to downstream) and by sampling horizon, indicates that inorganic compounds were detected at locations upstream, adjacent to, and downstream of the Site.

To provide a broader understanding of the data in the context of this large riverine system, summary statistics were calculated for each detected analyte in the samples collected during the field effort. Before summary statistics were calculated, the following steps were taken for each analyte. If a chemical was detected at least once, one-half the chemical's quantitation limit was used as a proxy concentration for those instances in which

the chemical was reported as undetected. However, if the proxy concentration was greater than any detected value, the proxy concentration was removed from the database. Although this approach is consistent with USEPA guidance (USEPA, 1989), which recognizes that high sample quantitation limits can lead to unrealistic concentration estimates, it does introduce some uncertainty into the data evaluation. Estimated concentrations (J-coded values), including those below the quantitation limit but above the Method Detection Limit (MDL), were treated as detected values. Duplicate sample analytical results were averaged, and the average used as the sample point concentration in the calculation of summary statistics. All detected analytes are included in the calculation of summary statistics.

Summary statistics were calculated for each depth interval according to the river reach represented by the data. These reaches, to a certain extent, also correspond to the surficial sediment substrate classifications determined by the geophysical surveys (i.e., sandy mud, muddy sand, sand, gravelly sand). The summary statistics for the Upstream, Adjacent Far Field, Adjacent Nearshore, Upper Navigational Channel, and Downstream data are presented in Tables 3-4 through 3-8, respectively.

The following summary statistics were calculated for each sediment stratum in the above-referenced exposure areas:

- Frequency of detection (FOD; defined as the number of detected samples : number of samples used to calculate summary statistics : number of total samples)
- Range of detected concentrations (minimum, maximum)
- Arithmetic mean of detected concentrations
- Location of maximum detection

These summary statistics were generated to determine ranges of concentrations and for use in the relatively simple evaluation presented in this Section. Additional treatment of the data, such as transformation and evaluation of distributional characteristics, is presented in the more detailed statistical analysis (see Section 5 and Appendix G of the Report).

With regard to the inorganic compounds, a few trends are apparent relative to the data presented in this section:

- While levels of inorganic compounds occur in upstream areas which are clearly not influenced by potentially Site-related compounds, concentrations in the Adjacent Nearshore area appear to generally be elevated relative to urban background (i.e., relative to the Upstream data set). Consistency with background conditions is explored further in Section 5 of the Report.
- In the muddy sand located in the immediate vicinity of the Site (i.e., Adjacent Nearshore), concentrations of metals in surficial and sub-surficial sediment are elevated relative to the concentrations in the main channel.
- In the Adjacent Nearshore, concentrations of metals are generally elevated in deeper sediments when compared to surficial sediments at individual sampling locations. The areas of higher metals concentrations typically correspond to depositional sediments (i.e., muddy sand) with finer grain sizes, and appear to be potentially co-located with the locations of historic outfalls from the Site.
- In the Adjacent Far Field, located to the west of the muddy sand adjacent to the Site, inorganic compound concentrations decrease markedly and are generally consistent with concentrations upstream of the Site and further downstream, adjacent to the turning basin.
- Surficial metals levels are slightly elevated in the muddy sand found in the Upper Navigational Channel, located just downstream of the Adjacent reach.

The potential significance of these (and other) trends is further discussed in Sections 5 through 9 of the Report.

3.2 Organic Compounds in Sediment

Previous studies of the Hudson River in the vicinity of the BASF Site identified a sub-set of VOCs of potential concern in sediments adjacent to the Site which exceed NYSDEC guidelines. These VOCs included benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene. A total of 37 surficial and 56 sub-surficial sediment samples were analyzed for organic compounds (specifically VOCs) as part of this study. These sampling stations were collected from the following strata and locations:

Sampling Horizon (ft)	Number of Sampling Stations Evaluated					
	Upstream	Adjacent Nearshore	Adjacent Far Field	Upper Navigational Channel	Downstream	Sum
0 to 0.5	2	34	1	--	--	37
2 to 4	--	20	2	1	--	23
4 to 6	--	20	--	1	--	21
6 to 8	--	8	--	--	--	8
8 to 10	--	4	--	--	--	4
Sum	2	86	3	2	--	93

Table 3-9 presents the sample-by-sample summary of the detected VOCs in sediment. Table 3-10 presents the sample-by-sample summary of detected VOCs with concentrations normalized to organic carbon. Summary statistics were also calculated for VOCs on both a bulk sediment and organic carbon-normalized basis. These summaries are also included in Tables 3-4 through 3-8. The data treatment for calculating summary statistics was consistent with that described for inorganic compounds.

With regard to the VOCs, a few trends are apparent relative to the data presented in this section:

- VOCs were generally detected only in the Nearshore area, at sampling stations that are located immediately adjacent to the Site bulkhead. Outside of this nearshore environment, VOC concentrations were markedly lower or not detected.
- Concentrations of VOCs in the Adjacent Nearshore area were generally highest in sub-surficial sediments in areas containing muddy sand substrate near the historic outfalls. The band of potentially impacted muddy sand extends from 90 to 185 ft west of the Site bulkhead prior to transitioning to coarser-grained material in the Adjacent Far Field
- Adjacent to the Site, the upstream extent of surficial VOCs lies between SD035 and SD034, sampling locations situated immediately to the north of the northern Site boundary. It is likely that the sub-surficial extent lies between SD035 and SD104, just upstream of the inactive storm sewer outfall.
- Adjacent to the Site, elevated VOC concentrations in surficial and sub-surficial sediments are bound by the extent of muddy sand, which extends 90 to 185 ft west of the bulkhead before transitioning to sandy substrate (i.e., the Adjacent Far Field).
- Within the Adjacent Nearshore environment, the downstream extent of potential VOC impacts is in the vicinity of SD114. Concentrations at this location range from slightly elevated to non-detect, with concentrations generally decreasing with sediment depth.

3.3 Simultaneously Extracted Metals, Acid Volatile Sulfides and TOC in Sediment

To help determine whether or not inorganic substances are potential stressors of concern in sediments at the Hudson River, SEM and AVS data were collected from a total of 48 sampling locations (representing approximately 45 to 50% percent of the surface samples evaluated in this study). These stations were broadly distributed and included nine Upstream, 10 Adjacent Far Field, 19 Adjacent Nearshore, nine Upper Navigational Channel, and one Downstream sampling locations.

Samples were collected from the top 0 to 4 cm of sediment to minimize the potential influence of deeper anoxic sediments on this measure of bioavailability. These data rely on the equilibrium partitioning (EqP) approach for establishing sediment quality criteria. The USEPA briefing report to the USEPA science advisory board presents an EqP approach for evaluating metal-contaminated sediments (USEPA, 1994). This document has been revised and expanded in subsequent EPA guidance for deriving Equilibrium Partitioning Sediment Benchmarks (ESBs) for metals mixtures (USEPA, 2005).

The recommended EqP approach for metals accounts for the bioavailability of metals in sediments. The basis of the EqP approach for deriving screening criteria for metals in sediments is that metal partitioning occurs in sediments between solid and aqueous phases. Sulfides play a critical role in the partitioning of metals in sediments. The majority of sulfides in sediments are present as solid phase iron monosulfides and disulfides (pyrite). Monosulfides are considerably more reactive than disulfides. The most labile sulfidic fraction in sediments consists of the AVS. This fraction is associated with the iron and manganese monosulfides. Iron and manganese sulfides readily dissolve in interstitial pore water in the presence of divalent metals. Conversely, many other metal sulfides are quite insoluble. Insoluble metal sulfide complexes (solid phase) tend to have low bioavailability and therefore low toxicity for aquatic organisms.

Divalent metals in sediments will bind to available AVS in order of increasing solubility. For the five metals evaluated by USEPA (USEPA, 1994), copper, lead, cadmium, zinc, and nickel will bind to available AVS and be sequentially converted to copper sulfide, lead sulfide, cadmium sulfide, zinc sulfide, and nickel sulfide (i.e., in the order of increasing solubility). This reaction takes place as long as sulfides, in particular AVS, are available. If the molar sum of divalent cations (i.e., copper, lead, cadmium, zinc, and nickel) is less than the molar concentration of available AVS, these metals will exist as metal sulfides. Such metal sulfides are insoluble and are not present in sediment pore water. Therefore, sediments with higher concentrations of AVS than metals will tend to exhibit low metals toxicity. Conversely, when the molar sum of the metals is greater than the molar AVS concentration, the portion of the metals in excess of the AVS concentration can potentially exist as free metals, and thus can potentially be bioavailable and toxic. The ESB document (USEPA, 2005) also considers a sixth metal (silver) in the EqP approach.

The appropriate analytical measurement of metals used to calculate the metals:AVS ratio is known as the SEM concentration. The SEM concentration represents the metals extracted in the AVS analytical procedure recommended by USEPA. Sediments with SEM:AVS ratios less than 1 typically have sufficient metal binding capacity to maintain dissolved metals concentrations in the pore water below toxic levels. When the SEM:AVS molar ratio is less than one, the USEPA briefing report to the USEPA science advisory board (USEPA, 1994) states that "in virtually no instance has metals toxicity been observed." Conversely, when the SEM:AVS ratio is greater than one, toxicity is often, but not always, predicted. This suggests that other binding phases beyond AVS (i.e., total organic carbon) may also limit the bioavailability and resulting toxicity of metals in sediments. Recent USEPA guidance (USEPA, 2005) suggests using the difference (SEM minus AVS) rather than the ratio (SEM:AVS) for evaluation of metals bioavailability in sediments; therefore, this evaluation considers both SEM:AVS and SEM-AVS.

When multiple metals are present, it is necessary to evaluate the metals in terms of their solubility products. For instance, if sediments at a site are contaminated with both lead and cadmium, it is possible that AVS (i.e., iron sulfide) could limit the bioavailability and toxicity of one or both of these metals. In the presence of sulfide ions, lead is less soluble than cadmium. Therefore, lead has a higher affinity for AVS than cadmium and will

preferentially bind to available AVS to form solid phase, non-toxic lead sulfide. If sufficient AVS is available, all of the lead in the system will be tightly bound as lead sulfide. If excess AVS is still available when all of the lead is sulfide-bound, then cadmium ions will bind to the remaining sulfide ions. When the molar concentration of lead and cadmium ions exceeds the molar concentration of sulfide ions, the metals will no longer be present as sulfide-bound, insoluble complexes. If this situation occurs, sediment toxicity is possible, depending upon the presence and role of other binding phases in the sediment.

The USEPA (2005) evaluation of metals bioavailability also evaluates possible binding of metals not just by AVS, but also by organic matter. The enhancements to the SEM-AVS approach presented in USEPA (2005) include calculating the difference between the total SEM and the total AVS, then normalizing this fraction (the sum SEM-AVS fraction) to the amount of organic carbon present in the sediment. This approach is presented as $(\Sigma \text{SEM-AVS})/f_{oc}$, where f_{oc} is the fraction of organic carbon in the sediment sample. This proposed revision to the method accounts for binding phases other than AVS, such as the fraction organic carbon.

Under the proposed USEPA (2005) approach, the $(\Sigma \text{SEM-AVS})/f_{oc}$ values can be compared to literature values for which toxicity has (or has not) been observed for invertebrate receptor species. The ESB document for metals mixtures (USEPA, 2005) suggests use of the following scale to evaluate whether or not the organic carbon binding phase, in conjunction with the AVS, is affecting the bioavailability of metals in sediment:

- If the $(\Sigma \text{SEM-AVS})/f_{oc}$ excess exceeds 3000 $\mu\text{mol/g}_{oc}$, the sediments are presumed to be "likely to be toxic";
- If the $(\Sigma \text{SEM-AVS})/f_{oc}$ excess is between 130 and 3,000 $\mu\text{mol/g}_{oc}$, predictions of effects are uncertain; and
- If the $(\Sigma \text{SEM-AVS})/f_{oc}$ excess is less than 130 $\mu\text{mol/g}_{oc}$, the sediments are presumed to "not likely" be toxic.

The SEM and AVS data obtained from the Hudson River OU sediment samples are presented in Table 3-11, and are interpreted further in the ecological risk characterization section (Section 7) of the Report.

3.4 Surface Water VOCs and Inorganic Compounds

Individual surface water sampling data is presented in Table 3-12 and summary statistics for total recoverable and dissolved inorganic compounds and VOCs in surface water are presented in Table 3-13. As indicated by the concentration ranges and mean concentrations, there is little difference in inorganic compound concentrations upstream and adjacent to the Site. For many compounds, concentrations were slightly higher upstream of the Site than adjacent to the Site.

With the exception of acetone and toluene, VOCs were non-detected in all surface water samples. Acetone concentrations were low and similar upstream and adjacent to the Site. Toluene was not detected upstream of the Site and low adjacent to the Site. The low levels of acetone and toluene detected in surface water samples could potentially be due to laboratory contamination.

As discussed further in the risk assessment chapters of the Report (Sections 6 and 7), as well as the CSM (Section 8 of the Report), a review of the surface water data indicates that it is not a medium of concern at this Site.

Table 3-1
Sediment Analytical Results for Inorganic Compounds - Upstream
BASF Corporation
Hudson River QJ-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	UPSTREAM Muddy Sand SD013 01SD013UA1 0-5	UPSTREAM Muddy Sand SD014 02SD014UA1 0-5	UPSTREAM Gravelly Sand SD015 01SD015UA1 0-5	UPSTREAM Sand SD016 02SD016UA1 0-5	UPSTREAM Gravelly Sand SD017 02SD017UA1 0-5	UPSTREAM Muddy Sand SD018 02SD018UA1 0-5	UPSTREAM Muddy Sand SD019 01SD019UA1 0-5	UPSTREAM Gravelly Sand SD020 02SD020UA1 0-5	UPSTREAM Gravelly Sand SD021 01SD021UA1 0-5	UPSTREAM Muddy Sand SD022 02SD022UA1 0-5
ALUMINUM	mg/kg	9440 J	9310	12300 J	5150	5730	11900 J	11300 J	3550	8560 J	13600 J
ANTIMONY	mg/kg	9.5 UJ	0.33 J	7.2 J	0.42 J	0.05 UJ	0.4 J	8.5 UJ	0.08 UJ	7.0 UJ	0.33 J
ARSENIC	mg/kg	4.0 J	2.8	3.8 J	1.4	1.1	3.2 J	5.1 J	1.3	2.5 J	3.9 J
BARIUM	mg/kg	79.3	79	110	21.4	15.7	104 J	76.9	14	27.8	117 J
BERYLLIUM	mg/kg	0.79 U	0.9 U	0.6 U	1.2 U	1.1 U	1.0 J	0.71 U	1.1 U	0.58 U	1.0 J
CADMIUM	mg/kg	0.79 U	0.9 U	0.6 U	1.2 U	1.1 U	1.1 J	0.71 U	1.1 U	0.58 U	1.1 J
CALCIUM METAL	mg/kg	13500 J	11800 J	4830	1700 J	2520 J	9210 J	5590 J	2190 J	1950 J	15600 J
CHROMIUM, TOTAL	mg/kg	24.5 J	22.5	26.2 J	9	9.5	23.4 J	25.5 J	6	14.1 J	27.3 J
COBALT	mg/kg	8.1	9.6	10.4	5	4.2	11.3 J	9.8	3.1	8.0	11.5 J
COPPER	mg/kg	31.0 J	28.9 J	16.7 J	11.7 J	8.5 J	34.8 J	25.1 J	5.3 J	10.9 J	32.6 J
IRON, TOTAL	mg/kg	20100	22100	29500	14800	15900	27700 J	24300	9970	19000	29200 J
LEAD	mg/kg	46.4 J	18 J	17.7 J	23 UJ	22 UJ	19 J	28.1 J	22 UJ	7.6 J	28.2 J
MAGNESIUM	mg/kg	6320 J	8870	5760 J	2780	4870	7120 J	6170 J	1840	5210 J	8130 J
MANGANESE	mg/kg	619	662	476	191	205	984 J	586	156	324	988 J
MERCURY	mg/kg	0.07 J	0.1	0.12 J	0.02	0.02	0.13 J	0.08 J	0.02 U	0.04 J	0.19 J
NICKEL	mg/kg	20.0	20.7	27.3	11.5	13.5	22.9 J	19.4	6.9	17.7	26 J
POTASSIUM	mg/kg	1570	1080	1600	643	434 U	1270 J	1650	449 U	882	1880 J
SELENIUM	mg/kg	0.77 U	0.9 U	0.61 U	1.1 U	1.1 U	1.0 J	0.71 U	1.1 U	0.56 U	1.0 J
SILVER	mg/kg	1.6 U	0.19	1.2 U	0.04	0.02 U	0.21 J	1.4 U	0.02 U	1.2 U	0.16 J
SODIUM	mg/kg	142	76 J	85.4	44.7 J	36.9 J	90.1 J	127	35.4 J	180	116 J
THALLIUM	mg/kg	4.7 UJ	0.12	3.6 J	0.04	0.03	0.14 J	4.3 UJ	0.02	3.5 UJ	0.16 J
VANADIUM	mg/kg	19.6	16.7	17.9	7.9	7.2	19.1 J	21.3	5.2	13.9	29.7 J
ZINC	mg/kg	120 J	110	153 J	45.8	52.3	152 J	108 J	32.8	58.6 J	190 J

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-1
Sediment Analytical Results for Inorganic Compounds - Upstream
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Location	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM	UPSTREAM
Geophysical	Sand	Muddy Sand	Gravelly Sand	Gravelly Sand	Gravelly Sand	Sand	Gravelly Sand	Sand	Gravelly Sand	Gravelly Sand	Muddy Sand
Substrate	SD023	SD024	SD025	SD026	SD027	SD028	SD029	SD030	SD031	SD032	SD033
Location ID	02SD023UA1	01SD024UA1	02SD025UA1	02SD026UA1	02SD027UA1	02SD028UA1	01SD029UA1	02SD030UA1	02SD031UA1	02SD032UA1	02SD033UA1
Sample ID	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5
Depth Interval	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ANALYSIS	8610	15700 J	7230	7440	4770	7180	8400 J	5080	8720	5080	8720
ALUMINUM	0.09 J	11.2 UJ	0.21 J	0.09 J	0.27 J	0.14 J	7.0 J	0.08 J	0.45 J	0.08 J	0.45 J
ANTIMONY	1.2	5.1 J	1.2	1.5	1.3	2.1	3.4 J	1.1	2.3	1.1	2.3
ARSENIC	36.5	113	42.7	35.8	47.4	52.5	47.3	27.8	55.9	27.8	55.9
BARIUM	1.2 U	0.93 U	1.1 U	1.2 U	1.1 U	1.2 U	0.58 U	1.2 U	1 U	1.2 U	1 U
BERYLLIUM	1.2 U	0.93 U	1.6	1.2 U	1 U	1.2 U	0.58 U	1.2 U	1 U	1.2 U	1 U
CADMIUM	6700 J	8880 J	5780 J	2170 J	6240 J	6080 J	8080	1390 J	5380 J	1390 J	5380 J
CALCIUM METAL	15.7	38.5 J	16.5	16.8	10.1	27.2	15.8 J	6.4	19.9	6.4	19.9
CHROMIUM, TOTAL	8.9	18.0	7.4	6.5	4.9	6.8	6.5	4.4	8.7	4.4	8.7
COPPER	18.4 J	32.4 J	18.6 J	10.7	15	34.9 J	14.2 J	6.7	33.6	6.7	33.6
IRON, TOTAL	22000	30800	18000	17700	13600	20200	26000	22600	21800	22600	21800
LEAD	24 UJ	33.8 J	23 UJ	24 UJ	48	25 J	32.5 J	23 UJ	34.1	23 UJ	34.1
MAGNESIUM	4710	6850 J	3950	3930	3590	4830	4880 J	2480	4940	2480	4940
MANGANESE	286	883	288	316 J	214 J	560	568	332 J	295 J	332 J	295 J
MERCURY	0.03	0.10 J	0.12	0.19	0.05	0.04	0.04 J	0.02 U	0.16	0.04 J	0.16
NICKEL	17.7	30.5	14.7	14.3	9.8	15.7	14.3	7.8	17.2	7.8	17.2
POTASSIUM	1050	972	1010	849	412 U	936	1240	508	854	508	854
SELENIUM	1.2 U	0.95 U	1.1 U	1.2 U	1 U	1.2 U	0.58 U	1.2 U	1 U	1.2 U	1 U
SILVER	0.03	0.03 J	0.07	0.03 J	0.08 J	0.05	1.2 U	0.02 UJ	0.22 J	0.02 UJ	0.22 J
SODIUM	78.4 J	143	86.4 J	82.1 J	73.9 J	55.3 J	138	43.6 J	97.1 J	43.6 J	97.1 J
THALLIUM	0.05	5.8 UJ	0.05	0.05	0.04	0.08	2.5 J	0.03	0.11	0.03	0.11
VANADIUM	13	26.6	12.5	11.1	8.7	11.8	15.1	6.6	15.6	6.6	15.6
ZINC	69.3	148 J	98	86.1	65.5	98.9	74.2 J	42.6	112	42.6	112

U = Not Detected; J = Estimated Value
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-2

Sediment Analytical Results for Inorganic Compounds - Adjacent Far Field
 BASF Corporation
 Hudson River OU-2 Investigation
 Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD
ALUMINUM	mg/kg	6570 J	5760	4180	5620	5080	5750	5390	6510	5690
ANTIMONY	mg/kg	7.1 UJ	0.05 UJ	0.08 J	0.08 J	0.09 J	0.08 J	0.09 J	6.9 UJ	7.1 UJ
ARSENIC	mg/kg	4.7 J	1.3	0.8	9.8	1.0	1.7	1.7	2.1	2.2
BARIUM	mg/kg	43.6	18.7	11.4	37.3	28.6	20.2	20.8	26.7	25.4
BERYLLIUM	mg/kg	0.59 U	1 U	1 U	1.1 U	1.2 U	1 U	1.1 U	0.59 U	0.59 U
CADMIUM	mg/kg	0.59 U	1 U	1 U	1.1 U	1.2 U	1 U	1.1 U	1.2 U	1.2 U
CALCIUM METAL	mg/kg	5880	1320 J	823 J	2250 J	3200 J	12900 J	9330 J	1690	2550
CHROMIUM, TOTAL	mg/kg	11.7 J	7.7 J	5.1 J	9.3 J	8.5 J	8.9 J	7.6 J	8.4	6.8
COBALT	mg/kg	5.9 U	4.3	4.2	4.9	4.8	4.3	5.4	5.8 U	5.9 U
COPPER	mg/kg	8.3	8.4	4.4	11.1	7.5	8.8	5.9	6.7 J	5.4 J
IRON, TOTAL	mg/kg	14000	14700	10900	18800	14100	16000	13900	13100	11900
LEAD	mg/kg	13.0 J	20 UJ	20 UJ	21 UJ	23 UJ	20 UJ	21 UJ	7.5 J	5.9 J
MAGNESIUM	mg/kg	2880 J	3380	2390	3270	2980	3600	3080	3640	3140
MANGANESE	mg/kg	319	217 J	117 J	234 J	263	197 J	213 J	R	R
MERCURY	mg/kg	0.04 U	0.02 U	0.02	0.02	0.02	0.03	0.02 U	0.04 U	0.04 U
NICKEL	mg/kg	11.2	8.7	8.4	10.1	8.2	10.5	10.1	11.6	9.1
POTASSIUM	mg/kg	1100	462	387 U	531	462 U	433	427 U	747	868
SELENIUM	mg/kg	0.6 U	1 U	1 U	1.1 U	1.1 U	1.1 U	0.55 U	0.56 U	0.56 U
SILVER	mg/kg	1.2 U	0.02 UJ	0.02 UJ	0.04 J	0.02 UJ	0.04 J	0.02 UJ	1.2 U	1.2 U
SODIUM	mg/kg	103	65.2	22.7	41.9	46.6	41.5	75	107	145
THALLIUM	mg/kg	9.6 UJ	0.05	0.02 U	0.04	0.02	0.03	1.2 U	1.2 U	1.2 U
VANADIUM	mg/kg	10.8	5.1	5.1	8.2	7.8	8.4	7.2	8.7	7.1
ZINC	mg/kg	63.7 J	46.6	38.3	61.7	53.3	65.8	51.7	52.2	44.8

U = Not Detected

J = Estimated Value

R = Analytical Value was Rejected

2 at end of sample ID indicates duplicate sample

*Depth intervals in feet unless otherwise noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds - Adjacent Nearshore, Upper Navigational Channel and Downstream
BASF Corporation
Hudson River Q1-Q2 Investigation
Ranxela, New York

Analyze	Location Description Geophysical	ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE		ADJACENT NEARSHORE	
		ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
ALUMINUM	mpkg	12100	10900	8490	12800	11200	8140	10500	13400	9280	15100	12800	11900 J				
ANTIMONY	mpkg	0.81 J	0.58 J	0.36 J	0.97 J	0.31 J	0.12 J	0.24 J	10.41 U	0.41 J	0.61 J	0.46 J	0.34 J				
ARSENIC	mpkg	11.4	7.6	3.6	5.5	4.7	2.1	6	10.7	6.8	4.4	4.2	14.8 J				
BARIUM	mpkg	92.4	87.3	64.8	142	88.6	59.1	83.8	99.8	77.3	159	134	101 J				
BERYLLIUM	mpkg	1 U	1 U	0.8 U	0.9 U	1 U	1.1 U	1 U	0.87 U	1 U	1.1 U	1.1 U	1.1 U				
CADMIUM	mpkg	2.5	2.3	0.9 U	8.7	1.5	1.1 U	1 U	0.87 U	1 U	5.8	5.2	1.1 J				
CALCIUM METAL	mpkg	6600 J	9090 J	6950 J	7410 J	8750 J	7930 J	9590 J	12200 J	10100 J	5940	5120	10400 J				
CHROMIUM, TOTAL	mpkg	126	54.8	23.5	132	28.5 J	25.2 J	22.3 J	27.3 J	21.3 J	130	109	29.4 J				
COBALT	mpkg	9.4	9.6	8.7	11.6	9.5	18.9	9.0	10.9	9.8	8.8	8.1	10.8 J				
COPPER	mpkg	164	56	30.1	71.8	41.4	30.4	30.4	30.3 J	31.3	76.2 J	86.7 J	35.1 J				
IRON, TOTAL	mpkg	24600	22900	20000	26900	22400	17900	21800	25000	21300	22800	21500	26700 J				
LEAD	mpkg	167	62	139	139	28.4	33.6	28.1	26.6 J	26.5	119 J	106 J	34.1 J				
MAGNESIUM	mpkg	6000	6320	5260	8600	6260	3940	6130	7040	8050	5040	4800	7180 J				
MANGANESE	mpkg	450 J	582 J	450	815 J	573 J	315 J	624 J	670	587 J	402	408	851 J				
MERCURY	mpkg	2.17	0.43	0.19	0.93	0.28	0.07	0.12	0.11	0.1	0.74	0.65	0.18 J				
NICKEL	mpkg	29.9	21.7	16.8	26.5	19.6	15.6	18.2	24.4	19.3	22	19.5	21.5 J				
POTASSIUM	mpkg	1210	1220	778	1310	1570	1280	1480	2070	1060	2980	2450	1400 J				
SELENIUM	mpkg	1 U	0.9 U	0.9 U	0.9 U	1 U	1.1 U	1 U	0.87 U	1 U	1.1 U	1.1 U	1.1 U				
SILVER	mpkg	2.95 J	0.52 J	0.32	0.86 J	0.33 J	0.11 J	0.27 J	1.7 U	0.31 J	0.72	0.15	0.19 J				
SODIUM	mpkg	120 J	115 J	133 J	113 J	153	120	130	133	96.9	138	114	123 J				
THALLIUM	mpkg	0.16	0.13	0.11	0.15	0.12	0.07	0.11	5.2 U	0.12	0.09	0.09	0.14 J				
THALLIUM	mpkg	20.6	21.5	15.5	27	20.4	13.5	19.9	17.3	17.3	31.1	0.09	22 J				
VANADIUM	mpkg	878	188	122	250	122	96.5	104	116 J	105	221 J	188 J	129 J				
ZINC	mpkg	878	188	122	250	122	96.5	104	116 J	105	221 J	188 J	129 J				

U = Not Detected
J = Estimated Value
A = Analytical Value was Rejected
2 at end of sample IC indicates duplicate sample
Depth Intervals in Feet Unless Otherwise Noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds - Adjacent Nearshore, Upper Navigational Channel and Downstream
BASF Corporation
Hudson River QJ-2 Investigation
Rensselaer, New York

Analyte	Location Description	Geophysical Substrate	Location ID	Depth Interval	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
					0-5	2-4	4-8	0-5	0-5	0-5	0-5	0-5
ALUMINUM	mg/kg				13600	8370	5160	11800	12400	16000	18900	22200
ANTHRACENE	mg/kg				0.59 J	0.71 J	7.5 UJ	0.5 J	0.5 J	10.8 UJ	13.5 UJ	14.2 UJ
ARSENIC	mg/kg				17	17.1	15.6	9.2	11.5	8.8	6.5 J	6.9 J
BARIUM	mg/kg				777	83.1	46.7	108	108	139	140 J	276 J
BERYLLIUM	mg/kg				1.1 U	0.88 U	0.83 U	1 U	0.9 U	0.90 U	1.1 UJ	1.2 UJ
CADMIUM	mg/kg				1.6	5.9	1.3 U	6.3	1.6	3.5	1.1 UJ	20.5 J
CALCIUM METAL	mg/kg				7920	4950	3880	5320 J	9520 J	8750	8470 J	7370 J
CHROMIUM, TOTAL	mg/kg				55.2 J	122	68.7	148 J	43.4 J	139 J	40.6 J	600 J
COBALT	mg/kg				10.5	8.8 U	6.3 U	12.7	10.1	14.4	14.1 J	13.8 J
COPPER	mg/kg				48.3	83.6 J	50.0 J	126	43.9	164 J	60.0 J	253 J
IRON, TOTAL	mg/kg				27200	14300	8320	21800	29200	27100	91900 J	29400 J
LEAD	mg/kg				50.5	134 J	93.4 J	149	43.1	110 J	48.0 J	595 J
MAGNESIUM	mg/kg				6340	3670	2000	5420	7180	7280 J	7840 J	7180 J
MANGANESE	mg/kg				401 J	R	R	358 J	802 J	585	901 J	605 J
MERCURY	mg/kg				0.28	0.88	1.6	0.72	0.24	0.45 J	0.24 J	1.4 J
NICKEL	mg/kg				25	17.3	11.6	33.4	22.5	29.3	30.3 J	38.3 J
POTASSIUM	mg/kg				2330	1190	763	1370	1870	2250	2440 J	2950 J
SELENIUM	mg/kg				1.1 U	0.88 U	0.65 U	1 U	0.9 U	0.90 U	1.2 UJ	1.2 UJ
SILVER	mg/kg				0.38 J	1.4 U	1.3 U	0.85 J	0.31 J	1.8 U	2.3 UJ	2.4 UJ
SODIUM	mg/kg				189	208	179	107	147	167	179 J	187 J
THALLIUM	mg/kg				0.13	1.4 U	1.3 U	0.13	0.11	5.4 UJ	8.8 UJ	7.1 UJ
VANADIUM	mg/kg				25.2	17.8	10.7	24.5	22.6	31.7	31.7 J	43.1
ZINC	mg/kg				155	257	125	301	152	257 J	189 J	648 J

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds, Upper Navigational Channel and Downstream
BASF Corporation
Hudson River OLU-2 Investigation
Rensselaer, New York

	Location Description Geophysical	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
	S-sedate	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand
	Location ID	SC084	SC085	SC086	SC086	SC086	SC086	SC087	SC087	SC087	SC088	SC088	SC089
	Sample ID	Q2SD084AA1	Q2SD084AA2	Q1SD085AB1	Q1SD085AB1	Q1SD085AC1	Q1SD085AA1	Q1SD087AA1	Q1SD087AB1	Q1SD087AC1	Q1SD088AA1	Q1SD088AA1	Q1SD089AB1
	Depth interval	0-5	0-5	2-4	2-4	4-6	0-5	0-5	2-4	4-6	0-5	0-5	2-4
ANALYTE													
ALUMINUM	mg/kg	12900	14700 J	23600 J	19500 J	17000	9380 J	20600 J	14800	12900	16900 J	9720 J	14000
ANTIMONY	mg/kg	0.42 J	0.5 J	15.1 UJ	12.3 UJ	9.8 UJ	6.8 UJ	15.0 UJ	11.4 UJ	9.5 J	10.8 UJ	8.6 UJ	10.2 UJ
ARSENIC	mg/kg	5.7	7.3 J	9.4 J	23.1 J	9.5	7.3	16.0 J	24.7	40.5	7.5	7.5	34.6
BARIUM	mg/kg	98.2	118 J	378 J	303 J	184	67.4	202 J	215	197	149	84.8	177
BERYLLIUM	mg/kg	1	1.1 UJ	1.3 UJ	1.0 UJ	0.82 U	0.73 U	1.3 UJ	0.35 U	0.79 U	0.81 U	0.71 U	0.85 U
CADMIUM	mg/kg	1	1.5 J	24.4 J	28.6 J	7.8	0.73 U	7.6 J	12.9	4.6	4.6	0.71 U	13.4
CALCIUM	mg/kg	7760	9210 J	8420 J	7670 J	14300	22100 J	9190 J	5920	5740	7830 J	7630 J	3860
CHROMIUM, TOTAL	mg/kg	95.7	37.5 J	646 J	454 J	225	23.8 J	424 J	455	180	174 J	23.2 J	370
COBALT	mg/kg	9.8	11.2 J	16.3 J	12.0 J	11.7	8.6	19.4 J	11.4	12.5	14.1	6.5	9.3
COPPER	mg/kg	40.9	48.6 J	203 J	201 J	118 J	47.5 J	287 J	747 J	899 J	193 J	54.8 J	5440 J
IRON, TOTAL	mg/kg	24200	27900 J	33800 J	30000 J	25400	21500	42700 J	30900	73400	28400	23900	30900
LEAD	mg/kg	34.8	38.2 J	772 J	437 J	219 J	25.4 J	321 J	380 J	406 J	198 J	24.3 J	410 J
MAGNESIUM	mg/kg	6720	7290 J	8190 J	6960 J	8310	6290 J	7940 J	5320	5980	6000 J	5740 J	4250
MANGANESE	mg/kg	497 J	322 J	838 J	H	R	432	1090 J	H	H	827	390	R
MERCURY	mg/kg	0.14	0.17 J	2.3 J	6.2 J	2.0	0.10 J	1.1 J	2.4	35.2	0.82 J	0.11 J	6.5
NICKEL	mg/kg	21.1	24.2 J	44.1 J	39.2 J	35.8	18.5	42.9 J	40.3	77.3	31.6	17.9	40.8
POTASSIUM	mg/kg	1850	2280 J	2870 J	2380 J	2070	1320	2750 J	1780	1770	2400	1560	1810
SELENIUM	mg/kg	1 U	1.1 UJ	1.2 UJ	1.0 UJ	0.84 U	0.77 U	1.3 UJ	0.86 U	0.83 U	0.89 U	0.70 U	0.85 U
SILVER	mg/kg	0.45 J	0.73 J	2.5 UJ	2.2 J	1.5 U	1.5 U	2.5 UJ	1.9 J	1.6 U	1.8 U	1.4 U	2.1
SODIUM	mg/kg	143	164 J	268 J	247 J	263	116	206 J	274	147	147	106	291
THALLIUM	mg/kg	0.12	0.14 J	7.8 UJ	2.0 UJ	1.6 U	4.4 UJ	7.5 UJ	1.9 U	1.6 U	5.4 UJ	4.3 UJ	1.7 U
TUNGSTEN	mg/kg	23.6	27.1 J	54.3 J	50.4 J	34.5	19.4	43.9 J	31.1	29.1	32.1	19.5	28.2
VANADIUM	mg/kg	142	161 J	650 J	783 J	443	102 J	434 J	817	330	94.8 J	94.8 J	1010
ZINC	mg/kg	142	161 J	650 J	783 J	443	102 J	434 J	817	330	94.8 J	94.8 J	1010

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
Depth Intervals in Feet Unless Otherwise Noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds - Adjacent Nearshore, Upper Navigational Channel and Downstream
BASIF Corporation
Hudson River OU-2 Investigation
Raritan, New York

Analysis	Location Description Geophysical/ Substrate Location ID Sample ID Depth Interval	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
ALUMINUM	mg/kg	21600 J	13200 J	11500 J	21200	20800	9260	10300	14100 J	11400	14500 J
ANTIMONY	mg/kg	29.7 J	9.4 UJ	8.8 UJ	11.8 U	12.1 UJ	7.8 U	0.2 J	10.3 UJ	0.43 J	11.4 UJ
ARSENIC	mg/kg	97.6 J	5.9 J	13.9	37.5	36.3 J	6.0	5.4	7.0 J	3.7	8.8
BARIUM	mg/kg	334 J	30.4	131	282	224 J	80.1	77	107	91.7	104
BERYLLIUM	mg/kg	1.1 UJ	0.78 U	0.73 U	0.88 U	1.1 J	0.65 U	1.2 U	0.95 U	1 U	0.85 U
CADMIUM	mg/kg	4.5 J	0.78 U	1.6	2.7	3.4 J	0.85 U	1.2 U	2.0	4.8	0.95 U
CALCIUM METAL	mg/kg	12500 J	8770 J	3660 J	6860	8360 J	3060	8840 J	7540 J	7610 J	9670 J
CHROMIUM, TOTAL	mg/kg	484 J	36.7 J	184 J	228	263 J	38.0	29.2 J	65.7 J	102 J	34.3 J
COBALT	mg/kg	10.7 UJ	11.4	7.5	12.3	15.8 J	7.5	8.4	11.5	10.6	12.1
COPPER	mg/kg	354 J	51.4 J	106 J	252	208 J	47.0 J	31.1	95.2 J	55.9	37.1 J
IRON, TOTAL	mg/kg	33100 J	22200	20100	95700	48500 J	17500	21300	22000	23900	25500
LEAD	mg/kg	695 J	97.2 J	171 J	318 J	475 J	80.1 J	28	62.8 J	75.6	38.5 J
MAGNESIUM	mg/kg	4820 J	7240 J	3730 J	6820	8360 J	4120	5920	6180 J	6120	7020 J
MANGANESE	mg/kg	R	459	269	672	845 J	267	468 J	624	620 J	777
MERCURY	mg/kg	19.9 J	0.17 J	1.5 J	16.5 J	33.3 J	7.1 J	0.1	0.27 J	0.3	0.19 J
NICKEL	mg/kg	92.7 J	23.6	24.6	40.4	43.6 J	14.9	19.6	24.9	22.1	24.6
POTASSIUM	mg/kg	1930 J	1980	1700	2810	3280 J	1450	1290	2230	1830	2290
SELENIUM	mg/kg	1.1 UJ	0.82 U	0.73 U	0.97 U	0.98 UJ	0.66 U	1.2 U	0.96 U	1 U	0.92 U
SILVER	mg/kg	2.1 UJ	1.6 U	1.5 U	2.0 U	2.0 UJ	1.3 U	0.17 J	1.7 U	0.59 J	1.9 U
SODIUM	mg/kg	440 J	131	119	405	448 J	223	129	135	106	153
THALLIUM	mg/kg	2.1 UJ	4.7 UJ	4.4 UJ	2.0 UJ	2.0 UJ	1.3 U	0.11	5.1 UJ	0.11	6.7 UJ
VANADIUM	mg/kg	26.6 J	24.0	22.0	31.2	37.9 J	14.9	20.2	25.1	20.8	25.2
ZINC	mg/kg	2440 J	142 J	235 J	507	786 J	110	102	179 J	195	152 J

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds - Adjacent Nearshore, Upper Navigational Channel and Downstream
BASF Corporation
Hudson River CU-2 Investigation
Rensselaer, New York

Location Description	Geophysical Substrate	Location ID	Depth Interval	ADJACENT NEARSHORE 4-8	ADJACENT NEARSHORE 6-8	ADJACENT NEARSHORE 8-10	UPPER NAVIGATIONAL CHANNEL 0-5	UPPER NAVIGATIONAL CHANNEL 01SDINVT12 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD061 02SD061DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD062 02SD062DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD064 02SD064DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD065 02SD065DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD066 02SD066DA1 0-5
ANALYST													
ALUMINUM	mg/kg	14600	2.5 U	13000	7.9 U	15200	11800	14400 J	10300	20300	9690	8320	8480
ANTIMONY	mg/kg	2.5 U	10.2	7.9 U	4.3	7.3 U	9.1 U	10.6 U	0.29 J	0.7 J	0.12 J	0.05 U	0.08 J
ARSENIC	mg/kg	134	134	119	127	127	119	4.6 J	3.7 J	18 J	2.2 J	1.6 J	1.9 J
BARIUM	mg/kg	0.78 U	0.78	0.78	0.93	0.93	0.76 U	0.90 U	1.1 U	262	60.4	43.9	49.3
BERYLLIUM	mg/kg	3.1 J	3.1 J	0.65 U	0.65 U	0.65 U	0.76 U	0.90 U	1.1 U	1 U	1.1 U	1 U	1.1 U
BROMINE	mg/kg	6900	17700	17700	17700	39300	4310	13.2	1.9 J	5.3	1.1 U	1 U	1.1 U
CALCIUM METAL	mg/kg	183	183	98.5	98.5	22.8	68.6	64.2	3510	9930	3170	6280	3610
CHROMIUM, TOTAL	mg/kg	12.1	11.2	11.2	11.2	13.7	9.5	282 J	64.2	195	20.3	16.5	25.6
COBALT	mg/kg	167 J	42.3 J	42.3 J	42.3 J	32.9 J	72.8	123 J	96.8 J	233	15.6 J	11.5 J	17.9 J
COPPER	mg/kg	27900	25900	25900	25900	34000	21900	23100	19200	34700	19300	17800	17800
IRON, TOTAL	mg/kg	500 J	54.3 J	54.3 J	54.3 J	16.6 J	144	266 J	79.9	263	23 U	21 U	37.7 J
LEAD	mg/kg	8400	8400	8400	8400	12600	4830	5640 J	4250	9040	4080	3740	3480
MANGANESE	mg/kg	420	466	466	466	713	400	449	315	870	356	285	238
MERCURY	mg/kg	1.8 J	0.51 J	0.51 J	0.51 J	0.11 J	0.11 J	1.3 J	0.29	9.17	0.71	0.05	0.19
NICKEL	mg/kg	29.5	23.6	23.6	23.6	28.5	20.8	27.0	17.5	34.8	16.1	14.5	13.5
POTASSIUM	mg/kg	2020	2470	2470	2470	3070	1810	2090	2090 J	3550 J	1930 J	1430 J	1700 J
SELENIUM	mg/kg	0.80 U	0.80 U	0.80 U	0.80 U	0.64 U	1.5 U	0.93 U	1.1 U	1.4 J	1.1 U	1 U	1.1 U
SILVER	mg/kg	1.8 U	1.3 U	1.3 U	1.3 U	1.2 U	1.5 U	1.8 U	0.34	2.23	0.16	0.07	0.25
SODIUM	mg/kg	184	212	212	212	291	151 U	138	103	166	96.8	89.4	99.9
THALLIUM	mg/kg	1.6 U	1.3 U	1.3 U	1.3 U	1.2 U	3.0 U	5.4 U	0.06	0.27	0.06	0.04	0.04
VANADIUM	mg/kg	28.8	22.8	22.8	22.8	28.9	21.3	35.9	21.7	37.3	18.6	14.9	18.3
ZINC	mg/kg	379	115	115	115	73.8	297 N	417 J	154 J	537	90.3 J	79.7 J	87.5 J

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-3
Sediment Analytical Results for Inorganic Compounds - Adjacent Nearshore, Upper Navigational Channel and Downstream
BASF Corporation
Hudson River O/L-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD067 02SD067DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD068 02SD068DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD069 02SD069DA2 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD069 01SD069DB1 2-4	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD069 01SD069DC1 4-6	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD070 02SD070DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD071 02SD071DA1 0-5	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD072 02SD072DA1 0-5
ALUMINUM	mg/kg	12800	18200	17500	9590	8320 J	14700	15300	12600
ANTIMONY	mg/kg	0.11 J	0.84 J	1.2 J	8.4 J	15.6 J	0.76 J	0.63 J	0.59 J
ARSENIC	mg/kg	2.9	7.2	5.7	6.2	9.7 J	7.3	5.2	3.7 J
BARIUM	mg/kg	87.6	237	218	95.6	116 J	181	170	128
BERYLLIUM	mg/kg	1.2 U	1.2 U	1 U	0.70 U	1.3 U	1.2 U	1 U	1.1 U
CADMIUM	mg/kg	1.2 U	13.6	16.7	2.5	3.0 J	8.7	8.7	6.6
CALCIUM METAL	mg/kg	5340	9590	7210	4860	8450 J	8860	5930	5170
CHROMIUM, TOTAL	mg/kg	33.9	252	293	46.0	45.4 J	231	192	124
COBALT	mg/kg	7.2	10.6	9.7	7.3	13.0 U	10.3	9.7	7.3
COPPER	mg/kg	23.6 J	117 J	132 J	58.4 J	89.4 J	125 J	92.3 J	51.3 J
IRON, TOTAL	mg/kg	19300	27200	25000	16200	14800 J	26100	24000	21100
LEAD	mg/kg	40.7 J	236 J	238 J	130 J	146 J	243 J	185 J	118 J
MAGNESIUM	mg/kg	3930	7110	6120	4350	4550 J	5960	5640	4550
MANGANESE	mg/kg	322	545	472	235 J	228 J	488	522	386
MERCURY	mg/kg	0.18	1.13	1.93	0.65	1.4 J	1.21	0.71	0.46
NICKEL	mg/kg	15.5	31	27.2	15.6	15.7 J	27.3	26.5	21
POTASSIUM	mg/kg	2110 J	4020 J	3220 J	1470	1690 J	2010 J	2700 J	2230
SELENIUM	mg/kg	1.2 U	1.2 U	1	0.67 U	1.3 U	1.2 U	0.9 U	1.1 U
SILVER	mg/kg	0.31	1.35	1.14	1.4 U	2.6 U	1.46	0.96	0.57
SODIUM	mg/kg	125	161	147	154	513 J	135	127	127
THALLIUM	mg/kg	0.06	0.15	0.15	1.4 U	2.6 U	0.15	0.14	0.07
VANADIUM	mg/kg	18.5	44.1	41.8	16.9	17.8 J	32.1	33.3	28.7
ZINC	mg/kg	119 J	372 J	382 J	208	285 J	426 J	289 J	184 J

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals in Feet Unless Otherwise Noted.

Table 3-4
Sediment Summary Statistics - Upstream
BASF Corporation
Hudson River OU-2 Investigation

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
UPSTREAM (0 - 0.5 ft)					
Inorganics					
ALUMINUM	28 : 28 : 28	3550	15700	8415	SD024
ANTIMONY	20 : 28 : 28	0.08	7.2	1.6	SD015
ARSENIC	28 : 28 : 28	1.1	8.7	2.9	SD001
BARIUM	28 : 28 : 28	14	117	57.2	SD022
CADMIUM	5 : 28 : 28	0.95	2.7	0.66	SD006
CALCIUM METAL	28 : 28 : 28	1390	16900	7585	SD005
CHROMIUM, TOTAL	28 : 28 : 28	6	54.9	19.8	SD006
COBALT	28 : 28 : 28	3.1	13	7.5	SD024
COPPER	28 : 28 : 28	5.3	50.5	22.1	SD006
IRON, TOTAL	28 : 28 : 28	9970	30800	20715	SD024
LEAD	19 : 28 : 28	7.6	203	32.6	SD028
MAGNESIUM	28 : 28 : 28	1940	8130	4896	SD022
MANGANESE	28 : 28 : 28	156	988	467	SD022
MERCURY	26 : 28 : 28	0.02	0.28	0.060	SD006
NICKEL	28 : 28 : 28	6.3	30.5	17.1	SD024
POTASSIUM	25 : 28 : 28	508	2420	1055	SD024
SILVER	17 : 20 : 28	0.03	0.31	0.094	SD006
SODIUM	28 : 28 : 28	35.4	160	95.1	SD021
THALLIUM	22 : 28 : 28	0.02	3.6	0.75	SD015
VANADIUM	28 : 28 : 28	5.2	26.6	14.3	SD024
ZINC	28 : 28 : 28	32.8	163	92.2	SD006
VOCs					
1,4-DICHLOROBENZENE	1 : 1 : 2	0.001	0.001	0.0010	SD019
2-BUTANONE (MEK)	1 : 2 : 2	0.012	0.012	0.0103	SD011
BENZENE	1 : 1 : 2	0.0011	0.0011	0.0011	SD019
CARBON DISULFIDE	2 : 2 : 2	0.0011	0.0014	0.0013	SD019
CHLOROBENZENE	1 : 1 : 2	0.001	0.001	0.0010	SD019
ETHYLBENZENE	1 : 1 : 2	0.00032	0.00032	0.00032	SD011
ISOPROPYLBENZENE	1 : 1 : 2	0.0012	0.0012	0.0012	SD019
M,P-XYLENES	1 : 2 : 2	0.0064	0.0064	0.0041	SD019
METHYL ACETATE	1 : 2 : 2	0.12	0.12	0.062	SD019
O-XYLENE	1 : 2 : 2	0.0024	0.0024	0.0021	SD019
STYRENE	2 : 2 : 2	0.0014	0.0015	0.0015	SD019
TOLUENE	2 : 2 : 2	0.0037	0.012	0.0079	SD019
TOTAL XYLENES	1 : 2 : 2	0.0088	0.0088	0.0062	SD019
Other					
TOTAL ORGANIC CARBON	10 : 10 : 10	555	15800	6462	SD011, SD022
Analyte	FOD	Concentration (mg/kg OC)			Location of Maximum Detection
		Minimum	Maximum	Mean	
UPSTREAM (0 - 0.5 ft)					
VOCs					
1,4-DICHLOROBENZENE	1 : 1 : 2	0.069	0.069	0.069	SD019
2-BUTANONE (MEK)	1 : 2 : 2	0.76	0.76	0.67	SD011
BENZENE	1 : 1 : 2	0.076	0.076	0.076	SD019
CARBON DISULFIDE	2 : 2 : 2	0.070	0.097	0.083	SD019
CHLOROBENZENE	1 : 1 : 2	0.069	0.069	0.069	SD019
ETHYLBENZENE	1 : 1 : 2	0.020	0.020	0.020	SD011
ISOPROPYLBENZENE	1 : 1 : 2	0.083	0.083	0.083	SD019
M,P-XYLENES	1 : 2 : 2	0.44	0.44	0.28	SD019
METHYL ACETATE	1 : 2 : 2	8.3	8.3	4.3	SD019
O-XYLENE	1 : 2 : 2	0.17	0.17	0.14	SD019
STYRENE	2 : 2 : 2	0.089	0.103	0.096	SD019
TOLUENE	2 : 2 : 2	0.23	0.83	0.53	SD019
TOTAL XYLENES	1 : 2 : 2	0.61	0.61	0.42	SD019

FOD - Frequency of Detection, Number of detected samples; Number of samples used to calculate statistics; Number of total samples.
Only detected compounds within each reach and depth are presented.

Table 3-5
Sediment Summary Statistics - Adjacent Far Field
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT FAR FIELD (0 - 0.5 ft)					
Inorganics					
ALUMINUM	19 : 19 : 19	3970	8250	5999	SD049
ANTIMONY	12 : 18 : 19	0.06	0.15	0.071	SD079
ARSENIC	18 : 18 : 18	0.6	34.8	6.2	SD039
BARIUM	19 : 19 : 19	11.4	178	39.4	SD046
CALCIUM METAL	19 : 19 : 19	823	13690	4746	SD036
CHROMIUM, TOTAL	19 : 19 : 19	5.1	16.8	9.6	SD049
COBALT	18 : 19 : 19	4	7.5	5.1	SD049
COPPER	19 : 18 : 19	4.3	16.2	9.5	SD041
IRON, TOTAL	19 : 19 : 19	10600	38500	17008	SD039
LEAD	4 : 19 : 19	24.7	37.1	14.5	SD079
MAGNESIUM	19 : 19 : 19	2390	4490	3344	SD079
MANGANESE	19 : 19 : 19	117	451	279	SD042
MERCURY	11 : 19 : 19	0.02	2.34	0.15	SD046
NICKEL	19 : 19 : 19	7.1	16	10.7	SD049
POTASSIUM	13 : 19 : 19	427	1200	584	SD049
SELENIUM	1 : 18 : 18	1.7	1.7	0.59	SD045
SILVER	9 : 18 : 19	0.02	0.31	0.038	SD046
SODIUM	19 : 19 : 19	22.7	221	72.6	SD046
THALLIUM	15 : 17 : 18	0.02	0.06	0.031	SD079
VANADIUM	19 : 19 : 19	5.1	12.8	8.7	SD079
ZINC	19 : 19 : 19	38.3	87.2	57.3	SD079
Other					
TOTAL ORGANIC CARBON	6 : 8 : 8	558	2460	1014	SD079
ADJACENT FAR FIELD (2 - 4 ft)					
Inorganics					
ALUMINUM	2 : 2 : 2	6000	7180	6590	SD041
ARSENIC	2 : 2 : 2	1.5	1.9	1.7	SD055
BARIUM	2 : 2 : 2	22.9	26.05	24.5	SD055
CALCIUM METAL	2 : 2 : 2	2115	2250	2183	SD041
CHROMIUM, TOTAL	2 : 2 : 2	7.5	7.5	7.5	SD041, SD055
COBALT	1 : 2 : 2	6.2	6.2	4.8	SD041
COPPER	2 : 2 : 2	6.05	6.7	6.4	SD041
IRON, TOTAL	2 : 2 : 2	12200	13100	12650	SD041
LEAD	2 : 2 : 2	6.7	14.8	10.7	SD041
MAGNESIUM	2 : 2 : 2	3340	3860	3600	SD041
NICKEL	2 : 2 : 2	10.35	11.3	10.8	SD041
POTASSIUM	2 : 2 : 2	706.5	727	717	SD041
SODIUM	2 : 2 : 2	126	174	150	SD041
VANADIUM	2 : 2 : 2	7.9	8.2	8.1	SD041
ZINC	2 : 2 : 2	43.7	48.5	46.1	SD055
VOCs					
1,2-DICHLOROBENZENE	1 : 2 : 2	0.009	0.009	0.0080	SD041
1,3-DICHLOROBENZENE	1 : 2 : 2	0.011	0.011	0.0080	SD041
CHLOROBENZENE	1 : 2 : 2	0.012	0.012	0.0095	SD041
Other					
TOTAL ORGANIC CARBON	1 : 1 : 1	948	948	948	SD041
Analyte	FOD	Concentration (mg/kg OC)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT FAR FIELD (2 - 4 ft)					
VOCs					
1,2-DICHLOROBENZENE	1 : 2 : 2	9.5	9.5	8.3	SD041
1,3-DICHLOROBENZENE	1 : 2 : 2	11.6	11.6	9.4	SD041
CHLOROBENZENE	1 : 2 : 2	12.7	12.7	9.9	SD041

FOD - Frequency of Detection, Number of detected samples; Number of samples used to calculate statistics; Number of total samples.
Only detected compounds within each reach and depth are presented.

Table 3-6
Sediment Summary Statistics - Adjacent Nearshore
SASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOI	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (0 - 0.5 ft)					
Inorganics					
ALUMINUM	36 : 36 : 36	8140	23500	12913	SD085
ANTIMONY	20 : 20 : 36	0.12	0.97	0.44	SD095
ARSENIC	36 : 36 : 36	2.1	115	10.2	SD080
BARIUM	36 : 36 : 36	59.1	376	115	SD085
CADMIUM	21 : 36 : 36	1.0	24.4	3.2	SD085
CALCIUM METAL	36 : 36 : 36	3660	50700	10407	SD099
CHROMIUM, TOTAL	36 : 36 : 36	19.8	646	101	SD085
COBALT	36 : 36 : 36	6.7	19.4	10.7	SD087
COPPER	36 : 36 : 36	18.9	287	76.5	SD087
IRON, TOTAL	36 : 36 : 36	17900	42700	24799	SD087
LEAD	36 : 36 : 36	24.3	772	104	SD085
MAGNESIUM	36 : 36 : 36	3790	8190	6244	SD095
MANGANESE	36 : 36 : 36	269	1580	618	SD098
MERCURY	36 : 36 : 36	0.07	2.3	0.51	SD085
NICKEL	36 : 36 : 36	13.6	44.1	24	SD085
POTASSIUM	36 : 36 : 36	779	2990	1835	SD082
SILVER	20 : 36 : 36	0.11	2.95	0.70	SD032
SODIUM	36 : 36 : 36	86.9	288	141	SD085
THALLIUM	20 : 20 : 36	0.07	0.16	0.12	SD032
VANADIUM	36 : 36 : 36	19.5	54.3	25	SD095
ZINC	36 : 36 : 36	94.9	561.5	195	SD082
VOCs					
1,1,1-TRICHLOROETHANE (TCA)	1 : 1 : 34	0.00039	0.00093	0.00033	SD087
1,2,4-TRICHLOROBENZENE	6 : 34 : 34	0.0026	5.0	0.29	SD087
1,2-DICHLOROBENZENE	32 : 34 : 34	0.00049	75	2.4	SD087
1,2-DICHLOROETHANE	1 : 2 : 34	0.002	0.002	0.0017	SD080
1,3-DICHLOROBENZENE	20 : 34 : 34	0.00061	9.8	0.42	SD087
1,4-DICHLOROBENZENE	25 : 34 : 34	0.00046	15.0	0.59	SD087
2-BUTANONE (MEK)	20 : 25 : 34	0.0022	0.064	0.013	SD095
ACETONE	25 : 25 : 34	0.0031	0.74	0.072	SD085
BENZENE	19 : 34 : 34	0.00037	27.0	1.8	SD088
CARBON DISULFIDE	24 : 25 : 34	0.00039	0.00855	0.0017	SD088
CHLOROBENZENE	34 : 34 : 34	0.0012	450	20.3	SD087
CHLOROMETHANE	1 : 22 : 34	0.0042	0.0042	0.0030	SD081
CYCLOHEXANE	9 : 25 : 34	0.00044	0.01175	0.0034	SD082
ETHYLBENZENE	13 : 34 : 34	0.00054	1.0	0.12	SD087
ISOPROPYLBENZENE	4 : 24 : 34	0.0017	0.0072	0.0034	SD082
M,P-XYLENES	17 : 34 : 34	0.0011	4.5	0.22	SD087
METHYL ACETATE	15 : 33 : 34	0.0013	0.75	0.11	SD090
METHYLCYCLOHEXANE	10 : 29 : 34	0.00092	0.24	0.025	SD085
METHYLENE CHLORIDE	1 : 25 : 34	0.008	0.026	0.0042	SD086
O-XYLENE	18 : 34 : 34	0.00057	1.3	0.12	SD087
STYRENE	1 : 20 : 34	0.0038	0.0038	0.0029	SD087
TOLUENE	14 : 34 : 34	0.00084	7.3	0.34	SD087
TOTAL XYLENES	19 : 34 : 34	0.00167	5.3	0.34	SD087
TRICHLOROETHYLENE	1 : 1 : 34	0.0006	0.0096	0.00060	SD088
TRICHLOROFLUOROMETHANE	4 : 4 : 34	0.00048	0.00095	0.000725	SD095
Other					
TOTAL ORGANIC CARBON	29 : 29 : 29	5250	50100	19518.96562	SD082
ADJACENT NEARSHORE (0 - 0.5 ft)					
VOCs					
1,1,1-TRICHLOROETHANE (TCA)	1 : 1 : 34	0.014	0.014	0.014	SD087
1,2,4-TRICHLOROBENZENE	6 : 34 : 34	0.10	500	24.0	SD087
1,2-DICHLOROBENZENE	32 : 34 : 34	0.025	7500	231	SD087
1,2-DICHLOROETHANE	1 : 5 : 34	0.20	0.20	0.14	SD080
1,3-DICHLOROBENZENE	20 : 34 : 34	0.026	980	37.1	SD087
1,4-DICHLOROBENZENE	25 : 34 : 34	0.029	1500	55.9	SD087
2-BUTANONE (MEK)	20 : 25 : 34	0.40	4.6	0.36	SD095
ACETONE	25 : 25 : 34	0.13	15.4	3.7	SD085
BENZENE	19 : 34 : 34	0.016	900	84.4	SD090
CARBON DISULFIDE	24 : 25 : 34	0.027	0.35	0.11	SD082
CHLOROBENZENE	34 : 34 : 34	0.082	45000	1846	SD087
CHLOROMETHANE	1 : 1 : 34	0.058	0.06	0.059	SD081
CYCLOHEXANE	9 : 24 : 34	0.027	0.42	0.23	SD082
ETHYLBENZENE	13 : 34 : 34	0.034	100	7.8	SD087
ISOPROPYLBENZENE	4 : 22 : 34	0.064	0.32	0.23	SD082
M,P-XYLENES	17 : 34 : 34	0.086	400	17.2	SD087
METHYL ACETATE	15 : 33 : 34	0.086	75	6.6	SD090
METHYLCYCLOHEXANE	10 : 29 : 34	0.035	5.0	0.95	SD085
METHYLENE CHLORIDE	1 : 25 : 34	4.1	4.1	0.41	SD086
O-XYLENE	18 : 34 : 34	0.043	130	7.6	SD087
STYRENE	1 : 11 : 34	0.21	0.21	0.15	SD087
TOLUENE	14 : 34 : 34	0.084	730	29.8	SD087
TOTAL XYLENES	19 : 34 : 34	0.13	530	24.8	SD087
TRICHLOROETHYLENE	1 : 1 : 34	0.095	0.09	0.081	SD088
TRICHLOROFLUOROMETHANE	4 : 6 : 34	0.046	0.08	0.064	SD095

Table 3-6
Sediment Summary Statistics - Adjacent Nearshore
BASF Corporation
Hudson River Q1-Q2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (2 - 4 ft)					
Inorganics					
ALUMINUM	20:20:20	9370	21000	16451	SD081
ANTIMONY	4:20:20	11.3	21.3	7.3	SD106
ARSENIC	20:20:20	3.9	26.0	13.7	SD081
BARIUM	20:20:20	83.1	236	200	SD108
BERYLLIUM	3:20:20	0.735	1.1	0.5	SD113
CADMIUM	20:20:20	1.7	28.8	11.6	SD085
CALCIUM METAL	20:20:20	3850	10700	7642	SD088
CHROMIUM, TOTAL	20:20:20	120	499	297	SD101
COBALT	19:20:20	0.3	15.2	11.9	SD113
COPPER	20:20:20	83.6	5440	475	SD080
IRON, TOTAL	20:20:20	14300	41100	26135	SD091
LEAD	20:20:20	119.5	1120	365	SD100
MAGNESIUM	20:20:20	3570	7600	6285	SD113
MANGANESE	12:12:20	404	878	644	SD113
MERCURY	20:20:20	0.49	33.7	5.0	SD104
NICKEL	20:20:20	17.3	44.3	33.8	SD106
POTASSIUM	20:20:20	1190	3170	2268	SD106
SELENIUM	1:20:20	1.0	1.0	0.48	SD110
SILVER	10:20:20	2.0	4.6	1.7	SD106
SODIUM	13:20:20	126	426	183.1	SD091
VANADIUM	20:20:20	17.8	54.3	35.6	SD106
ZINC	20:20:20	225	1010	517	SD089
VOCs					
1,2,4-TRICHLOROBENZENE	10:20:20	0.056	210	24.3	SD087
1,2-DICHLOROBENZENE	16:20:20	0.061	1900	136	SD087
1,2-DICHLOROETHANE	3:20:20	0.46	290	17.9	SD087
1,2-DICHLOROPROPANE	1:18:20	3.3	3.3	0.70	SD087
1,3-DICHLOROBENZENE	16:20:20	0.054	49	7.8	SD085
1,4-DICHLOROBENZENE	18:20:20	0.042	80	10.5	SD087
2-BUTANONE (MEK)	1:5:20	0.37	0.37	0.9	SD111
4-METHYL-2-PENTANONE (MIBK)	1:16:20	1.8	1.8	0.7	SD087
BENZENE	16:20:20	0.091	880	58.8	SD087
CARBON DISULFIDE	1:1:20	0.018	0.018	0.016	SD077
CHLOROBENZENE	20:20:20	0.23	11000	966	SD067
CYCLOHEXANE	3:17:20	0.046	0.77	0.33	SD067
ETHYLBENZENE	11:19:20	0.073	14	2.3	SD087
ISOPROPYLBENZENE	3:6:20	0.02	0.069	0.050	SD105
M,P-XYLENES	17:20:20	0.058	58	7.0	SD087
METHYL ACETATE	10:11:20	0.25	0.44	0.34	SD112
METHYLCYCLOHEXANE	12:19:20	0.058	2.9	0.66	SD087
O-XYLENE	17:19:20	0.07	13.0	1.7	SD087
TETRACHLOROETHENE (PCE)	1:17:20	2.1	2.1	0.4	SD087
TOLUENE	11:20:20	0.06	130	15.1	SD087
TOTAL XYLENES	18:20:20	0.129	71	8.6	SD087
TRICHLOROETHYLENE	1:19:20	9.0	9.0	1.3	SD087
Other					
TOTAL ORGANIC CARBON	13:13:13	15800	81800	47131	SD110
ADJACENT NEARSHORE (2 - 4 ft)					
VOCs					
1,2,4-TRICHLOROBENZENE	10:20:20	1.6	21000	1742	SD087
1,2-DICHLOROBENZENE	16:20:20	0.68	190000	14246	SD087
1,2-DICHLOROETHANE	3:20:20	18.9	29000	1676	SD087
1,2-DICHLOROPROPANE	1:18:20	530	330	42.9	SD087
1,3-DICHLOROBENZENE	16:20:20	1.4	4200	482	SD087
1,4-DICHLOROBENZENE	18:20:20	1.7	8300	811	SD087
2-BUTANONE (MEK)	1:4:20	9.8	9.79	7.21	SD111
4-METHYL-2-PENTANONE (MIBK)	1:18:20	180	180	41.7	SD087
BENZENE	16:20:20	0.99	88000	5639	SD087
CARBON DISULFIDE	1:1:20	0.74	0.74	0.74	SD077
CHLOROBENZENE	20:20:20	11.8	1100000	50925	SD087
CYCLOHEXANE	3:17:20	1.3	77	13.0	SD087
ETHYLBENZENE	11:20:20	1.6	2478	240	SD089
ISOPROPYLBENZENE	3:3:20	0.59	0.92	0.78	SD105
M,P-XYLENES	17:20:20	1.2	8581	781	SD089
METHYL ACETATE	10:13:20	4.3	20.00	11.3	SD086
METHYLCYCLOHEXANE	12:18:20	0.75	290	32.9	SD087
O-XYLENE	17:20:20	1.3	2085	212	SD089
TETRACHLOROETHENE (PCE)	1:18:20	210	210	24.7	SD087
TOLUENE	11:20:20	1.2	20662	1762	SD089
TOTAL XYLENES	18:20:20	2.5	10476	973	SD089
TRICHLOROETHYLENE	1:20:20	900	900	116	SD067

Table 3-6
Sediment Summary Statistics - Adjacent Nearshore
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, New York

Analyte	FDD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (4 - 6 ft)					
Inorganics					
ALUMINUM	20:20:20	5180	21600	15937	SD089
ANTIMONY	5:20:20	9.5	29.7	8.2	SD089
ARSENIC	20:20:20	6.0	97.8	19.3	SD089
BARIUM	20:20:20	48.7	543	210	SD104
BERYLLIUM	1:20:20	1.0	1.0	0.46	SD107
CADMIUM	18:20:20	2.1	30.7	10.9	SD103
CALCIUM METAL	20:20:20	3090	14300	8006	SD085
CHROMIUM, TOTAL	20:20:20	38	493	262	SD113
COBALT	18:20:20	7.5	20	11.4	SD108
COPPER	20:20:20	47	833	215	SD087
IRON, TOTAL	20:20:20	8320	73400	29511	SD087
LEAD	20:20:20	80.1	866	350	SD103
MAGNESIUM	20:20:20	2000	8430	5188	SD107
MANGANESE	12:12:20	287	861	533	SD107
MERCURY	20:20:20	1.1	35.2	5.1	SD087
NICKEL	20:20:20	11.8	92.7	36.1	SD089
POTASSIUM	20:20:20	783	3125	2199	SD112
SELENIUM	3:20:20	0.743	0.93	0.50	SD112
SILVER	8:20:20	1.8	3.45	1.5	SD112
SODIUM	14:20:20	127	440	193	SD089
VANADIUM	20:20:20	10.7	51.8	33.5	SD112
ZINC	20:20:20	110	2440	535	SD089
VOCs					
1,2,4-TRICHLOROBENZENE	8:20:20	0.087	1560	141	SD106
1,2-DICHLOROBENZENE	18:20:20	0.010	32000	1873	SD087
1,2-DICHLOROETHANE	2:19:20	8.9	62	8.4	SD087
1,2-DICHLOROPROPANE	1:18:20	0.83	0.83	0.3	SD087
1,3-DICHLOROBENZENE	19:20:20	0.018	470	58.7	SD087
1,4-DICHLOROBENZENE	19:20:20	0.063	4000	220	SD087
2-BUTANONE (MEK)	3:4:20	0.021	0.14	0.084	SD081
ACETONE	3:3:20	0.089	0.15	0.12	SD110
BENZENE	19:20:20	0.0076	490	44.8	SD087
CARBON DISULFIDE	3:4:20	0.001	0.033	0.016	SD081
CHLOROBENZENE	20:20:20	0.06529	5000	769	SD089
CYCLOHEXANE	5:18:20	0.0043	0.98	0.31	SD089
ETHYLBENZENE	14:20:20	0.0023	30	3.5	SD089
ISOPROPYLBENZENE	5:16:20	0.047	2.7	0.42	SD089
M,P-XYLENES	19:20:20	0.021	160	13.7	SD089
METHYL ACETATE	11:13:20	0.089	0.67	0.28	SD112
METHYL TERT-BUTYL ETHER	1:1:20	0.001	0.001	0.0010	SD110
METHYLCYCLOHEXANE	11:17:20	0.02995	8.8	1.1	SD089
O-XYLENE	16:20:20	0.04	52	5.1	SD089
STYRENE	1:16:20	1.7	1.7	0.37	SD089
TETRACHLOROETHENE (PCE)	2:16:20	0.071	2.0	0.37	SD087
TOLUENE	15:20:20	0.0014	77	10.6	SD089
TOTAL XYLENES	19:20:20	0.062	212	18.0	SD089
TRICHLOROETHYLENE	1:16:20	3.0	3.0	0.44	SD087
Other					
TOTAL ORGANIC CARBON	12:12:12	19000	80000	46146	SD105
ADJACENT NEARSHORE (4 - 6 ft)					
VOCs					
1,2,4-TRICHLOROBENZENE	8:20:20	5.1	65000	9047	SD087
1,2-DICHLOROBENZENE	18:20:20	0.28	320000	166243	SD087
1,2-DICHLOROETHANE	2:20:20	1695	6200	515	SD087
1,2-DICHLOROPROPANE	1:15:20	83.0	83	13.4	SD087
1,3-DICHLOROBENZENE	19:20:20	0.41	47000	2760	SD087
1,4-DICHLOROBENZENE	19:20:20	1.7	400000	21073	SD087
2-BUTANONE (MEK)	3:3:20	0.43	3.0	1.5	SD081
ACETONE	3:3:20	1.8	4.1	2.9	SD110
BENZENE	19:20:20	0.21	48000	4189	SD087
CARBON DISULFIDE	3:3:20	0.020	0.71	0.27	SD081
CHLOROBENZENE	20:20:20	2.4	952381	68042	SD089
CYCLOHEXANE	5:17:20	0.12	187	32.2	SD089
ETHYLBENZENE	14:20:20	0.064	5734	362	SD089
ISOPROPYLBENZENE	5:19:20	1.0	314	94.7	SD089
M,P-XYLENES	19:20:20	0.61	30476	1902	SD089
METHYL ACETATE	11:13:20	3.3	26	10.5	SD096
METHYL TERT-BUTYL ETHER	1:1:20	0.028	0.028	0.028	SD110
METHYLCYCLOHEXANE	11:23:20	0.75	1638	215	SD089
O-XYLENE	16:20:20	1.1	9906	595	SD089
STYRENE	1:17:20	324	384	41.2	SD089
TETRACHLOROETHENE (PCE)	2:17:20	3.6	200	36.4	SD087
TOLUENE	15:20:20	0.039	14867	1074	SD089
TOTAL XYLENES	19:20:20	1.7	40381	2399	SD089
TRICHLOROETHYLENE	1:17:20	300	300	42.4	SD087

Table 3-6
Sediment Summary Statistics - Adjacent Nearshore
BASF Corporation
Hudson River O&U Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (S - S R)					
Inorganics					
ALUMINUM	B : B : B	10800	22700	14700	SD112
ANTIMONY	2 : B : B	15.7	23.1	8.2	SD112
ARSENIC	8 : B : B	4.3	14	10.1	SD105
BARIUM	8 : B : B	85	342	162	SD112
BERYLLIUM	2 : B : B	0.78	0.91	0.83	SD111
CADMIUM	8 : B : B	1.1	28.3	7.2	SD112
CALCIUM METAL	8 : B : B	5130	33200	11896	SD111
CHROMIUM, TOTAL	8 : B : B	22.2	541	188	SD112
COBALT	8 : B : B	9.75	15.7	11.7	SD111
COPPER	8 : B : B	38.8	304	130	SD112
IRON, TOTAL	8 : B : B	23500	34900	27519	SD111
LEAD	8 : B : B	24.8	622	179	SD112
MAGNESIUM	8 : B : B	5360	12700	7241	SD111
MANGANESE	8 : B : B	422	783	569	SD108
MERCURY	7 : B : B	0.51	3.8	1.9	SD105
NICKEL	8 : B : B	20.3	41.1	28.0	SD112
POTASSIUM	8 : B : B	1705	3090	2297	SD111
SELENIUM	4 : B : B	0.82	0.995	0.65	SD110
SILVER	4 : B : B	1.85	3.9	1.6	SD112
SODIUM	4 : B : B	148	297	154	SD105
VANADIUM	8 : B : B	19.5	58.6	20.3	SD112
ZINC	8 : B : B	74.4	784	223	SD108
VOCs					
1,2,4-TRICHLOROBENZENE	2 : 5 : B	0.0021	0.54	0.15	SD112
1,2-DICHLOROBENZENE	4 : 7 : B	0.066	14	2.2	SD108
1,3-DICHLOROBENZENE	3 : 7 : B	0.30	7.7	1.7	SD108
1,4-DICHLOROBENZENE	6 : 7 : B	0.020	49	7.4	SD108
2-BUTANONE (MEK)	3 : 4 : B	0.013	0.25	0.078	SD114
ACETONE	2 : 3 : B	0.0095	0.043	0.02	SD110
BENZENE	7 : B : B	0.00041	35	4.8	SD108
CARBON DISULFIDE	2 : 2 : B	0.00097	0.0011	0.0010	SD110
CHLOROBENZENE	8 : B : B	0.0368	1000	127	SD108
CYCLOHEXANE	2 : 2 : B	0.0021	0.0028	0.0025	SD110
ETHYLBENZENE	4 : B : B	0.035	3.7	0.82	SD105
ISOPROPYLBENZENE	1 : 3 : B	0.017	0.0167	0.0076	SD110
m,p-XYLENES	6 : B : B	0.052	52	1.7	SD108
METHYL ACETATE	4 : B : B	0.087	0.48	0.18	SD112
METHYLCYCLOHEXANE	4 : 5 : B	0.0041	0.21	0.070	SD105
O-XYLENE	4 : B : B	0.060	3.7	0.62	SD108
TOLUENE	6 : B : B	0.049	2.7	0.45	SD108
TOTAL XYLENES	6 : B : B	0.18	15.7	2.3	SD108
OTHER					
TOTAL ORGANIC CARBON	B : B : B	3760	69500	37526	SD105
ADJACENT NEARSHORE (S - S R)					
VOCs					
1,2,4-TRICHLOROBENZENE	2 : 5 : B	0.56	5.9	3.0	SD112
1,2-DICHLOROBENZENE	4 : 7 : B	2.0	257	45.4	SD108
1,3-DICHLOROBENZENE	3 : 7 : B	9.0	142	35.7	SD108
1,4-DICHLOROBENZENE	6 : 7 : B	0.45	902	139	SD108
2-BUTANONE (MEK)	3 : 7 : B	1.4	25.4	11.0	SD114
ACETONE	2 : 3 : B	1.2	2.5	1.4	SD111
BENZENE	7 : B : B	0.022	645	84.1	SD108
CARBON DISULFIDE	2 : 2 : B	0.030	0.031	0.031	SD110
CHLOROBENZENE	8 : B : B	0.54	18382	2351	SD108
CYCLOHEXANE	2 : 2 : B	0.067	0.077	0.072	SD110
ETHYLBENZENE	4 : B : B	1.1	68.0	16.2	SD108
ISOPROPYLBENZENE	1 : 2 : B	0.38	0.38	0.24	SD110
m,p-XYLENES	6 : B : B	1.2	221	32.9	SD108
METHYL ACETATE	4 : B : B	1.3	8.3	3.7	SD112
METHYLCYCLOHEXANE	4 : 5 : B	0.13	3.0	1.3	SD105
O-XYLENE	4 : B : B	1.8	68.0	18.3	SD108
TOLUENE	6 : B : B	1.1	49.6	13.7	SD108
TOTAL XYLENES	6 : B : B	4.0	289	49.2	SD108

Table 3-5
Sediment Summary Statistics - Adjacent Nearshore
BASF Corporation
Hudson River OJ-2 Investigation
Roseton, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (8 - 10 ft)					
Inorganics					
ALUMINUM	4:4:4	13500	18000	14825	SD108
ANTIMONY	1:4:4	14	14	6.8	SD112
ARSENIC	4:4:4	4.6	25.2	13.8	SD108
BARIUM	4:4:4	127	188	164	SD112
BERYLLIUM	2:4:4	0.76	0.93	0.84	SD114
CADMIUM	3:4:4	2.5	17.4	6.9	SD112
CALCIUM METAL	4:4:4	8490	39300	17095	SD114
CHROMIUM, TOTAL	4:4:4	22.6	269	181	SD112
COBALT	4:4:4	10.1	19.7	11.9	SD114
COPPER	4:4:4	32.9	199	122	SD108
IRON, TOTAL	4:4:4	24900	34000	29900	SD114
LEAD	4:4:4	18.6	628	299	SD113
MAGNESIUM	4:4:4	6190	12800	8135	SD114
MANGANESE	4:4:4	436	713	587	SD114
MERCURY	4:4:4	0.11	12.4	4.0	SD108
NICKEL	4:4:4	95.7	38.7	30.2	SD109
POTASSIUM	4:4:4	1990	9070	2373	SD114
SELENIUM	1:4:4	1.3	1.3	0.60	SD108
SILVER	2:4:4	2.1	2.3	1.4	SD108
SODIUM	2:4:4	191	291	164	SD114
VANADIUM	4:4:4	26.2	40.5	31.0	SD112
ZINC	4:4:4	73.8	499	344	SD112
VOCs					
1,2,4-TRICHLOROBENZENE	1:1:4	0.054	0.054	0.054	SD112
1,2-DICHLOROBENZENE	3:3:4	0.027	0.99	0.12	SD108
1,3-DICHLOROBENZENE	1:2:4	1.3	1.3	0.77	SD112
1,4-DICHLOROBENZENE	3:3:4	0.11	5.1	1.9	SD108
2-BUTANONE (MEK)	1:1:4	0.0039	0.0039	0.0039	SD114
ACETONE	1:1:4	0.027	0.027	0.027	SD114
BENZENE	2:4:4	0.54	13	3.4	SD108
CARBON DISULFIDE	1:1:4	0.00042	0.00042	0.00042	SD114
CHLOROBENZENE	4:4:4	0.00072	300	76.5	SD108
CYCLOHEXANE	1:1:4	0.00024	0.00024	0.000	SD114
ETHYLBENZENE	2:4:4	0.11	0.88	0.30	SD108
M,P-XYLENES	3:4:4	0.085	5.3	1.5	SD108
METHYL ACETATE	2:3:4	0.080	0.97	0.15	SD112
METHYLCYCLOHEXANE	3:3:4	0.0032	0.12	0.054	SD112
O-XYLENE	3:4:4	0.048	1.1	0.33	SD108
TOLUENE	2:3:4	0.070	0.23	0.10	SD112
TOTAL XYLENES	3:4:4	0.19	6.4	1.9	SD108
Other					
TOTAL ORGANIC CARBON	4:4:4	3130	76800	38908	SD109
ADJACENT NEARSHORE (8 - 10 ft)					
Analyte	FOD	Concentration (mg/kg OC)			Location of Maximum Detection
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE (8 - 10 ft)					
VOCs					
1,2,4-TRICHLOROBENZENE	1:1:4	1.3	1.3	1.3	SD112
1,2-DICHLOROBENZENE	3:3:4	0.84	12.9	6.4	SD108
1,3-DICHLOROBENZENE	1:2:4	30.7	30.7	18.9	SD112
1,4-DICHLOROBENZENE	3:3:4	3.4	66.4	27.2	SD108
2-BUTANONE (MEK)	1:1:4	1.2	1.2	1.2	SD114
ACETONE	1:1:4	8.6	8.6	8.6	SD114
BENZENE	2:4:4	12.9	169.3	47.4	SD108
CARBON DISULFIDE	1:1:4	0.13	0.13	0.13	SD114
CHLOROBENZENE	4:4:4	0.23	9906	1017	SD108
CYCLOHEXANE	1:1:4	0.077	0.077	0.077	SD114
ETHYLBENZENE	2:4:4	2.6	11.2	5.4	SD108
M,P-XYLENES	3:4:4	2.6	69.8	22.0	SD108
METHYL ACETATE	2:3:4	2.6	6.7	4.1	SD112
METHYLCYCLOHEXANE	3:3:4	1.0	2.8	1.7	SD112
O-XYLENE	3:4:4	1.5	14.3	5.1	SD108
TOLUENE	2:3:4	2.2	5.4	2.7	SD112
TOTAL XYLENES	3:4:4	4.1	83.3	27.1	SD108

FOD - Frequency of Detection, Number of detected samples; Number of samples used to calculate statistics; Number of total samples.
Only detected compounds within each reach and depth are presented

Table 3-7
Sediment Summary Statistics - Upper Navigational Channel
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
UPPER NAVIGATIONAL CHANNEL (0 - 0.5 ft)					
Inorganics					
ALUMINUM	15: 15: 15	6600	20300	12583	SD062
ANTIMONY	12: 13: 15	0.08	1.075	0.44	SD069
ARSENIC	15: 15: 15	1.6	19	5.3	SD062
BARIUM	15: 15: 15	43.9	262	139	SD062
CADMIUM	10: 15: 15	1.9	17.2	5.6	SD069
CALCIUM METAL	15: 15: 15	2630	9930	5680	SD062
CHROMIUM, TOTAL	15: 15: 15	16.5	289	127	SD069
COBALT	15: 15: 15	4.8	12.8	8.4	SD062
COPPER	15: 15: 15	11.5	233	76.8	SD062
IRON, TOTAL	15: 15: 15	13400	34700	21847	SD062
LEAD	13: 15: 15	37.7	288	137	SD042
MAGNESIUM	15: 15: 15	2850	9940	5021	SD062
MANGANESE	15: 15: 15	199	670	399	SD062
MERCURY	14: 14: 14	0.05	3.2	0.80	SD062
NICKEL	15: 15: 15	11.8	34.8	21.7	SD062
POTASSIUM	15: 15: 15	1270	4020	2215	SD068
SELENIUM	2: 15: 15	0.75	1.4	0.63	SD062
SILVER	13: 15: 15	0.07	2.23	0.78	SD062
SODIUM	14: 15: 15	63.7	185	116	SD062
THALLIUM	13: 13: 15	0.04	0.27	0.10	SD062
VANADIUM	15: 15: 15	12.5	44.1	26.5	SD068
ZINC	15: 15: 15	79.7	537	251	SD062
Other					
TOTAL ORGANIC CARBON	10: 10: 10	6009	28100	13230	SD068
UPPER NAVIGATIONAL CHANNEL (2 - 4 ft)					
Inorganics					
ALUMINUM	1: 1: 1	9580	9580	9580	SD069
ANTIMONY	1: 1: 1	8.4	8.4	8.4	SD069
ARSENIC	1: 1: 1	6.2	6.2	6.2	SD069
BARIUM	1: 1: 1	95.6	95.6	95.6	SD069
CADMIUM	1: 1: 1	2.5	2.5	2.5	SD069
CALCIUM METAL	1: 1: 1	4860	4860	4860	SD069
CHROMIUM, TOTAL	1: 1: 1	46	46	46	SD069
COBALT	1: 1: 1	7.3	7.3	7.3	SD069
COPPER	1: 1: 1	58.4	58.4	58.4	SD069
IRON, TOTAL	1: 1: 1	16200	16200	16200	SD069
LEAD	1: 1: 1	130	130	130	SD069
MAGNESIUM	1: 1: 1	4350	4350	4350	SD069
MANGANESE	1: 1: 1	236	236	236	SD069
MERCURY	1: 1: 1	0.85	0.85	0.85	SD069
NICKEL	1: 1: 1	16.6	16.6	16.6	SD069
POTASSIUM	1: 1: 1	1470	1470	1470	SD069
SODIUM	1: 1: 1	154	154	154	SD069
VANADIUM	1: 1: 1	16.9	16.9	16.9	SD069
ZINC	1: 1: 1	209	209	209	SD069
VOCs					
METHYL ACETATE	1: 1: 1	0.067	0.067	0.067	SD069
Other					
TOTAL ORGANIC CARBON	1: 1: 1	23200	23200	23200	SD069
UPPER NAVIGATIONAL CHANNEL (2 - 4 ft)					
VOCs					
METHYL ACETATE	1: 1: 1	2.9	2.9	2.9	SD069

Table 3-7
Sediment Summary Statistics - Upper Navigational Channel
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
UPPER NAVIGATIONAL CHANNEL (4 - 6 ft)					
Inorganics					
ALUMINUM	1:1:1	8220	8220	8220	SD069
ANTIMONY	1:1:1	15.6	15.6	15.6	SD069
ARSENIC	1:1:1	9.7	9.7	9.7	SD069
BARIUM	1:1:1	116	116	116	SD069
CADMIUM	1:1:1	3	3	3	SD069
CALCIUM METAL	1:1:1	8450	8450	8450	SD069
CHROMIUM, TOTAL	1:1:1	45.4	45.4	45.4	SD069
COPPER	1:1:1	83.4	83.4	83.4	SD069
IRON, TOTAL	1:1:1	14600	14600	14600	SD069
LEAD	1:1:1	146	146	146	SD069
MAGNESIUM	1:1:1	4560	4560	4560	SD069
MANGANESE	1:1:1	229	229	229	SD069
MERCURY	1:1:1	1.4	1.4	1.4	SD069
NICKEL	1:1:1	15.7	15.7	15.7	SD069
POTASSIUM	1:1:1	1690	1690	1690	SD069
SODIUM	1:1:1	513	513	513	SD069
VANADIUM	1:1:1	17.8	17.8	17.8	SD069
ZINC	1:1:1	266	266	266	SD069
VOCs					
METHYL ACETATE	1:1:1	0.26	0.28	0.26	SD069
UPPER NAVIGATIONAL CHANNEL (4 - 6 ft)					
VOCs					
METHYL ACETATE	1:1:1	11.2	11.2	11.2	SD069

FOD - Frequency of Detection, Number of detected samples: Number of samples used to calculate statistics: Number of total samples.

Table S-8
Sediment Summary Statistics - Downstream
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (mg/kg)			Location of Maximum Detection
		Minimum	Maximum	Mean	
DOWNSTREAM (0 - 0.5 ft)					
Inorganics					
ALUMINUM	2 : 2 : 2	6540	9590	8065	SD076
ANTIMONY	2 : 2 : 2	0.09	0.32	0.21	SD076
ARSENIC	2 : 2 : 2	1.2	7	4.1	SD076
BARIUM	2 : 2 : 2	31.8	109	70.4	SD076
CADMIUM	1 : 2 : 2	2.1	2.1	1.3	SD076
CALCIUM METAL	2 : 2 : 2	1920	3930	2925	SD076
CHROMIUM, TOTAL	2 : 2 : 2	13.8	126	70.9	SD076
COBALT	2 : 2 : 2	6.2	8.6	7.4	SD076
COPPER	2 : 2 : 2	12.1	94.2	53.2	SD076
IRON, TOTAL	2 : 2 : 2	14900	20500	17700	SD076
LEAD	1 : 2 : 2	134	134	72.5	SD076
MAGNESIUM	2 : 2 : 2	3300	4200	3750	SD076
MANGANESE	2 : 2 : 2	275	325	300	SD076
MERCURY	2 : 2 : 2	0.05	1.22	0.64	SD076
NICKEL	2 : 2 : 2	13.1	20.7	16.9	SD076
POTASSIUM	2 : 2 : 2	911	1010	961	SD076
SILVER	2 : 2 : 2	0.05	0.77	0.41	SD076
SODIUM	2 : 2 : 2	58.8	98.1	78.5	SD076
THALLIUM	2 : 2 : 2	0.05	0.21	0.13	SD076
VANADIUM	2 : 2 : 2	10	18.9	14.5	SD076
ZINC	2 : 2 : 2	74.7	333	204	SD076
Other					
TOTAL ORGANIC CARBON	1 : 1 : 1	1660	1660	1660	SD075

FOD - Frequency of Detection, Number of detected samples: Number of samples used to calculate statistics: Number of total samples.
Only detected compounds within each reach and depth are presented.

Table 3-8
Sediment Analytical Results for Veliaella Organic Compounds
BASF Corporation
Hudson River DU-2 Investigation
Pensacola, New York

Location Description, Geophysical Substrate	UPSTREAM	UPSTREAM	UPSTREAM	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
Sample ID	Q8SC011UA1	Q8SC011UA1	Q1SD019UA1	01SD0041AB1	D1SD055AB1	Q2SD079AA1	D2SD082UA1	D2SD083UA1	Q2SD083UA1
Depth Interval	0-5	0-5	0-5	2-4	8-4	0-5	0-5	0-5	0-5
ANALYSIS									
1,1,1-TRICHLOROETHANE (TCA)	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
1,2,4-TRICHLOROBENZENE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
1,2-DICHLOROBENZENE	ug/kg	3.6 UJ	8.3 UJ	9.0 J	14 UJ	4.5 UJ	41 J	0.82 J	750 UJ
1,2-DICHLOROETHANE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
1,2-DICHLOROPROPANE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
1,3-DICHLOROBENZENE	ug/kg	3.6 UJ	8.3 UJ	11 J	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
1,4-DICHLOROBENZENE	ug/kg	3.6 UJ	1.0 J	27 UJ	14 UJ	4.5 UJ	570 UJ	0.69 J	49 J
2-BUTANONE (MEK)	ug/kg	12 J	17 UJ	193 UJ	70 UJ	8.9 UJ	1160 UJ	11	1500 UJ
4-METHYL-2-PENTANONE (MIBK)	ug/kg	7.2 UJ	17 UJ	190 UJ	70 UJ	8.9 UJ	1160 UJ	11 UJ	1500 UJ
ACETONE	ug/kg	14 UJ	38 UJ	279 UJ	140 UJ	19 UJ	2330 UJ	41 J	3000 UJ
BENZENE	ug/kg	3.6 UJ	1.1 J	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
CARBON DISULFIDE	ug/kg	1.1 J	1.4 J	27 UJ	14 UJ	4.5 UJ	1160 UJ	1.2 J	1500 UJ
CHLOROBENZENE	ug/kg	3.6 UJ	1.00 J	12 J	14 UJ	4.5 UJ	1700 UJ	12	1200 J
CHLOROMETHANE	ug/kg	3.6 UJ	8.3 UJ	53 UJ	28 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
CYCLOHEXANE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
ETHYLBENZENE	ug/kg	0.32 J	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
ISOPROPYLBENZENE	ug/kg	3.6 UJ	1.2 J	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
MIP-XYLENES	ug/kg	3.6 UJ	5.4 J	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
METHYL ACETATE	ug/kg	7.2 UJ	120	279 UJ	140 UJ	8.9 UJ	240 J	11 UJ	340 J
METHYLDIOXANE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
METHYLENE CHLORIDE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
METHYL TERT-BUTYL ETHER	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
TRICHLOROFLUOROMETHANE	ug/kg	3.6 UJ	2.4 J	27 UJ	14 UJ	4.5 UJ	570 UJ	0.63 J	750 UJ
O-XYLENE	ug/kg	1.4 J	1.5 J	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
STYRENE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
TETRACHLOROETHENE (PCE)	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
TOLUENE	ug/kg	3.6 UJ	12	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ
TRICHLOROETHYLENE	ug/kg	3.6 UJ	8.3 UJ	27 UJ	14 UJ	4.5 UJ	570 UJ	5.6 UJ	750 UJ

U = Not Disturbed

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R = Analytical Value was Rejected

2. At end of sample ID indicates duplicate sample

***Depth Intervals are in Feet**

Table 3-9

Sediment Analytics: Results for Volatile Organic Compounds
 BASF Corporation
 Hudson River OU-2 Investigation
 Honesdale, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD046 D2SD046AA1 0-5	ADJACENT NEARSHORE Muddy Sand SD056 22SD056AA1 0-5	ADJACENT NEARSHORE Muddy Sand SD057 01SD057AA1 0-5	ADJACENT NEARSHORE Muddy Sand SD058 02SD058AA1 0-5	ADJACENT NEARSHORE Muddy Sand SD077 02SD077AA1 0-5	ADJACENT NEARSHORE Muddy Sand SD077 02SD077AA2 0-5
1,1,1-TRICHLOROETHANE (TCA)	up/kg	6.5 U	6.4 U	11 U	6.4 U	5.2 U	5 U
1,2,4-TRICHLOROBENZENE	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
1,2-DICHLOROBENZENE	up/kg	20	3.7 J	13 J	6.4 U	5.2 J	2.1 J
1,2-DICHLOROETHANE	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
1,2-DICHLOROPROPANE	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
1,3-DICHLOROBENZENE	up/kg	3.3 J	5.4 U	1.3 J	6.4 U	0.77 J	5 U
1,4-DICHLOROBENZENE	up/kg	3.1 J	5.4 U	1.7 J	6.4 U	3.3 J	1.1 J
2-BUTANONE (MEK)	up/kg	7.9 J	5.7 J	21 U	13	8 J	14
4-METHYL-2-PENTANONE (MIBK)	up/kg	18 U	11 U	21 U	13 U	10 U	10 U
ACETONE	up/kg	29 J	20 J	42 U	40 J	31 J	49 J
BENZENE	up/kg	5.8 J	5.4 U	0.65 J	6.4 U	0.68 J	0.45 J
CARBON DISULFIDE	up/kg	0.70 J	0.39 J	0.83 J	0.97 J	1 J	0.98 J
CHLOROBENZENE	up/kg	180	10	18	1.6 J	3100 U	140 J
CHLOROMETHANE	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
CYCLOHEXANE	up/kg	0.44 J	5.4 U	1.7 J	6.4 U	5.5 J	6.2 J
ETHYLBENZENE	up/kg	0.55 J	5.4 U	1.8 J	6.4 U	0.42 J	5 U
ISOPROPYLBENZENE	up/kg	6.5 U	5.4 U	11 U	6.4 U	0.91 J	5 U
M,P-XYLENES	up/kg	1.4 J	5.4 U	2.8 J	6.4 U	1.3 J	5 U
METHYLACETATE	up/kg	13 U	11 U	50 J	13 U	10 U	10 U
METHYLCYCLOHEXANE	up/kg	0.62 J	5.4 U	15 U	6.4 U	0.73 J	0.85 J
METHYLENE CHLORIDE	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
METHYL TERT-BUTYL ETHER	up/kg	6.5 U	5.4 U	17 U	6.4 U	57 U	54 U
TRICHLOROFLUOROMETHANE	up/kg	6.5 U	5.4 U	17 U	6.4 U	57 U	54 U
TOXYLENE	up/kg	0.70 J	5.4 U	0.97 J	6.4 U	2.1 J	0.97 J
STYRENE	up/kg	6.5 U	5.4 U	3.8 J	6.4 U	5.2 U	5 U
TETRACHLOROETHENE (PCE)	up/kg	6.5 U	5.4 U	11 U	6.4 U	5.2 U	5 U
TOLUENE	up/kg	6.5 U	5.4 U	7.1 J	48	5.2 U	5 U
TRICHLOROETHYLENE	up/kg	4.5 U	5.4 U	11 U	5.4 U	5.2 U	5 U

U = Not Detected

J = Estimated Value

R = Analytical Value was Rejected

2 at end of sample ID indicates duplicate sample

*Depth Intervals are in Feet.

Table 3-9
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Hempstead, New York

Analyte	Location Description	Depth Interval	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
			Muddy Sand SD084 02SD084AA1	Muddy Sand SD085 01SD085AA1	Muddy Sand SD085 01SD085AB1	Muddy Sand SD085 01SD085AC1	Muddy Sand SD086 01SD086AA1	Muddy Sand SD087 01SD087AB1	Muddy Sand SD087 01SD087AC1	
1,1,1-TRICHLOROETHANE (TCA)	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	2000 U	1800 U	
1,2,4-TRICHLOROBENZENE	ug/kg	0-5	6.8 U	1700 U	20000 U	2400 U	11	21000 U	85000 U	
1,2-DICHLOROBENZENE	ug/kg	0-5	6.8 U	250 J	25000 U	7200 U	180	160000 U	3200000 U	
1,2-DICHLOROETHANE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	29000 U	82000 U	
1,2-DICHLOROPROPANE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	3800 U	830 U	
1,3-DICHLOROBENZENE	ug/kg	0-5	6.8 U	1700 U	49000 U	9900 U	12	42000 U	470000 U	
1,4-DICHLOROBENZENE	ug/kg	0-5	6.8 U	220 J	37000 U	38000 U	14	89000 U	400000 U	
2-BUTANONE (MEK)	ug/kg	0-5	11 J	3400 U	6000 U	4700 U	19 U	10000 U	9200 U	
4-METHYL-2-PENTANONE (MIBK)	ug/kg	0-5	14 U	3400 U	8000 U	4700 U	19 U	1800 U	9200 U	
ACETONE	ug/kg	0-5	46 J	740 J	12000 U	9300 U	25 J	20000 U	18000 U	
BENZENE	ug/kg	0-5	6.8 U	13000 U	37000 U	19000 U	2.5 J	85000 U	480000 U	
CARBON DISULFIDE	ug/kg	0-5	0.59 J	3400 U	1200 U	930 U	0.79 J	2800 U	1800 U	
CHLOROBENZENE	ug/kg	0-5	21 J	18000 U	160000 U	110000 U	100	1100000 U	2700000 U	
CHLOROMETHANE	ug/kg	0-5	6.8 U	1700 U	2400 U	1800 U	5.4 U	4000 U	3700 U	
CYCLOHEXANE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	1.0 J	770 U	750 U	
ETHYLBENZENE	ug/kg	0-5	6.8 U	1700 U	4500 U	4800 U	0.68 J	14000 U	9600 U	
ISOPROPYLBENZENE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	2600 U	730 U	
M-P-XYLENES	ug/kg	0-5	6.8 U	1700 U	11000 U	6200 U	1.8 J	58000 U	42000 U	
METHYL ACETATE	ug/kg	0-5	14 U	590 J	19000 U	9300 U	120	20000 U	13000 U	
METHYLCYCLOHEXANE	ug/kg	0-5	6.8 U	240 J	390 J	930 U	8.4 U	2900 U	4300 U	
METHYLENE CHLORIDE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	28	2000 U	1800 U	
METHYL TERT-BUTYL ETHER	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	2000 U	1800 U	
TRICHLOROFLUOROMETHANE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	2000 U	1800 U	
O-XYLENE	ug/kg	0-5	6.8 U	1700 U	3700 U	2500 U	6.62 J	15000 U	12000 U	
STYRENE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	9.4 U	2000 U	1800 U	
TETRACHLOROETHENE (PCE)	ug/kg	0-5	6.8 U	1700 U	1800 U	380 U	9.4 U	2100 U	2000 U	
TOLUENE	ug/kg	0-5	6.8 U	1700 U	25000 U	6000 U	1.8 J	130000 U	48000 U	
TRICHLOROETHYLENE	ug/kg	0-5	6.8 U	1700 U	1200 U	930 U	0.60 J	8000 U	5000 U	

U = Not Detected
J = Estimated Value
R = Analytical Value was Reported
2 at end of sample ID indicates duplicate sample
*Depth Intervals are in feet.

Table 3-2
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River Q1-Q2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD086 D1SD086AA1 0-1.5	ADJACENT NEARSHORE Muddy Sand SD087 01SD086AB1 2-4	ADJACENT NEARSHORE Muddy Sand SD089 01SD089AA1 4-6	ADJACENT NEARSHORE Muddy Sand SD089 D1SD089AA1 0-1.5	ADJACENT NEARSHORE Muddy Sand SD090 01SD090AA1 0-1.5	ADJACENT NEARSHORE Muddy Sand SD091 02SD091AB1 2-4	ADJACENT NEARSHORE Muddy Sand SD091 02SD091AB2 2-4
1,1,1-TRICHLOROETHANE (TCA)	up/kg	15000 UJ	5900 UJ	1400 UJ	8.6 U	3900 U	52000 U	14000 UJ
1,2,4-TRICHLOROBENZENE	up/kg	5000 J	4800 J	35000 J	4.6 J	3900 U	52000 U	14000 UJ
1,2-DICHLOROBENZENE	up/kg	75000 J	46000 J	55000 J	60	480 J	52000 U	14000 UJ
1,2-DICHLOROETHANE	up/kg	15000 UJ	13000 J	8900 U	8.8 U	3900 U	52000 U	14000 UJ
1,2-DICHLOROPROPANE	up/kg	15000 UJ	5900 UJ	1400 UJ	8.6 U	3900 U	52000 U	14000 UJ
1,3-DICHLOROBENZENE	up/kg	9800 J	15000 J	11000 J	9.8 J	3800 U	52000 U	14000 UJ
1,4-DICHLOROBENZENE	up/kg	15000 J	31000 J	8000 J	3.8 J	2800 J	27000 J	27000 J
2-BUTANONE (MEK)	up/kg	30000 UJ	25000 UJ	8900 UJ	2.2 J	7700 U	100000 U	27000 UJ
4-METHYL-2-PENTANONE (MIBK)	up/kg	30000 UJ	29000 UJ	8900 UJ	17 U	7700 U	100000 U	27000 UJ
ACETONE	up/kg	60000 UJ	59000 UJ	14000 UJ	11 J	15000 U	210000 UJ	55000 UJ
BENZENE	up/kg	7300 J	11000 J	18000 J	8.8 U	8000	51000 J	100000 J
CARBON DISULFIDE	up/kg	30000 UJ	5600 UJ	1400 UJ	0.89 J	7700 U	100000 U	27000 UJ
CHLOROBENZENE	up/kg	45000 J	38000 J	500000 J	93	120000	1300000 J	480000 J
CHLOROMETHANE	up/kg	15000 UJ	12000 UJ	2800 UJ	8.6 U	3800 U	52000 U	14000 UJ
CYCLOHEXANE	up/kg	15000 UJ	5600 UJ	980 J	8.8 U	3900 U	52000 U	14000 UJ
ETHYLBENZENE	up/kg	1000 J	13000 J	30000 J	8.6 U	280 J	52000 U	14000 UJ
ISOPROPYLBENZENE	up/kg	15000 UJ	5800 UJ	2700 J	8.6 U	3900 U	52000 U	14000 UJ
M,P-XYLENES	up/kg	4000 J	4400 J	15000 J	1.8 J	970 J	3800 J	6400 J
METHYL ACETATE	up/kg	30000 UJ	58000 UJ	14000 UJ	36	750 J	100000 U	27000 UJ
METHYLCYCLOHEXANE	up/kg	15000 UJ	5800 UJ	8900 J	8.6 U	3900 U	52000 U	14000 UJ
METHYLENE CHLORIDE	up/kg	15000 UJ	5800 UJ	1400 UJ	8.8 U	3800 U	52000 U	14000 UJ
METHYL TERT-BUTYL ETHER	up/kg	15000 UJ	5800 UJ	1400 UJ	8.6 U	3900 U	52000 U	14000 UJ
TRICHLOROFLUOROMETHANE	up/kg	15000 UJ	5800 UJ	1400 UJ	8.6 U	3900 U	52000 U	14000 UJ
O-XYLENE	up/kg	1300 J	11000 J	52000 J	0.70 J	260 J	52000 U	14000 UJ
STYRENE	up/kg	15000 UJ	5800 UJ	1700 J	8.8 U	3900 U	52000 U	14000 UJ
TETRACHLOROETHENE (PCE)	up/kg	15000 UJ	5800 UJ	1400 UJ	8.8 U	3900 U	52000 U	14000 UJ
TOLUENE	up/kg	7900 J	11000 J	77000 J	0.93 J	1800 J	52000 U	14000 UJ
TRICHLOROETHYLENE	up/kg	15000 UJ	5800 UJ	1400 UJ	8.6 U	3800 U	52000 U	14000 UJ

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth intervals are in Feet.

Table 3-9
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River OUS-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
1,1,1-TRICHLOROETHANE (TCA)	ug/kg	470 U	820 U	560 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
1,2,4-TRICHLOROBENZENE	ug/kg	87 J	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
1,2-DICHLOROETHANE	ug/kg	720	830 J	140 J	8.3 J	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	18
1,2-DICHLOROPROPANE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
1,3-DICHLOROBENZENE	ug/kg	670	110 J	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.8 U
1,4-DICHLOROBENZENE	ug/kg	1700	380 J	120 J	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	1.7 J
2-BUTANONE (MEK)	ug/kg	930 U	1600 U	1100 U	64	440 UJ	440 UJ	440 UJ	440 UJ	440 UJ	5.0 J
4-METHYL-2-PENTANONE (MIBK)	ug/kg	930 U	1600 U	1100 U	23 U	440 UJ	440 UJ	440 UJ	440 UJ	440 UJ	9.8 U
ACETONE	ug/kg	1900 UJ	3300 U	2200 U	180	850 UJ	850 UJ	850 UJ	850 UJ	850 UJ	20
BENZENE	ug/kg	190 J	1900	250 J	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	0.64 J
CARBON DISULFIDE	ug/kg	930 U	1600 U	1100 U	3.5 J	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	0.85 J
CHLOROBENZENE	ug/kg	7500	14000	13600	17	220 J	220 J	240 J	240 J	240 J	23
CHLOROMETHANE	ug/kg	470 U	820 U	550 U	12 U	180 UJ	180 UJ	180 UJ	180 UJ	180 UJ	4.9 U
CYCLOHEXANE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
ETHYLBENZENE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
ISOPROPYLBENZENE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
M,P-XYLENES	ug/kg	470 U	820 J	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
METHYL ACETATE	ug/kg	330 U	520 J	160 J	23 U	880 UJ	880 UJ	880 UJ	880 UJ	880 UJ	4.9 U
METHYLCYCLOHEXANE	ug/kg	470 U	820 U	57 J	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
METHYLENE CHLORIDE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
METHYL TERT-BUTYL ETHER	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
TRICHLOROFLUOROMETHANE	ug/kg	470 U	820 U	820 U	0.86 J	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	0.48 J
O-XYLENE	ug/kg	470 U	820 U	83 J	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
STYRENE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.8 U
TETRACHLOROETHENE (PCE)	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U
TOLUENE	ug/kg	470 U	200 J	550 U	4.6 J	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	0.84 J
TRICHLOROETHYLENE	ug/kg	470 U	820 U	550 U	12 U	88 UJ	88 UJ	88 UJ	88 UJ	88 UJ	4.9 U

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth Intervals are in Feet.

Table 9-9
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River OIL-2 Investigation
Hempstead, New York

Location Description Geophysical Substrate Location ID Sample ID	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
Depth Interval	4-6	0-5	2-4	4-6	0-5	4-6	4-6	4-6	4-6	4-6
Analysis										
1,1,1-TRICHLOROETHANE (TCA)	180 UJ	8.8 UJ	780 U	6.7 U	650 U	6.4 U	6.4 U	850 U	1000 U	780 U
1,2,4-TRICHLOROBENZENE	2800 J	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	140 J	1000 U	760 U
1,2-DICHLOROBENZENE	1200 J	8.8 UJ	61 J	6.7 U	850 U	6.4 U	6.4 U	3400	1600	200 J
1,2-DICHLOROETHANE	190 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
1,2-DICHLOROPROPANE	190 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
1,3-DICHLOROBENZENE	35000 J	8.8 UJ	250 J	6.7 U	650 U	6.4 U	6.4 U	140 J	780 U	780 U
1,4-DICHLOROBENZENE	6300 J	8.8 UJ	940	6.7 U	850 U	6.4 U	6.4 U	850	830 J	89 J
2-BUTANONE (MEK)	940 UJ	20 J	1620 U	21	1300 U	44	44	1700 U	2000 U	1500 U
4-METHYL-2-PENTANONE (MIBK)	840 UJ	18 UJ	1500 U	19 U	1300 U	13 U	13 U	1700 U	2000 U	1500 U
ACETONE	1900 UJ	80 J	3160 U	89	2800 U	28 U	28 U	3400 U	4100 U	3000 U
BENZENE	1300 J	0.74 J	270 J	0.43 J	650 U	0.70 J	0.70 J	2000	130 J	760 U
CARBON DISULFIDE	190 UJ	1.1 J	1500 U	1.0 J	1300 U	0.87 J	0.87 J	1700 U	2000 U	1500 U
CHLOROBENZENE	24000 J	2.6 J	25000	0.58 J	190 J	17	17	32500	6500	1300
CHLOROMETHANE	370 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	780 U
CYCLOHEXANE	190 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
ETHYLBENZENE	550 J	0.93 J	760 U	6.7 U	42 J	2.1 J	2.1 J	120 J	1000 U	760 U
ISOPROPYLBENZENE	110 J	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
M-P-XYLENES	2500 J	2.2 J	103 J	6.7 U	650 U	6.4 U	6.4 U	810 J	150 J	69 J
METHYL ACETATE	310 J	18 UJ	340 J	13 U	230 J	13 U	13 U	320 J	370 J	900 J
METHYLCYCLOHEXANE	190 UJ	8.8 UJ	94 J	7.9 J	52 J	4.1 J	4.1 J	570 J	1000 U	210 J
METHYLENE CHLORIDE	180 UJ	8.8 UJ	780 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
METHYL TERT-BUTYL ETHER	190 UJ	8.8 UJ	780 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
TRICHLOROFLUOROMETHANE	190 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
O-XYLENE	430 J	1.2 J	140 J	6.7 U	850 U	6.4 U	6.4 U	440 J	1000 U	760 U
STYRENE	180 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
TETRACHLOROETHYLENE (PCE)	71 J	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U
TOLUENE	7100 J	0.8 UJ	780 U	6.7 U	930	6.4 U	6.4 U	320 J	180 J	360 J
TRICHLOROETHYLENE	180 UJ	8.8 UJ	760 U	6.7 U	850 U	6.4 U	6.4 U	850 U	1000 U	760 U

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth intervals are in Feet.

Table S-8
Sediment Analytical Results for Volatile Organic Compounds
GASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Location Description	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
Geophysical								
Substrate								
Location ID	Muddy Sand SD105	Muddy Sand SD106	Muddy Sand SD107	Muddy Sand SD107AB2	Muddy Sand SD107	Muddy Sand SD107AC1	Muddy Sand SD108	Muddy Sand SD108
Sample ID	02SD105AB1	02SD106AC1	02SD107AB1	02SD107AB2	02SD107AC1	02SD107AC1	02SD108AD1	02SD108AF1
Depth Interval	2-4	4-6	2-4	2-4	4-5	4-5	6-8	8-12
Analyte								
1,1,1-TRICHLOROETHANE (TCA)	6000 U	16000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
1,2,4-TRICHLOROETHANE	5500 U	150000 U	1000 U	1200 U	23000 U	58 U	45000 U	14000 U
1,2-DICHLOROETHANE	51000 U	740000 U	2550 U	1200 U	23000 U	77 U	18000 U	990 U
1,2-DICHLOROETHANE	50000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
1,2-DICHLOROPROPANE	180000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
1,3-DICHLOROETHANE	6000 U	150000 U	2200 U	1200 U	72000 U	730 U	16000 U	14000 U
1,4-DICHLOROETHANE	18000 U	150000 U	6800 U	180 U	72000 U	730 U	49000 U	5100 U
2-BUTANONE (MIBK)	110000 U	360000 U	1200 U	2500 U	76000 U	1500 U	91000 U	28000 U
4-METHYL-2-PENTANONE (MIBK)	110000 U	360000 U	1300 U	2500 U	78000 U	1500 U	91000 U	28000 U
ACETONE	210000 U	720000 U	26000 U	4900 U	150000 U	2900 U	180000 U	55000 U
BENZENE	33000 U	87000 U	2200 U	380 U	46000 U	180 U	91000 U	13000 U
CARBON DISULFIDE	110000 U	360000 U	1300 U	2500 U	76000 U	1500 U	91000 U	28000 U
CHLOROBENZENE	1700000 U	4200000 U	210000 U	25000 U	900000 U	21800 U	1000000 U	300000 U
CHLOROMETHANE	58000 U	180000 U	6500 U	3200 U	36000 U	730 U	45000 U	14000 U
CYCLOHEXANE	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
METHYLBENZENE	53000 U	180000 U	1800 U	1200 U	3200 U	730 U	3750 U	850 U
ISOPROPYLBENZENE	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
M,P-XYLENES	11000 U	36000 U	7400 U	1200 U	9800 U	730 U	9600 U	5300 U
METHYL ACETATE	110000 U	260000 U	13000 U	2500 U	76000 U	1500 U	91000 U	28000 U
METHYLCYCLOHEXANE	53000 U	180000 U	910 U	1200 U	36000 U	730 U	45000 U	14000 U
METHYLENE CHLORIDE	52000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
METHYL TERT-BUTYL ETHER	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
TRICHLOROFLUOROMETHANE	52000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
O-XYLENE	53000 U	11000 U	1800 U	1200 U	36000 U	730 U	45000 U	14000 U
STYRENE	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
TETRACHLOROETHENE (PCE)	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U
TOLUENE	18000 U	24000 U	1200 U	1200 U	9400 U	730 U	34000 U	14000 U
TRICHLOROETHYLENE	53000 U	180000 U	6500 U	1200 U	36000 U	730 U	45000 U	14000 U

U = Not Collected
U = Estimated Value
A = Analytical Value was Rejected
2 at end of sample's ID indicates duplicate sample
Depth Intervals are in Feet.

Table 3-6

Sediment Analytical Results for Volatile Organic Compounds

BASIF Corporation

Hudson River OII-2 Investigation

Patterson, New York

Location Description	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
Geophysical Substrate	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand
Location ID	SD109	SD109	SD110	SD110	SD110	SD110	SD110	SD110	SD110
Sample ID	02SD109AB1	02SD109AC1	02SD110AB1	02SD110AC1	02SD110AB2	02SD110AB3	02SD110AC1	02SD110AC2	02SD110AC3
Depth Interval	2-4	4-6	2-4	4-6	6-8	2-4	2-4	6-8	4-6
Analysate	1,1,1-TRICHLOROETHANE (TOA)	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U
1,2,4-TRICHLOROBENZENE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U
1,2-DICHLOROBENZENE	670 U	6400 U	62 J	10 J	4.9 U	500 U	62 J	35 J	35 J
1,2-DICHLOROPROPANE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U
1,3-DICHLOROBENZENE	54 J	630 J	920 J	15 J	4.9 U	500 U	170 J	100 J	100 J
1,4-DICHLOROBENZENE	123 J	2300 J	1200 J	63 J	0.82 J	40 J	230 J	430 J	430 J
2-BUTANONE (MEK)	1300 U	1300 U	1400 U	39 J	13	1000 U	370 J	1100 U	1100 U
4-METHYL-2-PENTANONE (MIBK)	1300 U	1300 U	1400 U	16 U	9.7 U	1000 U	1300 U	1100 U	1100 U
ACETONE	2700 U	25000 U	2800 U	150 J	43	2000 U	3800 U	2200 U	2200 U
BENZENE	3200	13000	91 J	7.6 J	4.2 J	40 J	840 U	540 U	540 U
CARBON DISULFIDE	1300 U	1300 U	1400 U	2.8 J	1.1 J	1000 U	1300 U	1100 U	1100 U
CHLOROBENZENE	1400 J	18000	7800	145 U	12 J	400 J	7200	12000 J	12000 J
CHLOROMETHANE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U
CYCLOHEXANE	670 U	6400 U	720 U	4.3 J	2.8 J	500 U	940 U	540 U	540 U
ETHYLBENZENE	130 J	530 J	720 U	2.3 J	0.70 J	500 U	940 U	540 U	540 U
ISOPROPYLBENZENE	670 U	6400 U	54 J	60 J	3.4 J	30 J	940 U	540 U	540 U
M-P-XYLENES	76 J	680 J	110 J	22 J	3.3 J	100 J	58 J	120 J	120 J
METHYL ACETATE	5300 U	13000 U	1400 U	16 U	9.7 U	130 J	390 J	68 J	68 J
METHYLCYCLOHEXANE	670 U	6400 U	68 J	39 J	12 J	61 J	840 U	51 J	51 J
METHYLENE CHLORIDE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U
METHYL TERT-BUTYL ETHER	670 U	6400 U	720 U	1.0 J	4.9 U	600 U	940 U	540 U	540 U
TRICHLOROFLUOROMETHANE	670 U	6400 U	720 U	0.2 U	4.9 U	500 U	940 U	540 U	540 U
O-XYLENE	95 J	530 J	120 J	40 J	2.1 J	500 U	70 J	280 J	280 J
STYRENE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U
TETRACHLOROETHENE (PCE)	670 U	6400 U	720 U	6.2 U	4.9 U	500 U	940 U	540 U	540 U
TOLUENE	670 U	6400 U	110 J	1.4 J	0.73 J	88 J	940 U	50 J	50 J
TRICHLOROETHYLENE	670 U	6400 U	720 U	8.2 U	4.9 U	500 U	940 U	540 U	540 U

U = Not Detected

J = Estimated Value

R = Analytical Value was Rejected

2 at end of sample ID indicates duplicate sample

*Depth intervals are in Feet.

Table 3-3
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River OUS Investigation
Rensselaer, New York

Location Description	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
Geophysical Substrate	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand
Location ID	SD112	SD112	SD112	SD112	SD112	SD112	SD112	SD112	SD112
Sample ID	02SD112A01	02SD112A02	02SD112A01	02SD112A01	02SD112A01	02SD112A01	02SD112A01	02SD112A01	02SD112A01
Depth Interval	2-4	4-6	6-8	8-10	2-4	4-6	6-8	8-10	2-4
1,1,1-TRICHLOROETHANE (TCA)	850 U	1000 UJ	920 UJ	580 U	740 U	1100 U	550 U	480 U	480 U
1,2,4-TRICHLOROBENZENE	850 U	4200 J	340 J	54 J	740 U	1160 U	550 U	450 U	450 U
1,2-DICHLOROBENZENE	99 J	240 J	270 J	230 J	88 J	72 J	66 J	27 J	27 J
1,2-DICHLOROETHANE	850 U	1000 UJ	920 UJ	680 U	740 U	1160 U	550 U	460 U	460 U
1,2-DICHLOROPROPANE	680 U	1000 UJ	820 UJ	680 U	740 U	1100 U	580 U	460 U	460 U
1,3-DICHLOROBENZENE	520 J	630 J	2900 J	1300 J	160 J	280 J	300 J	480 U	480 U
1,4-DICHLOROBENZENE	480 J	12000 J	1800 J	500 J	220 J	260 J	460 J	110 J	110 J
2-BUTANONE (MEK)	1800 U	2000 UJ	1800 UJ	1300 U	1500 U	2200 U	1400 U	920 U	920 U
4-METHYL-2-PENTANONE (MIBK)	1800 U	2050 UJ	1800 UJ	1300 U	1500 UJ	2250 U	1400 U	920 U	920 U
ACETONE	3600 U	4100 UJ	3700 UJ	2600 UJ	3000 UJ	4300 UJ	2200 UJ	1800 UJ	1800 UJ
BENZENE	250 J	360 J	910 J	540 J	740 U	91 J	45 J	460 U	460 U
CARBON DISULFIDE	1800 U	2000 UJ	1800 UJ	1300 U	1500 U	2200 U	1400 U	920 U	920 U
CHLOROBENZENE	16000	32000 J	9100 J	5200	3200	4900	4900	1200	1200
CHLOROMETHANE	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
CYCLOHEXANE	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
ETHYLBENZENE	73 J	160 J	210 J	110 J	740 U	1100 U	35 J	460 U	460 U
ISOPROPYLBENZENE	580 U	1000 UJ	920 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
M-P-XYLENES	270 J	810 J	1350 J	570	88 J	320 J	320 J	65 J	65 J
METHYL ACETATE	480 J	670 J	480 J	370 J	360 J	360 J	200 J	60 J	60 J
METHYLCYCLOHEXANE	73 J	1000 UJ	84 J	120 J	740 U	74 J	550 U	39 J	39 J
METHYLENE CHLORIDE	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
METHYL TERT-BUTYL ETHER	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
TRICHLOROFLUOROMETHANE	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
O-XYLENE	180 J	265 J	230 J	153 J	80 J	96 J	60 J	48 J	48 J
STYRENE	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
TETRACHLOROETHYLENE (PCE)	850 U	1000 UJ	820 UJ	680 U	740 U	1100 U	550 U	460 U	460 U
TOLUENE	110 J	140 J	110 J	230 J	60 J	74 J	140 J	70 J	70 J
TRICHLOROETHYLENE	950 U	1000 UJ	920 UJ	560 U	740 U	1100 U	550 U	460 U	460 U

U = Not Detected
J = Estimated Value
R = Analytical Value was Rejected
2 at end of sample ID indicates duplicate sample
*Depth intervals are in Feet.

Table 3-9
Sediment Analytical Results for Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Hanssaker, New York

Analyte	Location Description Geophysical Substrate Location ID Sample ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD114 02SD114A01 4-8	ADJACENT NEARSHORE Muddy Sand SD114 02SD114A01 6-8	ADJACENT NEARSHORE Muddy Sand SD114 02SD114A01 8-10	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD069 01SD069DB1 2-4	UPPER NAVIGATIONAL CHANNEL Muddy Sand SD069 01SD069DB1 4-6
1,1,1-TRICHLOROETHANE (TCA)	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
1,2,4-TRICHLOROBENZENE	ug/kg 520 U	630 U	940 U	R	40 UJ	170 UJ
1,2-DICHLOROBENZENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
1,2-DICHLOROPROpane	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
1,3-DICHLOROBENZENE	ug/kg 520 U	630 U	940 U	R	40 UJ	170 UJ
1,4-DICHLOROBENZENE	ug/kg 42 J	260 J	220 J	R	40 UJ	170 UJ
2-BUTANONE (MEK)	ug/kg 1000 U	1200 U	250 J	3.9 J	200 UJ	870 UJ
4-METHYL-2-PENTANONE (MIBK)	ug/kg 1000 U	1200 U	1900 U	5.9 UJ	200 UJ	870 UJ
ACETONE	ug/kg 2100 UJ	2500 UJ	3800 UJ	27 J	400 UJ	1700 UJ
BENZENE	ug/kg 520 U	51 J	61 J	3.0 UJ	40 UJ	170 UJ
CARBON DISULFIDE	ug/kg 1000 U	1300 U	1900 U	0.42 J	40 UJ	170 UJ
CHLOROBENZENE	ug/kg 280 J	3100	1000	0.72 J	40 UJ	170 UJ
CHLOROMETHANE	ug/kg 520 U	630 U	940 U	3.6 UJ	81 UJ	350 UJ
CYCLOHEXANE	ug/kg 520 U	630 U	940 U	0.24 J	40 UJ	170 UJ
ETHYLBENZENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
ISOPROPYLBENZENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
M-P-XYLENES	ug/kg 520 U	200 J	100 J	3.0 UJ	40 UJ	170 UJ
METHYL ACETATE	ug/kg 250 J	230 J	1900 U	5.9 UJ	67 J	280 J
METHYLOXOHEXANE	ug/kg 520 U	110 J	940 U	3.2 J	40 UJ	170 UJ
METHYLENE CHLORIDE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
METHYL TERT-BUTYL ETHER	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
TRICHLOROFLUOROMETHANE	ug/kg 520 U	110 J	940 U	3.0 UJ	40 UJ	170 UJ
O-XYLENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
STYRENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ
TETRACHLOROETHENE (PCE)	ug/kg 520 U	630 U	840 U	3.0 UJ	40 UJ	170 UJ
TOLUENE	ug/kg 62 J	460 J	220 J	3.0 UJ	40 UJ	170 UJ
TRICHLOROETHYLENE	ug/kg 520 U	630 U	940 U	3.0 UJ	40 UJ	170 UJ

U = Not Detected

J = Estimated Value

R = Analytical Value was Rejected

2 at end of sample ID indicates duplicate sample

*Depth Intervals are in Feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
EASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	UPSTREAM Sandy Mud SD011 0-5	UPSTREAM Muddy Sand SD019 0-5	ADJACENT FAR FIELD Gravelly Sand SD041 2-4	ADJACENT FAR FIELD Cobbles SD056 2-4	ADJACENT FAR FIELD Sand SD079 0-5	ADJACENT NEARSHORE Muddy Sand SD032 0-5	ADJACENT NEARSHORE Muddy Sand SD033 0-5	ADJACENT NEARSHORE Muddy Sand SD034 0-5	ADJACENT NEARSHORE Muddy Sand SD035 0-5
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	0.11	0.29	28.49	7.11	0.91	5.69	0.22	0.23	12.76
1,2,4-TRICHLOROBENZENE	mg/kg OC	0.11	0.29	8.49	7.11	0.91	0.42	0.04	0.06	12.76
1,2-DICHLOROBENZENE	mg/kg OC	0.11	0.29	14.24	7.11	0.91	5.69	0.22	0.23	12.76
1,2-DICHLOROETHANE	mg/kg OC	0.11	0.29	14.24	7.11	0.91	5.69	0.22	0.23	12.76
1,2-DICHLOROPROPANE	mg/kg OC	0.11	0.29	11.60	7.11	0.91	5.69	0.22	0.08	12.76
1,3-DICHLOROBENZENE	mg/kg OC	0.11	0.07	14.24	7.11	0.91	5.69	0.05	0.20	1.67
1,4-DICHLOROBENZENE	mg/kg OC	0.11	0.07	14.24	7.11	0.91	10.99	0.87	0.92	23.51
2-BUTANONE (MEK)	mg/kg OC	0.23	0.59	68.57	35.53	1.61	10.99	0.44	0.46	12.76
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	1.33	1.14	14.24	7.11	3.66	10.99	9.25	3.44	40.82
ACETONE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
BENZENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	33.83	0.95	1.60	40.82
CARBON DISULFIDE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
CHLOROBENZENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
CHLOROMETHANE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
CYCLOHEXANE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
ETHYLBENZENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
ISOPROPYLBENZENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
M,P-XYLENES	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
METHYL ACETATE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	4.79	0.44	0.46	11.66
METHYL TERT-BUTYL ETHER	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.07	12.76
METHYLCYCLOHEXANE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
O-XYLENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.06	12.76
STYRENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
TETRACHLOROETHYLENE (PCE)	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
TOLUENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.20	0.23	12.76
TRICHLOROETHYLENE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
TRICHLOROFLUOROMETHANE	mg/kg OC	0.11	0.07	12.66	7.11	0.91	5.69	0.22	0.23	12.76
TOTAL ORGANIC CARBON (TOC)		0.016	0.012	0.0095	0.001	0.0025	0.050	0.013	0.013	0.029

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.

Half the detection limit is presented for non-detects. Duplicate samples have been averaged.

Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.

When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

*Depth intervals are in feet.

Table S-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OUS-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD043 0-5	ADJACENT NEARSHORE Muddy Sand SD058 0-5	ADJACENT NEARSHORE Muddy Sand SD057 0-5	ADJACENT NEARSHORE Muddy Sand SD058 0-5	ADJACENT NEARSHORE Muddy Sand SD077 0-5	ADJACENT NEARSHORE Muddy Sand SD077 2-4	ADJACENT NEARSHORE Muddy Sand SD077 4-6
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	0.20	0.19	0.30	0.16	0.13	7.38	1.11
1,2,4-TRICHLOROBENZENE	mg/kg OC	1.28	0.26	0.71	0.03	0.17	15.16	6.97
1,2-DICHLOROBENZENE	mg/kg OC	0.30	0.19	0.30	0.16	0.13	18.85	1.11
1,2-DICHLOROETHANE	mg/kg OC	0.20	0.19	0.30	0.16	0.13	1.17	1.11
1,3-DICHLOROBENZENE	mg/kg OC	0.20	0.19	0.07	0.16	0.09	3.81	1.07
1,4-DICHLOROBENZENE	mg/kg OC	0.19	0.19	0.09	0.16	0.10	20.49	8.20
2-BUTANONE (MEK)	mg/kg OC	0.48	0.40	0.58	0.87	0.60	5.74	5.59
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	0.40	0.39	0.56	0.33	0.25	5.74	5.59
ACETONE	mg/kg OC	1.79	1.41	1.15	2.06	2.08	11.68	11.07
BENZENE	mg/kg OC	0.54	0.41	0.04	0.18	0.03	155.74	12.30
CARBON DISULFIDE	mg/kg OC	0.04	0.03	0.05	0.06	0.05	0.74	0.74
CHLOROBENZENE	mg/kg OC	11.11	0.70	1.04	0.08	71.71	1393.44	819.67
CHLOROMETHANE	mg/kg OC	0.33	0.18	0.09	0.16	0.36	6.56	1.11
CYCLOHEXANE	mg/kg OC	0.03	0.19	0.09	0.16	0.08	4.92	0.82
ETHYLBENZENE	mg/kg OC	0.20	0.18	0.30	0.16	0.09	0.82	1.11
ISOPROPYLBENZENE	mg/kg OC	0.09	0.18	0.14	0.16	0.10	20.90	3.89
M,P-XYLENES	mg/kg OC	0.40	0.39	2.75	0.33	0.25	11.88	3.61
METHYL ACETATE	mg/kg OC	0.04	0.19	0.30	0.16	0.03	3.32	4.57
METHYL TERT-BUTYL ETHER	mg/kg OC	0.20	0.19	0.30	0.18	0.13	1.17	1.11
METHYLCYCLOHEXANE	mg/kg OC	0.04	0.19	0.05	0.16	0.07	8.20	2.45
METHYLENE CHLORIDE	mg/kg OC	0.20	0.19	0.21	0.16	0.13	1.17	1.11
STYRENE	mg/kg OC	0.20	0.19	0.30	0.16	0.13	1.17	1.11
TETRACHLOROETHENE (PCE)	mg/kg OC	0.20	0.19	0.39	2.96	0.13	4.92	2.46
TOLUENE	mg/kg OC	0.20	0.19	0.30	0.16	0.13	4.92	1.11
TRICHLOROETHYLENE	mg/kg OC	0.20	0.19	0.30	0.16	0.13	4.92	1.11
TRICHLOROFLUOROMETHANE	mg/kg OC	0.20	0.19	0.30	0.16	0.13	4.92	1.11
TOTAL ORGANIC CARBON (TOC)		0.017	0.014	0.018	0.020	0.020	0.024	0.024

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration. If the detection limit is presented for non-detects. Duplicate samples have been averaged.
Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize 1
When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
*Depth intervals are in feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OUI-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrata Location ID	ADJACENT NEARSHORE Muddy Sand SD076 0-5	ADJACENT NEARSHORE Muddy Sand SD080 0-5	ADJACENT NEARSHORE Muddy Sand SD081 0-5	ADJACENT NEARSHORE Muddy Sand SD081 2-4	ADJACENT NEARSHORE Muddy Sand SD081 4-6	ADJACENT NEARSHORE Muddy Sand SD082 0-5	ADJACENT NEARSHORE Muddy Sand SD083 0-5	ADJACENT NEARSHORE Muddy Sand SD084 0-5	ADJACENT NEARSHORE Muddy Sand SD085 0-5
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	4.46	0.28	0.10	6.20	1.93	0.12	0.18	0.23	17.63
1,2,4-TRICHLOROETHANE	mg/kg OC	5.37	8.20	2.83	4.82	20.11	1.77	1.17	0.64	5.19
1,2-DICHLOROETHANE	mg/kg OC	16.38	0.20	0.16	1.18	0.84	0.12	0.16	0.25	17.63
1,2-DICHLOROPROPANE	mg/kg OC	2.82	0.86	0.31	1.18	0.84	0.12	0.16	0.25	17.63
1,3-DICHLOROETHANE	mg/kg OC	9.60	6.20	0.59	13.26	3.42	0.38	0.07	0.25	17.63
1,4-DICHLOROETHANE	mg/kg OC		1.00	0.33	25.67	13.18	1.38	0.10	0.25	4.56
2-BUTANONE (MEK)	mg/kg OC	33.90	0.05	0.33	5.87	2.96	1.67	0.81	0.83	35.27
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	25.42	3.00	0.66	11.76	4.17	0.25	0.31	0.51	16.35
ACETONE	mg/kg OC	531.07	0.07	0.52	385.03	59.69	4.82	0.16	0.25	289.71
BENZENE	mg/kg OC		280.00	0.09	3422.46	1818.18	0.71	0.05	0.04	394.19
CARBON DISULFIDE	mg/kg OC	16.38	0.18	0.05	1.18	0.62	0.42	0.16	0.25	17.63
CHLOROBENZENE	mg/kg OC	16.38	0.30	0.17	7.91	2.35	0.79	0.16	0.25	17.63
CHLOROMETHANE	mg/kg OC	2.86	0.17	0.06	1.18	1.01	0.32	0.16	0.25	17.63
CYCLOHEXANE	mg/kg OC	12.99	0.65	0.23	25.67	12.62	0.78	0.16	0.25	12.24
ETHYLBENZENE	mg/kg OC	16.38	0.40	0.05	5.35	4.28	0.25	0.31	0.30	4.98
ISOPROPYLBENZENE	mg/kg OC	16.38	0.32	0.16	3.42	7.91	4.40	0.16	0.25	17.63
M-P-XYLENES	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
METHYL ACETATE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
METHYL TERT-BUTYL ETHER	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
METHYLCYCLOHEXANE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
METHYLENE CHLORIDE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
O-XYLENE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
STYRENE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
TETRACHLOROETHENE (PCE)	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
TOLUENE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
TRICHLOROETHYLENE	mg/kg OC	16.38	0.32	0.16	1.18	0.84	0.12	0.16	0.25	17.63
TRICHLOROFLUOROMETHANE	mg/kg OC			0.077			0.058	0.18	0.054	
TOTAL ORGANIC CARBON (TOC)	mg/kg OC	0.018	0.010	0.047	0.047	0.047	0.039	0.015	0.013	0.048

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.
Half the detection limit is presented for non-detects. Duplicate samples have been averaged.
Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.
When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
Depth intervals are in Feet.

Table 3-13
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OC-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD085 2-4	ADJACENT NEARSHORE Muddy Sand SD086 0-5	ADJACENT NEARSHORE Muddy Sand SD087 0-5	ADJACENT NEARSHORE Muddy Sand SD087 2-4	ADJACENT NEARSHORE Muddy Sand SD087 4-6	ADJACENT NEARSHORE Muddy Sand SD088 0-5	ADJACENT NEARSHORE Muddy Sand SD089 0-5	ADJACENT NEARSHORE Muddy Sand SD089 2-4
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	4149.38	1.74	500.00	21000.00	85000.00	13.14	0.88	9142.86
1,2,4-TRICHLOROETHANE	mg/kg OC	6016.60	28.44	7500.00	180000.00	320000.00	131.37	11.43	87619.05
1,2-DICHLOROETHANE	mg/kg OC	12.45	0.74	750.00	29000.00	6300.00	13.14	0.92	3618.05
1,2-DICHLOROPROPANE	mg/kg OC	12.45	0.74	960.00	330.00	55.00	13.14	0.82	2857.14
1,3-DICHLOROETHANE	mg/kg OC	1010.60	1.90	1500.00	4300.00	47000.00	8.31	0.72	5904.76
1,4-DICHLOROETHANE	mg/kg OC	787.63	2.21	1500.00	6300.00	40000.00	11.80	0.72	5904.76
2-BUTANONE (MEK)	mg/kg OC	62.24	1.50	180.00	180.00	180.00	26.81	1.82	20952.38
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	787.63	3.85	750.00	88000.00	48000.00	723.86	2.10	20952.38
ACETONE	mg/kg OC	33185.02	0.12	4500.00	110000.00	270000.00	884.72	0.13	895714.29
CARBON DISULFIDE	mg/kg OC	12.45	0.16	100.00	77.00	75.00	13.14	0.82	2478.19
CHLOROBENZENE	mg/kg OC	88.56	0.14	100.00	1400.00	980.00	4.56	0.82	2478.19
CHLOROMETHANE	mg/kg OC	12.45	0.74	400.00	100.00	75.00	13.14	0.82	8360.95
CYCLOHEXANE	mg/kg OC	228.22	0.28	18.95	5900.00	4300.00	10.19	0.34	8360.95
ETHYLBENZENE	mg/kg OC	8.09	0.74	750.00	290.00	430.00	4.02	0.82	552.38
ISOPROPYLBENZENE	mg/kg OC	56.02	4.11	190.00	1300.00	1200.00	4.02	0.19	2095.24
M,P-XYLENES	mg/kg OC	12.45	0.74	750.00	100.00	90.00	13.14	0.82	2095.24
METHYL ACETATE	mg/kg OC	414.94	0.28	750.00	13000.00	4800.00	3.75	0.18	20952.38
METHYL TERT-BUTYL ETHER	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
METHYLCYCLOHEXANE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
METHYLENE CHLORIDE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
O-XYLENE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
STYRENE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
TETRACHLOROETHENE (PCE)	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
TOLUENE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
TRICHLOROETHYLENE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
TRICHLOROFLUOROMETHANE	mg/kg OC	12.45	0.09	750.00	900.00	300.00	13.14	0.82	552.38
TOTAL ORGANIC CARBON (TOC)	mg/kg OC	0.048	0.048	0.010	0.010	0.010	0.037	0.005	0.005

No concentration is reported if it is 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.
Half the detection limit is presented for non-detects. Duplicate samples have been averaged.
Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.
When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
*Depth intervals are in Feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Parsippany, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD089 4-6	ADJACENT NEARSHORE Muddy Sand SD091 0-5	ADJACENT NEARSHORE Muddy Sand SD091 2-4	ADJACENT NEARSHORE Muddy Sand SD091 4-6	ADJACENT NEARSHORE Muddy Sand SD092 0-5	ADJACENT NEARSHORE Muddy Sand SD093 0-5	ADJACENT NEARSHORE Muddy Sand SD094 0-5	ADJACENT NEARSHORE Muddy Sand SD095 0-5
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	74285.71	195.00	187.65	5.05	0.22	41.00	17.52	0.43
1,2,4-TRICHLOROETHANE	mg/kg OC	112380.65	49.00	187.65	37.50	1.13	63.00	0.92	0.59
1,2-DICHLOROETHANE	mg/kg OC	1695.24	195.00	187.65	12.24	0.22	41.00	17.52	0.43
1,2-DICHLOROPROPANE	mg/kg OC	153.33	195.00	187.65	12.24	0.22	41.00	17.52	0.43
1,3-DICHLOROBENZENE	mg/kg OC	2095.24	195.00	187.65	34.90	0.07	11.00	17.52	0.43
1,4-DICHLOROBENZENE	mg/kg OC	15238.10	280.00	317.12	88.54	0.74	36.00	7.54	0.43
2-BUTANONE (MEK)	mg/kg OC			167.29	24.22	1.04	92.00	17.52	4.57
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC			167.29	24.22	0.44	92.00	35.03	0.82
ACETONE	mg/kg OC			902.60	9.80	4.25	130.00	15.82	12.86
BENZENE	mg/kg OC	30476.19	900.00	902.60	9.80	5.75	130.00	15.82	0.43
CARBON DISULFIDE	mg/kg OC	952980.95	12000.00	10250.14	390.63	0.35	1400.00	828.03	0.25
CHLOROBENZENE	mg/kg OC					245.28			1.21
CHLOROMETHANE	mg/kg OC								
CYCLOHEXANE	mg/kg OC	186.67		85.74	12.24	0.09	41.00	17.52	0.43
ETHYLBENZENE	mg/kg OC	5714.29	26.00	187.65	12.24	0.05	41.00	17.52	0.43
ISOPROPYLBENZENE	mg/kg OC	514.28	195.00	187.65	12.24	0.22	41.00	17.52	0.43
M,P-XYLENES	mg/kg OC	30476.19	97.00	67.97	12.24	0.15	12.00	17.52	0.43
METHYL ACETATE	mg/kg OC		75.00		24.22	5.00	32.00	11.46	0.82
METHYL TERT-BUTYL ETHER	mg/kg OC		195.00	159.77	12.24	0.20	41.00	9.63	0.43
METHYLCYCLOHEXANE	mg/kg OC			152.96	12.24	0.22	41.00	5.92	0.43
METHYLENE CHLORIDE	mg/kg OC	5904.78	28.00	187.65	12.24	0.09	41.00	17.52	0.43
O-XYLENE	mg/kg OC	323.81	195.00	86.74	12.24	0.22	41.00	17.52	0.43
STYRENE	mg/kg OC	133.33	195.00	187.65	12.24	0.22	20.00	17.52	0.32
TETRACHLOROETHYLENE (PCE)	mg/kg OC	14889.67	180.00	187.65	12.24	0.22	41.00	17.52	0.43
TOLUENE	mg/kg OC	133.33	195.00	187.65	12.24	0.22	41.00	17.52	0.32
TRICHLOROETHYLENE	mg/kg OC								
TRICHLOROFLUOROMETHANE	mg/kg OC								
TOTAL ORGANIC CARBON (TOC)		0.005	0.010	0.005	0.018	0.011	0.010	0.016	0.014

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.

Half the detection limit is presented for non-detects. Duplicate samples have been averaged.

Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.

When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

*Depth intervals are in feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OJ-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate	Location ID	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
			Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096	Muddy Sand SD096
			0-5	4-6	0-5	0-5	0-5	0-5	0-5	0-5
			Depth Interval	Depth Interval	Depth Interval	Depth Interval	Depth Interval	Depth Interval	Depth Interval	Depth Interval
			mg/kg OC	mg/kg OC	mg/kg OC	mg/kg OC	mg/kg OC	mg/kg OC	mg/kg OC	mg/kg OC
1,1,1-TRICHLOROETHANE (TOA)			0.25	4.45	0.01	0.25	0.35	0.44	0.21	3.57
1,2,4-TRICHLOROBENZENE			1.80	6.30	0.12	0.21	0.14	1.26	0.05	5.45
1,2-DICHLOROBENZENE			0.25	4.45	0.12	0.25	0.35	0.44	0.21	3.57
1,2-DICHLOROETHANE			0.25	4.45	0.12	0.25	0.35	0.44	0.21	3.57
1,3-DICHLOROPROPANE			0.17	11.00	0.03	0.25	0.35	0.10	0.21	10.39
1,3-DICHLOROBENZENE			0.17	15.00	0.03	0.25	0.35	0.11	0.21	20.13
1,4-DICHLOROBENZENE			0.50	22.50	0.24	1.20	0.72	1.52	0.71	17.53
2-BUTANONE (MEK)			0.49	22.50	0.24	0.60	0.72	0.90	0.42	17.53
4-METHYL-2-PENTANONE (MIBK)			2.00	12.00	0.13	4.90	0.39	5.66	2.60	21.43
ACETONE			0.06	12.00	0.02	0.29	0.38	0.44	0.21	21.43
BENZENE			0.09	440.00	0.24	0.11	0.09	0.07	0.04	2467.53
CARBON DISULFIDE			2.30	440.00	0.35	0.37	0.14	1.15	0.15	2467.53
CHLOROBENZENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
CHLOROMETHANE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
CYCLOHEXANE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
ETHYLBENZENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
ISOPROPYLBENZENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
M,P-XYLENES			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
METHYL ACETATE			0.49	26.00	0.24	0.60	0.72	0.90	0.42	18.63
METHYL TERT-BUTYL ETHER			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
METHYLOXOHEXANE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
METHYLENE CHLORIDE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
O-XYLENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
STYRENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
TETRACHLOROETHENE (PCE)			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
TOLUENE			0.06	5.50	0.12	0.82	0.35	0.44	0.21	3.57
TRICHLOROETHYLENE			0.25	4.45	0.12	0.29	0.35	0.44	0.21	3.57
TRICHLOROFLUOROMETHANE			0.48	4.45	0.12	0.29	0.35	0.44	0.21	3.57
TOTAL ORGANIC CARBON (TOC)			0.010	0.010	0.023	0.010	0.008	0.007	0.018	0.015

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.

Half the detection limit is presented for non-detects. Duplicate samples have been averaged.

Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.

When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

*Depth Intervals are in Feet.

Table 9-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OUL-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Locality ID	ADJACENT NEARSHORE Muddy Sand SD101 4-6	ADJACENT NEARSHORE Muddy Sand SD102 0-5	ADJACENT NEARSHORE Muddy Sand SD103 0-5	ADJACENT NEARSHORE Muddy Sand SD105 2-4	ADJACENT NEARSHORE Muddy Sand SD103 4-6	ADJACENT NEARSHORE Muddy Sand SD104 2-4	ADJACENT NEARSHORE Muddy Sand SD104 4-6	ADJACENT NEARSHORE Muddy Sand SD104 8-8	ADJACENT NEARSHORE Muddy Sand SD105 2-4
1,1,1-TRICHLOROETHANE (TOA)	Depth Interval									
1,2,4-TRICHLOROBENZENE	mg/kg OC	3.50	0.23	0.23	135.69	140.70	7.71	4.20	0.10	1.87
1,2-DICHLOROBENZENE	mg/kg OC	3.51	0.05	0.23	48.75	60.30	1.24	4.20	0.10	45.33
1,2-DICHLOROETHANE	mg/kg OC	3.90	0.23	0.23	11.81	4.77	7.71	4.20	0.10	5.87
1,2-DICHLOROPROPANE	mg/kg OC	3.90	0.23	0.23	1055.28	1658.29	5.07	4.20	0.10	1.87
1,3-DICHLOROBENZENE	mg/kg OC	9.74	0.10	0.23	228.13	316.56	19.07	4.20	0.10	12.67
1,4-DICHLOROBENZENE	mg/kg OC	21.43	0.04	0.23	60.30	23.62	16.21	4.20	0.10	11.39
2-BUTANONE (MEK)	mg/kg OC	18.59	0.45	1.04	50.25	65.93	5.48	1.82	0.42	26.87
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	18.59	2.03	4.15	2914.57	1206.03	507.10	2.44	0.03	426.67
ACETONE	mg/kg OC	24.68	0.23	0.04	50.25	65.93	5.48	1.82	0.42	26.87
BENZENE	mg/kg OC	1168.63	0.05	0.06	2914.57	1206.03	507.10	2.44	0.03	426.67
CARBON DISULFIDE	mg/kg OC		0.15	0.15						
CHLOROBENZENE	mg/kg OC									
CHLOROMETHANE	mg/kg OC									
CYCLOHEXANE	mg/kg OC	3.90	0.23	0.23	11.81	4.77	7.71	4.18	0.07	5.87
ETHYLBENZENE	mg/kg OC	6.10	0.23	0.06	38.78	27.84	7.71	0.57	0.10	1.60
ISOPROPYLBENZENE	mg/kg OC	3.90	0.23	0.23	11.81	5.53	7.71	4.20	0.10	0.92
M,P-XYLENES	mg/kg OC	14.28	0.08	0.11	155.78	130.65	2.09	0.81	0.10	10.80
METHYL ACETATE	mg/kg OC	25.87	0.45	0.47		15.58	6.80	3.02	0.21	4.27
METHYL TERT-BUTYL ETHER	mg/kg OC									
METHYLCYCLOHEXANE	mg/kg OC	3.90	0.23	0.23	11.81	4.77	1.81	0.75	0.13	7.60
METHYLENE CHLORIDE	mg/kg OC	3.90	0.23	0.23				0.07	0.10	
O-XYLENE	mg/kg OC	8.44	0.05	0.06	41.21	31.66	2.84	4.20	0.10	5.87
STYRENE	mg/kg OC	3.90	0.23	0.23	11.81	4.77	7.71	4.20	0.10	5.87
TETRACHLOROETHENE (PCE)	mg/kg OC	3.90	0.23	0.23	11.81	3.57	7.71	4.20	0.10	5.87
TOLUENE	mg/kg OC	3.90	0.23	0.23	301.51	356.78	7.71	11.96	0.10	4.27
TRICHLOROETHYLENE	mg/kg OC				11.81	4.77	7.71	4.20	0.10	5.87
TRICHLOROFLUOROMETHANE	mg/kg OC									
TOTAL ORGANIC CARBON (TOC)		0.015	0.012	0.020	0.030	0.020	0.049	0.044	0.031	0.076

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.
Half the detection limit is presented for non-detects. Duplicate samples have been averaged.
Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.
When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
*Depth intervals are in Feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate	Location ID	Depth Interval	ADJACENT NEARSHORE Muddy Sand SD105 4-6	ADJACENT NEARSHORE Muddy Sand SD105 5-8	ADJACENT NEARSHORE Muddy Sand SD106 2-4	ADJACENT NEARSHORE Muddy Sand SD106 4-6	ADJACENT NEARSHORE Muddy Sand SD107 2-4	ADJACENT NEARSHORE Muddy Sand SD107 4-6	ADJACENT NEARSHORE Muddy Sand SD108 2-4	ADJACENT NEARSHORE Muddy Sand SD108 4-6	ADJACENT NEARSHORE Muddy Sand SD108 6-8
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC			8.25	5.47	90.16	18762.85	53.61	508.91	1.84	484.91	404.41
1,2,4-TRICHLOROBENZENE	mg/kg OC			23.00	2.88	836.07	9749.67	110.20	506.91	2.26	387.93	257.95
1,2-DICHLOROBENZENE	mg/kg OC			6.25	5.47	434.43	1106.77	138.40	437.79	10.70	484.91	404.41
1,2-DICHLOROPROPANE	mg/kg OC			6.25	5.47			138.40		10.70		
1,3-DICHLOROBENZENE	mg/kg OC			0.98	5.47	144.26	1876.28	95.92	1658.99	10.70	344.83	141.54
1,4-DICHLOROBENZENE	mg/kg OC			11.83	1.28	295.08	1976.28	260.77	1658.99	10.70	1056.03	900.74
2-BUTANONE (MEK)	mg/kg OC			12.50	10.79					21.99		
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC			12.50	10.79					21.99		
ACETONE	mg/kg OC							87.67				
BENZENE	mg/kg OC			2.36	5.47	640.98	1146.25	937.34	1059.91	5.28	1788.79	643.58
CARBON DISULFIDE	mg/kg OC			81.25	18.71	27868.85	55335.97	8570.41	20737.33	615.84	21551.72	18382.35
CHLOROBENZENE	mg/kg OC											
CHLOROMETHANE	mg/kg OC			6.25	5.47			32.43		1.35		
CYCLOHEXANE	mg/kg OC			6.25	5.47	434.43	187.83	83.89	73.79	10.70	56.03	86.01
ETHYLBENZENE	mg/kg OC			6.25	5.47	434.43		138.40	437.79	10.70	484.91	404.41
ISOPROPYLBENZENE	mg/kg OC			1.88	1.28	190.33	474.31	284.41	225.81	10.70	206.90	220.59
M,P-XYLENES	mg/kg OC			4.63	4.32			67.67		18.32		
METHYL ACETATE	mg/kg OC											
METHYL TERT-BUTYL ETHER	mg/kg OC			6.25	3.02	434.43	1185.77	50.43	437.79	3.29	484.91	404.41
METHYLCYCLOHEXANE	mg/kg OC											
METHYLENE CHLORIDE	mg/kg OC			6.25	5.47	434.43	144.89	83.89	437.79	3.52	56.03	66.01
O-XYLENE	mg/kg OC			6.25	5.47			138.40		10.70		
STYRENE	mg/kg OC			6.25	3.47			32.43		10.70		
TETRACHLOROETHYLENE (PCE)	mg/kg OC			2.25	5.18	282.30	316.21	48.63	216.59	10.70	732.76	48.63
TOLUENE	mg/kg OC			6.25	5.47	434.43		138.40	437.79	10.70	484.91	404.41
TRICHLOROETHYLENE	mg/kg OC											
TRICHLOROFLUOROMETHANE	mg/kg OC											
TOTAL ORGANIC CARBON (TOC)				0.090	0.070	0.061	0.076	0.018	0.043	0.034	0.046	0.054

No concentration is reported if it is the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte.
Half the detection limit is presented for non-detects. Duplicate samples have been averaged.
Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.
When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
*Depth intervals are in feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD108 8-10	ADJACENT NEARSHORE Muddy Sand SD109 4-6	ADJACENT NEARSHORE Muddy Sand SD110 2-4	ADJACENT NEARSHORE Muddy Sand SD110 4-6	ADJACENT NEARSHORE Muddy Sand SD110 6-8	ADJACENT NEARSHORE Muddy Sand SD111 2-4	ADJACENT NEARSHORE Muddy Sand SD111 4-6	ADJACENT NEARSHORE Muddy Sand SD111 6-8
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.56
1,2,4-TRICHLOROETHANE	mg/kg OC	12.88	168.42	0.88	0.28	2.81	1.64	1.43	0.77
1,2-DICHLOROETHANE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
1,2-DICHLOROPROPANE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
1,3-DICHLOROETHANE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
1,4-DICHLOROETHANE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
2-BUTANONE (MEK)	mg/kg OC	68.41	121.05	13.10	1.74	0.48	6.08	17.62	1.60
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC			7.64	1.06	5.72	9.79	22.54	1.60
ACETONE	mg/kg OC			15.28	0.22	5.61	25.13	22.54	2.53
BENZENE	mg/kg OC	168.27	684.21	15.28	4.14	1.18	12.43	11.07	0.11
CARBON DISULFIDE	mg/kg OC			81.63	0.21	0.30			
CHLOROBENZENE	mg/kg OC	3305.25	9475.68	357.14	0.06	0.03	185.13	491.80	0.95
CHLOROMETHANE	mg/kg OC				3.57	4.60			
CYCLOHEXANE	mg/kg OC	91.15	168.42	3.93	0.12	2.81	12.43	11.07	0.77
ETHYLBENZENE	mg/kg OC	11.20	27.89	3.93	0.05	2.78	12.43	11.07	0.77
ISOPROPYLBENZENE	mg/kg OC	91.15	168.42	3.93	0.05	0.38	12.43	11.07	0.77
M,P-XYLENES	mg/kg OC	68.01	\$5.79	1.20	0.61	1.15	1.53	4.92	0.77
METHYL ACETATE	mg/kg OC			16.25	0.22	1.51	10.32	3.61	1.60
METHYL TERT-BUTYL ETHER	mg/kg OC	91.15	25.25		0.03	1.06	12.43	2.09	0.77
METHYLCYCLOHEXANE	mg/kg OC			3.93	1.06	0.07			0.77
METHYLENE CHLORIDE	mg/kg OC	14.32	27.89	3.93	0.11	0.07	1.85	11.48	0.77
O-XYLENE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
STYRENE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
TETRACHLOROETHYLENE (PCE)	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
TOLUENE	mg/kg OC	91.15	168.42	3.93	0.04	1.10	12.43	2.05	0.77
TRICHLOROETHYLENE	mg/kg OC	91.15	168.42	3.93	0.11	2.81	12.43	11.07	0.77
TRICHLOROFLUOROMETHANE	mg/kg OC					0.07			
TOTAL ORGANIC CARBON (TOC)		0.077	0.019	0.092	0.038	0.041	0.038	0.024	0.004

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte. Half the detection limit is presented for non-detects. Duplicate samples have been averaged.
 Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data. When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
 *Depth Intervals are in Feet.

Table S-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate Location ID Depth Interval	ADJACENT NEARSHORE Muddy Sand SD112 2-4	ADJACENT NEARSHORE Muddy Sand SD112 4-6	ADJACENT NEARSHORE Muddy Sand SD112 6-8	ADJACENT NEARSHORE Muddy Sand SD112 8-10	ADJACENT NEARSHORE Muddy Sand SD113 2-4	ADJACENT NEARSHORE Muddy Sand SD113 4-6	ADJACENT NEARSHORE Muddy Sand SD113 6-8	ADJACENT NEARSHORE Muddy Sand SD113 8-10	ADJACENT NEARSHORE Muddy Sand SD114 2-4
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	10.75	35.29	5.91	1.28	11.08	9.31	8.28	7.14	10.74
1,2,4-TRICHLOROBENZENE	mg/kg OC	2.39	13.98	4.70	5.44	2.63	1.22	1.99	0.84	10.74
1,2-DICHLOROBENZENE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
1,2-DICHLOROETHANE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
1,3-DICHLOROPROPANE	mg/kg OC	12.58	182.76	50.43	30.73	4.79	4.74	9.04	7.14	10.74
1,3-DICHLOROBENZENE	mg/kg OC	11.59	105.40	31.30	11.82	4.40	4.40	13.88	3.48	1.74
2-BUTANONE (MEK)	mg/kg OC	21.74	20.68	15.65	15.37	22.46	18.61	16.57	14.29	20.68
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC	21.74	88.46	15.65	15.37	22.46	18.61	16.57	14.29	20.68
ACETONE	mg/kg OC	6.04	33.84	15.83	12.77	11.08	1.54	1.35	7.14	10.74
BENZENE	mg/kg OC	388.47	1975.32	158.26	122.53	95.81	82.91	144.58	57.27	11.57
CARBON DISULFIDE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
CHLOROBENZENE	mg/kg OC	1.76	11.73	3.65	2.60	11.08	9.31	1.05	7.14	10.74
CHLOROMETHANE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
CYCLOHEXANE	mg/kg OC	8.52	58.53	22.61	15.84	2.85	5.41	6.83	2.64	10.74
ETHYLENE	mg/kg OC	11.59	13.84	8.35	8.76	10.78	6.43	8.02	2.48	10.83
ISOPROPYLBENZENE	mg/kg OC	1.76	44.23	1.46	2.84	11.08	1.26	8.38	1.21	10.74
METHYL ACETATE	mg/kg OC	4.35	15.02	4.00	4.28	2.40	1.66	1.81	1.49	10.74
METHYL TERT-BUTYL ETHER	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
METHYLENE CHLORIDE	mg/kg OC	2.66	40.51	1.91	5.44	1.90	1.25	4.22	2.17	3.39
O-XYLENE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
STYRENE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
TETRACHLOROETHYLENE (PCE)	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
TOLUENE	mg/kg OC	2.66	40.51	1.91	5.44	1.90	1.25	4.22	2.17	3.39
TRICHLOROETHYLENE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
TRICHLOROFLUOROMETHANE	mg/kg OC	10.75	44.23	8.00	7.80	11.08	9.31	8.28	7.14	10.74
TOTAL ORGANIC CARBON (TOC)	mg/kg OC	0.041	0.055	0.058	0.042	0.039	0.059	0.033	0.032	0.024

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte. Half the detection limit is presented for non-detects. Duplicate samples have been averaged. Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data. When TOC data was not available at any depth interval for a sample, 1% TOC was assumed. *Depth Intervals are in Feet.

Table 3-10
Sediment Analytical Results for Organic Carbon Normalized Volatile Organic Compounds
BASF Corporation
Hudson River OC-2 Investigation
Rensselaer, New York

Analyte	Location Description Geophysical Substrate	Location ID	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	UPPER NAVIGATIONAL CHANNEL	UPPER NAVIGATIONAL CHANNEL
		Depth Interval					
1,1,1-TRICHLOROETHANE (TCA)	mg/kg OC	4-6	6.10	47.87	0.86	3.66	3.66
1,2-DICHLOROBENZENE	mg/kg OC	6-10	1.80	47.87	0.86	3.66	3.66
1,2-DICHLOROETHANE	mg/kg OC	6-10	6.10	47.87	0.86	3.66	3.66
1,2-DICHLOROPROPANE	mg/kg OC	1-2	1.22	47.87	0.86	3.66	3.66
1,3-DICHLOROBENZENE	mg/kg OC	5-43	22.31	22.31	0.86	3.66	3.66
1,4-DICHLOROBENZENE	mg/kg OC	12.60	12.60	25.36	4.31	18.75	18.75
2-BUTANONE (MEK)	mg/kg OC	12.60	12.60	98.35	4.31	18.75	18.75
4-METHYL-2-PENTANONE (MIBK)	mg/kg OC				8.62	3.66	3.66
ACETONE	mg/kg OC	0.99	0.99	6.19	0.86	3.66	3.66
BENZENE	mg/kg OC	60.06	60.06	101.42	0.86	3.66	3.66
CARBON DISULFIDE	mg/kg OC				0.86	3.66	3.66
CHLOROBENZENE	mg/kg OC	6.10	6.10	47.87	0.86	3.66	3.66
CHLOROMETHANE	mg/kg OC	6.10	6.10	47.87	0.86	3.66	3.66
CYCLOHEXANE	mg/kg OC	3.88	3.88	10.14	0.86	3.66	3.66
ETHYLBENZENE	mg/kg OC	4.46	4.46		2.89	11.21	11.21
ISOPROPYLBENZENE	mg/kg OC						
M-P-XYLENES	mg/kg OC						
METHYL ACETATE	mg/kg OC						
METHYL TERT-BUTYL ETHER	mg/kg OC	2.13	2.13	47.87	0.86	3.66	3.66
METHYLCYCLOHEXANE	mg/kg OC				0.86	3.66	3.66
METHYLENE CHLORIDE	mg/kg OC	2.13	2.13	47.87	0.86	3.66	3.66
O-XYLENE	mg/kg OC	6.10	6.10	47.87	0.86	3.66	3.66
STYRENE	mg/kg OC	8.91	8.91	22.31	1.21	3.66	3.66
TETRACHLOROETHYLENE (PCE)	mg/kg OC	5.10	5.10	47.87	0.86	3.66	3.66
TOLUENE	mg/kg OC				1.21	3.66	3.66
TRICHLOROETHYLENE	mg/kg OC				0.86	3.66	3.66
TRICHLOROFLUOROMETHANE	mg/kg OC						
TOTAL ORGANIC CARBON (TOC)			0.052	0.010	0.003	0.023	0.023

No concentration is reported if 1/2 the Sample Quantitation Limit for a non-detect exceeded the maximum detected concentration for that analyte. Half the detection limit is presented for non-detects. Duplicate samples have been averaged.italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data. When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.
*Depth Intervals are in Feet.

Table 3-11
SEM and AVS Sediment Analytical Results
BASF Corporation
Hudson River DU-2 Investigation
Rensselaer, New York

		Acid Volatile Sulfides (umol/g)	Simultaneously Extracted Metals (umol/g)						Sum SEM/AVS	Sum SEM- AVS	(Sum SEM- AVS)/ _{OC} (umol/g _{OC})
Location ID	TOC (mg/kg)		Cadmium	Copper	Lead	Nickel	Zinc	Sum of SEM			
UPSTREAM											
SD001	1700	0.0873	0.0011	0.0892	0.0816	0.1516	0.8853	1.02	11.7	0.93	547.9
SD006	7530	0.4132	0.0006	0.12185	0.14165	0.14395	0.66775	1.08	2.6	0.66	86.9
SD011	15800	2.4639	0.0031	0.489	0.2548	0.2078	1.262	2.20	0.89	-0.27	-16.9
SD015	1480	ND	0.00139	0.085	0.0521	0.0477	0.512	0.79	-	-	-
SD017	555	ND	0.00025	0.1133	0.0405	0.1363	0.5507	0.84	-	-	-
SD021	1460	ND	0.00107	0.0692	0.0236	0.0358	0.252	0.38	-	-	-
SD022	15800	0.3212	0.0044	0.3289	0.1086	0.2419	1.2391	1.92	5.0	1.80	101.4
SD026	6130	ND	0.00025	0.1039	0.0743	0.165	1.0494	1.38	-	-	-
SD030	3070	0.0458	0.00025	0.2012	0.0349	0.0968	0.4712	0.90	19.2	0.86	275.7
ADJACENT FAR FIELD											
SD036	not sampled	ND	0.0015	0.32735	0.1132	0.13715	0.88345	1.46	-	-	-
SD038	1520	ND	0.0008	0.063	0.0681	0.100	0.5069	0.75	-	-	-
SD041	558	ND	0.00025	0.0504	0.432	0.1175	0.5109	1.11	-	-	-
SD042	not sampled	ND	0.0007	0.0661	0.0266	0.1141	0.5155	0.72	-	-	-
SD045	826	0.0343	0.0013	0.1023	0.0541	0.0869	0.4926	0.74	21.5	0.70	857.0
SD048	150	ND	0.0007	0.0362	0.014	0.0582	0.3855	0.49	-	-	-
SD050	150	ND	0.0006	0.0504	0.0372	0.0698	0.2961	0.44	-	-	-
SD052	1400	ND	0.0017	0.107	0.0637	0.1737	0.8589	1.22	-	-	-
SD055	985	ND	0.0008	0.1936	0.0386	0.1175	0.5706	0.92	-	-	-
SD079	2480	ND	0.0003	0.5458	0.2877	0.1874	1.1305	2.25	-	-	-
ADJACENT NEARSHORE											
SD056	14200	0.1403	0.006	0.5194	0.1482	0.3202	1.7133	2.71	19.3	2.57	180.9
SD057	18200	ND	0.00294	0.258	0.0864	0.0852	0.794	1.23	-	-	-
SD077	22900	3.2404	0.006	0.51385	0.181	0.2461	1.6774	2.62	0.81	-0.62	-28.9
SD080	10000	0.1778	0.0052	0.468	0.1752	0.2282	1.6062	2.47	13.9	2.30	223.5
SD081	15800	ND	0.005205	0.9555	0.126	0.0909	1.125	1.69	-	-	-
SD082	14400	3.88	0.08935	0.8405	1.69	0.1543	4.055	8.61	1.7	2.73	189.5
SD084	14200	1.95235	0.0063	0.8587	0.16865	0.24865	1.76215	2.78	1.4	0.81	67.2
SD085	46200	ND	0.113	1.28	2.86	0.278	5.93	10.46	-	-	-
SD086	6330	ND	0.00374	0.785	0.106	0.112	1.01	2.09	-	-	-
SD088	37300	3.37	0.0302	0.736	0.441	0.211	3.98	5.40	1.8	2.03	54.4
SD089	5250	ND	0.00409	0.387	0.0801	0.118	1	1.59	-	-	-
SD091	15100	ND	0.00867	0.332	0.336	0.109	2.51	3.29	-	-	-
SD092	10600	0.4996	0.005	0.3803	0.1115	0.2708	1.2608	2.13	4.3	1.84	154.6
SD094	15700	0.2713	0.0111	0.9695	0.2279	0.2402	1.7745	3.22	11.9	2.95	189.0
SD095	14000	ND	0.00374	0.195	0.126	0.092	1.15	1.57	-	-	-
SD097	23200	ND	0.0077	0.431	0.147	0.124	1.18	1.89	-	-	-
SD099	8360	ND	0.00365	0.26	0.113	0.112	1.04	1.53	-	-	-
SD100	7240	0.2889	0.0057	0.3053	0.166	0.2129	1.4563	2.15	7.5	1.86	256.8
SD103	18300	0.1216	0.008	0.4611	0.153	0.2453	1.7898	2.88	21.9	2.64	131.4
UPPER NAVIGATIONAL CHANNEL											
SD011-INV	7280	2.03	0.00766	0.294	0.285	0.0545	1.56	2.21	1.1	0.18	24.9
SD051	7530	ND	0.0024	0.1228	0.1023	0.128	1.0203	1.39	-	-	-
SD064	6990	0.0499	0.0063	0.1967	0.0836	0.1754	1.2039	1.68	33.6	1.63	232.6
SD066	6390	ND	0.0026	0.1353	0.1462	0.1182	0.8368	1.24	-	-	-
SD067	6000	ND	0.0051	0.2927	0.1824	0.1567	1.2636	1.90	-	-	-
SD068	28100	0.4388	0.0757	1.4898	0.5026	0.3085	4.5281	7.30	16.7	6.87	244.4
SD071	14600	ND	0.0057	5.7602	0.1627	0.1462	1.2116	7.29	-	-	-
SD073	11000	ND	0.002	0.0866	0.0861	0.126	0.8796	1.16	-	-	-
SD074	21200	ND	0.0012	0.063	0.0458	0.0835	0.5782	0.77	-	-	-
DOWNSTREAM											
SD075	1680	ND	0.0012	0.1149	0.1964	0.1294	0.9133	1.36	-	-	-

Shading indicates analyte was not detected. One-half detection limit is reported.

Bold text indicates Sum SEM / AVS is greater than 1.

Italic bold text indicates (Sum SEM- $\text{AVS}/\mu\text{mol/g}_{\text{OC}}$ greater than 130 $\mu\text{mol/g}_{\text{OC}}$ (below this value the sediments are presumed to "not likely" be toxic (USEPA, 2005))

AVS - Acid Volatile Sulfides

ND - Not Detected. Calculations not conducted when AVS was not detected.

SEM - Simultaneously Extracted Metals

TOC - Total Organic Carbon

$\mu\text{mol/g}_{\text{OC}}$ - Fraction organic carbon

$\mu\text{mol/g}_{\text{OC}}$ - gram organic carbon

According to USEPA guidance (2005):

If the (Sum SEM- $\text{AVS}/\mu\text{mol/g}_{\text{OC}}$ exceeds 3000 $\mu\text{mol/g}_{\text{OC}}$, the sediments are presumed to be "likely to be toxic";

If the (Sum SEM- $\text{AVS}/\mu\text{mol/g}_{\text{OC}}$ is between 130 and 3,000 $\mu\text{mol/g}_{\text{OC}}$, predictions of effects are uncertain; and

If the (Sum SEM- $\text{AVS}/\mu\text{mol/g}_{\text{OC}}$ is less than 130 $\mu\text{mol/g}_{\text{OC}}$, the sediments are presumed to "not likely" be toxic.

Table 3-12
Surface Water Analytical Results
BASF Corporation
Hudson River OU-2 Investigation
Ranassaer, New York

Analysis	Location Description Location ID Sample Date Sample ID	UPSTREAM SW01 11/30/2005 01SW01U1	UPSTREAM SW01 11/30/2005 01SW01U1F	UPSTREAM SW02 11/30/2005 01SW02U1	UPSTREAM SW02 11/30/2005 01SW02U1F	UPSTREAM SW02 11/30/2005 01SW02U2	UPSTREAM SW02 11/30/2005 01SW02U2F	ADJACENT NEARSHORE SW03 11/30/2005 01SW03A1	ADJACENT NEARSHORE SW03 11/30/2005 01SW03A1F
Inorganics									
ALUMINUM	ug/l	8930	2990	13000	1110	13100	1280	8770	170
ANTIMONY	ug/l	R	R	R	R	R	R	R	R
ARSENIC	ug/l	1.5	0.698	2.1	0.469	2.2	0.389	1.6	0.28
BARIUM	ug/l	93.1	42.4	127	24.0	125	27.2	99.7	24.6
BERYLLIUM	ug/l	0.239	0.118	0.319	0.115 U	0.322	0.115 U	0.238	0.115 U
CADMIUM	ug/l	0.134 J	0.055	0.168 J	0.05 U	0.171 J	0.05 U	0.124 J	0.05 U
CALCIUM METAL	ug/l	30100	28700	20400	18400	20300	18500	21000	18400
CHROMIUM, TOTAL	ug/l	7.9	3.0	12.7	2.4	14.9	1.8	8.6	1.7 U
COBALT	ug/l	3.0	0.945	4.1	0.394	4.2	0.42	2.8	0.145
COPPER	ug/l	7.5	3.2	9.6	1.8	9.8	1.9	8.0	1.2
IRON, TOTAL	ug/l	8620	2640	12300	986	12600	1110	8290	210
LEAD	ug/l	5.5	1.6	6.3	0.628	6.4	0.642	6.8	0.307
MAGNESIUM	ug/l	7220	5850	6770	3960	6700	3890	5990	3790
MANGANESE	ug/l	230	70.5	303	39.9	298	41.8	286	34.2
MERCURY	ug/l	4.73 J	3.53 J	8.06 J	1.46 J	7.98 J	1.85 J	6.46 J	3.4 J
NICKEL	ug/l	14.9	7.1 J	18.5	6.9 U	22.0	8.9 U	31.6	6.9 U
POTASSIUM	ug/l	4030	2180 J	5030	1480 J	4980	1500 J	3910	1200 J
SELENIUM	ug/l	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
SILVER	ug/l	0.033	0.027 U	0.043	0.027 U	0.041	0.027 U	0.04	0.027 U
SODIUM	ug/l	19200	18700	11800	10700	11400	10800	13300	11700
THALLIUM	ug/l	0.083	0.06 U	0.109	0.06 U	0.11	0.06 U	0.075	0.06 U
VANADIUM	ug/l	9.4	4.0	11.8	1.8	12.2	1.9	9.3	R
ZINC	ug/l	28.6	11.3	38.2	7.0	35.7	11.9	31.0	7.8
VOCs									
ACETONE	ug/l	2.2 J	NS	2.3 J	NS	3.3 J	NS	2.9 J	NS
TOLUENE	ug/l	1.0 U	NS	1.0 U	NS	1.0 U	NS	0.43 J	NS
Other									
HARDNESS, TOTAL AS CaCO3	mg/l	110	NS	101	NS	77.0	NS	76.7	NS
SOLIDS, TOTAL SUSPENDED (TSS)	mg/l	133	NS	196	NS	190	NS	144	NS
TOTAL ORGANIC CARBON	mg/l	3.92	4.47	4.72	5.75	4.71	5.92	4.52	5.59

J = Estimated Value

NS = Not Sampled

R = Analytical Value was Rejected

U = Not Detected

*Depth Intervals in Feet Unless Otherwise Noted.

2 at end of sample ID indicates duplicate sample

Dissolved phase results are indicated by F in sample ID (sample was filtered in the field)

Table 3-12
Surface Water Analytical Results
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	Location Description Location ID Sample Date	ADJACENT NEARSHORE SW04 11/30/2005 01SW04A1F	ADJACENT NEARSHORE SW05 11/30/2005 01SW05A1F	ADJACENT NEARSHORE SW06 11/30/2005 01SW06A1F	ADJACENT NEARSHORE SW06 11/30/2005 01SW06A1F	ADJACENT NEARSHORE SW07 11/30/2005 01SW07A1F	ADJACENT NEARSHORE SW07 11/30/2005 01SW07A1F
Inorganics	ug/l	765	11700	47.5	11400	95.2	12100
ALUMINUM	ug/l	R	R	R	R	R	R
ANTIMONY	ug/l	0.424	2.0	0.269	2.0	0.245	2.2
ARSENIC	ug/l	30.2	119	17.3	114	17.8	117
BARIUM	ug/l	0.115 U	0.329	0.115 U	0.312	0.115 U	0.353
BERYLLIUM	ug/l	0.05 U	0.867 J	0.05 U	0.169 J	0.05 U	0.19 J
CADMIUM	ug/l	18700	22100	16900	22900	20300	22400
CALCIUM METAL	ug/l	1.7 U	12.4	1.7 U	10.4	1.7 U	10.7
CHROMIUM, TOTAL	ug/l	0.323	3.7	0.109	3.8	0.146	4.0
COBALT	ug/l	3.0	8.3	1.1	9.2	1.1	9.7
COPPER	ug/l	1.8	9.1	1.1	9.2	1.1	9.7
IRON, TOTAL	ug/l	765	11700	30.3	11600	126	11900
LEAD	ug/l	0.699	7.2	0.144	6.1	0.13	5.6
MAGNESIUM	ug/l	4040	6790	3410	6950	4070	6930
MANGANESE	ug/l	60.0	338	26.5	287	24.8	304
MERCURY	ug/l	2.28 J	5.18 J	2.11 J	8.07 J	2.59 J	5.34 J
NICKEL	ug/l	12.8	15.0	6.9 U	15.9	6.9 U	15.2
POTASSIUM	ug/l	4060	4610	1010 J	4540	1240 J	4840
SELENIUM	ug/l	1.6 U	1.6 U	1.6 U	1.8	1.6 U	1.6 U
SILVER	ug/l	0.034	0.043	0.027 U	0.052	0.027 U	0.075
SODIUM	ug/l	13100	12900	10100	13900	12900	13600
THALLIUM	ug/l	0.078	0.087	0.06 U	0.093	0.06 U	0.105
VANADIUM	ug/l	9.9	11.4	R	11.6	R	12.5
ZINC	ug/l	32.2	40.9	9.7	36.9	6.9 U	36.7
VOCs	ug/l	NS	NS	NS	NS	NS	NS
ACETONE	ug/l	2.9 J	1.9 J	NS	2.3 J	NS	3.6 J
TOLUENE	ug/l	0.43 J	0.33 J	NS	1.0 U	NS	1.0 U
Other	mg/l	63.3	73.0	NS	84.3	NS	86.3
HARDNESS, TOTAL AS CaCO3	mg/l	132	190	NS	191	NS	210
SOLIDS, TOTAL SUSPENDED (TSS)	mg/l	5.08	4.64	5.53	4.41	4.95	4.52
TOTAL ORGANIC CARBON	mg/l						

J = Estimated Value

NS = Not Sampled

R = Analytical Value was Rejected

U = Not Detected

*Depth Intervals in Feet Unless Otherwise Noted.

2 at end of sample ID indicates duplicate sample

Dissolved phase results are indicated by F in sample ID (sample was filtered in the field)

Table 3-13
Surface Water Summary Statistics
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (ug/L)			Location of Maximum
		Minimum	Maximum	Mean	
UPSTREAM					
Dissolved Inorganics					
ALUMINUM	2:2:2	1195	2990	2092.5	SW01
ARSENIC	2:2:2	0.429	0.698	0.5635	SW01
BARIUM	2:2:2	25.6	42.4	34	SW01
BERYLLIUM	1:2:2	0.118	0.118	0.08775	SW01
CADMIUM	1:2:2	0.055	0.055	0.04	SW01
CALCIUM METAL	2:2:2	18450	28700	23575	SW01
CHROMIUM, TOTAL	2:2:2	2.1	3	2.55	SW01
COBALT	2:2:2	0.407	0.945	0.676	SW01
COPPER	2:2:2	1.85	3.2	2.525	SW01
IRON, TOTAL	2:2:2	1048	2640	1844	SW01
LEAD	2:2:2	0.635	1.6	1.1175	SW01
MAGNESIUM	2:2:2	3975	5850	4912.5	SW01
MANGANESE	2:2:2	40.85	70.5	55.675	SW01
MERCURY	2:2:2	0.001655	0.00353	0.0025925	SW01
NICKEL	1:2:2	7.1	7.1	5.275	SW01
POTASSIUM	2:2:2	1490	2190	1840	SW01
SODIUM	2:2:2	10750	18700	14725	SW01
VANADIUM	2:2:2	1.85	4	2.925	SW01
ZINC	2:2:2	9.45	11.3	10.375	SW01
Total Recoverable Inorganics					
ALUMINUM	2:2:2	8930	13050	10990	SW02
ARSENIC	2:2:2	1.5	2.15	1.825	SW02
BARIUM	2:2:2	93.1	126	109.55	SW02
BERYLLIUM	2:2:2	0.239	0.3205	0.27975	SW02
CADMIUM	2:2:2	0.134	0.1695	0.15175	SW02
CALCIUM METAL	2:2:2	20350	30100	25225	SW01
CHROMIUM, TOTAL	2:2:2	7.9	13.8	10.85	SW02
COBALT	2:2:2	3	4.15	3.575	SW02
COPPER	2:2:2	7.5	9.7	8.6	SW02
IRON, TOTAL	2:2:2	9620	12450	10535	SW02
LEAD	2:2:2	5.5	6.35	5.925	SW02
MAGNESIUM	2:2:2	6735	7220	6977.5	SW01
MANGANESE	2:2:2	230	300.5	265.25	SW02
MERCURY	2:2:2	0.00473	0.007995	0.0063625	SW02
NICKEL	2:2:2	14.9	20.25	17.575	SW02
POTASSIUM	2:2:2	4030	5005	4517.5	SW02
SILVER	2:2:2	0.033	0.042	0.0375	SW02
SODIUM	2:2:2	11500	19200	15350	SW01
THALLIUM	2:2:2	0.083	0.1095	0.09625	SW02
VANADIUM	2:2:2	9.4	12	10.7	SW02
ZINC	2:2:2	28.6	36.95	32.775	SW02
VOCs					
ACETONE	2:2:2	2.2	2.8	2.5	SW02

Table 3-13
Surface Water Summary Statistics
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Analyte	FOD	Concentration (ug/L)			Location of Maximum
		Minimum	Maximum	Mean	
ADJACENT NEARSHORE					
Dissolved Inorganics					
ALUMINUM	5 : 5 : 5	47.5	765	365.94	SW04
ARSENIC	5 : 5 : 5	0.245	0.424	0.3154	SW04
BARIUM	5 : 5 : 5	17.3	30.2	22.86	SW04
CALCIUM METAL	5 : 5 : 5	16900	20300	18880	SW06
COBALT	5 : 5 : 5	0.109	0.323	0.2052	SW04
COPPER	5 : 5 : 5	1.1	2.1	1.46	SW07
IRON, TOTAL	5 : 5 : 5	90.3	765	373.66	SW04
LEAD	5 : 5 : 5	0.13	0.699	0.3422	SW04
MAGNESIUM	5 : 5 : 5	3410	4180	3898	SW07
MANGANESE	5 : 5 : 5	24.8	60	35.56	SW04
MERCURY	5 : 5 : 5	0.00211	0.0034	0.002574	SW03
NICKEL	2 : 5 : 5	6.9	7.5	4.95	SW04
POTASSIUM	5 : 5 : 5	1010	1580	1300	SW04
SODIUM	5 : 5 : 5	10100	12500	11800	SW04
VANADIUM	2 : 2 : 5	1.3	1.5	1.4	SW04
ZINC	4 : 5 : 5	7.8	35.1	15.89	SW07
Total Recoverable Inorganics					
ALUMINUM	5 : 5 : 5	8770	12100	10624	SW07
ARSENIC	5 : 5 : 5	1.6	2.2	1.9	SW07
BARIUM	5 : 5 : 5	99.7	119	111.14	SW05
BERYLLIUM	5 : 5 : 5	0.238	0.353	0.2996	SW07
CADMIUM	5 : 5 : 5	0.112	0.367	0.1924	SW05
CALCIUM METAL	5 : 5 : 5	20400	22900	21760	SW06
CHROMIUM, TOTAL	5 : 5 : 5	8.6	12.4	10.34	SW05
COBALT	5 : 5 : 5	2.8	4	3.46	SW07
COPPER	5 : 5 : 5	8	9.7	8.95	SW07
IRON, TOTAL	5 : 5 : 5	8290	11900	10426	SW07
LEAD	5 : 5 : 5	6.1	7.2	6.68	SW05
MAGNESIUM	5 : 5 : 5	5900	6950	6512	SW06
MANGANESE	5 : 5 : 5	286	336	301	SW05
MERCURY	5 : 5 : 5	0.00518	0.00903	0.006816	SW04
NICKEL	5 : 5 : 5	12.8	31.6	18.1	SW03
POTASSIUM	5 : 5 : 5	3910	4840	4392	SW07
SELENIUM	1 : 5 : 5	1.8	1.8	1	SW06
SILVER	5 : 5 : 5	0.034	0.075	0.0488	SW07
SODIUM	5 : 5 : 5	12900	13800	13280	SW07
THALLIUM	5 : 5 : 5	0.075	0.105	0.0896	SW07
VANADIUM	5 : 5 : 5	9.3	12.5	10.94	SW07
ZINC	5 : 5 : 5	31	40.9	35.54	SW05
VOCs					
ACETONE	5 : 5 : 5	1.9	3.6	2.72	SW07
TOLUENE	3 : 3 : 5	0.33	0.43	0.396666667	SW03, SW04

FOD - Frequency of Detection, Number of detected samples: Number of samples used to calculate statistics:
Number of total samples.

4.0 Literature Cited

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USEPA, 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response. U.S. EPA. EPA/SHO/1-89/002.

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USEPA. 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver and Zinc). January 2005. EPA-600-R-02-011. Office of Research and Development.

Appendix C

Geophysical Survey

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

HUDSON RIVER GEOPHYSICAL SURVEYS METHODS AND RESULTS

1.0 INTRODUCTION

On November 29 and 30, 2005, CR Environmental, Inc. (CR) performed geophysical surveys of a reach of the Hudson River in Albany, NY, adjacent to the BASF Site for ENSR. The surveys were designed to provide descriptions of the riverbed's substrate texture and to identify outfalls and other structures of interest on the eastern bank of the River. Geophysical data were used to guide subsequent sediment sampling efforts conducted in December 2005 and May 2006.

The survey operation was based out of Scarano Boatyard on the Hudson River in Albany, NY, to which CR's 26-ft aluminum research vessel, *R/V Lophius*, was transported by trailer from its homeport of Falmouth, Massachusetts. The survey area consisted of an approximately 3.2 mile reach of the Hudson River extending from the turning basin located to the south of the BASF Site northward to a point approximately 600 feet south of the Route 90 Bridge. Geophysical survey technologies employed included side scan sonar and sub-bottom profiling sonar. The sections that follow describe in detail the survey methodologies and results. Note that all data and figures have been projected to the New York (East) State Plane grid, NAD83, U.S. Survey in feet.

2.0 GEOPHYSICAL SURVEY METHODS

The *R/V Lophius* has an enclosed pilothouse, a 110 volt generator, and a hydraulic winch and A-frame for deploying equipment. Navigation for the survey was accomplished using a Trimble AgGPS 132 12-channel Differential Global Positioning System (DGPS) capable of receiving the U.S. Coast Guard (USCG) Beacon corrections. The DGPS provides a digital output of positions accurate to less than 1.0 meter. The DGPS system was interfaced to a laptop computer running HYPACK MAX hydrographic survey software. HYPACK continually recorded vessel position and depth data in the New York State Plane East grid (3101), NAD83, and provided a steering display for the vessel captain. Background raster files were imported into HYPACK to guide the survey. Imported raster files included orthophotos, NY DEC bathymetric contours created from multibeam surveys, and NY DEC sediment classifications.

2.1 Side Scan Sonar Data Acquisition

The purpose of the side-scan sonar survey was to gather detailed information on the surficial character of the river bottom. The survey was performed with an Edgetech Model 560 digital side scan sonar with a 272 TD towfish and Chesapeake Technology,

Inc. SonarWiz acquisition software. The side-scan towfish was towed as near to the bottom as possible. Survey transects were oriented parallel to the river's course. The side-scan system was operated using a 50 meter recording range (total swath width = 100 meters) and 500 kHz frequency. Several transects were surveyed using a 25 meter recording range to provide higher resolution imagery of features adjacent to the Site.

2.2 Side Scan Sonar Processing

Raw side-scan sonar data were processed using Chesapeake Technology, Inc.'s SonarWeb software to correct for towfish layback, adjust for signal attenuation related to swath width, and to georeference sonar imagery (i.e., project the sonar data into real-space coordinates). First, water column portions of the acoustic returns were removed through review and processing of each survey transect. The raw data were then corrected by calculating and applying accurate layback and catenary coefficients to each of the data files. Data processing also included adjustments for variations of the sonar beam angle of incidence relative to the seafloor (Beam Angle Corrections) and signal attenuation with distance (Time Varied Gain Corrections).

Once corrected, data from each survey lane were merged to create georeferenced mosaics of the survey area (in JPG format) with resolution ranging from 5 to 30 cm per pixel. Several versions of mosaics were produced, including gray and brown scaled images, and mosaics with and without Beam Angle Corrections. Data from a survey transect collected using a 25 meter recording range along the Site bulkhead was processed to a resolution of 5 cm per pixel to aid in the identification of outfalls and debris. Data were saved in several forms including: georeferenced JPG files, high-resolution annotated "waterfall" imagery (uncorrected raw data) of each survey lane, and navigation overview plots. Also, a set of HTML files for the project was created, allowing Web-browser (i.e., Internet Explorer or Netscape) access to all survey data and imagery. Georeferenced sonar data were incorporated in a GIS database to allow for comparison with other data sets.

2.3 Sub-Bottom Sonar Acquisition

The river reach was surveyed using a SyQwest 10-kHz Stratabox sub-bottom profiling system. The goal of the survey was to provide insight into the geologic and depositional characteristics of the riverbed by documenting sub-surface sediment strata and underlying parent material. Sub-bottom data were collected simultaneously with the side scan sonar survey and along several transects oriented perpendicular to the river's course. Data were recorded using proprietary StrataBox software.

2.4 Sub-Bottom Sonar Data Processing

Sub-bottom profile data were processed using Chesapeake Technology's SonarWeb software. Appropriate adjustments to TVG were made during processing. Sub-bottom profiles were exported in JPG format with accompanying HTML-navigable indices.

3.0 RESULTS

3.1 Side Scan Sonar

Figure 1 shows the area covered by the side scan sonar survey. Towed side-scan sonar results are presented as a beam-angle corrected mosaic of gray or shaded information. In general, weak signal returns correspond to smooth seafloor substrates (e.g., fine sediments with little micro-topography), soft materials that absorb the signal, or seabed sloping away from the signal source (towfish). These features appear lighter gray on the sonar record. Strong signal returns correspond to rough seabed substrates (e.g., gravel, cobble), highly reflective materials, or to a seabed sloping towards the signal source. These features appear as dark gray to black on the sonar record. Features that rise above the seabed (e.g., boulders) reflect more of the sonar energy than the surrounding substrate resulting in strong signal returns. These features often prevent insonification of the area opposite the signal source, resulting in a sonar "shadow" (white portion of the record).

A GIS database was created from surficial sediment texture data documented by the ENSR/CR 2005 sediment sampling effort. These sediment sample locations are shown on Figure 2. A post-map depicting color-coded textures at each sampling point was placed on top of the 30-cm resolution side scan sonar mosaic allowing evaluation of side scan backscatter relative to empirical sediment classifications. The evaluation was used to develop GIS polygons representing various sediment textures. The side scan sonar mosaic was also evaluated using image processing software. The mosaic was manipulated to generate artificial contours representing broad-scale trends in backscatter values. This contour map was imported to ArcView GIS as a georeferenced TIFF and used to assist in sediment classification. It is noteworthy that the wide distribution of a relatively limited number of sediment samples necessitated interpolation over large areas. It is CR's opinion that the side scan sonar data allows accurate identification of approximate sediment texture (i.e., cobble vs. gravel vs. sand vs. mud or silt), but that refinement of textures beyond these classes is subject to greater uncertainty. The resulting Figure 2 shows sediment textural classifications based on review of the sonar and sediment geotechnical data. The data suggest that the dominant substrate throughout the majority of the survey area is a sandy gravel (or gravelly sand). Muddy sand and sandy mud substrates were identified adjacent to the Site, along the northeastern shoreline, and in a cove located on the northwestern bank.

3.2 Sub-Bottom Profiling

Sub-bottom sonar profiles documented sub-surface conditions approximately 1 to 40 feet below the sediment surface. Penetration was generally less than 10 feet in the river reach upstream of the Site. As shown on Figure 3, the data for the majority of the upstream reach suggested a thin (~1 – 10 ft thick) mobile sand and gravel layer underlain by a dense reflector. Sonar penetration was greatest in the muddy sand sediment adjacent to and downstream of the site. Figure 4 is a sediment profile collected adjacent to the southern portion of the Site. This profile suggests the presence of as much as 26 feet of sediment above a strong reflector. Figure 5 is a sub-bottom profile collected near the southern edge of the Turning Basin. This profile clearly depicts as much as 25 feet of stratified sediment.

FIGURES

FIGURE 1

**SIDE SCAN SONAR MOSAIC
HUDSON RIVER, ALBANY NY
(Beam-Angle Corrected 500 kHz Data)**

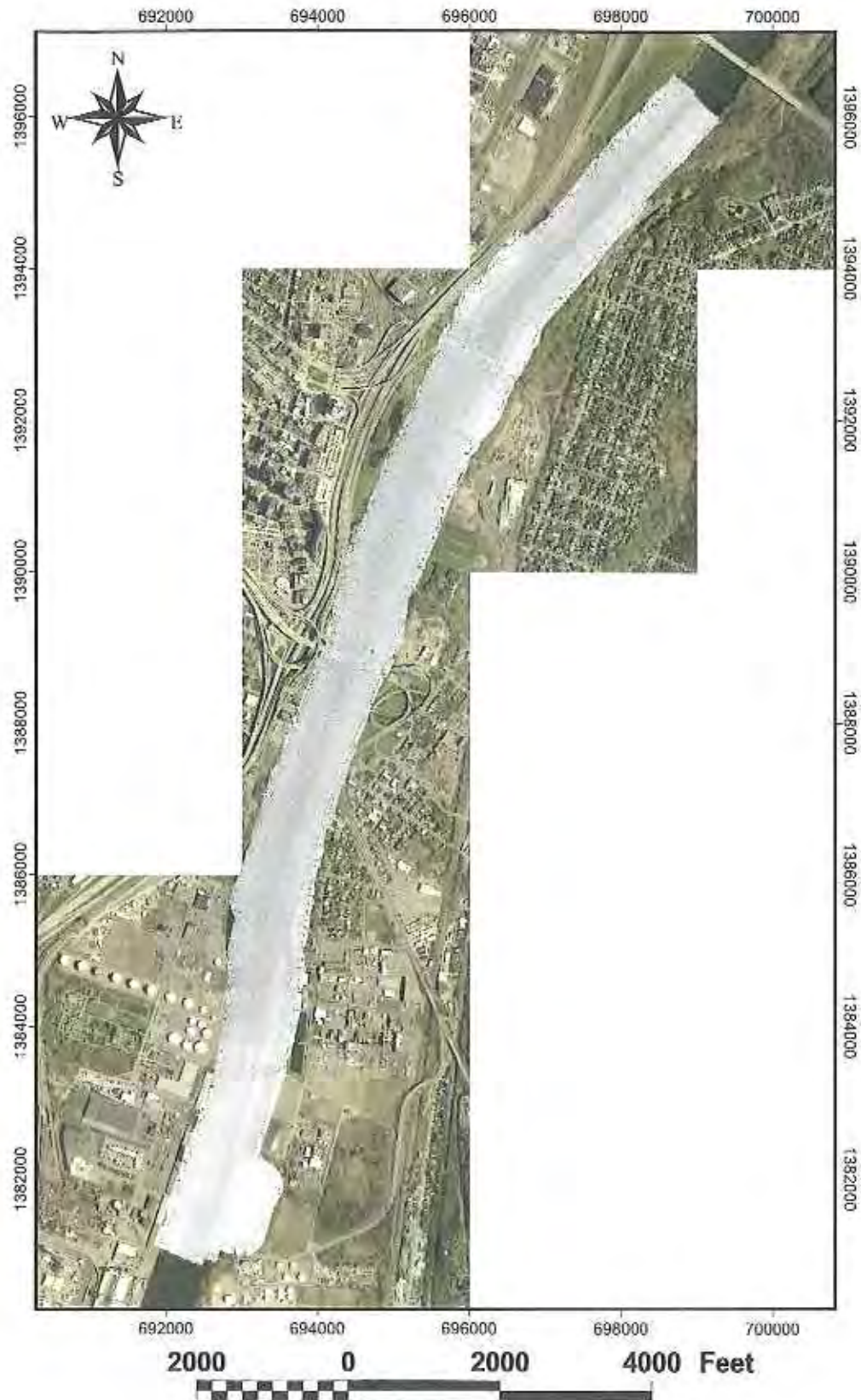
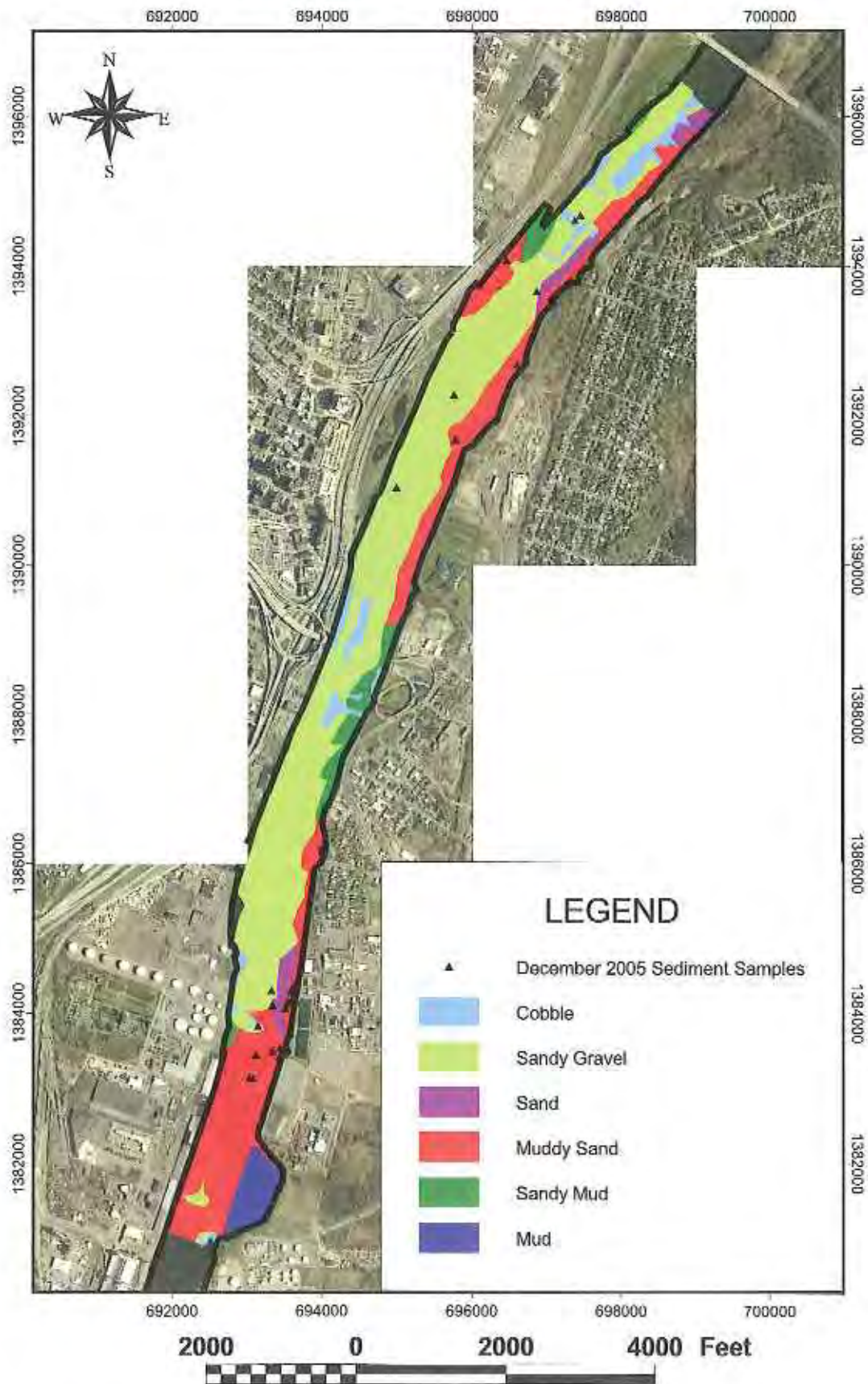


FIGURE 2

**DOMINANT SEDIMENT TEXTURE CLASSES BASED
ON SIDE SCAN SONAR EVALUATION**



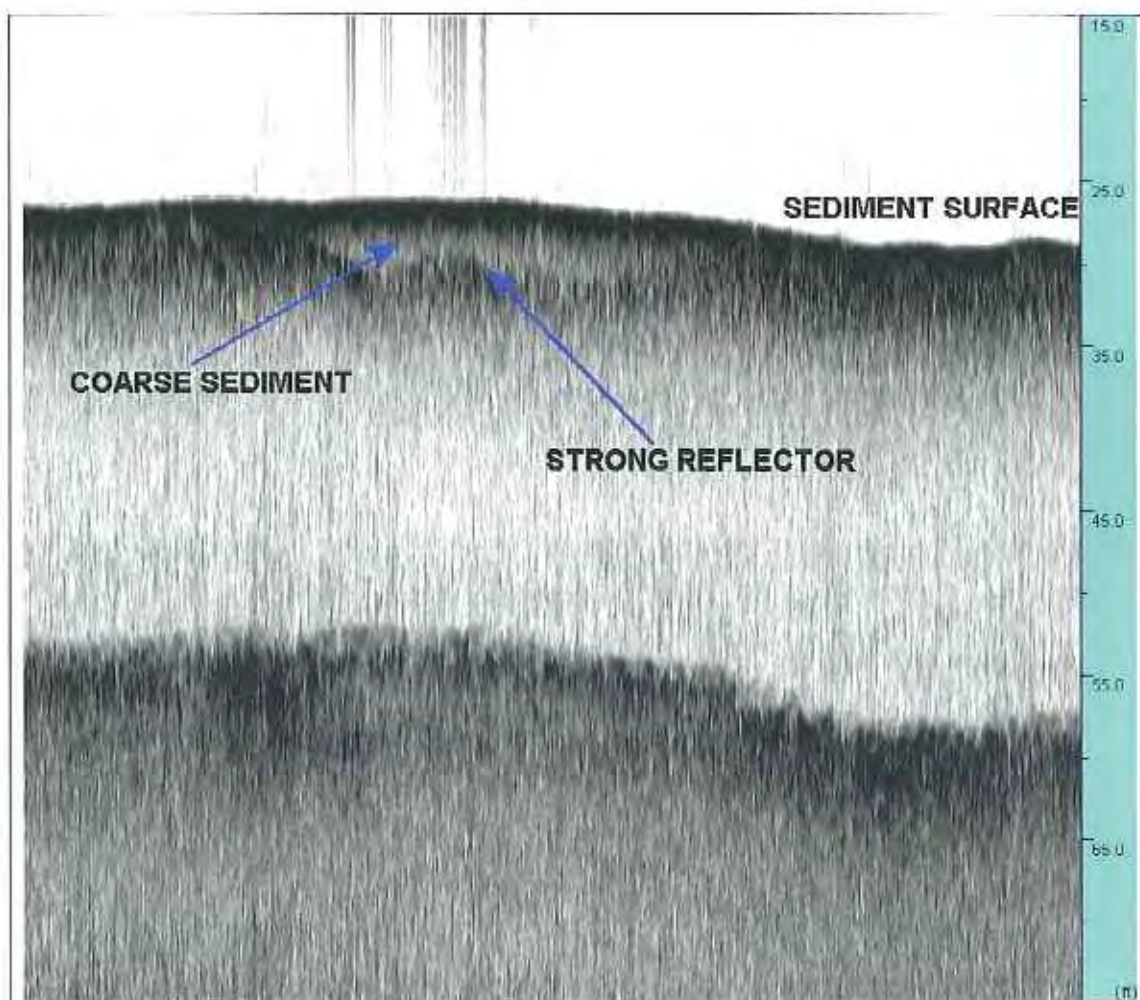


FIGURE 3 – Typical sonar profile collected upstream of the Site depicts approximately 6 feet of coarse sediment above strong reflector.

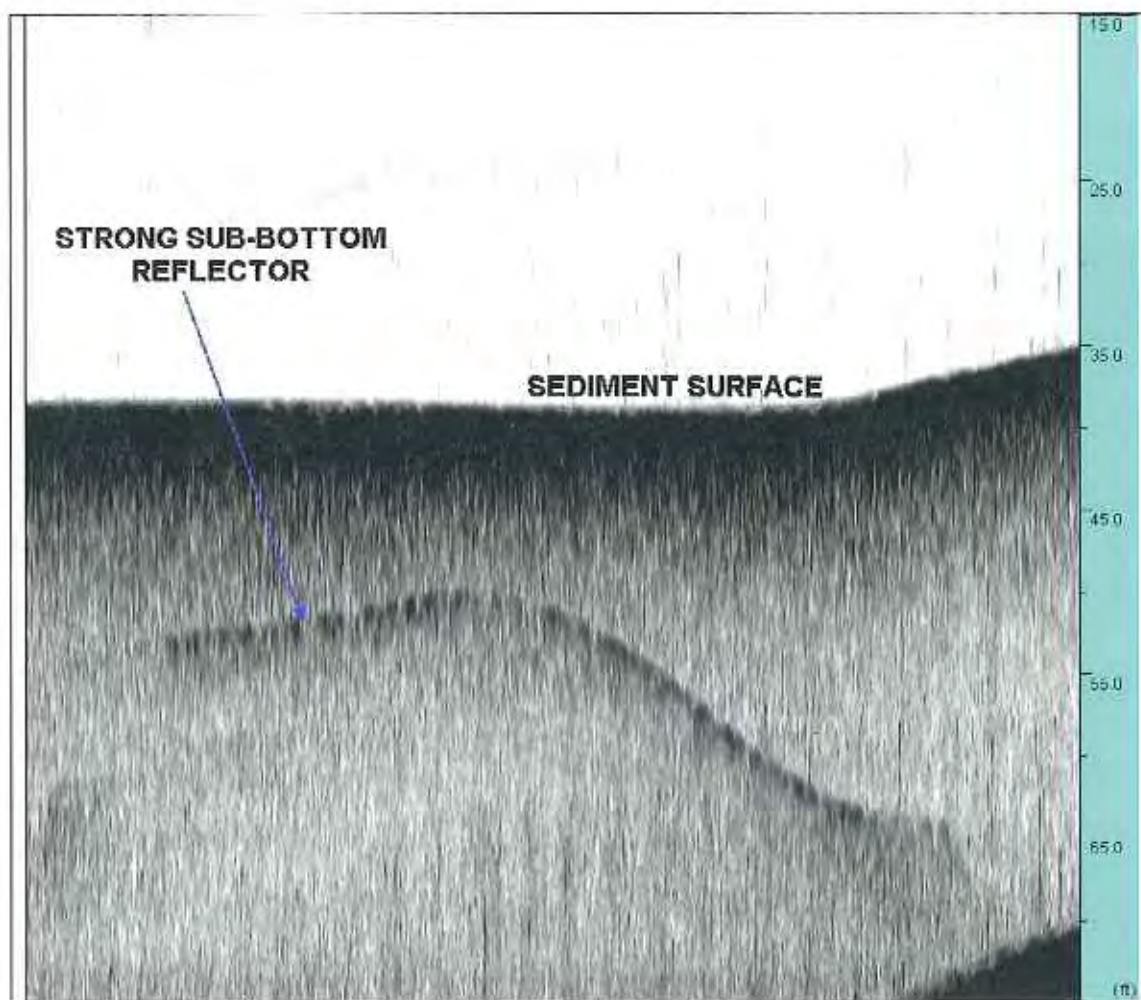


FIGURE 4 – Sonar profile collected adjacent to the southern portion of the BASF Site suggests 12 – 26 feet of sediment.

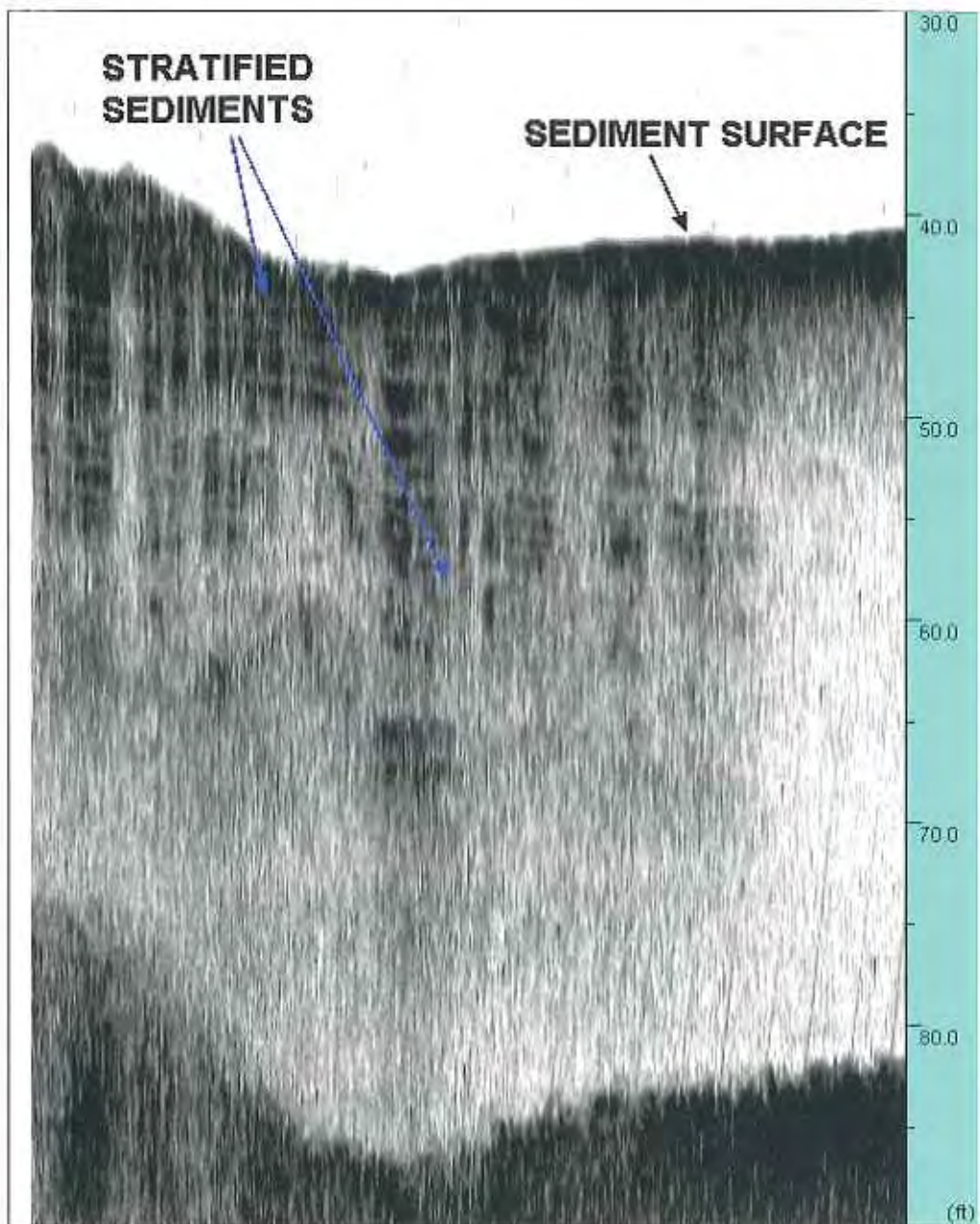


FIGURE 5 – Sub-bottom sonar profile depicting approximately 25 feet of stratified sediment.

Appendix D

Analytical Data

Part 1 - Sediment and Surface Water Analytical Data

Provided on CD

Part 2 - Data Validation Memos and Forms

Provided on CD

Appendix E

Benthic Macroinvertebrate Survey

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

**Hudson River
BASF Rensselaer Site
Albany and Rensselaer County, NY**

**Application of Biological Impairment Criteria to
Resident Benthic Macroinvertebrates**

June 16, 2006

**J. Kelly Nolan
Rapid Watershed Assessment Associates**

Water body: Hudson River
Drainage Basin: Middle Hudson
USGS Cataloging Unit: 02020006

Background and Methods:

In December 2005, ENSR Corporation (ENSR) sampled surface water and sediment upstream and downstream of the Rensselaer BASF Corporation (BASF) site (the Site) to assess if significant biological impairment had occurred along this freshwater tidal-influenced section of the Hudson River relative to upstream reference conditions. The BASF Rensselaer site, which permanently shut down at the end of 2000, was a chemical facility that manufactured organic dyes, pigments, and auxiliary chemicals. The goal of this analysis was to compare the resident benthic macroinvertebrate communities collected upstream from the Site to resident benthic macroinvertebrate communities collected adjacent to or downstream from the Site, and determine if significant biological impairment had occurred.

ENSR collected eight replicate ponar grab samples upstream, and ten replicate ponar grab samples adjacent to or downstream from the BASF site area. Sampling methodology, rationale of sample site selection, maps of the sampling locations, substrate grain size, and description of each substrate type found upstream, adjacent to, or downstream from the BASF Site is provided within the Hudson River Operable Unit 2 Investigation, BASF Rensselaer Work Plan (ENSR, 2005).

J. Kelly Nolan, Rapid Watershed Assessment Associates, completed sub sampling, taxa identification, statistical analysis, and reporting.

One sampling replicate from each sampling station was inspected for a 100-specimen sub-sample of macroinvertebrates following procedures outlined by Bode (2002) for ponar sediment sampling. Samples were rinsed with tap water in a U.S. number 40 standard sieve to remove fine particles left in the samples from field sieving. The remaining material was transferred and evenly distributed to a pan. Small randomly selected amounts of the sample were placed in a Petri dish with water, and then examined under a dissecting microscope, removing organisms from the debris and placing them in vials that contained 70 percent alcohol. The process was repeated for each sampling replicate until either 100 organisms were removed or the entire sample was examined. Organisms were identified to the lowest possible level and or to the level of taxonomy outlined by Bode (1990). Oligochaetes and Chironomids were slide-mounted and viewed using a compound microscope and other organisms were identified using a dissecting microscope. The number of species and total number of individuals for each sub-sample is listed in appendix I.

The suite of macroinvertebrate community indices for ponar samples (species richness, biotic index, percent model affinity, dominance-3, and species diversity), as outlined in Bode et al., (2002), was applied to each of the 100 specimen sub-samples to determine if significant differences exist between sampling stations. Biological impairment is determined by comparing indices of community structure and function at upstream and downstream sites using application of the student t-test at the level $P = 0.05$. If results are significant, biological impairment is indicated (Bode et al., 1999). The Biological

Assessment Profile (BAP) was also determined for each 100-specimen sub-sample, as outlined by Bode (2002). The BAP is obtained from the five indices by converting each indices score to a 0 – 10 water quality scale and calculating the mean. The mean score identifies the assessed impact for each station (table I). For complete rationale of biological impairment criteria and methods, definition of each macroinvertebrate community indice, and BAP scoring, see Bode et al. (1990 and 2002).

Table I.

Multi metrics used in NYS for ponar samples and Biological Assessment Profile	
Species Richness	is the total number of species or taxa found in the sub-sample. Higher species richness values are mostly associated with clean water conditions.
Biotic Index	is the Hilsenhoff Biotic Index and is calculated by multiplying the number of individuals of each species or taxa by its assigned tolerance value, summing these products, and dividing the total number of individuals. Tolerance values range from intolerant (0) to tolerant (10). High BI values are suggestive of organic (sewage) pollution, while low values indicate a lack of sewage effects.
Percent Model Community	is a measure of similarity to a model non-impacted community based on percent abundance of seven major groups. For ponar samples, the NYS model is 20% Oligochaeta, 15% Mollusca, %15 Crustacea, %20 Non-Chironomidae Insecta, and %20 Chironomidae, and %10 Other. The lower the similarity value the greater the impact.
Species Diversity	is the value that combines species richness and community balance or evenness. High species diversity values usually indicate diverse, well balanced communities, while low values indicate stress or impact.
Dominance-3	is a measure of community balance or evenness of the distribution of the combined percent contribution of the three most numerous species. High dominance values indicate unbalanced communities strongly dominated by one or more very numerous species.
Biological Assessment Profile (BAP)	is the assessed impact for each station. The BAP score is the mean value of the above 5 metrics after converting each metric score to a common scale of 0 - 10. The higher the BAP score the better the assessed impact category. There are four impact categories in NYS: non-, slightly, moderately, or severely impacted.

The percent composition of substrate grain size determines the availability of suitable habitat, as well as the composition of benthic organisms. For comparison purposes, substrate grain size is assigned to a numeric phi scale as outlined by Cummins (1962), and multiplied by its percent composition to determine its phi value. A phi unit is the summation of a site's phi values. According to Bode et al. (1999), the mean particle size at the upstream site should not differ from that at the downstream site by more than 3 phi units.

A Bray-Curtis similarity cluster analysis was completed to compare the similarity between each sample and site using PRIMER software (Clarke & Warwick, 1994 and 2001). Morphological deformity analysis was attempted to identify any non-lethal toxic effects from substances occurring at or near the Site. The method focuses on mentum mouthparts of *Chironomus sp.* larvae; exposure to unacceptable levels of toxicants may result in mentum deformities at a greater frequency and severity in exposed populations than in non-exposed

populations (Lenat, 1993; Warwick, 1988). Morphological deformity analysis followed procedures in Bode et al. (2002) which require a minimum of fifteen mature *Chironomus* specimens from a sub-sample in order to perform the analysis.

Results:

Seven of the eighteen samples (39%) contained the 100 taxa required to analyze multiple indices: these seven samples included three samples upstream from the Site (stations SD-3, SD-5, and SD-7) and four samples adjacent to or downstream from the Site (stations SD-12, SD-13, SD-16, and SD-17) (appendix I). These 100-specimen sub-samples were considered replicate samples of their respective locations and were used in the application of biological impairment criteria as outlined in Bode et al. (1990). The sub-samples met the replicate similarity criteria of $\geq 50\%$ as outlined by Bode et al. (2002).

Similarity among stations SD-5, SD-7 (upstream), SD-12, and SD-16 (adjacent/downstream) was greater than 75%, a threshold designated as representing a reasonable level of similarity for sites with low levels of species diversity (Kelly, M.G., 2001). (See Figure 1.)

The percent composition of the habitat substrate for the seven samples was converted to phi values and the median phi value was determined. The median phi value for samples upstream from the Site (stations SD-3, SD-5, and SD-7) and adjacent to or downstream from the Site (stations SD-12, SD-13, SD-16, and SD-17) ranged from 2.7 – 5.4 (table II).

Table II. Median substrate particle size in phi units and number of organism obtained from the sample.

Station	Median particle size (phi units)	Number of organisms from sample
SD 6	0.4	2
SD 2	0.6	1
SD 4	1.4	0
SD 8	1.8	4
SD 9	1.9	6
SD 18	2.7	52
SD 16	2.7	100
SD 12	3.1	100
SD 5	3.1	100
SD 11	3.3	3
SD 7	3.4	100
SD 3	3.6	100
SD 17	4.0	100
SD 15	4.2	33
SD 14	4.6	12
SD 10	5.2	50
SD 13	5.4	100

The mean Biological Assessment Profile (BAP) score for the upstream sampling locations (mean = 2.41; s.d. = 0.51; n = 3) was lower than the mean BAP score for the adjacent or downstream sampling stations (mean = 2.55; s.d. = 1.58; n = 4), but this difference was not significant at the level $p = 0.05$ ($t = -0.16$, d.f. = 4, $P = 0.88$). Figure 2 plots the individual indices and BAP scores and includes a BAP trend line with R^2 results.

The mean species richness, biotic index, species diversity, percent model affinity, and dominance-3 indices for the upstream sampling stations were not significantly different from their respective mean indices at sampling stations adjacent to or downstream from the Site (see Table III).

Bray Curtis similarity analysis for all 100-specimen sub-samples showed an overall community similarity between sampling stations of greater than 55 percent (Figure 1).

Upstream versus downstream morphological deformity analysis was not completed, as the fifteen minimum mature *Chironomus sp.* specimens were not available in any sub-sample (appendix I).

Table III. Student t-test results for significant differences in indices between sampling stations. P value was >0.05 for all indices.

Site	Upstream			At/Downstream					
Station	SD 3, 5, 7			SD 12, 13, 16, 17					
	Mean	SD	n	Mean	SD	n	t	d.f.	P
SPECIES RICHNESS:	12.00	1.73	3	10.50	2.65	4	0.90	5	0.41
BIOTIC INDEX:	9.13	0.12	3	8.86	0.72	4	0.75	3	0.51
SPECIES DIVERSITY:	1.25	0.22	3	1.19	0.58	4	0.18	4	0.86
MODEL AFFINITY:	43.33	5.03	3	45.50	13.38	4	-0.29	4	0.78
DOMINANCE - 3:	83.00	4.36	3	83.25	11.15	4	-0.04	4	0.97

Figure 1. Bray Curtis similarity values of taxa from Upstream samples SD-3, SD-5, and SD-7 and Adjacent/Downstream samples SD-12, SD-13, SD-16, and SD-17.

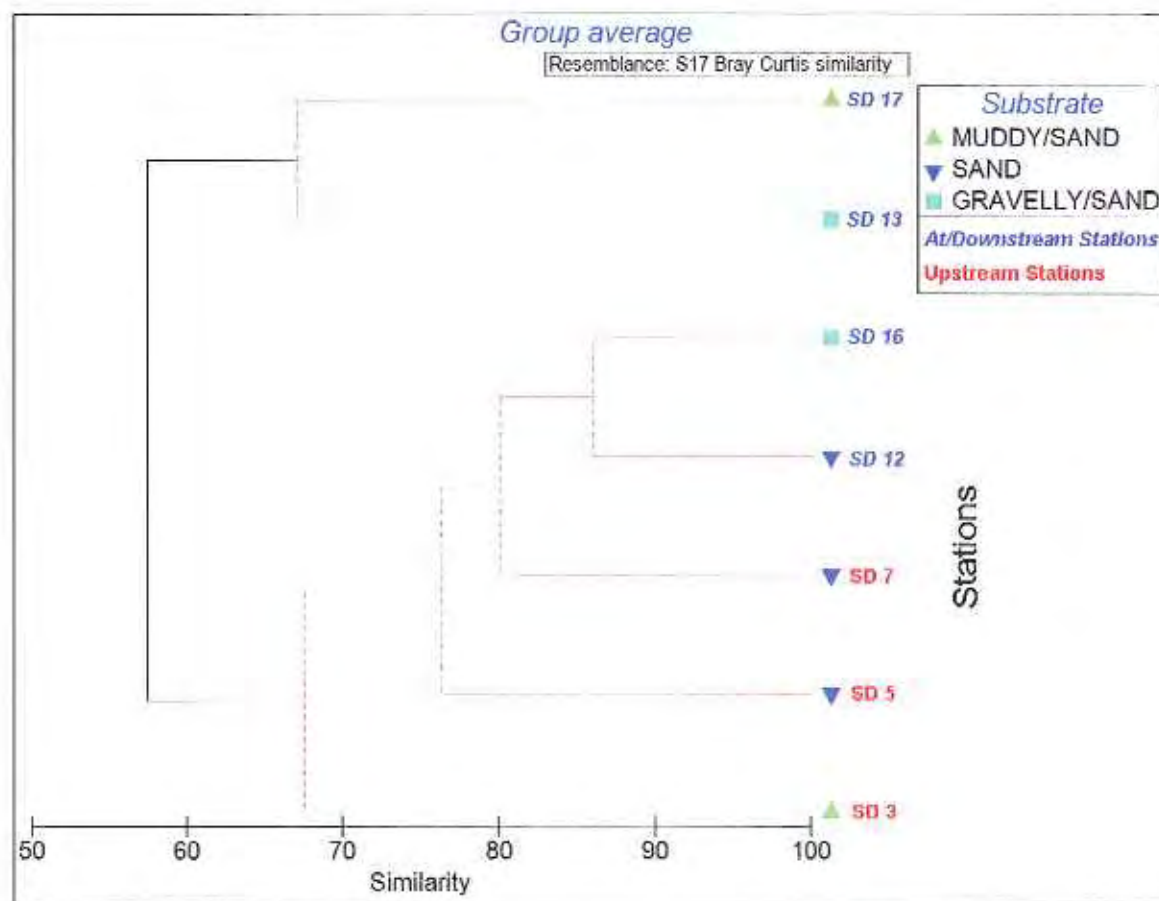
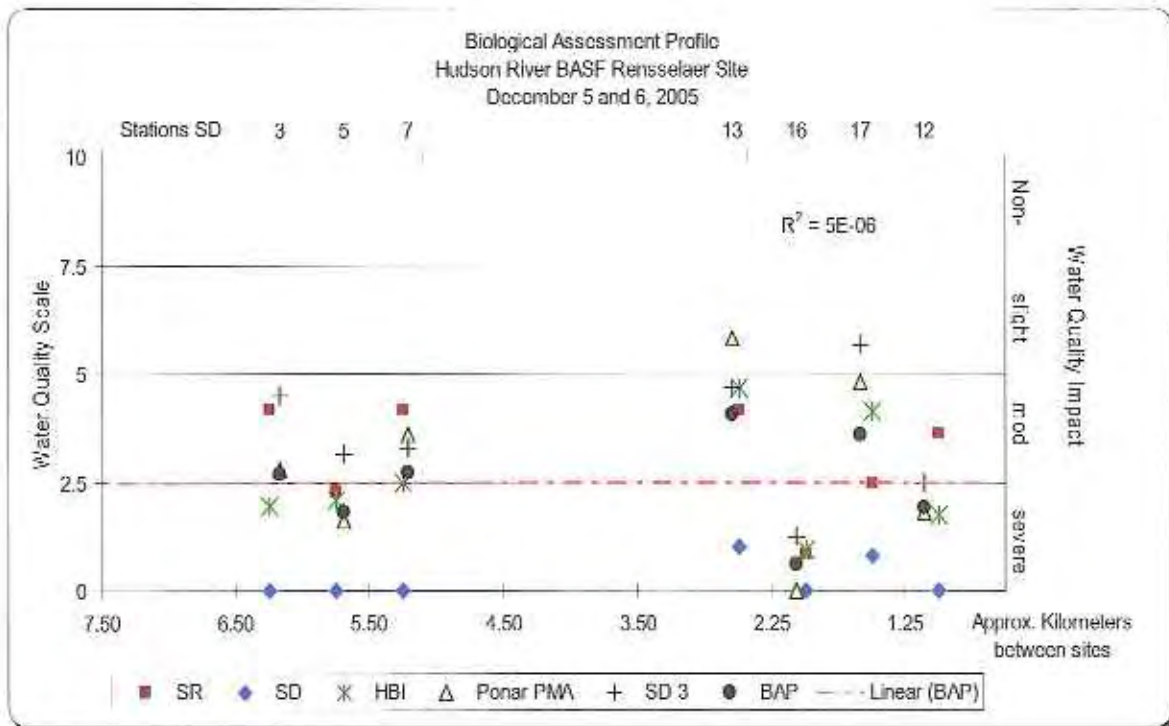


Figure 2. Biological Assessment Profile (BAP) is comprised of five contributory indices that are determined from a sub-sample of macroinvertebrates. Values are plotted on a normalized scale of water quality. The graph depicts the BAP score for Upstream Sampling Stations 3, 5, and 7 Downstream Sampling Stations 12, 13, 16, and 17 with linear regression line plotted for BAP scores.



Discussion

The most abundant and dominant taxon in each of the 100-organism samples evaluated was the tolerant oligochaete worm *Limnodrilus hoffmeisteri*. When dominant and abundant, *L. hoffmeisteri* is often indicative of organic enrichment and metal contamination (Kennedy, 1965; Brinkhurst et al., 1972; Burt et al., 1991). Each of the samples also contained stress-tolerant chironomid genera (i.e. *Chironomus* sp., *Cryptochironomus* sp., *Procladius* sp.) and the facultative species *Phaenopsectra obediens* gr. Several samples (SD 3, 5, 7, 13, and 17) contained *Coelotanyppus* sp., which is generally not as stress-tolerant as the above-mentioned species; this taxon is thought to be relatively intolerant of organic pollutants (Bode et al., 2002). A member of the Ephemeroptera genus *Hexagenia*, a facultative genus, was collected from a few samples at both sites (Appendix I). Overall, the species diversity was low for all samples at all sites. The mean BAP score upstream from the Site was classified based on the sampling results within the severely impacted category (BAP = 2.41). A slight, though statistically insignificant, improvement in water quality was observed adjacent to and downstream from the Site, with a mean BAP score of 2.55 (which is classified within the moderately impacted category (Bode et al., 2002).

Biological monitoring and analysis provides distinct information that can be used to supplement other methods of analysis (such as chemical sampling, laboratory or *in situ* toxicity testing, or fish surveys) to help determine if constituents of interest that exceed ambient water quality criteria and/or sediment quality standards may be impacting overall community structure. The biological data from the BASF Rensselaer study indicates that upstream, downstream, and adjacent sampling stations are all similarly biologically impaired, and that the most likely source of impairment, according to the benthic macroinvertebrate community structure, is from organic enrichment and metal contamination. The ability to discern biological impairment upstream and downstream from the BASF Site may be masked, in part, both by tidal influence (which would move water and contaminants in both directions) and by the possibility that other sources of urban contaminants are entering the system upstream from and in the vicinity of the project locus. The primary goal of this study was to determine if any significant biological changes are evident above and below the BASF Rensselaer facility; based on biological impairment criteria and analysis, no significantly detrimental biological impairment was found between them.

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Appendix I

Hudson River Albany and Rensselaer County NY December 5 and 6, 2005

Taxa	Sample	1	2	3	4	5	6	7	8	9	1	11	12	13	14	15	16	17	18
<i>Ablabesmyia annulata</i>														1					
<i>Chironomus</i> sp_			8					2			4					2		1	5
<i>Coelotanyus</i> sp_			4		6			1			6			6				10	13
<i>Corbicula fluminea</i>								7	1		2		7	20	2		2	11	6
<i>Cryptochironomus</i> sp_			5										1	1					2
<i>Demicryptochironomus</i> sp_			1					1	1				2						
<i>Dicretodipes fumidus</i>																			1
<i>Dreissena polymorpha</i>							1	3		6				2					
<i>Dubiraphia</i> sp_					3														
<i>Ferrissia</i> sp_														1					
<i>Gammarus</i> sp_								2					1	5		3	1	1	
<i>Hexagenia</i> sp_					3						1			2				1	
<i>Hyalella azteca</i>																	1		
<i>Limnodrilus hoffmeisteri</i>			63		76		71	1		11			81	51	10	27	89	46	8
<i>Microtendipes pedellus</i> gr_								1		1									
<i>Phaenopsectra obediens</i> gr_																	3	4	
<i>Phylocentropus</i> sp_								1											
<i>Polypedilum halterale</i> gr_											1		1						
<i>Polypedilum</i> sp_														2					
<i>Procladius</i> sp_														2		1		11	
<i>Procladius subiettei</i>			7								16								2
<i>Prodiamesa olivacea</i>			1																
<i>Quistadrilus multisetosus</i>			3		4			1			1						1	14	2
<i>Sialis</i> sp_					1														
<i>Stenelmis</i> sp_							1												
<i>Stylurus</i> sp_											1		1						
<i>Thienemannimyia</i> gr_ spp_													1						
<i>Trilobos jucundum</i>			1		1			7			2		1						12
Undet_ Tubificidae w/ cap_ setae					2									2					
Undet_ Tubificidae w/o cap_ setae												3							
Undetermined Ceratopogonidae					3						2		1	5					
Undetermined Chironomidae			2								1								
Undetermined Chironomini			1																1
Undetermined Dolichopodidae			1																
Undetermined Hirudinea					1				1		1							1	
Undetermined Libellulidae								1											
Undetermined Physidae													1						
Undetermined Sphaeriidae				3															
Undetermined Unionidae			1	1					2				2				3		
Total		1	1	100	0	100	2	100	4	6	50	3	100	100	12	33	100	100	52

Appendix I cont.

STREAM SITE: Hudson River 01 Rep 1
LOCATION: Albany and Rensselaer County NY
DATE: 06 December 2006
SAMPLE TYPE: Ponar
SUBSAMPLE: 100

MOLLUSCA			
PELECYPODA	Unionidae	Undetermined Unionidae	1

SPECIES RICHNESS: 1

Appendix I cont.

STREAM SITE:	Hudson River	02 Rep 1
LOCATION:	Albany and Rensselaer County NY	
DATE:	06 December 2005	
SAMPLE TYPE:	Ponar	
SUBSAMPLE:	100	

MOLLUSCA			
PELECYPODA	Unionidae	Undetermined Unionidae	1

SPECIES RICHNESS:	1

Appendix I cont.

STREAM SITE: Hudson River 03 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 06 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	63
		Quistadrilus multifisetosus	3
MOLLUSCA			
PELECYPODA			
	Sphaeriidae	Undetermined Sphaeriidae	3
ARTHROPODA			
INSECTA			
DIPTERA	Dolichopodidae	Undetermined Dolichopodidae	1
	Chironomidae	Procladius sublettei	7
		Coelotanypus sp.	4
		Procladius olivacea	1
		Chironomus sp.	8
		Cryptochironomus sp.	5
		Demicryptochironomus sp.	1
		Tribelos jucundum	1
		Undetermined Chironomini	1
		Undetermined Chironomidae	2

SPECIES RICHNESS: 13
 BIOTIC INDEX: 9.22
 SPECIES DIVERSITY: 1.48
 MODEL AFFINITY: 44
 DOMINANCE - 3: 78
 BAP: 2.7

Appendix I cont.

STREAM SITE:	Hudson River	04 Rep 1
LOCATION:	Albany and Rensselaer County NY	
DATE:	06 December 2005	
SAMPLE TYPE:	Ponar	
SUBSAMPLE:	100	

SPECIES RICHNESS:	0

Appendix I cont.

STREAM SITE: Hudson River 05 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 06 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	76
		Quistadrilus multisetosus	4
		Undet. Tubificidae w/ cap. setae	2

HIRUDINEA

Glossiphoniidae	Undetermined Hirudinea	1

ARTHROPODA

INSECTA

EPHEMEROPTERA	Ephemeridae	Hexagenia sp.	3
COLEOPTERA	Elmidae	Dubiraphia sp.	3
MEGALOPTERA	Sialidae	Sialis sp.	1
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	3
	Chironomidae	Coelotanypus sp.	6
		Tribelos jucundum	1

SPECIES RICHNESS:	10
BIOTIC INDEX:	9.17
SPECIES DIVERSITY:	1.04
MODEL AFFINITY:	38
DOMINANCE - 3:	86
BAP:	1.82

Appendix I cont.

STREAM SITE: Hudson River 06 Rep 1
LOCATION: Albany and Rensselaer County NY
DATE: 06 December 2005
SAMPLE TYPE: Ponar
SUBSAMPLE: 100

MOLLUSCA
PELECYPODA

Dreissenidae Dreissena polymorpha 1

ARTHROPODA

INSECTA

COLEOPTERA

Elmidae Stenelmis sp. 1

SPECIES RICHNESS: 2

Appendix I cont.

STREAM SITE: Hudson River 07 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 06 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA

Tubificidae

Limnodrilus hoffmeisteri
Quistadrilus multisetosus

71
 1

MOLLUSCA

PELECYPODA

Unionidae

Undetermined Unionidae

2

Corbiculidae

Corbicula fluminea

7

Dreissenidae

Dreissena polymorpha

3

ARTHROPODA

CRUSTACEA

AMPHIPODA

Gammaridae

Gammarus sp.

2

INSECTA

ODONATA

Libellulidae

Undetermined Libellulidae

1

TRICHOPTERA

Dipseudopsidae

Phylocentropus sp.

1

DIPTERA

Chironomidae

Coelotanypus sp.

1

Demicryptochironomus sp.

1

Chironomus sp.

2

Microtendipes pedellus gr.

1

Tribelos jucundum

7

SPECIES RICHNESS: 13

BIOTIC INDEX: 9

SPECIES DIVERSITY: 1.23

MODEL AFFINITY: 48

DOMINANCE - 3: 86

BAP: 2.7

Appendix I cont.

STREAM SITE: Hudson River 08 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 06 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA

Tubificidae

Limnodrilus hoffmeisteri

1

HIRUDINEA

Glossiphoniidae

Undetermined Hirudinea

1

MOLLUSCA

PELECYPODA

Corbiculidae

Corbicula fluminea

1

ARTHROPODA

INSECTA

DIPTERA

Chironomidae

Demicryptochironomus sp.

1

SPECIES RICHNESS:

4

Appendix I cont.

STREAM SITE: Hudson River 09 Rep 1
LOCATION: Albany and Rensselaer County NY
DATE: 05 December 2005
SAMPLE TYPE: Ponar
SUBSAMPLE: 100

MOLLUSCA
PELECYPODA

Dreissenidae Dreissena polymorpha

6

SPECIES RICHNESS: 1

Appendix I cont.

STREAM SITE: Hudson River 10 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	11
		Quistadrilus multisetosus	1

HIRUDINEA

	Glossiphoniidae	Undetermined Hirudinea	1
	Corbiculidae	Corbicula fluminea	2

ARTHROPODA

INSECTA

EPHEMEROPTERA	Ephemeridae	Hexagenia sp.	1
ODONATA	Gomphidae	Stylurus sp.	1
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	2
	Chironomidae	Coelotanypus sp.	6
		Procladius sublettei	16
		Chironomus sp.	4
		Microtendipes pedellus gr.	1
		Polypedilum halterale gr.	1
		Tribelos jucundum	2
		Undetermined Chironomidae	1

SPECIES RICHNESS: 12

Appendix 1 cont.

STREAM SITE: Hudson River 11 Rep 1
LOCATION: Albany and Rensselaer County NY
DATE: 06 December 2005
SAMPLE TYPE: Ponar
SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Undet. Tubificidae w/o cap. setae	3

SPECIES RICHNESS: 1

Appendix I cont.

STREAM SITE: Hudson River 12 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 06 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA

Tubificidae

Limnodrilus hoffmeisteri

81

MOLLUSCA

GASTROPODA

Physidae

Undetermined Physidae

1

Unionidae

Undetermined Unionidae

2

Corbiculidae

Corbicula fluminea

7

ARTHROPODA

CRUSTACEA

AMPHIPODA

Gammaridae

Gammarus sp.

1

INSECTA

ODONATA

Gomphidae

Stylurus sp.

1

DIPTERA

Ceratopogonidae

Undetermined Ceratopogonidae

1

Chironomidae

Thienemannimyia gr. spp.

1

Cryptochironomus sp.

1

Demicryptochironomus sp.

2

Polypedilum halterale gr.

1

Tribelos jucundum

1

SPECIES RICHNESS: 12
 BIOTIC INDEX: 9.31
 SPECIES DIVERSITY: 0.88
 MODEL AFFINITY: 39
 DOMINANCE - 3: 90
 BAP: 1.93

Appendix I cont.

STREAM SITE: Hudson River 13 rep. 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA

Tubificidae

Limnodrilus hoffmeisteri

51

Undet. Tubificidae w/ cap. s

2

MOLLUSCA

GASTROPODA

Ancylidae

Ferrissia sp.

1

Dreissenidae

Dreissena polymorpha

2

Corbiculidae

Corbicula fluminea

20

ARTHROPODA

CRUSTACEA

AMPHIPODA

Gammaridae

Gammarus sp.

5

INSECTA

EPHEMEROPTERA

Ephemeridae

Hexagenia sp.

2

DIPTERA

Ceratopogonidae

Undetermined Ceratopogon

5

Chironomidae

Ablabesmyia annulata

1

Coelotanypus sp.

6

Procladius sp.

2

Cryptochironomus sp.

1

Polypedilum sp.

2

SPECIES RICHNESS:

13

BIOTIC INDEX:

8.14

SPECIES DIVERSITY:

1.7

MODEL AFFINITY:

59

DOMINANCE - 3:

77

BAP:

4.06

Appendix I cont.

STREAM SITE: Hudson River 14 rep 1
LOCATION: Albany and Rensselaer County NY
DATE: 06 December 2006
SAMPLE TYPE: Ponar
SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	10
MOLLUSCA			
PELECYPODA	Corbiculidae	Corbicula fluminea	2

SPECIES RICHNESS: 2

Appendix I cont.

STREAM SITE: Hudson River 15 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	27
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	3
INSECTA			
DIPTERA	Chironomidae	Procladius sp.	1
		Chironomus sp.	2

SPECIES RICHNESS: 4

Appendix I cont.

STREAM SITE: Hudson River 16 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	89
		Quistadrilus multisetosus	1
MOLLUSCA			
PELECYPODA	Unionidae	Undetermined Unionidae	3
	Corbiculidae	Corbicula fluminea	2
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	1
	Talitridae	Hyalella azteca	1
INSECTA			
DIPTERA	Chironomidae	Phaenopsectra obediens gr.	3

SPECIES RICHNESS: 7
 BIOTIC INDEX: 9.62
 SPECIES DIVERSITY: 0.53
 MODEL AFFINITY: 30
 DOMINANCE - 3: 95
 BAP: 0.61

Appendix I cont.

STREAM SITE: Hudson River 17 rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

TUBIFICIDA

Tubificidae

Limnodrilus hoffmeisteri
Quistadrilus multisetosus

46
 14

HIRUDINEA

Glossiphoniidae
 Corbiculidae

Undetermined Hirudinea
Corbicula fluminea

1
 11

ARTHROPODA

CRUSTACEA

AMPHIPODA

Gammaridae

Gammarus sp.

1

INSECTA

EPHEMEROPTERA

Ephemeridae

Hexagenia sp.

1

DIPTERA

Chironomidae

Coelotanypus sp.

10

Procladius sp.

11

Chironomus sp.

1

Phaenopsectra obediens gr.

4

SPECIES RICHNESS: 10
 BIOTIC INDEX: 8.35
 SPECIES DIVERSITY: 1.66
 MODEL AFFINITY: 54
 DOMINANCE - 3: 71
 BAP: 3.58

Appendix I cont.

STREAM SITE: Hudson River 18 Rep 1
 LOCATION: Albany and Rensselaer County NY
 DATE: 05 December 2005
 SAMPLE TYPE: Ponar
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Limnodrilus hoffmeisteri	8
		Quistadrilus multisetosus	2
MOLLUSCA			
PELECYPODA			
	Corbiculidae	Corbicula fluminea	6
ARTHROPODA			
INSECTA			
DIPTERA	Chironomidae	Coelotanypus sp.	13
		Procladius sublettei	2
		Chironomus sp.	5
		Cryptochironomus sp.	2
		Dicrotendipes fumidus	1
		Tribelos jucundum	12
		Undetermined Chironomini	1

SPECIES RICHNESS: 10

Appendix F

Sediment Boring Logs

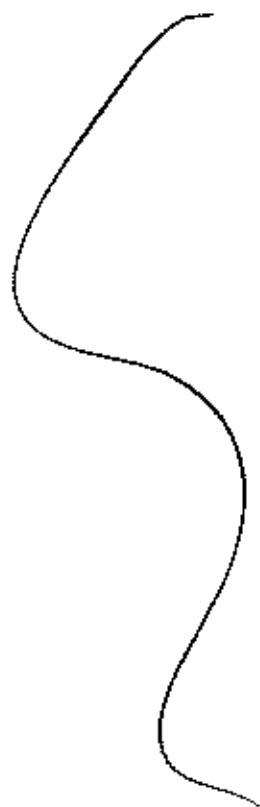
Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

Provided on CD



Tab
G



Appendix G
Statistical Analysis of
Upstream/Downstream Sediment
Quality

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

Contents

1.0	Introduction.....	1-1
1.1	Data Selection and Treatment.....	1-1
1.1.1	Data Sets Used in the Statistical Evaluation	1-1
1.1.2	Selection of Compounds for Inclusion in the Statistical Evaluation.....	1-2
1.1.3	Treatment of Non-Detects.....	1-4
2.0	Statistical Methods.....	2-1
2.1	Tests for Normality	2-1
2.2	Parametric Comparison of Means	2-1
2.2.1	Non-Parametric Comparison of Populations.....	2-1
2.3	Evaluation of Power	2-2
3.0	Results of Statistical Analyses.....	3-1
3.1	Upstream vs. Adjacent.....	3-1
3.2	Upstream vs. Adjacent Nearshore.....	3-1
3.3	Adjacent Far Field vs. Adjacent Nearshore.....	3-2
3.4	Upstream vs. Adjacent Far Field	3-2
3.5	Adjacent Nearshore vs. Upper Navigational Channel	3-2
3.6	Upstream vs. Upper Navigational Channel.....	3-3
3.7	Adjacent Far Field vs. Upper Navigational Channel.....	3-3
4.0	Uncertainties Associated with the Statistical Analysis	4-1
5.0	Conclusions	5-1
6.0	Literature Cited	6-1

Attachment 1 Statistical Analysis Documentation (provided on CD)

List of Tables

Table 1-1 Samples Used in Statistical Analyses

Table 2-1 Distribution of Data Sets

Table 2-2 Selection of Test Type and S Based on Data Distribution

Table 3-1 Results of Statistical Analysis – Upstream vs. Adjacent

Table 3-2 Results of Statistical Analysis – Upstream vs. Adjacent Nearshore

Table 3-3 Results of Statistical Analysis – Adjacent Far Field vs. Adjacent Nearshore

Table 3-4 Results of Statistical Analysis – Upstream vs. Adjacent Far Field

Table 3-5 Results of Statistical Analysis – Upper Navigational Channel vs. Adjacent Nearshore

Table 3-6 Results of Statistical Analysis – Upstream vs. Upper Navigational Channel

Table 3-7 Results of Statistical Analysis – Adjacent Far Field vs. Upper Navigational Channel

1.0 Introduction

As part of the Site Investigation Report (Report), statistical analyses of the surficial sediment data were conducted to determine if concentrations of inorganic compounds in the sediments in the vicinity of the Site are consistent (or inconsistent) with concentrations of compounds upstream of the Site. Compound concentrations from upstream sediment stations were statistically compared to concentrations in the sediment data sets in the vicinity of the Site to evaluate whether or not the observed concentrations are consistent among these data sets. Where concentrations among upstream and adjacent sediment data sets were determined to be similar, the presence of the compound in sediments may be due to an upstream or regionally distributed source. The statistical testing was conducted in accordance with the USEPA Guidance for *Characterizing Background Chemicals in Soil at Superfund Sites* (USEPA, 2001a).

1.1 Data Selection and Treatment

The following section details the data evaluation process used in the statistical analysis, which focused on surficial sediment samples from 101 surficial sediment sampling locations, including 28 upstream samples and 83 samples from the general vicinity of the Site.

1.1.1 Data Sets Used in the Statistical Evaluation

This section provides an overview of the approach and statistical calculations performed. As described in the USEPA's (2001b) Method for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual and consistent with the NYSDEC-approved Work Plan (ENSR, 2005a), sampling station locations were selected following a "Targeted Sampling Design" where prior knowledge of Site-related factors is incorporated into the process of station location. The targeted sampling design was developed to meet the following criteria:

- Sampling stations were selected that are representative of the defined area of interest;
- Stations with similar physical characteristics were selected to minimize the sampling error, as described in the study data quality objectives (DQO) process (USEPA, 2001b); and
- Sampling station locations were targeted to represent "worst case" conditions by selecting sampling locations in the vicinity of known outfalls and depositional areas.

The surficial sediment data were grouped by location as described in the Report. Another data set, referred to as the Adjacent data set, was generated for the statistical analysis by combining the data in the Adjacent Nearshore, Adjacent Far Field, and Upper Navigational Channel reaches. There was not a sufficient number of samples in the Downstream data set for a statistical analysis to be completed using this reach. The five data sets (populations) are described below:

- The **Upstream** data set includes 28 samples collected upstream of the influence of the Site (i.e., this data set serves as the Reference Conditions data set). It is assumed that the data from this reach of the river are uninfluenced by Site conditions and represent anthropogenic urban background conditions.
- The **Adjacent Nearshore** data set includes 36 samples collected within a band of muddy sand immediately adjacent and to the west of the Site.
- The **Adjacent Far Field** data set includes 19 samples collected in the more coarse-grained sediment located to the west of the muddy sand samples in the Adjacent Nearshore sampling reach. The Adjacent Far Field data set is within the same river reach as the Site, but may not be influenced by the Site.

- The **Upper Navigational Channel** data set includes 15 samples collected immediately downstream of the Site, in a depositional environment that is co-located with what is understood to be the northernmost extent of an area where New York State has reportedly conducted periodic navigational dredging to maintain depth for shipping purposes.
- The **Adjacent** data set includes all data collected in the reach of the river that includes the Site. This data set includes the 36 nearshore muddy sand samples (referred to as the **Adjacent Nearshore** data set), as well as the 19 samples collected from the coarser grained materials to the west of the muddy sand (**Adjacent Far Field**) and the 15 samples in the **Upper Navigational Channel** immediately downstream of the Site.

Table 1-1 presents a summary of the data sets sorted by sample ID. Discrete statistical evaluations were conducted using these groups of data to support the data evaluation efforts:

- Upstream vs. Adjacent: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of all samples collected in the Hudson River in the vicinity of the Site;
- Upstream vs. Adjacent Nearshore: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of nearshore muddy sand samples collected from immediately adjacent to and downstream from the Site;
- Adjacent Far Field vs. Adjacent Nearshore: This evaluation was conducted to compare samples that were collected in the same river reach as the Site but are not immediately adjacent to the Site bulkhead to samples collected from the nearshore muddy sand immediately adjacent to and downstream from the Site; and
- Upstream vs. Adjacent Far Field: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of samples collected from more coarse-grained sediments which may or may not be potentially influenced by former Site activities.
- Upper Navigational Channel vs. Adjacent Nearshore: this evaluation was conducted to compare samples from the area maintained for navigation (i.e., periodically dredged) to the near shore muddy sediments to determine if sediments from the near shore may be impacting the dredged area.
- Upstream vs. Upper Navigational Channel: this evaluation was conducted to compare the Upstream reference data set to a data set comprised of samples collected from the area maintained for navigation.
- Adjacent Far Field vs. Upper Navigational Channel: this evaluation was conducted to compare samples that were collected in the same river reach as the Site, but outside the influence of the Adjacent Nearshore sediments, to samples collected from the area maintained for navigation.

In order to provide reviewers with consistent terminology relative to the pair-wise statistical evaluation, the following terminology is used consistently throughout this chapter: the presumed "unimpacted" or "upstream" data set is referred to as "*Reference Reach*", whereas the experimental data set being tested to determine consistency with the Reference Reach is referred to as the "*Test Reach*". The details of the statistical methods are discussed in the following section, followed by the results of the analyses.

1.1.2 Selection of Compounds for Inclusion in the Statistical Evaluation

Sediment samples collected from the Hudson River were analyzed for an extensive list of compounds. However, in order to focus the background conditions analysis, statistical calculations were performed for a sub-set of the compounds detected in Hudson River sediments. The criteria listed below were used to select the compounds for inclusion in the statistical evaluation:

- If concentrations of a compound were below their respective NYSDEC low effect sediment screening values in all samples, then the compound was not included in the statistical evaluation. The evaluation of sediment data relative to ecological sediment quality benchmarks is summarized in Section 7 of the Report.
- Inorganic compounds that are considered essential macronutrients were not considered in the statistical evaluation; these analytes included magnesium, calcium, sodium, and potassium.

Screening of the surficial sediment with these criteria resulted in the selection of 12 inorganic compounds for the statistical analysis (antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver and zinc).

No organic compounds were included in the statistical evaluation. Several VOCs, particularly chlorinated benzene compounds, were detected at concentrations that exceeded their respective low effect sediment screening values. However, the highest concentrations of these compounds were located in areas well-defined by the locations of the outfalls. Furthermore, with the exception of the likely laboratory contaminant toluene at location SD011, VOCs were not detected in any samples in the Upstream data set.

Inclusion of non-detect results in the statistical analysis can create bias. With greater numbers of non-detect results, the bias becomes greater. When the frequency of detect is low, the statistical analysis will provide more information about the analytical detection limits than about actual sediment concentrations. In order to address this potential concern, the frequency of detection was calculated for each set of data. When a compound from either paired data set in a statistical run was detected in fewer than 50% of samples, no statistical evaluation was conducted. When a compound was detected in at least 50% but fewer than 80% of samples, the test used for comparison was defaulted to a non-parametric test (i.e., the Wilcoxon Rank Sum (WRS) test). In the WRS test, the data are assigned a rank and this rank is used in the calculation of the test statistic. Therefore, non-detects would appropriately be given the lowest ranks, but the actual value of the detection limit would not influence the test, as would be the case in a parametric t-test.

Based on these criteria, statistical evaluations were not run for the following tests:

- Upstream vs. Adjacent – cadmium (frequency of detection (FOD) 18% in the Upstream data set).
- Upstream vs. Adjacent Nearshore – cadmium (FOD 18% in the Upstream data set).
- Adjacent Far Field vs. Adjacent Nearshore – cadmium and lead (FOD 0% and 21%, respectively, in Adjacent Far Field data set).
- Upstream vs Adjacent Far Field – cadmium and lead (FOD 0% and 21%, respectively, in the Adjacent Far Field data set and cadmium FOD 18% in the Upstream data set).
- Upstream vs. Upper Navigational Channel – cadmium (FOD 18% in the Upstream data set).
- Adjacent Far Field vs. Upper Navigational Channel – cadmium and lead (FOD 0% and 21%, respectively, in the Adjacent Far Field data set).

In addition, several compounds were detected in 50 to 80% of samples. By default, the following comparisons were tested using the non-parametric WRS test:

- Upstream vs. Adjacent – antimony (Upstream FOD 71%), lead (Upstream FOD 68% and Adjacent FOD 76%) and silver (Adjacent FOD 61%).
- Upstream vs. Adjacent Nearshore – antimony (Upstream FOD 71%), lead (Upstream FOD 68%) and silver (Adjacent Nearshore FOD 56%).

- Adjacent Far Field vs. Adjacent Nearshore – antimony (Adjacent Far Field FOD 67%), mercury (Adjacent Far Field FOD 58%) and silver (Adjacent Far Field FOD 50% and Adjacent Nearshore FOD 56%).
- Upstream vs. Adjacent Far Field – antimony (Upstream FOD 71% and Adjacent Far Field FOD 67%), mercury (Adjacent Far Field FOD 58%) and silver (Adjacent Far Field FOD 50%).
- Upper Navigational Channel vs. Adjacent Nearshore – cadmium (Upper Navigational Channel FOD 67% and Adjacent Nearshore FOD 58%) and silver (Adjacent Nearshore FOD 56%).
- Upstream vs. Upper Navigational Channel – antimony (Upstream FOD 71%) and lead (Upstream FOD 68%).
- Adjacent Far Field vs. Upper Navigational Channel – antimony (Adjacent Far Field FOD 67%) and silver (Far Field FOD 50%).

The sediment summary statistics are presented in Appendix B of the Report. Compounds that were not detected or were only detected below the sediment screening benchmarks in the data sets collected in the vicinity of the Site were not considered for inclusion in the statistical evaluations.

1.1.3 Treatment of Non-Detects

Because the data sets that included >50% non-detects were excluded, the non-detect values in the remaining data sets were assumed not to introduce significant statistical bias. Therefore, all non-detect values were replaced with $\frac{1}{2}$ the value of the sample quantitation limit (SQL) for the purposes of calculating the statistics. Where $\frac{1}{2}$ the SQL was greater than the highest detected concentrations, the sample results for the non-detect were eliminated from the analysis.

Table 1-1
Samples Used in Statistical Analysis
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Data Set			
Adjacent Far Field	Adjacent Nearshore	All Adjacent	Upper Navigational Channel
02SD036AA1	02SD032UA1	01SD047AA1	01SDINV011
02SD037AA1	02SD039UA1	02SD038AA1	02SD067DA1
02SD038AA1	02SD037AA1	02SD039AA1	02SD068DA1
02SD039AA1	01SD038AA1	02SD040AA1	02SD069DA1
02SD040AA1	01SD039AA1	02SD041AA1	02SD070DA1
02SD041AA1	01SD040AA1	02SD042AA1	02SD071DA1
02SD042AA1	02SD041AA1	02SD043AA1	02SD072DA1
02SD043AA1	01SD042AA1	02SD044AA1	02SD073DA1
02SD044AA1	01SD043AA1	02SD045AA1	02SD074DA1
02SD045AA1	02SD044AA1	02SD046AA1	02SD075DA1
02SD046AA1	01SD045AA1	02SD047AA1	02SD076DA1
02SD047AA1	02SD046AA1	02SD048AA1	02SD077DA1
02SD048AA1	01SD047AA1	02SD049AA1	02SD078DA1
02SD049AA1	02SD048AA1	02SD050AA1	02SD079DA1
02SD050AA1	01SD049AA1	02SD051AA1	02SD080DA1
02SD051AA1	02SD050AA1	02SD052AA1	02SD081DA1
02SD052AA1	01SD051AA1	02SD053AA1	02SD082DA1
02SD053AA1	02SD052AA1	02SD054AA1	02SD083DA1
02SD054AA1	01SD053AA1	02SD055AA1	02SD084DA1
02SD055AA1	02SD054AA1	02SD056AA1	02SD085DA1
02SD056AA1	01SD055AA1	02SD057AA1	02SD086DA1
02SD057AA1	02SD056AA1	02SD058AA1	02SD087DA1
02SD058AA1	01SD057AA1	02SD059AA1	02SD088DA1
02SD059AA1	02SD058AA1	02SD060AA1	02SD089DA1
02SD060AA1	01SD059AA1	02SD061AA1	02SD090DA1
02SD061AA1	02SD060AA1	02SD062AA1	02SD091DA1
02SD062AA1	01SD061AA1	02SD063AA1	02SD092DA1
02SD063AA1	02SD062AA1	02SD064AA1	02SD093DA1
02SD064AA1	01SD063AA1	02SD065AA1	02SD094DA1
02SD065AA1	02SD064AA1	02SD066AA1	02SD095DA1
02SD066AA1	01SD065AA1	02SD067AA1	02SD096DA1
02SD067AA1	02SD066AA1	02SD068AA1	02SD097DA1
02SD068AA1	01SD067AA1	02SD069AA1	02SD098DA1
02SD069AA1	02SD068AA1	02SD070AA1	02SD099DA1
02SD070AA1	01SD069AA1	02SD071AA1	02SD100DA1
02SD071AA1	02SD070AA1	02SD072AA1	02SD101DA1
02SD072AA1	01SD071AA1	02SD073AA1	02SD102DA1
02SD073AA1	02SD072AA1	02SD074AA1	02SD103DA1
02SD074AA1	01SD073AA1	02SD075AA1	
02SD075AA1	02SD074AA1	02SD076AA1	
02SD076AA1	01SD075AA1	02SD077AA1	
02SD077AA1	02SD076AA1	02SD078AA1	
02SD078AA1	01SD077AA1	02SD079AA1	
02SD079AA1	02SD078AA1	02SD080AA1	
02SD080AA1	01SD079AA1	02SD081AA1	
02SD081AA1	02SD080AA1	02SD082AA1	
02SD082AA1	01SD081AA1	02SD083AA1	
02SD083AA1	02SD082AA1	02SD084AA1	
02SD084AA1	01SD083AA1	02SD085AA1	
02SD085AA1	02SD084AA1	02SD086AA1	
02SD086AA1	01SD085AA1	02SD087AA1	
02SD087AA1	02SD086AA1	02SD088AA1	
02SD088AA1	01SD087AA1	02SD089AA1	
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02SD093AA1	02SD092AA1	02SD094AA1	
02SD094AA1	01SD093AA1	02SD095AA1	
02SD095AA1	02SD094AA1	02SD096AA1	
02SD096AA1	01SD095AA1	02SD097AA1	
02SD097AA1	02SD096AA1	02SD098AA1	
02SD098AA1	01SD097AA1	02SD099AA1	
02SD099AA1	02SD098AA1	02SD100AA1	
02SD100AA1	01SD099AA1	02SD101AA1	
02SD101AA1	02SD100AA1	02SD102AA1	
02SD102AA1	01SD101AA1	02SD103DA1	
02SD103DA1			
02SD036AA1			
02SD037AA1			
02SD038AA1			
02SD039AA1			
02SD040AA1			
02SD041AA1			
02SD042AA1			
02SD043AA1			
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02SD083AA1			
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02SD093AA1			
02SD094AA1			
02SD095AA1			
02SD096AA1			
02SD097AA1			
02SD098AA1			
02SD099AA1			
02SD100AA1			
02SD101AA1			
02SD102AA1			
02SD103DA1			

2.0 Statistical Methods

The statistical software Stata 8.2 was used to perform the statistical calculations. Due to low FOD for cadmium (18% in the Upstream data set), no statistical evaluation was performed. The results of the distribution tests, the statistical analyses, and the raw results from the Stata 8.2 program are presented in Attachment 1.

2.1 Tests for Normality

Each compound in each data set was tested to determine whether the data were normally or lognormally distributed. The Shapiro Wilk test was used for this determination ($\alpha=0.10$). To evaluate a lognormal distribution, the data were transformed by calculating the natural logarithm of each concentration. If both untransformed and log-transformed data were normally distributed, untransformed data were selected for the analysis. Generalized statistical references describing the various methods are listed in the references. The results of the Shapiro Wilk tests are presented in Table 2-1.

2.2 Parametric Comparison of Means

For any individual compound, where both of the data distributions were normal or both of the data distributions were lognormal in a paired data set (i.e., the same distribution exists in both the Reference Reach and the Test Reach), a student's t-test ($\alpha=0.10$) was used to compare the means. The variances of each paired data set were calculated, and compared using an F-test ($\alpha=0.10$). The t-test for either equal or unequal variance was used, as appropriate. For the lognormally distributed data sets, all calculations were performed on the log-transformed data. In addition, in order to provide additional insight into the data distribution, all data sets that were lognormally distributed were also tested using non-parametric tests.

2.2.1 Non-Parametric Comparison of Populations

For any individual compound, if the data distribution for either member of a paired data set was neither normally nor lognormally distributed (i), or if the distributions were mixed (e.g., one normal, the other lognormal), then a non-parametric comparison was necessary. The Wilcoxon Rank Sum Test (also known as the Mann-Whitney U Test) was used for the non-parametric comparison ($\alpha=0.10$). All data sets that were lognormally distributed were also tested using non-parametric tests.

Hypothesis Testing

The surficial sediment chemistry data from the Hudson River was evaluated using statistical Background Test Form 2 from the USEPA Guidance for Characterizing Background Chemicals in Soil at Superfund Sites (USEPA, 2001a). Background Test Form 2 requires a strict burden of proof by selecting the null hypothesis that the compound concentration in potentially contaminated areas exceeds background (Reference Reach) by more than a substantial difference S ($\Delta > S$). This approach favors the protection of the environment (USEPA, 2001a). A significant difference (S) of one standard deviation ($1s$) of the Reference Reach data set was used to provide a reasonable ability to distinguish differences between data sets. An "S" term of $1s$ has been previously used in CERCLA riverine risk assessments approved by the USEPA Las Vegas Laboratories statistical experts at the Charles River OU Superfund Site (ENSR, 2005b). If Reference Reach data were normally or lognormally distributed, S was calculated as $1s$, with s calculated in log-space for lognormally distributed data. If the Reference Reach data were neither normally nor lognormally distributed, a percentile value was calculated equivalent to the mean plus one standard deviation in a normally distributed data set (84.13th percentile). The S for non-parametric tests was determined as the difference between the 84.13th percentile and the median (50th percentile).

The specific statistical tests performed, and the S selected, are specified in Table 2-2 and outlined in Figure 5-1. The specific hypotheses to be used in the ERA are as stated in Test Form 2 (USEPA, 2001a):

H_0 : The mean of the compound concentration in the Test Reach data set is greater than the mean of the Reference Reach data set by S ($\Delta > S$) where, $S = 1s$ of the Reference Reach data set ($U_{\text{Test Reach}} \geq U_{\text{Reference Reach}} + S$).

H_A : The mean of the compound concentration in the Test Reach data set does not exceed the mean of the Reference Reach data set by S ($\Delta \leq S$) ($U_{\text{Test Reach}} < U_{\text{Reference Reach}} + S$).

If the null hypothesis H_0 is rejected, it can be concluded with statistical significance that the mean of the Test Reach surficial sediment data set is not significantly greater than the mean of the Reference Reach surficial sediment data set, or that, in general, concentrations downstream are not significantly greater than relative upstream concentrations. If the null hypothesis is not rejected, it was assumed that the mean from the Test Reach surficial sediment data set may be greater than the mean of the Reference Reach surficial sediment data set, although this is not a statistically significant conclusion. This hypothesis was tested at the 0.10 level of significance ($\alpha = 0.10$).

2.3 Evaluation of Power

Power represents the ability of the test to reject the null hypothesis; specifically, are there enough samples to make it theoretically possible to reject the null hypothesis? Because of the structure of the null hypothesis (USEPA Test Form 2), insufficient power may result in a Type II error, the incorrect acceptance of the null hypothesis, that the Test Reach data are greater than the Reference Reach data.

For the parametric t-tests, the power of each comparison was calculated. These results can be used to aid the interpretation of statistical results, and may be useful to identify data gaps. Power was not calculated for non-parametric WRS tests, or if the t-test null hypothesis was rejected.

Table 2-1
Distribution of Data Sets
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Constituent	Distributions				
	Upstream	All Adjacent	Upper Navigational Channel	Adjacent Nearshore	Adjacent Far Field
Antimony	Not normal	Not normal	Lognormal	Not normal	Not normal
Arsenic	Lognormal	Lognormal	Lognormal	Not normal	Not normal
Cadmium	Not normal	Not normal	Not normal	Not normal	Not normal
Chromium	Lognormal	Not normal	Not normal	Not normal	Normal and Lognormal
Copper	Lognormal	Lognormal	Lognormal	Not normal	Normal and Lognormal
Iron	Normal and Lognormal	Lognormal	Normal and Lognormal	Not normal	Not normal
Lead	Not normal	Not normal	Not normal	Not normal	Not normal
Manganese	Lognormal	Lognormal	Normal and Lognormal	Lognormal	Normal and Lognormal
Mercury	Lognormal	Not normal	Lognormal	Not normal	Not normal
Nickel	Normal and Lognormal	Not normal	Normal and Lognormal	Not normal	Lognormal
Silver	Lognormal	Not normal	Normal and Lognormal	Lognormal	Not normal
Zinc	Normal and Lognormal	Lognormal	Normal and Lognormal	Not normal	Normal and Lognormal

Table 2-2
Selection of Test Type and S Based on Data Distribution
BASF Corporation
Hudson River OU-2 Investigation
Rensselaer, New York

Distribution of Data		Statistical Test	S
Upstream or Far Field	Adjacent or Near Shore		
Normal	Normal	Student's t-test for equal or unequal variance, as appropriate, on untransformed data	s
Log-normal	Log-normal	Student's t-test for equal or unequal variance, as appropriate, on log-transformed data and Wilcoxon Rank Sum test on untransformed data	[a]
Normal	Log-normal or not normal	Wilcoxon Rank Sum test on untransformed data	s
Log-normal	Normal or not normal	Wilcoxon Rank Sum test on untransformed data	[a]
Not normal	Any	Wilcoxon Rank Sum test on untransformed data	[a]

S = Significant difference

s = one standard deviation of upstream data set

[a] Difference between 84.13th percentile and the median (50th percentile). Equivalent to one standard deviation above the mean in a normally distributed data set.

3.0 Results of Statistical Analyses

The statistical software Stata 8.2 was used to perform the statistical calculations. Raw results from the Stata 8.2 program are presented in Attachment 1.

3.1 Upstream vs. Adjacent

In the Upstream vs. Adjacent evaluation, parametric tests were run using log-transformed data for five of the twelve inorganic compounds evaluated. Non-parametric tests were run for eleven compounds, including the five lognormally distributed compounds. As described above, no statistical evaluation was conducted for cadmium due to low frequency of detection in the data sets. The step-by-step summary of the statistical results is presented in Table 3-1.

The null hypothesis was rejected for two parametric t-tests (iron and manganese) and four non-parametric WRS tests (antimony, lead, nickel and silver), indicating that concentrations of these compounds are consistent between the Upstream and Adjacent data sets. For the log-normal t-tests, the WRS test was also conducted, and supported the results of the t-tests (i.e., the WRS rejected the null hypothesis where the t-test also rejected, but did not reject when the t-test did not). For the remaining compounds (arsenic, chromium, copper, mercury and zinc) the null hypothesis was not rejected, indicating either the Adjacent data set is greater than the Upstream data set, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power for the tests when the null hypothesis was not rejected ranged from 23% to 41%, so power is likely to be insufficient for these compounds. A Type II error (not rejecting the null hypothesis when, in fact, the data sets are comparable) may, therefore, have occurred. Additional data provided by more sampling may provide adequate data to increase power in the test, reducing the possibility of a Type II error.

3.2 Upstream vs. Adjacent Nearshore

In the Upstream vs. Adjacent Nearshore evaluation, parametric tests were run using log-transformed data for manganese and silver. Non-parametric tests were run for eleven compounds, including the two lognormally distributed compounds. The step-by-step summary of the statistical results is presented in Table 3-2.

The null hypothesis was rejected for the t-test with manganese, indicating the concentrations of manganese are consistent between Upstream and Adjacent Nearshore data sets. The null hypothesis was not rejected for the t-tests with silver, indicating that the two data sets are not consistent. The results of the non-parametric WRS tests supported the results from the parametric tests for silver (null hypothesis not rejected), but were not the same for manganese. Since parametric tests have more power in general than non-parametric tests, the results of the t-test were used as the primary result. Examination of power calculations, where available (t-tests), indicates power for the test with silver was 22%. Power was inadequate to detect a difference in the silver t-test.

For the nine remaining compounds tested using the WRS, the null hypothesis was rejected for antimony, but not the other metals. This indicates that concentrations of antimony in the Upstream and Adjacent Nearshore data sets are comparable and that, for the remaining metals, either that the concentrations of metals in the Adjacent Nearshore data set are greater than the Upstream data set, or that the test did not have sufficient power to recognize a difference. Since power was not calculated for the non-parametric tests, the p-values calculated for each test were examined. The null hypothesis, as tested in Stata, for the WRS test is that the data sets are equal. The null was rejected at $\alpha=0.1$ for arsenic, chromium, and zinc. However, the z-value, which provides the direction of the results (i.e., is data set one greater than or less than the data set two?), indicates that the concentrations of the Adjacent Nearshore data set is likely greater than that in the Upstream for many of the metals.

3.3 Adjacent Far Field vs. Adjacent Nearshore

In the Adjacent Far Field vs. Adjacent Nearshore evaluation, a parametric test was run using log-transformed data for manganese. Non-parametric tests were run for ten compounds, including the lognormally distributed compound (manganese). The step-by-step summary of the statistical results is presented in Table 3-3.

The null hypothesis was rejected for the non-parametric WRS test with arsenic, indicating that the concentrations of arsenic are consistent between Adjacent Far Field and Adjacent Nearshore data sets. For the remaining compounds, the null hypothesis was not rejected, indicating either the Adjacent Nearshore data set is greater than the Adjacent Far Field data set, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (manganese t-test), indicates power for the manganese t-test, where the null hypothesis was not rejected, was 99%, so power is likely adequate to detect a difference.

For the log-transformed parametric t-tests, the WRS test was also run. The null hypothesis was not rejected for manganese, tested using log-transformed t-tests. The results of the corresponding WRS tests also resulted in the null hypothesis not being rejected.

Examination of the p-values and z-values of the WRS tests indicate that, with the exception of antimony, Adjacent Nearshore concentrations are greater than the Adjacent Far Field concentrations ($p < 0.1$ but $z < 0$).

3.4 Upstream vs. Adjacent Far Field

In the Upstream vs. Adjacent Far Field evaluation, parametric tests were run using untransformed data for silver and for log-transformed data for chromium, copper, manganese and nickel. Non-parametric tests were run for ten compounds, including the four lognormally distributed compounds. The step-by-step summary of the statistical results is presented in Table 3-4.

The null hypothesis was rejected for the all parametric and non-parametric tests, indicating that the concentrations of all metals tested are consistent between Upstream and Adjacent Far Field data sets.

3.5 Adjacent Nearshore vs. Upper Navigational Channel

In the Adjacent Nearshore vs. Upper Navigational Channel evaluation, parametric tests were run using log-transformed data for manganese and silver. Non-parametric tests were run for twelve compounds, including the two lognormally distributed compounds. The step-by-step summary of the statistical results is presented in Table 3-5.

The null hypothesis was rejected for one parametric t-test (silver) and eight non-parametric WRS tests (cadmium, chromium, copper, iron, lead, mercury, nickel and zinc), indicating that concentrations of these compounds are consistent between the Adjacent Nearshore and Upper Navigational Channel data sets. For the log-normal t-tests, the WRS test was also conducted, and supported the results of the t-tests (i.e., the WRS rejected the null hypothesis where the t-test also rejected, but did not reject when the t-test did not). For the remaining compounds (antimony, arsenic and manganese) the null hypothesis was not rejected, indicating either the Upper Navigational Channel data set is greater than the Adjacent Nearshore data set, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power for the manganese test, where the null hypothesis was not rejected, was 37%, so power is likely to be insufficient. A Type II error (not rejecting the null hypothesis when, in fact, the data sets are comparable) may, therefore, have occurred. Additional data provided by more sampling may provide adequate data to increase power in the test, reducing the possibility of a Type II error.

3.6 Upstream vs. Upper Navigational Channel

In the Upstream vs. Upper Navigational Channel evaluation, parametric tests were run using log-transformed data for five of the twelve inorganic compounds evaluated, and using untransformed data for three of the twelve compounds. Non-parametric tests were run for nine compounds, including the five lognormally distributed compounds. As described above, no statistical evaluation was conducted for cadmium due to low frequency of detection in the data sets. The step-by-step summary of the statistical results is presented in Table 3-6.

The null hypothesis was rejected for two of the parametric t-tests (iron and manganese) and one non-parametric WRS test (antimony), indicating that concentrations of these compounds are consistent between the Upstream and Upper Navigational Channel data sets. For the log-normal t-tests, the WRS test was also conducted, and supported the results of the t-tests (i.e., the WRS rejected the null hypothesis where the t-test also rejected, but did not reject when the t-test did not). For the remaining compounds (arsenic, chromium, copper, lead, mercury, nickel, silver and zinc) the null hypothesis was not rejected, indicating either the Upper Navigational Channel data set is greater than the Upstream data set, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power for the tests when the null hypothesis was not rejected ranged from 11% to 99%, so power is likely to be insufficient for some of these compounds (nickel power = 20%, arsenic power = 11%, copper power = 71% and silver power = 17%). A Type II error (not rejecting the null hypothesis when, in fact, the data sets are comparable) may, therefore, have occurred. Additional data provided by more sampling may provide adequate data to increase power in the test, reducing the possibility of a Type II error. Power was adequate to detect a difference for mercury (99%).

3.7 Adjacent Far Field vs. Upper Navigational Channel

In the Adjacent Far Field vs. Upper Navigational Channel evaluation, parametric tests were run using untransformed data for two of the twelve inorganic compounds and using log-transformed data for two of the twelve inorganic compounds evaluated. Non-parametric tests were run for eight compounds, including the two lognormally distributed compounds. As described above, no statistical evaluation was conducted for cadmium or lead due to low frequency of detection in the data sets. The step-by-step summary of the statistical results is presented in Table 3-7.

The null hypothesis was rejected for arsenic using a non-parametric WRS test, indicating that concentrations of arsenic are consistent between the Adjacent Far Field and Upper Navigational Channel data sets. For the log-normal t-tests, the WRS test was also conducted, and supported the results of the t-tests (i.e., the WRS did not reject the null hypothesis where the t-test not rejected). For the remaining compounds (antimony, chromium, copper, iron, manganese, mercury, nickel, silver and zinc) the null hypothesis was not rejected, indicating either the Upper Navigational Channel data set is greater than the Adjacent Far Field data set, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power for the tests when the null hypothesis was not rejected ranged from 34% to 100%, so power is likely to be insufficient for some these compounds (manganese power = 34%). A Type II error (not rejecting the null hypothesis when, in fact, the data sets are comparable) may, therefore, have occurred. Additional data provided by more sampling may provide adequate data to increase power in the test, reducing the possibility of a Type II error. Power was adequate to detect a difference for copper (100%), nickel (100%) and zinc (100%).

Table 3-2
Results of Statistical Analysis - Upstream vs. Adjacent Watersheds
BASF Corporation
Hudson River OUE Investigation
Patterson, New York

Chemical	Frequency of Detection		Contributions ¹⁾		Tests to Run		Parametric Tests: Normal Distribution		Parametric Tests: Log-Normal Distribution		Non-parametric Tests		Results	Are Site Data consistent with Upstream Data?	
	Adjacent Neighboring	Upstream	Adjacent Neighboring	Upstream	Parametric test: Lognormal data	Non-parametric Wilcoxon rank sum test	homogeneity of variance F-test	test p-value (p, 1)	power	homogeneity of variance F-test	test p-value (p, 1)	power			p-value
Antimony	100%	71%	--	--	04.15% sigma	Yes							0.0082	2.950	Reject Ho
Arsenic	100%	100%	--	--	LN sigma	Yes							0.0010	-9.289	Do not reject Ho
Cadmium	58%	18%	--	--	NA	Yes							0.6356	-0.474	NA
Chromium	100%	100%	--	--	07% sigma	Yes							0.0482	-1.876	Do not reject Ho
Copper	100%	100%	--	--	LN sigma	Yes							0.0039	-2.761	Do not reject Ho
Lead	100%	100%	--	--	04.15% sigma	Yes							0.2871	1.115	Do not reject Ho
Lead	100%	00%	--	--	04.15% sigma	Yes							0.6357	-0.474	Do not reject Ho
Manganese	100%	100%	LN	LN	LN sigma	Yes				0.0290	unequal	0.5590	0.3181	1.245	Reject Ho
Mercury	100%	58%	--	--	LN sigma	Yes							0.0006	-2.627	Do not reject Ho
Nickel	100%	100%	--	--	LN sigma	Yes							0.6281	-0.487	Do not reject Ho
Silver	58%	25%	LN	LN	LN sigma	Yes				0.0001	unequal	0.8183	0.7056	-0.379	Do not reject Ho
Zinc	100%	100%	--	--	LN sigma	Yes							0.0085	-2.750	Do not reject Ho

S = One standard deviation
 H = 24,13% mean intra-uterine not neonatal scale

[illegible]

Table 9-3
Florida Oil Spill: Analysis - Adjusted For Field vs. Adjacent Neighbors
BASS Corporation
Pudon Place 0.12 Investigation
Flowerland, New York

[illegible]

8 = One standard deviation

LN is indicates normal size; b, den. LN indicates lymph node enlargement -- indicates a disturbance of normal LN. Hypothecus rejected 1 p.u. vs ≤ 10 for forest and roots. And hypothecus rejected 1 p.u. vs ≤ 10 and 2.00 vs 2.00 for Q1 for WBS. Items 1 p.u. vs ≤ 10 and 2.00 vs 2.00 are bolded.

Table 3-4
Results of Statistical Analysis - Upstream vs. Adjacent Far Field
JASF Corporation
Hudson River PCB Investigation
Barnsboro, New York

Chemical	Frequency at Detection		Distribution ^a	Tests to Run		Parametric Tests: Normal Distribution				Non-parametric Tests				Pass/Fail	Are Site Data consistent with Upstream Data?
	Adjacent Far Field	Upstream		Permissible Test	Non-parametric Wilcoxon rank sum test	Test for Homogeneity of variances	F-test	p-value	power	Test for Homogeneity of variances	t-test	p-value	power		
				Raw data	Log-Trans. data					Exact p-value					
Aluminum	67%	71%	LN		Yes									Reject H ₀	Yes
Arsenic	100%	100%	LN		Yes									Reject H ₀	Yes
Cadmium	0%	16%	LN		Yes									NA	NA
Chromium	100%	100%	LN	Yes	Yes									Reject H ₀	Yes
Copper	100%	100%	LN	Yes	Yes									Reject H ₀	Yes
Iron	100%	100%	N + LN		Yes									Reject H ₀	Yes
Lead	21%	65%	LN		Yes									NA	NA
Manganese	100%	100%	LN		Yes									Reject H ₀	Yes
Mercury	50%	50%	LN		Yes									Reject H ₀	Yes
Nickel	100%	100%	N + LN		Yes									Reject H ₀	Yes
Silver	50%	85%	LN		Yes									Reject H ₀	Yes
Zinc	100%	100%	N + LN	Yes	Yes									Reject H ₀	Yes

S = One standard deviation

S = 84.13% non-parametric not normal tests

(a) N indicates normal distribution, LN indicates log-normal distribution -- Ind. cases distribution not normal
Null hypothesis rejected if p-value < 0.10 for t-tests and Mann-Whitney U-test
Null hypothesis rejected if p-value < 0.10 for WTS tests
p-values that are significant (i.e., < 0.10) are bolded.
Z-scores that are significant (i.e., < 0.10) are bolded.

Table 8-5
Results of Statistical Analysis - Upper Newburgh Channel vs. Alluvium Material
BOF Corporation
Hudson River O&G Investigation
Rensselaer, New York

Chemical	Frequency of Detection		Distribution ^a	Tests to Run			Parametric Tests: Normal Distribution				Parametric Tests: Log-normal distribution				Non-parametric Tests		Results	Assess Data consistent with upstream Data?
	Adjacent Nearestshore	Upper Nearestshore		Parametric Test	Log-Trans. data	K-S parameteric With-out test stat test	Hypothesis of Validity		t-test positive (p-value)	power	homogeneity of variance	F-test p-value	blast p-value [p.]	power	p-value	z-score		
							F-test p-value	blast test p-value										
Antimony	100%	93%	LN		Yes										0.6201	0.227	Do not reject Ho	No
Barium	100%	100%	LN		Yes										0.3586	0.445	Do not reject Ho	No
Cadmium	90%	87%	LN		Yes										0.0300	0.901	Reject Ho	Yes
Chromium	100%	100%	LN		Yes										0.0000	0.445	Reject Ho	Yes
Copper	100%	100%	LN		Yes										0.0039	0.901	Reject Ho	Yes
Lead	100%	100%	N + LN		Yes										0.0888	1.819	Reject Ho	Yes
Manganese	100%	87%	N + LN		Yes										0.0000	0.424	Reject Ho	Yes
Mercury	100%	100%	LN	Yes	Yes										0.0001	-1.189	Do not reject Ho	No
Nickel	100%	100%	LN		Yes										0.0001	0.901	Reject Ho	Yes
Silver	58%	57%	N + LN	Yes	Yes										0.0258	2.223	Reject Ho	Yes
Zinc	100%	100%	N + LN	Yes	Yes										0.0001	0.857	Reject Ho	Yes
															0.0000	0.507	Reject Ho	Yes

SE = One standard deviation
 SS = 54.73% non-parametric tests

[a] N indicates normal distribution, LN indicates log-normal distribution, -- indicates degenerate distribution.

4.0 Uncertainties Associated with the Statistical Analysis

In general, the statistical analysis was conducted in order to reduce uncertainties in the evaluation of sediment quality in the industrialized Hudson River. However, there are specific uncertainties associated with the statistical analysis. None of the data sets assessed in the statistical evaluation were quantitatively examined for outliers. In general, the presence of outliers would tend to make two different groups of data look different, when they in fact might be more similar if the outlier(s) were to be omitted.

Where the Reference (Upstream, Adjacent Far Field, or Upper Navigational Channel) data were normally distributed, S was defined as one standard deviation, regardless of the test used to compare to other data sets. For all tests where the Reference (Upstream, Adjacent Far Field, or Upper Navigational Channel) data were not normally distributed, a non-parametric test was used and a non-parametric S was calculated. The value selected for S (the difference between the median and the 84.13th percentile of the data) is equivalent to one standard deviation above the mean in a normally distributed data set. Further, s was selected to represent S for ease of statistical implementation. One standard deviation may or may not have significance from a human health or ecological risk perspective. However, this value was previously used in a CERCLA riverine risk assessment that was subject to regional and national USEPA review and approval (Charles River Baseline Ecological Risk Assessment; ENSR, 2005b), and it was therefore deemed appropriate for the Hudson River analysis.

None of the inorganic chemistry data were normalized to grain size, organic carbon, or other site-specific conditions that may influence the concentration of metals in sediment. It is widely recognized that the distribution of compounds in sediment may be biased due to factors such as the local depositional environment. For example, deposition takes place in areas where the velocity of water flow is slow. During deposition, fine-grained materials are deposited, and compounds that tend to be present in or adsorbed to these fine-grained materials would be deposited in higher concentrations. Certain organic compounds, in particular, tend to adsorb to organic carbon present in the system. Compared to sand and gravel, fine-grained materials are naturally higher in metals concentrations. Therefore, concentrations of a number of compounds may be biased high in depositional areas due to adsorption and other chemical and physical properties completely unrelated to the Site activities or other sources of potential contamination. Should additional statistical analyses be conducted as part of the OU-2 investigation, consideration should be given to normalizing metals data factors such as sediment grain size (e.g., percent fines), TOC, or other native metals (e.g., aluminum or iron).

5.0 Conclusions

The statistical evaluation resulted in the following findings:

- Upstream vs. Adjacent - Concentrations of five of the 11 evaluated inorganic compounds in the combined Adjacent sediments (cadmium not considered due to low FOD) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, mercury and zinc). These results are largely due to the contribution of the Adjacent Nearshore sediments in the combined data set.
- Upstream vs. Adjacent Nearshore - Concentrations of nine of the 11 evaluated inorganic compounds in the Adjacent Nearshore sediments (cadmium not considered due to low FOD) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, iron, lead, mercury, nickel, silver, and zinc). Therefore, the majority of the evaluated Adjacent Nearshore inorganic compounds are inconsistent with Upstream reference conditions.
- Adjacent Far Field vs. Adjacent Nearshore - Concentrations of nine of the 10 evaluated inorganic compounds in Adjacent Nearshore sediments (cadmium and lead not considered due to low FOD) are inconsistent with the concentrations in the Adjacent Far Field data set (i.e., antimony, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). Since more elevated concentrations are observed within the Adjacent Nearshore samples, this suggests that the Adjacent Nearshore muddy sands are inconsistent with, and more impacted than, the Adjacent Far Field coarse-grained materials.
- Upstream vs. Adjacent Far Field - Concentrations of all 10 evaluated inorganic compounds in the Adjacent Far Field sediments (cadmium and lead not considered due to low FOD) are consistent with the concentrations in the Upstream data set (i.e., antimony, arsenic, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). This indicates that the Adjacent Far Field inorganic compound concentrations are consistent with Upstream reference conditions.
- Upper Navigational Channel vs. Adjacent Nearshore - Concentrations of nine of the 12 evaluated inorganic compounds in the Adjacent Nearshore sediments are consistent with the concentrations in the Upper Navigational Channel data set (i.e., cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc). This indicates that concentrations of the majority of the evaluated inorganic compounds in the Adjacent Nearshore samples are consistent with the Upper Navigational Channel samples.
- Upstream vs. Upper Navigational Channel - Concentrations of eight of the 11 evaluated inorganic compounds in Upper Navigational Channel sediments (cadmium not considered due to low FOD) are inconsistent with the concentrations in the Upstream data set (i.e., arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc). Since more elevated concentrations are observed within the Upper Navigational Channel samples, this suggests that the Upper Navigational Channel samples area inconsistent with, and more impacted than, the Upstream sediment.
- Adjacent Far Field vs. Upper Navigational Channel - Concentrations of nine of the 10 evaluated inorganic compounds in Adjacent Far Field sediments (cadmium and lead not considered due to low FOD) are inconsistent with the concentrations in the Upper Navigational Channel data set (i.e., antimony, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc). Since more elevated inorganic concentrations are observed within the Upper Navigational Channel samples, this suggests that the Upper Navigational Channel samples area inconsistent with, and more impacted than, the Adjacent Far Field samples.

These results indicate that the metals impacted sediments under consideration in this evaluation are generally located near the Site, in the Adjacent Nearshore muddy sand sediments and in the Upper Navigational Channel. It is important to recognize that the statistical analysis is not intended to assign attribution or define

sources. Given the dynamics in the river, with coarse-grained material located upstream of the Site, and fine muddy sediments located in the nearshore environment, it is possible that the fine-grained sediments in this reach of the river are impacted by the Site; alternatively, it is possible that at least some of the inorganic compounds observed in this nearshore depositional environment are attributable to sources other than the Site.

6.0 Literature Cited

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Attachment 1

Statistical Analysis Documentation

(provided on CD)

Appendix H

Analysis of Potential Risks to Human Health

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

Contents

1.0 Introduction	1-1
2.0 Potential Exposure Pathways Evaluated in the Human Health Risk Assessment	2-1
2.1.1 Potential Exposure Pathways for Sediment	2-1
2.1.2 Potential Exposure Pathways for Surface Water	2-1
2.2 Human Health Screening Values	2-2
3.0 Screening Results	3-1
3.1 Sediment	3-1
3.1.1 Surficial Sediment	3-1
3.1.2 Sub-Surficial Sediments	3-1
3.2 Surface Water	3-1
4.0 Discussion	4-1
5.0 Literature Cited	5-1

List of Tables

Table 3-1 Human Health Based Screening of VOCs in Surficial Sediment Against NYSDEC Bioaccumulation Sediment Criteria

Table 3-2 Human Health Based Screening of VOCs in Sub-Surficial Sediment Against NYSDEC Bioaccumulation Sediment Criteria

Table 3-3 Human Health Based Surface Water Screening

1.0 Introduction

As part of the Site Investigation Report (Report), a screening level analysis was conducted to evaluate the potential for risk of harm to human health due to exposure to sediment or surface water adjacent to the Site. This screening level analysis goes beyond the qualitative assessment described in NYSDEC site investigation guidance (NYSDEC, 2002) by including a quantitative assessment of the data (i.e., comparison to risk-based screening criteria) as well as evaluation of current and future potential exposure pathways.

As described below, the results of this screening level analysis indicate that there is no potential current risk to human health associated with exposure to sediment or surface water adjacent to the Site.

2.0 Potential Exposure Pathways Evaluated in the Human Health Risk Assessment

Section 2 of the Report presented a description of the environmental setting and site characteristics, which are critical for understanding the potential for human exposure to sediment and surface water at the Site. The Site is situated on the east bank of the Hudson River and is surrounded by industrial properties and roadways. Access to the river from the Site is limited because the shoreline is dominated by a bulkhead made of metal sheeting, and the Site is surrounded by a locked chain link fence. There is an approximately five to ten ft drop between the on-Site ground surface and the surface of the water in the river, depending on the tidal stage. Adjacent to the Site, the water is approximately six to ten ft deep (depending upon tidal fluctuation), with a water depth of 20 to 40 ft in the middle of the river channel.

Flows in the Hudson River are generally dominated by tidal influence, with a four- to five-foot tidal range at the Site. The reach of the Hudson River adjacent to the Site is within the upper limits of the ship channel that is dredged for commercial navigation purposes. A turning basin is located at the Port of Albany, located approximately 1,200 ft from the southern property boundary. The turning basin is dredged on a five to seven year cycle.

The river has been divided into several reaches for the field investigation: Upstream, Adjacent Nearshore, Adjacent Far Field, Upper Navigational Channel, and Downstream. Data from these reaches are considered in the human health risk analysis.

As described in NYSDEC guidance (2002), an exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. A complete exposure pathway has five elements: (1) a contaminant source; (2) contaminant release and transport mechanisms; (3) a point of exposure; (4) a route of exposure; and (5) a receptor population. An exposure pathway may be eliminated from further evaluation when any one of the five elements comprising an exposure pathway has not existed in the past, does not exist in the present, and will never exist in the future.

2.1.1 Potential Exposure Pathways for Sediment

Sediments adjacent to the Site are submerged beneath at least five or more feet of tidally influenced water. Boring logs from the December 2005 and May 2006 sampling events showed five to nine ft of overlying water for samples collected closest to the shoreline, and the visual observations from the field program indicated that significant rubble (e.g., old pilings) is present in the immediate vicinity of the Site. Therefore, the potential for human exposure to sediments is minimal. Direct contact with the sediment was assumed to be an incomplete exposure pathway due to the depth of the water and the inaccessibility of the sediments. Inhalation of VOCs in sediment is also expected to be negligible due to the presence of the overlying water column. Nevertheless, the human health risk assessment (HHRA) conservatively evaluated potential exposure to sediment adjacent to the Site as a result of consumption of fish exposed to sediments.

2.1.2 Potential Exposure Pathways for Surface Water

Given the fast-moving water and use of the river for commercial ship traffic, recreational swimming is unlikely to occur within this reach of the Hudson River. However, the river is used for boating and fishing and exposure to surface water adjacent to the Site could occur during these activities. Therefore, the HHRA conservatively evaluated potential exposure to surface water, including incidental ingestion and dermal contact with surface water. Inhalation of volatile organic compound (VOCs) in surface water is expected to be negligible due to dispersion and dilution of any VOCs that may volatilize from the water column into ambient air. The evaluation of the surface water pathway also included a comparison to surface water quality criteria derived to be protective of potential fish consumption.

2.2 Human Health Screening Values

The data considered in this preliminary analysis includes surface water, surficial sediment, and core sediment samples collected during the December 2005 and May 2006 field efforts. The compounds of interest for the human health assessment included detected inorganic compounds and VOCs. Compounds were evaluated by comparing results on a sample-by-sample basis to selected human health screening values. Calcium, magnesium, and potassium are considered to be essential nutrients and were not considered in the screening.

For sediments, data were compared against NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) normalized to organic carbon content. The NYSDEC sediment criteria have been derived for a limited suite of organics (52 non-polar organic compounds) using an equilibrium partitioning (EqP) methodology (NYSDEC, 1999). The derivation procedure is the same as that recommended by USEPA, except that New York State water quality standards and guidance values are used instead of USEPA ambient water quality criteria (except in the absence of state water quality criteria). The New York State water quality criteria are from the Department of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (NYSDEC, 1998). Since the water quality criteria are based on potential bioaccumulation into fish, the NYSDEC sediment criteria are by default protective of potential fish consumption. It should be noted that there are limitations to the EqP methodology and its application in derivation of sediment criteria. The EqP methodology is uncertain and variable depending on factors including the value of the K_{ow} used, the organic content of the sediment sample, whether the sediment and pore water are at an equilibrium (which may not be the case for sites that are dredged). For compounds with a K_{ow} less than 100 ($\log_{10}K_{ow} \leq 2$), the methodology may underestimate acceptable sediment concentrations (NYSDEC, 1999). Thus, the NYSDEC sediment criteria for human health bioaccumulation should be used with awareness of their inherent uncertainties and conservatism. The NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) are limited to organic compounds and do not include criteria for metals. Therefore, the metals data are not evaluated in the risk screening due to a lack of applicable criteria.

Analytical results for VOCs were organic carbon-normalized using sample-specific total organic carbon (TOC) data. When TOC data were not available for a particular horizon, TOC data from a different depth interval of the same sample were used to normalize the VOC data. Several samples with VOC data (SD087, SD090, SD093, SD096, and SD098) did not have TOC data for any depth interval so the TOC was conservatively assumed to be 1% in these samples in order to allow a comparison against NYSDEC screening values.

The hierarchy of surface water screening values included NYSDEC water quality standards (NYSDEC, 1998), federal ambient water quality criteria for consumption of water and organisms (AWQC; USEPA, 2006), and the lower of the Maximum Contaminant Level (MCL; USEPA, 2003a) and the Region 9 PRG for tapwater (USEPA, 2004). It is recognized that the comparison to drinking water-based human health screening values is conservative for the Class C Hudson River.

3.0 Screening Results

The following sub-sections present the results of the human health screening on a medium-by-medium basis.

3.1 Sediment

3.1.1 Surficial Sediment

As shown in Table 3-1, organic carbon normalized NYSDEC Human Health Bioaccumulation Criteria are available for four of the detected VOCs in surficial sediment (benzene, 1,2-dichloroethane, tetrachloroethene, and trichloroethylene). The NYSDEC bioaccumulation criteria were not exceeded in the two upstream surficial samples but each was exceeded at least once within the Adjacent Nearshore area. However, only benzene was detected within the surficial sediments and the other exceedances represent non-detects. Organic carbon normalized concentrations of benzene in 11 of the 34 Adjacent Nearshore area surficial sediment samples exceed the NYSDEC criterion for benzene. However, the benzene sediment criterion of $0.6 \mu\text{g/g OC}$ is likely to be conservative. As previously noted, the EqP methodology likely underestimates acceptable sediment concentrations for organic compounds with $\log_{10}K_{ow} \leq 2$. Further, available information indicates that nonaqueous exposure (e.g., bioaccumulation in fish) is not likely to be important for compounds with low hydrophobicity ($\log_{10}K_{ow}$ values less than 4) (USEPA, 2003b). Since the $\log_{10}K_{ow}$ for benzene is approximately 2 (NYSDEC, 1999), the sediment criterion for benzene is likely overly conservative, and it is unlikely that fish bioaccumulation pathways are significant. As discussed below, the exceedance of the NYSDEC benzene sediment criterion should also be considered in the context of surface water data for benzene.

3.1.2 Sub-Surficial Sediments

Exposure pathways to sub-surficial sediment are currently incomplete at this Site. However, given the dynamic nature of the Hudson River sediment environment, it is conceivable that these sub-surficial sediments may become exposed under future foreseeable conditions. Therefore, the sub-surficial sediments were also compared to the human health screening values to help place these data in context.

As shown in Table 3-2, the available NYSDEC criteria for VOCs were exceeded within the sub-surficial sediments down to the 8 to 10 ft strata. All four of the available NYSDEC Human Health Bioaccumulation Criteria were exceeded in the sub-surficial samples collected in the Adjacent Nearshore area. A review of the detected concentrations indicates that the majority of the NYSDEC sediment criteria exceedances in the sub-surficial sediments are for benzene with 40 of the 52 sub-surficial samples exceeding the NYSDEC criteria. The most elevated benzene levels were detected in the 2 – 4 ft horizon. As described above for benzene, the $\log_{10}K_{ow}$ values are well below 4 for 1,2-dichloroethane, tetrachloroethene, and trichloroethylene, indicating that bioaccumulation in fish is not likely to be important. Therefore, this sediment screening is likely to be conservative, particularly for sub-surficial sediments to which exposure is limited.

These results indicate that most of the VOC exceedances are clustered in the vicinity of the middle outfall. In many cases, the most contaminated samples are covered with cleaner material, and the distribution of contaminants is relatively heterogeneous both vertically and horizontally (clean samples located close to contaminated samples within the same station or nearby).

3.2 Surface Water

Surface water samples were collected within the Upstream and Adjacent reaches of the river. The results of the human health based screening of inorganics and VOCs are presented in Table 3-3. Table 3-3 presents the comparison of total recoverable and dissolved (field filtered) phase inorganics data against state and federal water quality standards for the protection of human health. With the exception of mercury, all of the screening levels include ingestion of surface water as a drinking water source in the derivation of the standard. It is

recognized that this may be overly conservative since the Hudson River in the vicinity of the Site is not used as a public water supply. The mercury screening level is based on the ingestion of fish tissue. Concentrations of iron, manganese, and mercury exceeded the associated screening levels in both Upstream and Adjacent sampling locations. The Upstream locations (SW-01 and SW-02) had exceedances for all three of these compounds and had the highest concentration of iron in the surface water. Filtered samples within the Adjacent Nearshore had fewer exceedances of the iron and manganese screening levels indicating that a significant fraction of the metals may be present within the solids found in the water. All samples exceeded the fish consumption based mercury screening value; however, mercury concentrations in all samples are below the NYSDEC water supply-based surface water screening level of $0.7 \mu\text{g/L}$ (NYSDEC, 1998). As presented in Table 3-3, although insufficient data are available for a robust statistical analysis, it is apparent that concentrations of inorganic compounds in surface water adjacent to the Site are generally consistent with upstream surface water concentrations.

Only two VOCs, acetone and toluene, were detected in the surface water (Table 3-3). Upstream and Adjacent Nearshore concentrations of these possible laboratory contaminants were generally similar and were all below the NYSDEC public water supply standards. Benzene was not detected in any surface water samples at a detection limit of $1 \mu\text{g/L}$, which is below the NYSDEC human health water quality criterion of $6 \mu\text{g/L}$ used in the derivation of the sediment criterion (NYSDEC, 1999). Because benzene was not detected in the surface water, there is some uncertainty as to whether levels of benzene in sediment are likely to bioaccumulate into fish.

Table 2-8
Human Health Based Screening of VOCs in Sub-Surface Sediment Against NYSDOT Bioaccumulation Sediment Criteria

[illegible]

Human Health Sediment Screening Values Source:
 NYSDEC. 1989. Technical Guidance for Screening Contaminated Sediments. Division of Fish, Wildlife and Marine Resources.

14000
14028

ND, ES, NC = No Criteria

U = Non-delet at: atoralary detection limit

```
order, payload = r
```

Only compounds 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 84

22 at end of sample 10 indicates duplicate sample

Shaded cell indicates average human health

Non-defects with detection limits equal to or greater than any standard.

Mallicized level indicates depth-specific TCC data was not available so TCC from a different

When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

Figure 1. The effect of the number of nodes (n) on the performance of the proposed algorithm. The figure shows two plots: (a) Success probability vs. n and (b) Average number of iterations vs. n . Both plots show a decreasing trend as n increases from 10 to 100. Plot (a) has a y-axis ranging from 0.8 to 1.0, while plot (b) has a y-axis ranging from 0 to 100. In both cases, the values are higher for $\alpha = 0.9$ than for $\alpha = 0.7$.

Table S-3
Human Health Based Surface Water Screening
BASF Corporation
Hudson River OU-2 Investigation
Raniselaar, New York

Analysis	ADJACENT NEARSHORE SW04 11/30/2005 01SW04ATF	ADJACENT NEARSHORE SW05 11/30/2005 01SW05ATF	ADJACENT NEARSHORE SW06 11/30/2005 01SW06ATF	ADJACENT NEARSHORE SW07 11/30/2005 01SW07ATF	ADJACENT NEARSHORE SW07 11/30/2005 01SW07ATF
Inorganics (ug/L)					
ALUMINUM	765	47.5	11400	36.2	752
ARSENIC	0.424	0.269	2	0.245	0.359
BARIUM	30.2	17.3	114	17.8	24.4
BERYLLIUM	0.115 U	0.115 U	0.312	0.115 U	0.115 U
CADMIUM	0.08 U	0.05 U	0.169 J	0.05 U	0.05 U
CALCIUM METAL	18700	16900	22500	20300	20100
CHROMIUM, TOTAL	1.7 U	1.7 U	10.4	1.7 U	1.7 U
COBALT	0.323	0.108	3.3	0.146	0.303
COPPER	1.8	1.1	3.2	1.1	2.1
IRON, TOTAL	765	90.3	11600	126	577
LEAD	0.499	0.144	6.1	0.13	0.431
MAGNESIUM	4040	3410	6950	4070	4180
MANGANESE	60	25.5	287	24.8	32.3
MERCURY	0.00228 J	0.00211 J	0.00607 J	0.00259 J	0.00249 J
NICKEL	7.6	6.9 U	15.9	6.9 U	6.9 J
POTASSIUM	1590 J	1010 J	4540	1240 J	1470 J
SELENIUM	1.6 U	1.6 U	1.8	1.6 U	1.6 U
SILVER	0.027 U	0.027 U	0.052	0.027 U	0.027 U
SODIUM	12500	10100	13300	12300	12400
THALLIUM	0.08 U	0.08 U	0.093	0.06 U	0.06 U
VANADIUM	1.5	R	11.8	R	1.3
ZINC	23.4	9.7	33.9	6.9 U	35.1
VOCs					
ACETONE	NS	1.9 J	NS	NS	NS
TOLUENE	NS	0.23 J	1.0 U	NS	NS

J = Estimated Value
NS = Not Sampled
R = Analytical Value was Rejected
U = Not Detected
EN = Essential Nutrient

Human Health Surface Water Screening Value Sources (in order of preference):
1 - NYSDDEC ambient water quality standard (value for public water supply unless otherwise noted)(NYSDDEC, 1998)
2 - Federal ambient water quality criteria (value for water + organism)(USEPA, 2002)
3 - USEPA Region 9 Toxwater PRG (USEPA, 2004)
4 - Fish consumption based value which applies to dissolved phase
Results are Total Recoverable phase unless otherwise noted
Dissolved phase results are indicated by F in sample ID (sample was filtered in the field)
2 at end of sample ID indicates duplicate sample
Shaded cells indicate detected value exceeds screening value.

4.0 Discussion

A screening level analysis was conducted to evaluate the potential for risk of harm to human health due to exposure to sediment or surface water adjacent to the Site. This assessment goes beyond the qualitative assessment described in NYSDEC site investigation guidance (NYSDEC, 2002) by including a quantitative assessment of the data.

The qualitative exposure assessment described in NYSDEC guidance (2002) is designed to identify areas of concern and compounds of concern, evaluate actual or potential exposure pathways, characterize the potentially exposed receptors, and identify how any unacceptable exposure pathways might be eliminated or mitigated. As described in Section 2, it was conservatively assumed that exposure pathways to surface water and sediment were potentially complete, primarily for recreational receptors that may swim, fish, or visit the river in the vicinity of the Site.

The results of this screening level analysis indicate that there is no potential current risk to human health associated with exposure to sediment or surface water adjacent to the Site.

Adjacent surface water concentrations of potentially Site-related compounds were generally similar to upstream concentrations. Further, no Site-related VOCs were detected in surface water, indicating that the Site is not adversely impacting surface water quality in the river.

The potential for human exposure to sediments adjacent to the Site is minimal given the limited access to the Site and the adjacent sediments. The Site itself is securely fenced and guarded making access to the river from the Site unlikely. In addition, access to river sediments is limited by the metal bulkhead along the shoreline of the Site and the five to ten ft drop from the top of the bulkhead to the water surface. Further, water adjacent to the Site is too deep for wading, and there is considerable submerged debris in the region; surficial sediments are under at least five ft of water. In short, direct contact with contaminated sediments is highly unlikely.

In the unlikely event that someone did contact surficial sediments adjacent to the Site, such limited exposure is not expected to pose an unacceptable risk to human health. While benzene in sediment exceeded its NYSDEC sediment criterion for bioaccumulation into fish, benzene was not detected in surface water at detection limits that achieve the NYSDEC water quality criterion set for protection of fish consumption. In addition, the remaining three VOCs with NYSDEC sediment criterion (1,2-dichloroethane, tetrachloroethene, and trichloroethylene) and sub-surficial sediment exceedances were also not detected in surface water. Given these results, the uncertainty in the EqP methodology used to derive the NYSDEC sediment criterion, and the likelihood that the method over-predicts for organics with low hydrophobicity such as benzene, there is some uncertainty as to whether levels of benzene or other VOCs present in sediment are likely to bioaccumulate into fish.

Since NYSDEC Human Health Bioaccumulation Sediment Criteria (NYSDEC, 1999) are limited to organic compounds and do not include criteria for metals, there is also some uncertainty related to potential risks due to bioaccumulation of inorganic compounds into fish.

If conditions change in the future and sub-surficial sediments (which are characterized by higher levels of several compounds) become exposed, additional risk analysis may be required.

5.0 Literature Cited

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Appendix I
Screening Level Ecological Risk
Assessment

Site Investigation Report

Hudson River Operable Unit 2

BASF Rensselaer

Rensselaer, New York

Contents

1.0 Introduction	1-1
2.0 Problem Formulation	2-1
2.1 Definition of Risk Assessment Objectives	2-1
2.2 Ecological Characterization	2-1
2.3 Exposure Pathway Identification	2-1
2.4 Identification of Risk Characterization Endpoints.....	2-2
2.5 Ecological Conceptual Site Model.....	2-2
2.6 Data Evaluated in ERA	2-2
2.7 Selection of Screening Level Ecological Chemicals of Potential Concern	2-3
3.0 Risk Analysis	3-1
3.1 Benchmark Screening Results	3-1
3.1.1 Sediment Screening Results	3-1
3.1.2 Surface Water Screening Results	3-4
3.2 SEM and AVS Analysis.....	3-4
3.3 Benthic Macroinvertebrate Community	3-5
4.0 Risk Characterization.....	4-1
5.0 Literature Cited	5-1

List of Tables

- Table 3-1 NYSDEC Screening of Inorganic Compounds in Surficial Sediment
- Table 3-2 NYSDEC Screening of Organic Carbon-normalized VOCs in Surficial Sediment
- Table 3-3 NYSDEC Screening of Inorganic Compounds in Sub-Surficial Sediment
- Table 3-4 NYSDEC Screening of Organic Carbon-normalized VOCs in Sub-Surficial Sediment
- Table 3-5 NYSDEC Screening of Compounds in Surface Water
- Table 3-6 Summary of SEM and AVS Data Evaluation

List of Figures

- Figure 3-1 Benthic Macroinvertebrate Community Similarity Analysis

1.0 Introduction

As part of the Site Investigation Report (Report), a screening level analysis was conducted to evaluate potential risks to the environment due to exposure to sediment and surface water in the Hudson River adjacent to the Site. This screening level analysis identifies potential Site-related compounds in sediment and surface water which may pose a potential risk to ecological receptors. This section is not intended to serve as a comprehensive evaluation of potential risks to ecological receptors, but rather to help frame the need for and scope of any future evaluation of potential ecological risks. In addition to evaluating the concentrations of compounds in surface water and sediment relative to benchmark screening values, the screening level risk analysis also incorporates a direct measurement of the potential for biological impairment of the local benthic macroinvertebrate communities.

The results of the screening level ecological risk assessment (ERA) indicate that: (1) surface water is not a medium of concern at the Site, and (2) despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments (0 – 0.5 ft), there is no difference in the abundance or diversity of the macroinvertebrate community adjacent to the Site, relative to upstream locations.

This section is organized according into the three following major sections suggested by USEPA's Framework for Ecological Risk Assessment (USEPA, 1992):

- 1) **Problem Formulation:** In this step, the objectives of the ERA are defined, and a plan for characterizing and analyzing risks is determined. Available information regarding stressors and the specific site is integrated. Products generated through problem formulation include measurement and assessment endpoints and the conceptual site model (CSM).
- 2) **Risk Analysis:** Risk analysis is directed by the problem formulation. Data are evaluated to characterize potential ecological exposures and effects.
- 3) **Risk Characterization:** During risk characterization, exposure and stressor response profiles are integrated through risk estimation. Risk characterization also includes a summary of uncertainties, strengths, and weaknesses associated with risk assessment

These three components are semi-sequential. The risk assessment process is frequently iterative, and new information brought forth during the risk characterization phase, for instance, may lead to a review of the problem formulation phase, or additional data collection and analysis. This analysis also incorporates aspects of the qualitative site characterization recommended for site characterization in NYSDEC guidance (2002).

Results of the chemical analysis of sediment and surface water and the benthic macroinvertebrate community analysis are considered together to create a preliminary estimate of the potential for ecological risk in the Hudson River adjacent to the Site.

2.0 Problem Formulation

Problem formulation is the initial step of the ERA process and provides the basis for decisions regarding the scope and objectives of the ERA. Information is collected to develop a CSM in which the screening level chemicals of potential concern (SLCOPCs) and exposure pathways are identified. The problem formulation phase for the ERA includes:

- Definition of risk assessment objectives;
- Ecological characterization;
- Exposure pathway evaluation;
- Definition of data evaluated in the ERA;
- Identification of risk characterization endpoints;
- Development of the CSM; and
- Selection of SLCOPCs.

2.1 Definition of Risk Assessment Objectives

The primary objective of this assessment is to evaluate recently collected analytical chemistry data to determine whether or not there is potential current or future exposure by environmental receptors to chemical stressors in surface water and/or surficial sediment at OU-2.

2.2 Ecological Characterization

The Hudson River adjacent to the Site contains a variety of benthic and aquatic plants and animals that could be exposed to compounds in the sediment or surface water. Section 2 of the Report presents a description of the Site and the physical and biological characteristics of the Hudson River, which forms the western boundary of the Site.

2.3 Exposure Pathway Identification

Potentially complete exposure pathways for ecological receptors were identified through a review of historic Site information. Exposure pathways for several groups of ecological receptors were identified as potentially relevant. Each exposure pathway includes a potential source of SLCOPC, an environmental medium (surface water or sediment), and a potential exposure route. Incomplete routes of exposure were not evaluated in this study. This approach is used to focus the risk evaluation on exposure pathways that are considered to be potentially complete and for which there are adequate data pertaining to the receptors, exposure, and toxicity for completion of the risk analysis.

The screening level ERA focuses on impacts to lower trophic level receptors in the river and does not evaluate all potentially complete exposure pathways. Impacts to higher trophic level wildlife receptors may be evaluated if additional assessment is recommended at the conclusion of the screening level ERA. Based on this analysis, the following potentially complete ecological exposure pathways have been identified:

- Direct contact and ingestion of surface water by aquatic receptors (i.e., fish and invertebrates) exposed to surface water; and
- Direct contact with surficial sediment by benthic receptors (i.e., benthic macroinvertebrates).

Although benthic receptors are not currently exposed to the sub-surficial sediments, this exposure pathway has been conservatively included in the ERA in the event that future mixing events or remedial response actions expose these receptors to sub-surficial sediments.

2.4 Identification of Risk Characterization Endpoints

The ERA ecological measurement and assessment endpoints at the Site were designed to evaluate potential ecotoxicological effects associated with exposure to identified SLCOPCs. According to the USEPA (1989), assessment endpoints are formal expressions of the actual environmental value to be protected. Measurement endpoints are the physical, chemical, or biological aspects of the ecological system that are measured to approximate or represent assessment endpoints. Measurement endpoints are often stressor-specific and are used to evaluate the assessment endpoint with respect to potential ecological risks. The assessment and measurement endpoints are listed below:

Assessment Endpoint 1 Sustainability of a benthic macroinvertebrate community in the Hudson River adjacent to the Site (OU-2) comparable to communities identified in the urbanized, upstream background reach of the Hudson River (i.e., the stress-tolerant oligochaete and chironomid communities identified in the macroinvertebrate survey).

Measurement Endpoint 1-1 Comparison of bulk sediment analytical chemistry results to sediment quality benchmarks. Concentrations in excess of sediment quality benchmarks will be considered indicative of a potential for ecological risks.

Measurement Endpoint 1-2 Preliminary indication of sediment metals bioavailability based on simultaneously extracted metals (SEM)/acid volatile sulfides (AVS) relationships. SEM/AVS ratios greater than one in a sediment sample will be considered an indicator of potential bioavailability for divalent cationic metals, although this is a conservative use of the AVS concept and there is some uncertainty in this methodology.

Measurement Endpoint 1-3 Reconnaissance-level field assessment of the benthic macroinvertebrate community. Various community composition, abundance, and diversity metrics will be used to evaluate the potential risks associated with exposure to sediment *in situ*.

Assessment Endpoint 2 Sustainability of a residential warmwater and anadromous fish community in the Hudson River adjacent to the Site (OU-2) comparable to communities in the urbanized, upstream background reach and/or downstream reach of the Hudson River.

Measurement Endpoint 2-1 Comparison of surface water analytical chemistry results to surface water quality benchmarks. Concentrations in excess of surface water quality benchmarks will be considered indicative of a potential for ecological risks.

2.5 Ecological Conceptual Site Model

The CSM for the Site (see Section 8 of the Report) is presented as a series of working hypotheses regarding how the SLCOPCs might pose hazards to the ecosystem and ecological receptors at the Site. The CSM helps describe the origin, fate, transport, exposure pathways, and receptors of concern at the Hudson River within the Study Area. The screening level ERA focuses on those pathways for which (1) chemical exposure are the highest and most likely to occur; and (2) there are adequate data pertaining to the receptors, exposure pathways, and ecotoxicity.

2.6 Data Evaluated in ERA

Evaluation of potential ecological risks was conducted through analysis of surface water and sediment quality data collected during the 2005 and 2006 field programs. The individual data and summary statistics were

discussed in Section 4 and Appendix B of the Report. The screening level ERA evaluated each location on a sample-by-sample basis with duplicate results averaged and ½ the detection limit used as the surrogate concentration for non-detects.

2.7 Selection of Screening Level Ecological Chemicals of Potential Concern

SLCOPCs represent the analytes detected in the environmental media that were considered in the ERA. Exposure to the SLCOPCs could present a potential risk for ecological receptors. To distinguish SLCOPCs from the master list of compounds in the data set, concentrations of each compound in each medium were compared to their respective risk-based benchmark. Compounds with concentrations less than their respective compound-specific low effect screening benchmark were not retained as SLCOPCs; compounds with concentrations in excess of the screening values were retained as SLCOPCs. If no screening value was available, the compound was selected as a SLCOPC.

3.0 Risk Analysis

The risk analysis phase of the ERA is based on the CSM developed in problem formulation. Risk analysis includes the characterization of potential ecological exposure and corresponding effects. The ecological exposure assessment involves the identification of potential exposure pathways and an evaluation of the magnitude of exposure of identified ecological receptors. The ecological effects assessment describes the potential adverse effects associated with the identified SLCOPCs to ecological receptors and reflects the type of assessment endpoints selected.

3.1 Benchmark Screening Results

Potential adverse ecological effects to benthic invertebrates and aquatic receptors were evaluated based on comparisons to literature-derived screening values. The presence of SLCOPCs in environmental media at concentrations which exceed benchmark screening values does not necessarily constitute ecological risk. For instance, certain SLCOPCs may not be bioavailable, may not be absorbed into an organism's system following ingestion, or may not be absorbed through direct contact due to the chemical form of the SLCOPCs.

To identify SLCOPCs in the sediment data set, concentrations of each compound were compared against their respective NYSDEC sediment quality risk-based benchmarks (NYSDEC, 1999). Surface water screening values were selected from the NYSDEC water quality standards (WQS) for the protection of aquatic life (NYSDEC, 1998). When appropriate, surface water screening criteria were adjusted to the average hardness value for the river. Both total recoverable and dissolved phase surface water data were evaluated for inorganic compounds.

3.1.1 Sediment Screening Results

As indicated in Section 4 of the main report, a total of 101 surficial sediment samples and 23 core (sub-surficial) samples were collected as part of the sediment field program. The comparison of these data against NYSDEC sediment quality benchmarks is presented in Tables 3-1 through 3-4. NYSDEC sediment screening values were available for 12 inorganic compounds and for ten VOCs.

Analytical results for VOCs were organic carbon-normalized using sample-specific total organic carbon (TOC) data. When TOC data were not available for a particular horizon, TOC data from a different depth interval of the same sample were used to normalize the VOC data. Several samples with VOC data (SD087, SD090, SD093, SD096, and SD098) did not have TOC data for any depth interval so the TOC was conservatively assumed to be 1% in these samples in order to allow a comparison against NYSDEC screening values.

3.1.1.1 Surficial Assessment

The surficial sediment samples collected from the top 0.5 ft were considered in the evaluation of potential risk to the benthic macroinvertebrate community. Table 3-1 presents the evaluation of inorganic compounds and Table 3-2 presents the VOC evaluation.

Inorganic Compounds

Within the Upstream surface sediment data set, the low effect screening value was exceeded for antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury nickel, and zinc. One severe effect screening value exceedance was observed for lead at SD028.

The Adjacent Far Field surface sediment data set included 19 surficial samples (plus duplicates) collected from the sand and gravelly sand area located to the west of the Site. The low effect screening value was exceeded for arsenic, copper, iron, lead, and mercury within the surficial data set. The arsenic and mercury severe effect

screening values were each exceeded in one location (SD039 and SD046 for arsenic and mercury, respectively).

The Adjacent Nearshore data set included 36 surficial samples (plus duplicates) collected from the muddy sand area located directly adjacent to and just downstream of the Site. Many of these samples were located in close proximity to the historic sewer outfalls. Within the surficial data set, low and severe effect screening value exceedances were noted at least once for the following compounds: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc. Low effect exceedances only were also observed for nickel.

The Upper Navigational Channel data set included 15 surficial samples (plus duplicates) collected immediately downstream of the Site, in a depositional environment that is co-located with what is understood to be the northern extreme of navigational dredging in this portion of the river. Low effect screening value exceedances were noted at least once for the following compounds: arsenic, iron, manganese, and nickel. Concentrations of the following compounds exceeded both low and severe effect screening values: cadmium, chromium, copper, lead, mercury, silver, and zinc.

Sample location SD063 is located within the muddy sand along the western shore of the Hudson River. This sample is located to the west of the Upper Navigational Channel and to the south of the Adjacent Far Field data set so it is being evaluated as a single location. Low effect screening value exceedances were observed for copper, iron, lead, nickel, and zinc.

The Downstream data set contains two surficial samples located downstream of the Site in the vicinity of the turning basin. Analytical results from the sample located in the muddy sand directly to the west of the turning basin (SD075) did not exceed any of the low or severe effect sediment benchmarks. However, the sample located in the muddy sand downstream of the turning basin (SD076) exceeded the low effect screening values for arsenic, cadmium, chromium, copper, iron, mercury, nickel, and zinc. Chromium and zinc also exceed the severe effect screening value.

VOCs

No exceedances of the organic carbon-normalized NYSDEC benthic aquatic life chronic sediment toxicity criteria were observed in the two Upstream surficial samples (SD011 and SD019) and VOCs were not detected in the single surficial sample in the Adjacent Far Field data set (SD079).

Within the Adjacent Nearshore data set, screening values for all of the VOCs with NYSDEC screening values were exceeded in at least some samples. These included the following compounds, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, ethylbenzene, toluene, and total xylenes. Chlorobenzene concentrations exceeded the NYSDEC screening value most frequently and generally had the highest magnitude of the exceedances. Many of the exceedances of the NYSDEC chlorobenzene screening value are clustered around the middle outfall location closest to the North Lagoon (an inactive production sewer). Concentrations of VOCs are generally much lower at the southerly outfall owned by the City of Rensselaer.

Surficial samples within the Upper Navigational Channel and the two Downstream sample locations near the turning basin (SD075 and SD076) were not analyzed for VOCs; however, VOCs were undetected in several sampling stations located between the southerly outfall and these Downstream stations, indicating that downstream impacts from VOCs are unlikely (i.e., the VOC impacted sediment is generally in the nearshore environment in the vicinity of the bulkhead).

3.1.1.2 Sub-Surficial Assessment

The sub-surficial sediment samples collected at least 2 ft below the sediment surface were also considered in the evaluation of potential risk to the benthic macroinvertebrate community. Benthic macroinvertebrates are not likely to be exposed to concentrations present in sub-surficial samples since this is below the depth of most

ecological receptor activities. It is therefore recognized that potential exposure pathways to sub-surficial sediment are currently incomplete; however, if conditions were to change and these sediments were to become exposed, developing an understanding of the compound levels relative to screening values is potentially relevant. These samples have conservatively been included in this assessment to help place these data into perspective relative to the NYSDEC sediment screening values. Table 3-3 presents the evaluation of inorganic compounds and Table 3-4 presents the VOC evaluation. As described previously, analytical results for VOCs were organic carbon-normalized to allow comparisons against NYSDEC screening values.

Inorganic Compounds

Sub-surficial samples were not collected from within the Upstream and Downstream Study Areas. The Adjacent Far Field data set included two core samples collected down to 4 ft within the sand and gravelly sand area located to the west of the Site. No detected concentrations within the Adjacent Far Field data set exceeded the NYSDEC screening values.

The Adjacent Nearshore data set included 20 core samples collected from the muddy sand area located directly adjacent to and just downstream of the Site. Many of these samples were located in close proximity to the three historic sewer outfalls. Only low effect screening value exceedances were noted for manganese. Both low and severe effect screening value exceedances were also observed for the following compounds: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc.

For many locations, concentrations in the deeper samples, generally the 2 to 4 ft and 4 to 6 ft strata, were higher than those observed in the surficial samples. In three of the four cores that penetrated to the 8 to 10 ft depth (SD108, SD112, and SD113), severe effect screening value exceedances were observed for many of the inorganic compounds at multiple depths. In many cases, the deeper samples had higher concentrations of many compounds than the 0 to 0.5 ft layer.

The Upper Navigational Channel data set included a single core (SD069) with samples collected at two depths. Low effect screening value exceedances were noted for arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Severe effect screening value exceedances were also noted for lead and mercury.

VOCs

Sub-surficial samples were not collected from within the Upstream and Downstream areas. A total of 23 core samples were analyzed for VOCs within the Adjacent Far Field, Adjacent Nearshore, and Upper Navigational Channel.

Two cores were collected within the Adjacent Far Field data set. Table 3-4 indicates that chlorobenzene exceeded the screening value in the 2 to 4 ft sample from SD041. The only detected concentration to exceed the NYSDEC screening value in the two Adjacent Far Field cores was chlorobenzene in SD041. These results indicate that the more coarse substrate located to the west of the Site (i.e., the Adjacent Far Field data set) is generally not impacted by Site-related VOCs.

Within the Adjacent Nearshore data set, screening values for all of the VOCs with NYSDEC screening values were exceeded in at least some samples. These included the following compounds, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, ethylbenzene, isopropylbenzene, toluene, and total xylenes. As was observed in the surficial data set, chlorobenzene concentrations exceeded the NYSDEC screening value most frequently and generally had the greatest magnitude of the exceedances. Many of the exceedances of the NYSDEC chlorobenzene screening value are clustered around the middle outfall location closest to the North Lagoon. Concentrations of VOCs are generally much lower at the southerly outfall which never served as a production sewer.

The Upper Navigational Channel data set included a single core (SD069) with samples collected at two depths. No detected concentrations of VOCs in the sub-surficial Upper Navigational Channel samples exceeded the NYSDEC screening values.

As was observed for the inorganic compounds, in many cases, the deeper samples in the Nearshore environment contained higher levels of VOCs than did the surficial sediments. For instance, at station SD089, the surficial sample had low levels of VOCs, but the 2 to 4 ft and 4 to 6 ft samples had exceedances of all NYSDEC screening values and had the highest observed chlorobenzene concentration. The surficial sediments represent the horizon at which ecological receptors are most likely to be exposed to chemical stressors (i.e., the bioactive zone). The higher concentrations present in the deeper sediments are below the depth of most ecological receptor activities; therefore exposure to these elevated VOCs is not likely. However these samples have conservatively been included in this assessment to help place these data into perspective relative to the NYSDEC criteria.

3.1.2 Surface Water Screening Results

Surface water samples were collected from two Upstream locations (SW01 and SW02) and five adjacent Nearshore locations (SW03 to SW07). The comparison of these data against NYSDEC surface water quality benchmarks is presented in Table 3-5. NYSDEC surface water criteria for aquatic life were available for 17 inorganic compounds and for one of the two detected VOCs. A NYSDEC aquatic life criterion was not available for manganese so the comparison was based on an aesthetic protection level. Hardness dependent screening values were adjusted to the average hardness observed throughout the Study Area (86.1 mg/L as CaCO_3).

Criteria for total recoverable and dissolved inorganic compounds were exceeded in both the Upstream and Adjacent Nearshore reaches for aluminum, copper, iron, lead, and manganese. Because inorganic compounds occurred at similar concentrations within the Upstream and Adjacent Nearshore reaches, there is no indication that potential risk from these compounds is related to the Site.

With the exception of two likely laboratory contaminants (acetone and toluene), VOCs were non-detect in all samples. Acetone concentrations were low and similar upstream and adjacent to the Site. Toluene was non-detect upstream of the Site and low adjacent to the Site. No NYSDEC aquatic life criterion was available for acetone; although all concentrations were well below the NYSDEC drinking water value (50 $\mu\text{g/L}$). Toluene was well below the NYSDEC aquatic life criterion. These low levels of acetone and toluene could potentially be due to laboratory contamination. These results indicate that surface water is not a medium of concern at this Site.

3.2 SEM and AVS Analysis

Although analysis of SEM, AVS, and TOC data alone is not a completely comprehensive metric of bioavailability, an evaluation of these data is useful as a preliminary indicator of whether or not selected inorganic substances (divalent metals) are likely to be bioavailable in sediments. Therefore, SEM, AVS, and TOC data were collected and analyzed at nearly 50% of the surface sediment locations. These samples were collected from the top four cm of sediment in order to help assess whether or not selected divalent metals are likely to be bioavailable, and therefore potentially toxic, to benthic receptors. Appendix B provides additional detail regarding the collection of the samples and the theory behind the equilibrium partitioning (EqP) approach for establishing sediment quality criteria. A summary of the SEM and AVS data evaluation is presented in Table 3-6. Sulfides were not detected in more than half of the samples (29 of 48 locations) so comparisons could not be conducted with these samples.

Only two samples had SEM to AVS ratios of less than one, indicating that metals would not likely be bioavailable in these locations (SD011 and SD077). All other locations, including many within the Upstream reach, had SEM to AVS ratios above one, indicating that the divalent metals may be bioavailable.

However, when the influence of organic carbon is considered, the bioavailability of the divalent metals appears to be more limited. Seven locations from within the Upstream, Adjacent Nearshore, and Upper Navigational Channel reaches had $(\Sigma\text{SEM-AVS})/f_{oc}$ values of less than $130 \mu\text{mol/g}_{oc}$ where the sediments are presumed to "not likely" be toxic (USEPA, 2005). None of the samples had an $(\Sigma\text{SEM-AVS})/f_{oc}$ value above $3000 \mu\text{mol/g}_{oc}$ where the sediments are presumed to "likely" be toxic (USEPA, 2005). The remaining samples were between these two thresholds in a range where the prediction of effects is uncertain.

Results of the SEM and AVS analysis indicate that the levels of AVS alone may not be sufficient to bind the divalent metals. However, increasing levels of organic carbon, particularly in the Adjacent Nearshore area, may help to decrease the bioavailability of the metals.

3.3 Benthic Macroinvertebrate Community

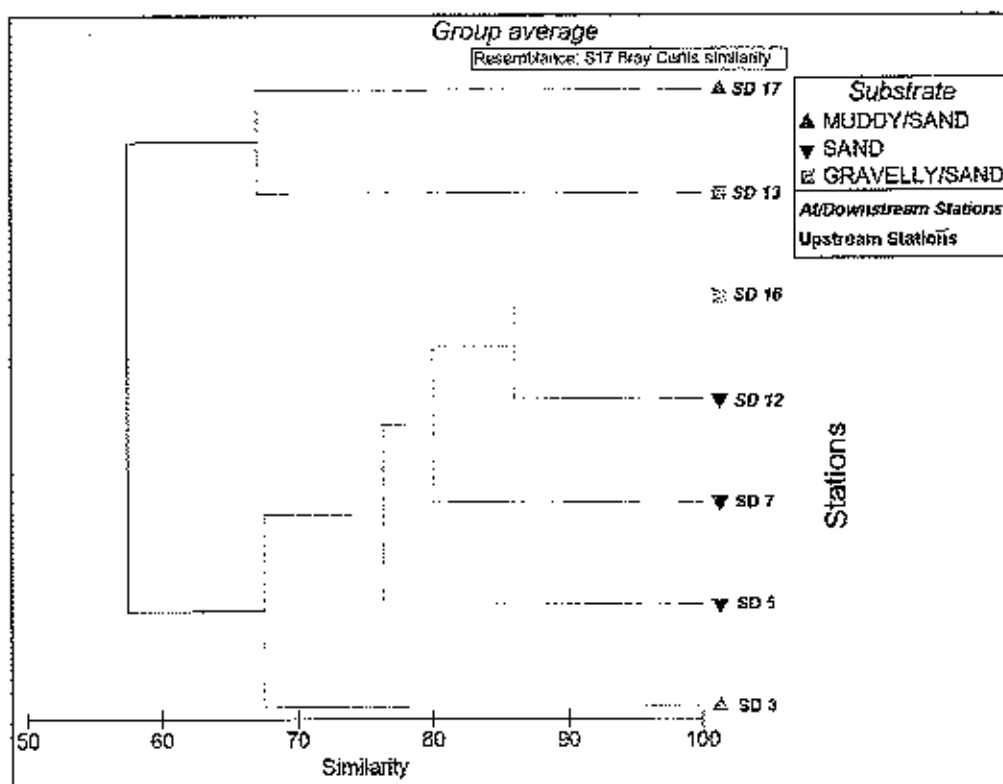
A site-specific reconnaissance-level macroinvertebrate community survey was conducted to provide a direct assessment of the integrity of the benthic community near the Site. Eighteen surficial sediment samples were taken for analysis of the benthic invertebrate community. Seven of the eighteen samples (39%) contained the 100 taxa required to analyze multiple indices: these seven samples included three samples upstream from the Site (invertebrate stations INV-3, INV-5, and INV-7) and four samples collected adjacent to and just downstream of the Site (invertebrate stations INV-12, INV-13, INV-16, and INV-17). Several of these adjacent samples were collected from Adjacent Nearshore sampling stations with elevated levels of VOCs and/or inorganic compounds.

The macroinvertebrate survey indicated that the more stress-tolerant oligochaetes (i.e., *Limnodrilus hoffmeisteri*) and chironomids (i.e., *Chironomus* sp., *Cryptochironomus* sp., *Procladius* sp.) were the dominant types of organisms found throughout the Study Area (including the Upstream reach of the river, outside of Site-related influence).

The benthic macroinvertebrate communities analyzed upstream, adjacent to, and downstream of the Site all are ecologically similar, regardless of the compound concentrations found in the co-located surficial sediment samples. Invertebrate diversity and abundance in the sediment were similar across all samples (including the Upstream samples) and many of the taxa present are typically associated with high stress environments. These conditions were expected given the daily shifts in flow direction (due to tidal influence) and the historical urban/industrial setting of this part of the Hudson River. Similarity analyses (Figure 3-1) indicate that the differences (in terms of taxa observed, diversity, abundance, and habitat) observed upstream, adjacent to, and downstream of the Site were minimal, were not significant, and appear to be un-related to proximity to the Site or to compound concentrations in the co-located sediment samples. These results indicate that the observed biological impairment of the macroinvertebrate community reflects conditions throughout the Study Area (i.e. from the Upstream reach to the most downstream sampling location in the Upper Navigational Channel).

Appendix E of the Report provides the full macroinvertebrate community survey report.

Figure 3-1 Benthic Macroinvertebrate Community Similarity Analysis



Notes: Bray Curtis similarity values of taxa from Upstream samples SD-3, SD-5, and SD-7 and Adjacent/Downstream samples SD-12, SD-13, SD-16, and SD-17. See Appendix E of the main report for additional details.

[illegible]

Order a Source:
KYSDEC, 1999. *Technical Guidance for Streambed Contaminated Sediments*.

Notes:
J = Estimated value
P = Observed value
C = Non-detect at laboratory reference limit
N = No WHO/CDC data
Only one record was with non-detect (at least one sample is a non-detect) and was not analyzed
Data sources indicate not analyzed
2 out of 3 samples (2 out of 3 duplicate sample)
Value is based on laboratory reference of 1E
EPA's default soil ingestion measurement of 50 mg/d
EPA's default soil ingestion rate is equal to 100 mg/d for an average adult

Table 3-1
 WSDC Screening of Inorganic Compounds in Surface Sediment
 SAGE Corporation
 Hudson River CL-2 Testigator
 Fairport, New York

Analysis Type	Location	Severe Effect?	ADJACENT FAP FIELD S0037 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0039 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0040 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0041 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0042 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0043 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0044 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0045 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0046 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0047 Gravelly Sand GSD040AA1 0-3.5 ft	ADJACENT FAP FIELD S0048 Gravelly Sand GSD040AA1 0-3.5 ft
ANTHRACENE	NC	NC	5480	5500	7000	5500	5500	5500	5500	5500	5500	5500	5500
ANTHRACENE	2	25	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ
ARSENIC	6	33	1.3	1.3	2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
BARIUM	NC	NC	17.7	23.2	35.4	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2
BARIUM	0.6	9	1.1	1.1	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
CADMIUM	NC	NC	5800	1800	11400	1800	1800	1800	1800	1800	1800	1800	1800
CADMIUM METAL	25	110	7.5 J	9.2 J	12.4	8.1 J	8.1 J	8.1 J	8.1 J	8.1 J	8.1 J	8.1 J	8.1 J
CHROMIUM, TOTAL	NC	NC	4.7	4.7	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
COPPER	15	110	5.3	6.8	10.7	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
IRON, TOTAL	20000	20000	14000	15000	18500	15000	15000	15000	15000	15000	15000	15000	15000
LEAD	31	110	21 J	22 J	24 J	21 J	21 J	21 J	21 J	21 J	21 J	21 J	21 J
MANGANESE	NC	NC	3940	2450	3770	3900	3900	3900	3900	3900	3900	3900	3900
MANGANESE	450	1100	257 J	242 J	308	245 J	245 J	245 J	245 J	245 J	245 J	245 J	245 J
MERCURY	0.15	1.3	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J
NICKEL	15	50	5.4	11	14.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
POTASSIUM	NC	NC	420 J	462	800	462	462	462	462	462	462	462	462
POTASSIUM	NC	NC	1.1 J	1.1 J	1.2 J	1.1 J	1.1 J	1.1 J	1.1 J	1.1 J	1.1 J	1.1 J	1.1 J
SELENIUM	1	3.2	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J
SILVER	NC	NC	34.0	33.5	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
SODIUM	NC	NC	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J	0.02 J
THALLIUM	NC	NC	7	7	7	7	7	7	7	7	7	7	7
VANADIUM	120	370	44.8	57.8	73.4	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1
ZINC	NC	NC	57.8	57.8	73.4	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1

Notes:
 WSDC, 1999. Technical Guidance for Screening Contaminant Sediments.
 J = Estimated value
 L = Reported value
 L = No value at laboratory detection limit
 NC = No WSDC Criteria
 Only compounds which were detected in at least one sample are shown.
 Blank spaces indicate not analyzed.
 * at end of sample. * indicates replicate sample
 * indicates cell indicates exceedance of LEL
 * indicates cell indicates exceedance of SE and EE
 Non-detects at detection limit is 0.01 mg/kg dry solids - 1 are not covered.

BASE Corporation
Hudson River Office Investigation
Rensselaer, New York

Cited Source: www.vhsoc.org "2009 Technical Guidance for Screening Contaminated Sediments."

10

ANSCOC Screening of organic Compounds in Surface Sediment
BASF Corporation
Hudson River O&E Investment
Hanselma, New York

Analysis Category	Sample Level	Seven Element Data (S/L)	Other Data (S/L)	Downstream Data (S/L)	Downstream Data (S/L)
ALUMINUM	NC	25	7220	6640	9930
ANTHRAQUONE	2	NC	2,17	0.06 J	0.28 J
BARSE NC	6	34	2.7	2	7
CADMIUM	NC	NC	50.9	0.6	109
CADMIUM METAL	0.6	9	1 U	1.1 J	2.1
CHROMIUM	NC	NC	3002	1560	2970
CHROMIUM TOTAL	26	110	13.3	18.8	128
COPPER	NC	NC	9.7	4.2	6.6
COPPER TOTAL	16	113	56.3	12.1 J	94.2 J
IRON TOTAL	25000	40000	22000	14500	20000
LEAD	31	110	40.9	22 UJ	134 J
MANGANESE	NC	NC	3940	3500	4800
MANGANESE	460	1100	297	275	325
MERCURY	0.15	1.3	0.38	0.65	1.22
NICKEL	16	50	34.3	13.1	30.7
POTASSIUM	NC	NC	767	311 J	660 J
SILICUM	NC	NC	2.7	1.1 J	1 U
SILVER	1	2.2	3.17	0.65	6.77
SODIUM	NC	NC	195	58.8	58.1
THALLIUM	NC	NC	0.35	0.65	0.21
THALLIUM	NC	NC	11.3	0	18.9
THALLIUM	120	270	198	74.7	339
NC					

Citrusa Source:
 NYS DEC, 1999. "soiltest: Guidance for Screening Contaminated Sediments,
 Nates".
 R = Estimated value
 J = Peleped value
 U = Not detect at laboratory detection limit
 LC = No NYSED Criteria
 Early compounds often were detected in at least one sample are shown
 Only compounds not analyzed.
 (yellow shaded soil indicates exposure at LEL
 Green shaded soil indicates exposure at SEC or WEL
 Grey shaded soil indicates exposure at neither SEC nor WEL
 All data are not disclosed

Table 3-2
 NYSDOC Screening of Organic Carbon-Normalized VOCs in Surficial Sediment
 BASF Corporation
 Hudson River CCL-2 Investigation
 Rensselaer, New York

Analyte (mg/kg OC)	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand	ADJACENT NEARSHORE SD109 12/7/2005 01SD096A47 0 - 0.5 ft Muddy Sand
1,1,1-TRICHLOROETHANE (TCA)	NC	0.6921 U	0.8702 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
1,2,4-TRICHLOROBENZENE	91	0.58 U	0.58 U	0.58 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
1,3-DICHLOROBENZENE	12	0.21 J	0.1432 J	1.2569 J	0.0519 J	0.0537 J	0.0537 J	0.456 U
1,2-DICHLOROETHANE	NC	0.58 U	0.58 U	0.58 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
1,2-DICHLOROPROPANE	NC	0.58 U	0.58 U	0.58 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
1,3-DICHLOROBENZENE	12	0.58 U	0.58 U	0.58 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
1,4-DICHLOROBENZENE	12	0.58 U	0.58 U	0.58 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
2-BUTANONE (MEK)	NC	1.2 J	1.482 U	1.5193 J	0.7143 J	0.4209 J	0.4209 J	1.0362 J
2-HEXANONE	NC	1.2 U	1.482 U	1.7836 U	0.8442 U	0.8943 U	0.8943 U	0.9326 U
4-METHYL-2-PENTANONE (MIBK)	NC	1.2 U	1.482 U	1.7836 U	0.8442 U	0.8943 U	0.8943 U	0.9326 U
ACETONE	NC	4.8 J	0.5838 J	5.653 J	2.5974	2.0325 J	2.0325 J	4.1451 J
BENZENE	28	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
CARBON DISULFIDE	NC	0.31 J	0.0919 J	0.0746 J	0.0423 J	0.0504 J	0.0504 J	0.267 J
CHLOROBENZENE	91	0.37 J	0.1432 J	1.1602 J	0.1494 J	0.1493 J	0.1493 J	0.1451 J
CHLOROMETHANE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
CYCLOHEXANE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
ETHYLBENZENE	24	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
ISOPROPYLBENZENE	12	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
M.P.-XYLENES	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
METHYL ACETATE	NC	1.2 U	1.482 U	1.7836 U	0.8442 U	0.8943 U	0.8943 U	0.9326 U
METHYL TERT-BUTYL ETHER	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
METHYLCYCLOHEXANE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
METHYLENE CHLORIDE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
O-XYLENE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
STYRENE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
TETRACHLOROETHENE (PCE)	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
TOLUENE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
TRICHLOROETHYLENE	49	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
TRICHLOROFLUOROMETHANE	NC	0.58 U	0.5821 U	0.8702 U	0.4156 U	0.4553 U	0.4553 U	0.456 U
TOTAL ORGANIC CARBON (%)		1.00	0.839	0.724	1.54	1.23	1.23	1.99

Criteria Source:
 NYSDOC, 1999. Technical Guidance for Screening Contaminated Sediments.

Notes:

J = Estimated value

U = Rejected value

NC = No NYSDOC Criteria

U = Non-detect at laboratory detection limit

Only compounds which were detected in at least one sample are shown.

Blank samples indicate not analyzed.

2 at end of sample (2) indicates duplicate sample

Smoked cell indicates organic exoedience

Non-detects with detection limit equal to or greater than any standard are not colored.

Italicized text indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.

When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

Table 3-3
 NYSED Screening of Inorganic Compounds in Sub-Surface Sediment
 BASF Corporation
 Hudson River OU-2 Investigation
 Bannockburn, New York

	Analysis (mg/kg)	Lowest Effect Level (LEL)	Severe Effect Level (SEL)	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT FAR FIELD	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
ALUMINUM	7180	NC	NC	5650	6970	8870	5180	18500	19500	17000	14500
ANTIMONY	7.1 U	2	25	7.1 U	6.9 U	8.1 U	7.5 U	11.2 U	12.3 U	9.8 U	11.4 U
ARSENIC	1.5	6	33	2.1	1.7	17.1	15.6	11.5	23.1 J	9.5	24.7
BARIUM	22.9	NC	NC	25.4	26.7	83.1	42.7	243	301 J	164	215
BERYLLIUM	0.59 U	NC	NC	0.59 U	0.58 U	0.68 U	0.63 U	0.63 U	1.0 U	0.82 U	0.95 U
CADMIUM	1.2 U	0.6	5	1.2 U	1.2 U	5.9	1.3 U	17.6	28.6 J	7.8	12.9
CALCIUM METAL	2250	NC	NC	2850	1680	4850	3690	8200	7570 J	14300	5820
CHROMIUM TOTAL	7.5	26	110	6.6	8.4	122	68.7	356	454 J	225	455
COBALT	5.2	NC	NC	5.9 U	5.8 U	6.8 U	6.3 U	10.5	12.0 J	11.7	11.4
COPPER	6.7 J	18	110	5.4 J	8.7 J	83.6 J	80.0 J	178 J	201 J	119 J	747 J
IRON TOTAL	13100	20000	40000	13000	13700	14300	8320	23100	30000 J	25400	30300
LEAD	14.6 J	81	110	5.9 J	7.5 J	134 J	93.4 J	389 J	437 J	219 J	390 J
MAGNESIUM	3890	NC	NC	3140	3340	3370	2000	6540	6990 J	8310	5320
MANGANESE	1.2 R	490	1100	1.2 R	1.2 R	1.4 R	1.3 R	1.6 R	2.0 R	1.6 R	1.8 R
MERCURY	0.04 U	0.15	1.3	0.04 U	0.04 U	0.06	1.6	3.7	5.2 J	2	2.4
NICKEL	11.3	18	50	9.1	11.8	17.3	11.6	34.4	39.2 J	35.2	40.3
POTASSIUM	727	NC	NC	866	747	1190	783	2110	2380 J	2270	1780
SELENIUM	0.61 U	NC	NC	0.56 U	0.53 U	0.63 U	0.65 U	0.95 U	1.0 U	0.84 U	0.96 U
SILVER	1.2 U	1	2.2	1.2 U	1.2 U	1.4 U	1.3 U	2.2	2.2 J	1.8 J	1.9 J
SODIUM	174	NC	NC	145	137	238	175	199	247 J	263	274
THALLIUM	1.2 U	NC	NC	1.2 U	1.2 U	1.4 U	1.3 U	1.9 U	2.0 U	1.6 U	1.9 U
VANADIUM	8.2	NC	NC	7.1	8.7	17.5	10.7	43.7	50.4 J	34.5	31.1
ZINC	43.7	120	270	44.8	52.2	257	125	504	783 J	443	617

Criteria Source:
 NYSED, 1998

Technical Guidance for Screening Contaminated Sediments

Notes:

J = Estimated value

R = Rejected value

U = Not detected at laboratory collection limit

NC = No NYSED Criteria

Only compounds which were detected in at least one sample site shown.

Blank spaces indicate not analyzed.

2 at end of sample ID indicates duplicate sample

Yellow shaded cell indicates exceedance of LEL

Green shaded cell indicates exceedance of SEL and LEL

Non-detects with detection limits equal to or greater than any standard are not colored.

Ecological receptors are not likely to be exposed to sub-surface sediments; however, to be conservative these samples have been included in this evaluation.

Table 3.3
BASF Corporation
Hudson River O-2 Investigation
Hesselaer, New York

	Analyte (mg/kg)	Lowest Effect Level (LEL)	Severe Effect Level (SEL)	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE	ADJACENT NEARSHORE
	ALUMINUM	NC	NC	2800	21000	21200	22800	9260	15900	14800	17800
	ANTIMONY	2	25	9.5 J	11.8 U	12.1 U	12.1 U	7.8 U	9.9 U	9.7 U	12.3 U
	ARSENIC	5	33	40.8	97.8 J	37.5	36.3 J	6.0	10.7	6.4	7.1
	BARIUM	NC	NC	177	334 J	282	224 J	80.1	159	147	198
	BERYLLIUM	NC	NC	0.79 U	1.1 U	0.8 U	1.1 J	0.65 U	0.83 U	0.81 U	1.0 U
	CADMIUM	0.6	9	4.6	4.5 J	2.7	3.4 J	0.65 U	3.5	3.7	9.2
	CALCIUM METAL	NC	NC	3740	12000 J	6850	8360 J	3290	10400	11200	9300
	CHROMIUM TOTAL	26	180	370	454 J	229	180 J	38	251	178	234
	COBALT	NC	NC	9.3	10.7 U	12.5	15.8 J	7.5	13.5	12.6	13.6
	COPPER	16	110	833 J	354 J	252	203 J	47.0 J	94.2 J	90.5 J	251 J
	IRON TOTAL	20000	40000	73400	20900	35700	46500 J	17500	33500	29500	30700 J
	LEAD	31	110	406 J	419 J	316 J	475 J	80.1 J	114 J	125 J	482 J
	MAGNESIUM	NC	NC	5880	4250	6520	8350 J	4120	6880	7070	7470 J
	MANGANESE	460	1500	1.7 R	2.1 R	672	945 J	267	1.7 R	1.6 R	2.0 R
	MERCURY	0.15	1.3	35.2	5.5	16.5 J	33.3 J	7.1 J	0.57	0.52	1.1
	NICKEL	16	50	77.3	40.5	92.7 J	40.4	14.9	31.2	29.1	32.8
	POTASSIUM	NC	NC	1780	1600	1930 J	3280 J	1450	2350	2150	2670 J
	SELENIUM	NC	NC	0.83 U	0.85 U	0.87 U	0.83 U	0.65 U	0.84 U	0.85 U	0.83 U
	SILVER	1	2.2	1.6 U	2.1	2.0 U	2.0 U	1.3 U	1.7 U	1.6 U	1.7 U
	SODIUM	NC	NC	287	291	440	442 J	223	123	129	226 J
	TALLIUM	NC	NC	1.6 U	2.1 U	2.0 U	2.0 U	1.3 U	6.5 U	3.2 U	4.1 U
	VANADIUM	NC	NC	23.1	28.5 J	31.2	37.5 J	14.9	28.7	25.2	34.5
	ZINC	123	270	330	1010	507	736 J	110	276	270	361

Cálculo Source:

Source: NVSDC, 1999, Technical Guidebook for Screening Contaminated Sediments-18.

Notes:

 μ_i = Estimated value
$$\text{triple product} = \frac{1}{2} \left(\frac{1}{2} \right) \left(\frac{1}{2} \right) = \frac{1}{8}$$

U = Non-detect at laboratory detection limit.

NC = No NYSED Criteria

Black spaces indicate not analyzed.

0 at end of sample. D indicates duplicates as noted.

Yellow shaded cell indicates expenditure of 1000 at end of segment. C indicates duplicate sample

137-200-0000

Non-defects with detection limits equal to or greater than any standard are not colored green standard cell in places exceeding 0.5% and 1.0%.

Non-diseased with defects: 11 (8 equal to 3), 4 greater than 3) are not ordered.

Table 3-3
 NYSDDEC Screening of Inorganic Compounds in Sub-Surficial Sediment
 BASF Corporation
 Hudson River QU-2 Investigation
 Rensselaer, New York

Analyte (mg/kg)	Lowest Effect Level (LEL)	Severe Effect Level (SEL)	ADJACENT NEARSHORE SD109 5/12/2006 Muddy Sand 02SD109AC1 4-6 ft	ADJACENT NEARSHORE SD110 5/12/2006 Muddy Sand 02SD110AC1 2-4 ft	ADJACENT NEARSHORE SD110 5/12/2006 Muddy Sand 02SD110AC1 5-8 ft	ADJACENT NEARSHORE SD110 5/12/2006 Muddy Sand 02SD110AC1 9-11 ft	ADJACENT NEARSHORE SD111 5/12/2006 Muddy Sand 02SD111AC1 2-4 ft	ADJACENT NEARSHORE SD111 5/12/2006 Muddy Sand 02SD111AC1 4-6 ft	ADJACENT NEARSHORE SD111 5/12/2006 Muddy Sand 02SD111AC1 6-8 ft	ADJACENT NEARSHORE SD112 5/12/2006 Muddy Sand 02SD112AC1 2-4 ft	ADJACENT NEARSHORE SD112 5/12/2006 Muddy Sand 02SD112AC1 4-6 ft
ALUMINUM	NC	NC	12600	11500	12100	11500	13000	14100	15900	15900	19000 J
ANTIMONY	2	25	8.6 U	0.1 U	8.6 U	8.4 U	11.2 J	9.7 U	7.4 J	11.6 U	18.7 J
ARSENIC	6	35	10.1	15.2	10.5	9.8	8.6	10.6	10.4	6.5	16.3 J
BARIUM	NC	NC	119	155 J	219	137	224	142	114	186 J	282 J
BERYLLIUM	NC	NC	0.72 U	0.76 U	0.74 U	0.70 U	1.0	0.81 U	0.81	0.55 U	1.5 U
CADMIUM	0.6	5	2.1 J	2.4	2.2	2.2	15.3 J	6.4 J	0.62 U	8.5	28.7 J
CALCIUM METAL	NC	NC	5540	4780	6050	5800	8570	6310	33200	2630	8940 J
CHROMIUM, TOTAL	28	110	130	243	62.8	61.7	339	236	22.2	182	410 J
COBALT	NC	NC	3.8	11.8	9.5	10.2	14.5	10.3	15.7	15.3	12.9 J
COPPER	16	110	86.5 J	89.7 J	90.4 J	87.5 J	181 J	143 J	36.5 J	107 J	227 J
IRON, TOTAL	20000	40000	22900	27300	25900	27000	32100	25100	34800	28200	30400 J
LEAD	5	110	121 J	145 J	482	324	456 J	328 J	24.8 J	218 J	458 J
MAGNESIUM	NC	NC	5520	6040	5530	5740	7440	5710	12700	8380	7350 J
MANGANESE	460	1100	389	445	616	433	805	411	740	869	619 J
MERCURY	0.15	1.3	1.2 J	1.7	2	1.5	1.7 J	2.1 J	0.04 U	0.98	2.6 J
NICKEL	18	50	25.8	33.6	21.6	21.5	35.9	26.7	31.3	31.5	36.7 J
POTASSIUM	NC	NC	2060	2170	1750	1660	2630	2030	3050	2170	2810 J
SELENIUM	NC	NC	0.72 U	1.0	1.1	0.89	0.67 U	0.80 U	0.82	0.93 U	1.3 J
SILVER	1	2.2	1.4 U	2.4	1.7	1.6	2	1.6 U	1.2 U	2.5	3.5 J
SODIUM	NC	NC	352	178 U	150	142	188 U	166	229	161 U	200 U
THALLIUM	NC	NC	1.4 U	1.5 U	1.5 U	1.4 U	1.9 U	1.6 U	1.2 J	5.7 U	2.3 U
VANADIUM	NC	NC	24.5	34.6	22.2	21.1	40.8	30.3	27.4	32.2	48.3 J
ZINC	120	270	264	485 J	262	235	489	490	74.4	405 J	548 J

Criteria Source:
 NYSDDEC, 1999. Technical Guidance for Screening Contaminated Sediments.

Notes:
 J = Estimated value
 R = Rejected value
 U = Non-detect at laboratory detection limit
 NC = No NYSDDEC Criteria
 Only compounds which were detected in at least one sample are shown.

Blank species indicate not analyzed.
 2 at end of sample ID indicates duplicate sample.
 Yellow shaded cell indicates exceedance of LEL.
 Green shaded cell indicates exceedance of SEL and LEL.
 Non-detects with detection limits equal to or greater than any standard are not reported.
 Ecological receptors are not likely to be exposed to sub-surficial sediments; however, to be conservative these samples have been included in this evaluation.

Table 3-3
 NYSDC Screening of Inorganic Compounds in S.b-Surface Sediment
 BASF Corporation
 Hudson River CU-2 Investigation
 Bannockburn, New York

Analyte (mg/kg)	Lowest Effect Level (LEL)	Severe Effect Level (SEL)	ADJACENT NEARSHORE	UPPER NAVIGATIONAL C-HANNEL	UPPER NAVIGATIONAL C-HANNEL
ALUMINUM	NC	NC	13200	9590	8220 J
ANTIMONY	2	25	7.3 U	8.4 J	15.6 J
ARSENIC	8	33	4.8	6.2	9.7 J
BARIUM	NC	NC	127	55.6	116 J
BERYLLIUM	NC	NC	0.39	0.70 U	1.3 U
CADMIUM	0.6	9	0.61 U	2.5	3.0 J
CALCIUM METAL	NC	NC	32300	4860	8450 J
CHROMIUM, TOTAL	26	110	22.8	48	45.4 J
COBALT	NC	NC	13.7	7.3	13.0 U
COPPER	18	110	32.9 J	56.4 J	83.4 J
IRON, TOTAL	20000	40000	34000	16200	14600 J
LEAD	31	110	16.6 J	130 J	145 J
MAGNESIUM	NC	NC	12600	4350	4550 J
MANGANESE	460	1100	713	236 J	229 J
MERCURY	0.15	1.3	0.11 J	0.65	1.4 J
NICKEL	18	50	28.5	16.6	15.7 J
POTASSIUM	NC	NC	3070	1470	1650 J
SELENIUM	NC	NC	0.64 U	0.67 U	1.3 U
SILVER	7	2.2	1.2 U	1.4 U	2.6 U
SODIUM	NC	NC	291	154	513 J
THALLIUM	NC	NC	1.2 U	1.4 U	2.6 U
VANADIUM	NC	NC	26.9	16.9	17.8 J
ZINC	120	270	73.8	209	256 J

Criteria Source:
 NYSDC, 1996. Technical Guidance for Screening Contaminated Sediments

Notes:

J = Estimated value

R = Rejected value

U = Non-detect at laboratory detection limit

NC = No NYSDC Criteria

Only compounds which were detected in at least one sample are shown.

Blank spaces indicate not analyzed.

2 at end of sample ID indicates duplicate sample

Yellow shaded cell indicates exceedance of LEL

Green shaded cell indicates exceedance of SEL and LEL

Non-detects with detection limits equal to or greater than any standard are not colored.

Ecological receptors are not likely to be exposed to sub-surface sediments; however, to be conservative these samples have been included in this evaluation.

Table 3-4
 NYSED Screening of Organic Carbon-Normalized VOCs in Sub-Surface Sediment
 GASF Compactor
 Hudson River CO₂ Investigation
 Port Jervis, New York

	Specific Analyte Life Chronic Toxicity Sediment Criteria	UPPER NAVIGATIONAL CHANNEL SD089 12/2005 ONSD089DCT 2 - 4 ft	UPPER NAVIGATIONAL CHANNEL SD089 12/2005 ONSD089DCT 2 - 4 ft
Analyte (Impg/L, DO)	Impg/L OCL	Muddy Sand	Muddy Sand
1,1,1-TRICHLOROETHANE (TOX)	NC	1.7241 UJ	7.3276 UJ
1,2,4-TRICHLOROETHANE	81	1.7241 UJ	7.3276 UJ
1,2-DICHLOROETHANE	12	1.7241 UJ	7.3276 UJ
1,2-DICHLOROETHANE	NC	1.7241 UJ	7.3276 UJ
1,2-DICHLOROPROPANE	NC	1.7241 UJ	7.3276 UJ
1,3-DICHLOROETHANE	12	1.7241 UJ	7.3276 UJ
1,4-DICHLOROETHANE	12	1.7241 UJ	7.3276 UJ
2-BUTANONE (MEX)	NC	8.6207 UJ	37.5 UJ
2-PENTANONE	NC	8.6207 UJ	37.5 UJ
4-METHYL-2-PENTANONE (MEX)	NC	8.6207 UJ	37.5 UJ
ACETONE	NC	17.2414 UJ	73.2759 UJ
BENZENE	29	1.7241 UJ	7.3276 UJ
CARBON DISULFIDE	NC	1.7241 UJ	7.3276 UJ
CHLOROBENZENE	8.5	1.7241 UJ	7.3276 UJ
CHLOROMETHANE	NC	3.4494 UJ	16.0062 UJ
CYCLOHEXANE	NC	1.7241 UJ	7.3276 UJ
ETHYLBENZENE	24	1.7241 UJ	7.3276 UJ
ISOPROPYLBENZENE	12	1.7241 UJ	7.3276 UJ
M-P-XYLENES	NC	1.7241 UJ	7.3276 UJ
METHYL ACETATE	NC	8.6207 UJ	11.5065 UJ
METHYL 1-ETHYL-2-ETHYL ETHER	NC	1.7241 UJ	7.3276 UJ
METHYLCYCLOHEXANE	NC	1.7241 UJ	7.3276 UJ
METHYLENE CHLORIDE	NC	1.7241 UJ	7.3276 UJ
OXOLENE	NC	1.7241 UJ	7.3276 UJ
STYRENE	NC	1.7241 UJ	7.3276 UJ
1,2-DICHLOROETHANE (PCE)	NC	1.7241 UJ	7.3276 UJ
TOLUENE	40	2.4136 UJ	7.3276 UJ
TRICHLOROETHYLENE	NC	1.7241 UJ	7.3276 UJ
TRICHLOROETHYLENE	NC	1.7241 UJ	7.3276 UJ
TOTAL ORGANIC CARBON (%)		2.32	2.32

Criteria Source:
 NYSED, 1988. Technical Bulletin for Screening Contaminated Sediments.

Notes:
 U = Failed value
 R = Failed value
 U = Failed value
 NC = No NYSED Criteria
 Only compounds which were detected in at least one sample are shown.
 Blank spaces indicate not analyzed.
 2 in end of sample ID indicates duplicate sample
 Shaded cell indicates criteria exceedance
 Non-detects with detection limit equal to or greater than any standard are not colored.
 Analyzed test indicates depth-specific TOC data was not available so TOC from a different depth interval was used to normalize the VOC data.
 When TOC data was not available at any depth interval for a sample, 1% TOC was assumed.

Table 9-5
 NYSDEC Screening of Compounds in Surface Water
 BASF Corporation
 Hudson River OU-2 Investigation
 Plesseter, New York

Analyte	NYSDEC Surface Water Criteria for Aquatic Life (ug/L)	UPSTREAM SW01 11/30/2005 01SW01U1	UPSTREAM SW01 11/30/2005 01SW01U1F	UPSTREAM SW02 11/30/2005 01SW02U1	UPSTREAM SW02 11/30/2005 01SW02U2	UPSTREAM SW02 11/30/2005 01SW02U1F	UPSTREAM SW02 11/30/2005 01SW02U2F	UPSTREAM SW02 11/30/2005 01SW02U2F	ADJACENT NEARSHORE SW03 11/30/2005 01SW03A1	ADJACENT NEARSHORE SW03 11/30/2005 01SW03A1F	ADJACENT NEARSHORE SW04 11/30/2005 01SW04A1
Inorganics (ug/L)											
ALUMINUM	100	8990	2990	13000	13100	1110	1280	6770	170	9150	
ARSENIC	150	1.5	0.698	2.1	2.2	0.469	0.389	1.6	0.28	1.7	
BARIUM	NC	93.1	42.4	127	125	24	27.2	99.7	24.6	106	
BERYLLIUM	1100	0.239	0.118	0.319	0.322	0.115 U	0.115 U	0.238	0.115 U	0.286	
CADMIUM	1.86	0.134 J	0.055	0.168 J	0.171 J	0.05 U	0.05 U	0.124 J	0.05 U	0.112 J	
CALCIUM METAL	NC	30100	28700	20400	20300	18400	18500	21000	18400	20400	
CHROMIUM, TOTAL	65.56	7.9	3	12.7	14.9	2.4	1.8	8.6	1.7 U	9.6	
COBALT	5	3	0.945	4.1	4.2	0.394	0.42	2.8	0.145	3	
COPPER	7.98	7.5	3.2	9.6	9.8	1.8	1.9	8	1.2	8.8	
IRON, TOTAL	300	8620	2640	12300	12600	986	1110	8250	210	8640	
LEAD	5.21	5.5	1.6	6.3	6.4	0.628	0.642	6.8	0.307	6.7	
MAGNESIUM	35000	7220	5950	6770	6700	3960	3990	5990	3790	5900	
MANGANESE	300	230	70.5	303	288	38.9	41.8	286	34.2	292	
MERCURY	0.77	0.00473 J	0.00353 J	0.00806 J	0.00793 J	0.00146 J	0.00185 J	0.00848 J	0.0034 J	0.00903 J	
NICKEL	45.82	14.8	7.1 J	18.5	22	6.9 U	6.9 U	31.6	6.9 U	12.8	
POTASSIUM	NC	4030	2180 J	5030	4960	1480 J	1500 J	3910	1200 J	4080	
SELENIUM	4.6	1.6 U	1.6 U	1.6 U	1.8 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	
SILVER	0.1	0.038	0.027 U	0.043	0.041	0.027 U	0.027 U	0.04	0.027 U	0.034	
SODIUM	NC	19200	18700	11600	11400	10700	10800	13300	11700	13100	
THALLIUM	8	0.083	0.06 U	0.109	0.11	0.06 U	0.06 U	0.075	0.06 U	0.078	
VANADIUM	14	9.4	4	11.8	12.2	1.8	1.9	9.3	R	9.9	
ZINC	72.76	28.8	11.3	38.2	35.7	7	11.9	31	7.8	32.2	
VOCS											
ACETONE	NC	2.2 J	NS	2.3 J	3.3 J	NS	NS	2.9 J	NS	2.9 J	
TOLUENE	100	1.0 U	NS	1.0 U	1.0 U	NS	NS	0.43 J	NS	0.43 J	
Other											
HARDNESS (mg/L) as CaCO ₃		110	NS	101	77	NS	NS	76.7	NS	83.3	

J = Estimated Value
 NS = Not Sampled
 R = Rejected Value
 U = Not Detected
 NC = No NYSDEC Criteria

Criteria Source:
 NYSDEC 1998, New York State Ambient Water Quality Standards and Guidance Values.
 1 - Criterion adjusted to mean hardness concentration of 88.1 mg/L
 2 - Manganese criterion available for Aesthetic only.
 3 - Criterion available for dissolved phase only.
 Results are Total Recoverable phase unless otherwise noted
 Dissolved phase results are indicated by F in sample ID (sample was filtered in the field)
 2 at end of sample ID indicates duplicate sample
 Shaded cell indicates detected value exceeds screening value.

Table 3-5
 NYSDEC Screening of Compounds in Surface Water
 BASF Corporation
 Hudson River OU-2 Investigation
 Penseleer, New York

Analyte	NYSDEC Surface Water Criteria (ug Aquatic Life)	ADJACENT NEARSHORE SW04 11/30/2005 01SW04A1F	ADJACENT NEARSHORE SW05 11/30/2005 01SW05A1F	ADJACENT NEARSHORE SW06 11/30/2005 01SW06A1F	ADJACENT NEARSHORE SW06 11/30/2005 01SW06A1F	ADJACENT NEARSHORE SW07 11/30/2005 01SW07A1F	ADJACENT NEARSHORE SW07 11/30/2005 01SW07A1F
Inorganics (ug/L)							
ALUMINUM	100	765	11700	11400	95.2	12100	752
ARSENIC	150	0.424	2	2	0.245	2.2	0.359
BARIUM	NC	30.2	119	114	17.8	117	24.4
BERYLLIUM	1100	0.115 U	0.329	0.312	0.115 U	0.353	0.115 U
CADMIUM	1.86	0.05 U	0.357 J	0.169 J	0.05 U	0.19 J	0.05 U
CALCIUM METAL	NC	18700	22100	22900	20300	22400	20100
CHROMIUM, TOTAL	85.56	1.7 U	12.4	10.4	1.7 U	10.7	1.7 U
COBALT	5	0.323	3.7	3.8	0.146	4	0.303
COPPER	7.88	1.8	9.1	9.2	1.1	9.7	2.1
IRON, TOTAL	300	765	11700	11500	126	11500	677
LEAD	3.21	0.699	7.2	6.1	0.13	5.6	0.431
MAGNESIUM	35000	4040	6790	6950	4070	6930	4180
MANGANESE	300	60	335	287	24.8	304	32.3
MERCURY	0.77	0.00228 J	0.00518 J	0.00807 J	0.00259 J	0.00534 J	0.00249 J
NICKEL	45.82	7.5	15	15.9	6.9 U	15.2	6.9 J
POTASSIUM	NC	1580 J	4610	4540	1240 J	4840	1470 J
SELENIUM	4.6	1.6 U	1.6 U	1.8	1.6 U	1.8 U	1.6 U
SILVER	0.1	0.027 U	0.043	0.052	0.027 U	0.075	0.027 U
SODIUM	NC	12500	12900	13300	12300	13800	12400
THALLIUM	8	0.06 U	0.097	0.093	0.06 U	0.105	0.06 U
VANADIUM	14	1.5	11.4	11.6	R	12.5	1.3
ZINC	72.78	23.4	40.9	38.9	6.9 U	36.7	35.1
VOCs							
ACETONE	NC	NS	1.9 J	2.3 J	NS	3.6 J	NS
TOLUENE	100	NS	0.39 J	1.0 U	NS	1.0 U	NS
Other							
HARDNESS (mg/L) as CaCO ₃		NS	73	84.3	NS	86.3	NS

J = Estimated Value
 NS = Not Sampled
 R = Rejected Value
 U = Not Detected
 NC = No NYSDEC Criteria

Criteria Source:
 NYSDEC 1998, New York State Ambient Water Quality Standards and Guidance Values.
 1 - Criterion adjusted to mean hardness concentration of 86.1 mg/L.
 2 - Manganese criterion available for Aesthetic only.
 3 - Criterion available for dissolved phase only.
 Results are Total Recoverable phase unless otherwise noted
 Dissolved phase results are indicated by F in sample ID (sample was filtered in the field)
 2 at end of sample ID indicates duplicate sample
 Shaded cell indicates detected value exceeds screening value.

4.0 Risk Characterization

This section presents the screening level ERA risk characterization for the ecological receptors potentially exposed to sediment and surface water. The ecological risk characterization integrates the results of the exposure and effects phases of work (i.e., risk analysis), and presents an integrated approach to provide estimates of actual or potential risks to ecological receptors.

Surface water criteria for total recoverable and dissolved inorganic compounds were exceeded in both the Upstream and Adjacent Nearshore reaches; however, concentrations were generally consistent between the two reaches. With the exception of two likely laboratory contaminants (acetone and toluene), VOCs were non-detected in all surface water samples. Acetone concentrations were low and similar upstream and adjacent to the Site. Toluene was non-detect upstream of the Site and low adjacent to the Site. Based on the comparison to NYSDEC surface water screening values and consistency of concentrations throughout the Study Area, surface water is not a medium of concern at the Site, and there are unlikely to be unacceptable risks to fish in the vicinity of the Site from exposure to surface water.

NYSDEC sediment screening criteria were exceeded in surficial sediments much of the Study Area. Concentrations of inorganics and VOCs in surficial sediment were highest in the muddy sand adjacent to the Site (i.e., the Adjacent Nearshore reach), and metals from at least some sampling locations may be bioavailable to benthic receptors. There is some uncertainty as to whether compounds in sediment, particularly those with low $\log_{10} K_{ow}$ values (e.g., benzene and other VOCs), are likely to bioaccumulate into fish. Metals concentrations were also elevated above screening criteria in surficial sediments within the muddy sand of the Upper Navigational Channel just downstream of the Site and in the Upstream and Adjacent Far Field reaches.

The highest observed concentrations of inorganics and VOCs were in the Adjacent Nearshore reach in the deeper sediments, two ft or more below the sediment surface. However, exposure to these sub-surficial sediments is not likely to be a complete ecological exposure pathway for ecological receptors as the sediments are situated well below the bioactive zone for most benthic organisms. There is some uncertainty as to whether re-suspension of sub-surficial sediments could pose a risk to the environment. Sediments in the 0.5 – 2 ft sediment horizon have not yet been fully characterized.

The macroinvertebrate survey indicates that there is a similar benthic macroinvertebrate community throughout the entire Study Area (including the Upstream reach). Although several macroinvertebrate sampling stations were located within the Adjacent Nearshore reach, immediately adjacent to the Site bulkhead, no relationship between proximity to the Site and a decrease in macroinvertebrate community fitness was observed. Likewise, no relationship between increased VOC and/or inorganic compound concentrations and a decrease in macroinvertebrate community fitness was observed. It is likely that the observed macroinvertebrate community integrates exposures to a number of stressors present in the Hudson River in the vicinity of Albany.

Despite the presence of inorganic and VOC concentrations in excess of screening criteria in surficial sediments, review of the available macroinvertebrate biology data indicates that the diversity and abundance of the macroinvertebrate communities observed upstream of, adjacent to, and downstream of the Site are similar. Similarly, no relationship between elevated levels of compounds in the sediment and the macroinvertebrate community health was observed. There is some uncertainty as to whether compounds in sediment are likely to bioaccumulate into fish and, due to a lack of existing sediment data in the 0.5 – 2 ft horizon, there is some uncertainty as to the potential for risks to deep burrowing benthic receptors adjacent to the Site. Additional ecological risk analysis and evaluation of the preponderance of evidence from multiple measurement endpoints would be required to more definitively evaluate the potential for ecological risks due to exposure to stressors of concern.

5.0 Literature Cited

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About ENSR

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