PROPOSED REMEDIAL ACTION PLAN
HARBOR AT HASTINGS
Operable Unit No. 2

Village of Hastings-on-Hudson,
Westchester County, New York
Site No. 3-60-022

October 2003

Prepared by:

Division of Environmental Remediation
New York State Department of Environmental Conservation

PROPOSED REMEDIAL ACTION PLAN

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Operable Unit #2
Village of Hastings, Town of Greenburgh
Westchester County, New York
Site No. 360022
October 2003

SECTION 1: SUMMARY AND PURPOSE OF THE PROPOSED PLAN

The New York State Department of Environmental Conservation (NYSDEC), in consultation with the New York State Department of Health (NYSDOH), is proposing a remedy for Operable Unit #2 (OU2) of the Harbor at Hastings site. As described in Section 2 below, Operable Unit #2 generally consists of the off-site impacts of the Harbor at Hastings site on the Hudson River. The first Operable Unit (OU #1), consisting of on-site soil and groundwater contamination, is the subject of a separate Proposed Remedial Action Plan.

The presence of hazardous waste has created significant threats to human health and/or the environment that are addressed by this proposed remedy. As more fully described in Sections 3 and 5 of this document, past wire manufacturing operations have resulted in the disposal of hazardous wastes, including polychlorinated biphenyls (PCBs) and metals. These wastes have contaminated the sediment and surface water in the Hudson River adjacent to the site and have resulted in:

- significant environmental damage associated with the releases of PCBs and metals from the site to the sediments and surface waters of the state;
- contravention of the surface water standard for bioaccumulation of PCBs, which was promulgated to protect humans who may consume fish (for concentrations of contaminants in surface water at the site, see Table 1);
- contravention of the surface water standard for bioaccumulation of PCBs, which was promulgated to protect fish-eating wildlife (for concentrations of contaminants in surface water at the site, see Table 1); and
- a bioaccumulation of contaminants in flora or fauna to a level that causes, or contributes to, significant adverse ecotoxicological effects in flora or fauna or leads or contributes to the need to recommend that human consumption be limited (for concentrations of contaminants in fish, see Table 5).

To eliminate or mitigate these threats, the NYSDEC proposes the following remedy for Operable Unit #2 of the Harbor at Hastings Site:

1. Removal of contaminated fill and sediments offshore of the northwest corner of the property that contains the highest levels of PCBs,
2. Dredging of soft sediment within approximately 100 feet of the remaining shoreline that contains greater than 1 part per

million (ppm) PCBs, and site-related metals that exceed site-specific remedial goals, and

3. Long term monitoring of the effects of residual contamination and periodic re-evaluation of the remedy.

The proposed remedy, discussed in detail in Section 8, is intended to attain the remediation goals identified for this site in Section 6. The remedy must conform with officially promulgated standards and criteria that are directly applicable, or that are relevant and appropriate. The selection of a remedy must also take into consideration guidance, as appropriate. Standards, criteria and guidance are hereafter called SCGs.

This Proposed Remedial Action Plan (PRAP) identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for this preference. The NYSDEC will select a final remedy for the site only after careful consideration of all comments received during the public comment period.

The NYSDEC has issued this PRAP as a component of the Citizen Participation Plan developed pursuant to the New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) Part 375. This document is a summary of the information that can be found in greater detail in the December 2000 remedial investigation (RI) report entitled "Remedial Investigation Report", the March 2003 feasibility study (FS) entitled "Feasibility Study", and other relevant documents. The public is encouraged to review the project documents, which are available at the following repositories:

Hastings Public Library
7 Maple Avenue
Hastings-on-Hudson, NY 10706
Mon - Wed: 9:30 - 8:30, Thur: 9:30 - 6:00,
Sat: 9:30 - 5:00, Sun 1:00 - 5:00
Phone: (914) 478-3307

Village Clerk
Municipal Offices
615 Broadway
Hastings on Hudson, NY 10706
Mon - Fri: 8:30 - 4:00
Phone (914) 478-3400

NYSDEC Region 3 Office
21 South Putt Corners Road
New Paltz, NY 12561-1696
Attn: Michael Knipfing
Monday - Friday: 8:30 - 4:30
Phone: (914) 256-3154

NYSDEC Central Office
625 Broadway, 12th Floor
Albany, NY 12233-7016
Attention: George Heitzman
Monday - Friday: 8:15 - 4:15
Phone: (518) 402-9774

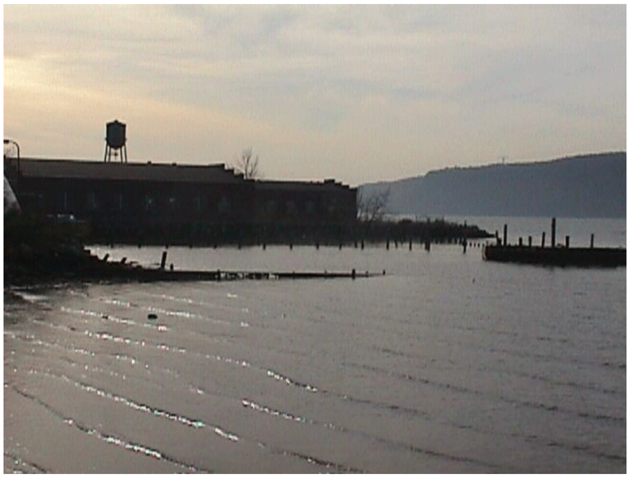
The NYSDEC seeks input from the community on all PRAPs. A public comment period has been set from October 27, 2003 through December 29, 2003 to provide an opportunity for public participation in the remedy selection process. A public meeting is scheduled for November 19, 2003 in the Hastings High School Auditorium beginning at 7:00 pm.

At the meeting, the results of the RI/FS will be presented along with a summary of the proposed remedy. After the presentation, a question-and-answer period will be held, during which verbal or written comments may be submitted on the PRAP. Written comments may also be sent to Mr. Heitzman at the above address through December 29, 2003.

The NYSDEC may modify the preferred alternative or select another of the alternatives presented in this PRAP, based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives identified here.

Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is the NYSDEC's final selection of the remedy for this site.

SECTION 2: <u>SITE LOCATION AND DESCRIPTION</u>



<u>The Property (Operable Unit #1)</u>

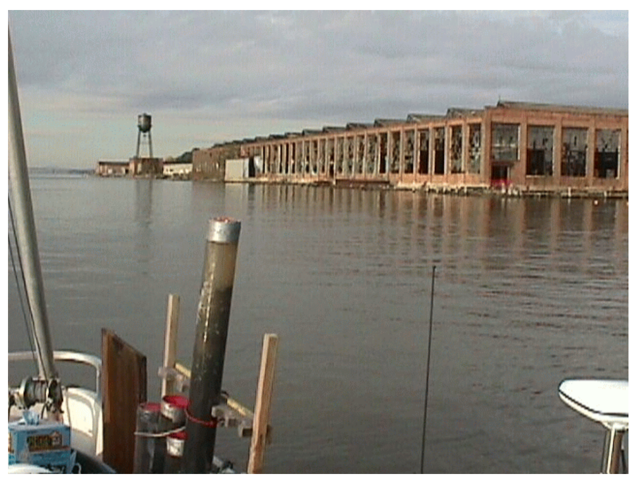
The Harbor at Hastings property is located on approximately 26 acres on the eastern shore of the Hudson River in the Village of Hastings-on-Hudson, Westchester County. As shown in Figure 1, the site is bounded to the east by the Metro North Commuter Railroad, and to the north and west by the Hudson River. To the south, the property is bordered by the former Mobil Oil Terminal and the Uhlich Color Company, which together comprise the Tappan Terminal Inactive Hazardous Waste Disposal Site #3-60-015.

The property landmass was created by filling into the Hudson River between the mid-1800's and the early 1900's. Specific sources of fill material are unknown, but common practice was to use demolition debris, ash and furnace slag as riverfront fill. The shoreline of the property is comprised of variable timber bulkheads, sheet piling, stone revetment, dock platforms, and timber piles that once supported docks.

Two point sources of past discharges to the Hudson River were observed during the investigation. A discharge pipe, permitted under the State Permit Discharge Elimination System (SPDES) is present along Building 15, at approximately the mid-point of the property shoreline. At the southern end of the site, a wooden sluice was present that appeared to be related to past industrial processes at the site. Buildings adjacent to this sluice included a boiler house and metal processing facility. This sluice was cut off from the river and backfilled in 2000 when the bulkhead at the southern end of the site was replaced.

Presently, the property is owned by ARCO Environmental Remediation Limited (AERL), a subsidiary of the Atlantic Richfield Corporation, who leases certain buildings on the site to three tenants. Other buildings are abandoned and in disrepair. Several of these buildings were demolished between 1999 and 2002. An estimated 90% of the property is covered by asphalt paving, concrete slabs or buildings.

<u>Off-Site Impacts (Operable Unit #2)</u>



This action or Operable Unit is the second of two Operable Units that have been designated for the inactive hazardous waste disposal site. An Operable Unit represents a portion of the site which, for technical or administrative reasons, can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination. This

Operable Unit addresses off-site contamination in the sediments and ecosystem of the Hudson River. For clarity, OU#2 will be referred to as “the site” in this PRAP, and OU#1 as “the property” in the discussion that follows. “Inactive hazardous waste disposal site” will include both operable units.

The site is located in the Hudson River between river miles 21.5 and 22, as measured from the southern tip of Battery Park in Manhattan, and is approximately 5 miles south of the Tappan Zee Bridge in Tarrytown. Operable Unit #2 (OU#2) is situated immediately west of OU#1, and its eastern boundary is the OU#1 shoreline. The remaining boundaries of OU#2 were determined as the extent of site-related sediment contamination, to the degree that it could be measured during the investigation. The western boundary of OU#2 is generally parallel to, and approximately 400 feet from, the shoreline. The northern boundary of the site is approximately 300 feet north of the northwest corner of the property, and includes the former marina area adjacent to the Hudson Valley Health & Tennis Club. The southern extent of the site extends approximately 500 feet south of the southern property line, and lies adjacent to the Tappan Terminal Site. Certain boundaries of the site are currently estimated, because the RI did not fully define the extent of OU#1-related contaminants in all directions. However, based on the known extent of contaminant migration, OU#2 comprises at least 35 acres.

SECTION 3: <u>SITE HISTORY</u>

3.1: <u>Operational/Disposal History</u>

c.1850 to 1919 - The land beneath the property was created by filling. Industries on the property included the National Conduit and Cable Company, the Hastings Pavement Company and the American Brass Company. Submerged fill material present beneath the OU#2 site may have also been placed there during this time period.

1919 to 1977 - The property was owned and operated by the Anaconda Wire and Cable Company for the manufacture of copper wire, lead covered cable, high voltage cable and insulated wire. Beginning in the late-1930's, PCB (Aroclor) mixtures were used to impregnate paper and asbestos-wrapped cable before the outer sheathing was applied. These PCB mixtures were prepared and the cables were impregnated in tanks housed in buildings located in the northwestern part of the site. A more complete description of the property history and industrial facilities is provided in the October 1995 “Summary and Evaluation of Existing Data” Report. In 1977, Anaconda was acquired by the Atlantic Richfield Corporation (ARCO).

1978 to 1998 - Several owners and tenants occupied the property. From 1988 through 1992, Building 15 was leased to Age Carting for operation as a construction and demolition (C&D) transfer station. During this period, an estimated 150,000 cubic yards of C&D waste was disposed in Building 15 and elsewhere on the property. Under a Court Order, this material was removed from the property by 1998.

1998 to present - In September 1998, AERL acquired the property from Harbor at Hastings Associates. During this period, several buildings in the southern part of the site were demolished, site security was improved, and all sub-leases with the three primary tenants were terminated.

3.2: <u>Remedial History</u>

Operable Unit #1 - Between 1976 and 1989, several geotechnical and environmental investigations were conducted on the property which involved soil sampling and analysis. In particular, the December 1987 "Site Investigation Report" summarized the results of surface and subsurface soil samples, groundwater monitoring, and building sump samples. Based on this report, the U.S. Environmental Protection Agency (EPA) issued a Preliminary Assessment for the property in January 1989. Additional investigations were conducted during 1989, resulting in the October 1989 "Environmental Investigation Report." These investigations revealed the presence of PCBs, petroleum hydrocarbons and metal contaminants in surface and subsurface soils. These contaminants were also found in groundwater beneath the property at levels exceeding water quality standards. The maximum concentration of PCBs found during these investigations prior to 1990 was 4,100 ppm in subsurface soils in the northwest corner of the property.

In July 1989, the NYSDEC listed the site as a Class 2 site in the Registry of Inactive Hazardous Waste Disposal Sites in New York. A Class 2 site is a site where hazardous waste presents a significant threat to the public health or the environment and action is required.

In November 1995, the Atlantic Richfield Company (ARCO) entered into an Order on Consent with the NYSDEC to perform an Remedial Investigation and Feasibility Study (RI/FS) for the inactive hazardous waste disposal site. The RI consisted of series of on-site investigations, which led to the discovery and delineation of an area of highly contaminated soil in the northwest corner of the property. As an extension of the northwest corner investigation, ARCO performed a series of 43 sediment borings in the river beginning in July 1998. Additional samples taken between July and September 1998 confirmed the presence of elevated levels of PCBs in Hudson River sediments.

Operable Unit #2 - As a result of these investigations, Operable Unit #2 of the inactive hazardous waste disposal site was designated in September 1998. In September 1998, fish samples were collected from the site which demonstrated that on-site related contaminants were accumulating in the flesh of certain species at concentrations exceeding local background and health-based levels. Based on this discovery, a fish advisory was issued by the NYSDOH to eat no American eel collected near the site.

SECTION 4: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers. The PRP for the site, documented to date, is ARCO Environmental Remediation, LTD. (AERL), an indirect subsidiary of BP/ARCO .

After OU#2 was designated, ARCO was given the opportunity to perform the RI/FS in conjunction with their supplemental OU#1 RI/FS work, but they declined. As a result, the OU#2 RI/FS was referred for implementation under the State Superfund.

After the remedy is selected, the PRP will again be contacted to assume responsibility for the remedial program. If an agreement cannot be reached with ARCO, the NYSDEC will evaluate the site for further action under the State Superfund. The PRP is subject to legal actions by the state for recovery of all response costs the state has incurred.

SECTION 5: SITE CONTAMINATION

A remedial investigation/feasibility study (RI/FS) has been conducted to evaluate the alternatives for addressing the significant threats to human health and the environment.

5.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site.

The RI was conducted between September 1998 and December 2000**.** The field activities and findings of the investigation are described in the December 2000 “Remedial Investigation Report”.

The following activities were conducted during the RI:

- Site surveying and off-shore bathymetry (water depth) measurements;
- Collection of sediment samples for chemical analysis from 99 site locations and 10 background locations. Samples were generally taken from the following intervals: 0-6 inches, 6 inches-2 feet, 2-4 feet, and every two feet thereafter. The maximum depth of sample collection for chemical analysis was 18 feet below the sediment surface;
- Sediment toxicity testing, both 10-day acute testing and 28-day chronic testing, on surficial sediment samples collected from 7 on-site and 2 background locations;
- Macroinvertebrate population surveys and tissue testing on specimens collected from surficial sediments at 7 on-site and 2 background locations; and
- Analysis of fish tissue from specimens collected from four on-site locations.

Additional investigation activities were conducted during the feasibility study. The field activities and results of these investigations are described in the November 2002 "Feasibility Study Report". The following supplemental investigation activities were conducted during the feasibility study phase:

- Surface water sampling at 4 locations on a time-weighted basis over a complete tidal cycle;
- Geotechnical testing of sediment and underlying silt and sand samples collected from 18 borings to a maximum depth of 82 feet below the sediment surface; and
- Measurement of river flow velocity and direction over a 2-day period of spring tide conditions. Measurement of naturally-occurring turbidity levels during this period.

To determine whether the sediments and surface water contain contamination at levels of concern, data from the investigation were compared to the following SCGs:

- Surface water SCGs are based on NYSDEC "Ambient Water Quality Standards and Guidance Values".
- Sediment SCGs are based on the NYSDEC "Technical Guidance for Screening Contaminated Sediments."

Background sediment samples were taken from 10 locations. These locations were upstream and across the river from the site, and were unaffected by historic or current site operations. The samples were analyzed for metals and PCBs. The results of the analysis were compared to data from the RI to determine appropriate site remediation goals. One background surface water sample was also taken and analyzed for metals and PCBs.

Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the site require remediation. These are summarized below. More complete information can be found in the RI report.

5.1.1: <u>Site Geology and Hydrogeology</u>

The Hudson River at Hastings-on-Hudson is a tidal estuary, subject to ebb and flow tides which repeat every 12.5 hours. The average daily water level variation between low and high tide is 5.1 feet. Water depths range from 0 to 42 feet in the study area. The navigable channel of the river is defined as areas where depth exceeds 18 feet below mean low water. The maximum depth of the river, approximately 50 feet, occurs about 1200 feet west of the OU#1 shoreline, which is one-quarter of the distance to the opposite shore.

Flow velocities measured at the site were as high as 4.0 feet per second (ft/s), and are generally lower closer to the shoreline and near the river bottom. Currents are strong at the site because of its location at the outlet of the Tappan Zee, where the river width decreases significantly and the flow is channelized. Salinity at the site is in the range of 10-14 parts per thousand, indicative of a brackish surface water, with little variation in salinity between water at the surface and bottom.

The Hudson River receives discharges of regional groundwater from the adjacent upland areas, which creates upflow through the sediment layers. A slight artesian condition was observed during the investigation of OU#1, in which the head of water in the underlying confined aquifer was above the ground surface. As a result of these upflow conditions, sediments beneath the river are partially unconsolidated, which contributes to their erosion and transport during normal flow conditions and storm events. The Hudson River also receives groundwater flow laterally from the unconfined upper water-bearing zone. This flow passes through the shoreline in areas where bulkheads are not water tight, and where stone revetment is present.

The following stratigraphic units, described from top to bottom, were identified beneath the site:

Soft Sediment Unit

The Soft Sediment Unit is a very loose silt and clayey silt layer that has been described as "soupy" and "fluffy", emphasizing its low solids content. Deeper samples of this unit were described as a black muck, indicating a slightly higher solids content.

The thickness of the Soft Sediment Unit varies considerably, depending on the erosional conditions at each sampling location. Offshore of the northwest corner of the property, which is an exposed headland area, the Soft Sediment Unit is 1 foot or less. Close to the property shoreline, where currents are slower, the thickness ranges from 5 to 10 feet. In the former marina and north boat slip, which are highly depositional areas, the Soft Sediment Unit is 14 to 24 feet thick. A deposition rate of 1-2 inches per year of soft sediment was measured in the north boat slip.

The upper portion of the Soft Sediment Unit is subject to erosion and re-deposition during normal flow conditions and storm events. It is also the unit which is most likely to support sediment-dwelling organisms (benthos).

Fill Unit

Unlike other units, the Fill Unit was found in only a limited portion of the study area, about ½ acre offshore of the northwest corner of the property. This unit appears to be a submerged extension of the fill used to create the property landmass, consisting of silt, sand and gravel mixed with varying amounts of brick, concrete, wood, slag, ash, glass, and cinders.

The surface of the Fill Unit has a downward slope away from the property shoreline, to where it pinches out approximately 150 feet from shore. Near shore, the Fill Unit is armored with boulders and large concrete pieces for erosion protection. The maximum depth of the fill unit is 25 feet.

Based on measurements of similar on-site fill, the Fill Unit is relatively permeable (2.5×10^{-3} cm/s). Because there is no shoreline bulkhead separating the on-site and off-site fill in the northwest corner area, they are believed to be hydraulically connected.

Marine Silt Unit

The Marine Silt Unit underlies both the Fill and Soft Sediment Units. It consists of a soft grey clay and silt with occasional layers of sandy silt and shells. It ranges in depth from 0 feet in the main navigable channel, to more than 40 feet throughout the site. Because of its low permeability (1x10^{-7} cm/s), the Marine Silt Unit serves as a confining unit for contaminants migrating from layers above and groundwater discharging from the layer below. Structurally, the Marine Silt Unit is highly compressible and has low shear strength, so it is not a suitable bearing surface for potential remedial structures.

Basal Sand Unit

The Basal Sand Unit, which was found between 54 and 67 feet below the sediment surface, consists of medium to coarse sand and gravel. The Basal Sand Aquifer has a relatively high permeability (10^{-3} cm/s), and is confined by the Marine Silt Unit above it. Structurally, the Basal Sand unit has a high bearing capacity, and is also known as "the bearing sand" because it supports the piles on which the on-site buildings are constructed. It would also be the bearing unit for any structures associated with the OU#2 remediation.

5.1.2: Nature of Contamination

As described in the RI report, many sediment and surface water samples were collected to characterize the nature and extent of contamination. As summarized in Table 1, the main categories of contaminants that exceed their SCGs are PCBs and inorganics (metals).

PCBs are a group of 209 different synthetic organic chemicals that were used in industry due to their resistance to heat and electrical insulating properties. PCBs have low solubility in water, low volatility in air, and tend to adsorb to oils, fats and carbon-rich materials, if available. In the environment, PCBs are relatively persistent, and are degraded only under certain highly favorable conditions. PCBs bioaccumulate in animals, and concentrations in portions of the food chain can be 100,000 times higher than the levels found elsewhere in the environment.

PCBs were typically formulated into "Aroclor" mixtures, in which the degree of chlorination varied depending on the use of the product. The primary PCB mixture found on the Harbor at Hastings property and in site sediments was Aroclor 1260, with lesser amounts of Aroclors 1254 and 1248. In pure form, Aroclor 1260 is 60% chlorine by weight, and is one of the heaviest, most viscous, and most persistent PCB mixtures. Aroclor 1260 is described in technical literature as a "sticky resin", but was reportedly mixed with a carrier solvent when it was used on the property. Aroclor 1260 has very low solubility in water, and is strongly bound to organic material in site sediments.

The highest levels of Aroclor 1260 found at the site were associated with an elastic material that resembles rubber cement. This elastic material also appeared as smaller hair-like filaments within the sediment matrix. It is believed that this elastic material is the Aroclor wire insulating mixture that was formulated in the northwest corner of the property. This material apparently migrated through the soil beneath the property and was washed into the river as eroded surface soil. Samples containing the elastic material were found in sediments adjacent to the northwest corner of the property, as indicated by "limits of rubbery

Elastic Material of Highly Concentrated PCBs
(sample collected from Operable Unit #1)

Hair-like Filament of Elastic Material
(sample collected from Operable Unit #1)

material" on Figures 2 and 4 through 10. Samples outside this area generally contained lower levels of PCBs, indicating that the contamination is sorbed onto the sediment particles.

The inorganic contaminants of concern are the metals copper, lead, mercury, nickel, silver and zinc. Copper and lead are known to have been used by Anaconda in the manufacture of wire and cable. Some of the remaining metals may be associated with the ash and furnace slag that comprises much of the fill beneath the property, and which has been discharged by erosion along the shoreline. Some of these metals, particularly mercury, may be partially attributable to upstream sources and atmospheric deposition.

5.1.3: Extent of Contamination

This section describes the findings of the investigation for the environmental media that were investigated.

Chemical concentrations are reported in parts per million (ppm) and parts per trillion (ppt) for surface water, and parts per million (ppm) for sediment and fish tissue. For comparison purposes, where applicable, SCGs are provided for each medium.

Table 1 summarizes the degree of contamination for the contaminants of concern in sediment and surface water, and compares the data with the SCGs for the site.

The following are the media which were investigated and a summary of the findings of the investigation.

Sediments

Sediments were divided into two subsets for evaluation: surface sediment (0-6 inches), and subsurface sediment (greater than 6 inches below the sediment surface). Contamination in surface sediment is considered to be the most bioavailable for uptake by organisms and transfer into the food chain. Subsurface sediments are a concern because they may become exposed by normal and extraordinary erosional events, causing contaminants in these sediments to become more bioavailable. Because groundwater flows upward through the sediments and discharges into the Hudson River, subsurface sediments are also a potential source for contaminants to dissolve into the water column and be transported into the river.

Surface Sediments (0-6 inches)

The extent of PCB contamination in surficial sediments is shown on Figure 2. The highest concentrations were found offshore of the northwest corner of the property, where a maximum value of 5200 ppm was found. That sample, which includes some elastic material, was taken at the edge of the fill unit, where it meets the soft sediment. It appears that the elastic material moved horizontally through the more permeable Fill Unit until it reached the edge of the unit, and surfaced at the top of the Soft Sediment. A conceptual model of PCB migration pathways in sediment is shown in Figure 3.

Elsewhere in the northwest area, surficial PCB concentrations range from 1 to 150 ppm extending about 250 feet from the shoreline. Next to this area,

Remediation Goals for PCBs in Sediments

For PCBs and other organic contaminants, the "Technical Guidance for Screening Contaminated Sediments" lists four screening values that correspond to different levels of protection. The following values for these criteria were calculated using the site-specific values of organic carbon content, as directed by the guidance:

Sediment Screening Criteria for PCBs

Protection of human health from toxic effects of bioaccumulation	0.015 ppb
Protection of wildlife from toxic effects of bioaccumulation	26.2 ppb
Protection of aquatic life from chronic toxicity	774 ppb
Protection of aquatic life from acute toxicity	258 ppm

Remediation Goals That Account for Background Contamination

Because sediments in the lower Hudson River are widely contaminated with low levels of PCBs that exceed some of these screening criteria, background levels were factored into the development of site-specific remediation goals.

Background levels of PCBs in the 10 samples taken upstream and across the river from the site ranged from non-detectable to 1.2 ppm. As a result, the Feasibility Study considered 1 ppm as a remedial goal based on background conditions.

offshore of the water tower area, surficial PCB levels range from 1 to 63 ppm, and are generally within 100 feet of the shore. In the former marina area, one sample, collected nearest to the shore, contained 22 ppm of PCBs. The remaining samples from this area contained less than 1 ppm of PCB.

Elsewhere, three isolated areas of lower level PCB contamination were found in surface sediments, as shown on Figure 2. These are

- 300-600 feet offshore of the North Boat Slip, where PCB levels are 2.8 to 9.9 ppm;
- 100-300 feet offshore of Building 15, where PCB levels are 1.5 to 2.7 ppm; and
- 0-600 feet offshore of the south end sluiceway, where PCB levels range from 1 to 48 ppm.

In the ten background surface sediment samples, the highest level of PCBs was 1.2 ppm, comprised totally of Aroclor 1248. Only one of these background samples had a detectable level of Aroclor 1260, 0.52 ppm of a total PCB concentration of 0.76 ppm.

Inorganic contaminants found in shallow sediments that exceed their SCGs include copper, lead, mercury, nickel, silver and zinc. The following is a summary of the patterns of detection for these metals. An explanation of the sediment screening criteria is provided in the boxes below.

- As shown on Figure 4, copper exceeded the severe effect level (ER-M) of 270 ppm in three locations: offshore of the sluice discharge area, offshore of the Building 15 SPDES discharge pipe, and in the northwest area over the Fill Unit. Concentrations of copper range from 683 to 2560 ppm in these areas. The low effect level (ER-L) of 34 ppm was exceeded in a wide area of the 35 acre site.
- As shown on Figure 5, lead exceeded the severe effect level of 218 ppm in three locations:

An Explanation of Sediment Remediation Goals for Metals

Sediment cleanup goals for metals are based on their toxicity to sediment-dwelling (benthic) organisms. For each metal, the following criteria were considered. Specific values are listed in Table 3.

Sediment Screening Criteria

The following effects-based values are based on observed toxicity from field studies, as reported in the literature:

Effects Range - Low (ER-L) - The level of sediment contamination that can be tolerated by most benthic organisms, but still causes toxicity to a few species. Also called the Low Effects Level.

Effects Range - Median (ER-M) - The level at which significant harm to benthic aquatic life is anticipated. Also called the Severe Effects Level.

Remediation Goals That Account for Background Contamination

Because sediments in the lower Hudson River are widely contaminated with some metals that exceed effects-based levels, background levels were factored into the development of site-specific remediation goals.

Preliminary Remedial Goal (PRG) - The greater of the Low Effects Level or the background concentration.

Modified Remedial Goal (MRG) - To evaluate the feasibility of achieving a range of cleanup values, several multiples of the PRG value were calculated. The extent of contamination that exceeds each level was plotted and visually examined. The trade-off between increasing protection and a more implementable remedy was then evaluated. With the exception of mercury, the selected MRG for all

offshore of the sluice area, in the northwest area over the Fill Unit, and far offshore of the northwest area, approximately 400 feet from the property shoreline. Concentrations of lead in these areas were 1390, 2700 and 462 ppm, respectively. The low effect level (ER-L) of 47 ppm was exceeded in a wide area of the site.

- Mercury exceeded the severe effect level of 0.71 ppm in a wide area of the site, as shown on Figure 6. Mercury also exceeded the ER-M in four of ten background samples, as shown on Table 4. The range of mercury contamination in shallow sediments (0.018 to1.4 ppm) is similar to background levels (0.41 to 2.5). The pattern of mercury contamination is that levels are higher near shore and near the former marina, which are both sediment deposition areas. Because mercury levels are consistent with background, and there is no pattern of mercury contamination near OU#1 source areas, mercury appears to be caused by regional or upstream contaminant sources.

- Nickel exceeded the severe effect level of 52 ppm in two surface sediment samples, one offshore of the sluice (1390 ppm), and one offshore o the water tower area (90 ppm). The low effects level (ER-L) was exceeded in 54 samples taken from the site.

- Silver exceeded the severe effect level of 3.7 ppm in two samples in the northwest area, where detections were 3.9 and 4.0 ppm. The low effect level of 1.0 ppm was exceeded in 51 samples site wide.

- Zinc exceeded the severe effect level of 410 ppm at two locations, offshore of the sluice (424-5710 ppm) and in the northwest area (826 ppm). The low effect level of 150 ppm was exceeded in 41 samples taken from the site.

Subsurface Sediments (> 6 inches)

As shown on Figure 7, PCB contamination is more widespread in the subsurface than in surface sediments. Concentrations are also generally higher in the subsurface, with several detections of PCBs greater than 1000 ppm in the Fill Unit samples taken from the northwest area. A significant area of PCB contamination is present west and southwest of the water tower, which is not present in surface sediments. PCB concentrations in this area range from 1 to 260 ppm.

In the old marina area, no PCBs were detected in deep sediments close to the shore, but a level of 41.6 ppm was found at the northern edge of the study area. To determine whether this is an isolated detection, anomaly, or pattern of northward migration, additional sampling is necessary.

Elsewhere, PCB concentrations are higher and more widespread in subsurface sediments offshore of Building 15 (2 to 97 ppm) than in corresponding surface sediments. At the southern end of the site, PCB levels are lower in the subsurface than at the surface, but extend to a greater extent and to a more southerly direction. Some of the PCBs detected in this area were Aroclors 1242 and 1248, which are not believed to be site-related.

The maximum depth of PCB contamination that exceeds 1 ppm occurs in the Fill Unit, where 22 feet or more of the sediment column is contaminated. Outside of the Fill Unit, the maximum depth of PCB contamination is approximately 10 feet in all areas.

In background subsurface sediment samples, the maximum PCB detection was 2.1 ppm, all of which was Aroclor 1248. No Aroclor 1260 was found in subsurface sediment samples.

The level and extent of metals contamination is also greater in subsurface sediments than in surface sediments, as discussed below:

- As shown on Figure 8, copper exceeded the ER-M (270 ppm) across a wide portion of the near shore area adjacent to the property. Of the 43 samples that exceeded the SCG, the highest levels were found offshore of the Building 15 discharge pipe (4310 ppm) and offshore of the sluice (2680 ppm).

- Lead exceeded the ER-M (218 ppm) in similar areas as copper, but to a lesser distance from the shoreline. Lead contamination was also found in the South Boat Slip, where the maximum value of 573 ppm was found.

- Mercury contamination was found in widespread areas of deeper sediment at the site. Subsurface sediment contained higher levels of mercury than surface sediment, and the highest of these (4.0 ppm) was found offshore of the Building 15 discharge pipe. As shown on Figure 9, there is no pattern of contamination that indicates the degree to which OU1-related sources have contributed to mercury contamination in subsurface sediments.

- Nickel exceeded the ER-M at the same locations as for shallow sediments, offshore of the sluice and offshore of the water tower area.

- Silver exceeded the ER-M of 3.7 ppm in broad areas offshore of the south boat slip, north boat slip and old marina areas. Concentrations in these areas reached 6.3, 6.5, and 5.9 ppm respectively, compared to the SCG of 3.7 ppm. Silver was not identified as a contaminant of concern on the OU#1 property, and the pattern of silver contamination is not consistent with the presence of on-site source areas.

- Zinc exceeded the ER-M (410 ppm) in subsurface sediments in three areas: offshore of the sluice, near the Building 15 discharge pipe, and offshore of the water tower area. Maximum concentrations in these three areas were 5710, 6450, and 1580 ppm, respectively.

Surface Water

Levels of PCB in Hudson River surface water were higher than the 0.001 parts per trillion (ppt) standard in all of the 5 samples taken. The highest level, 62.4 ppt, was found in the North Boat Slip area of the site. Elevated levels were also found in samples taken offshore of Dobbs Ferry, the background location (57.0 ppt), in the former marina area (52.7 ppt), and offshore of the northwest corner (46.6 ppt). The sample taken offshore of Dobbs Ferry was significantly more turbid than the others, and elevated levels seen there may have resulted from suspended material in the sample. A much lower level (18.0 ppt) was found in the south boat slip.

The PCB analysis for these samples was congener-specific, so an evaluation of Aroclor patterns was not performed. However, the highest degree of chlorination, which is consistent with higher numbered Aroclors (eg. Aroclor 1260), was found in the sample collected from the old marina. The lowest degree of chlorination was found in the sample collected from Dobbs Ferry, the upstream location. These results suggest that the site is a source of dissolved PCBs in the Hudson River.

Biota

Toxicity to sediment-dwelling macroinvertebrates was evaluated using both 10-day acute and 28-day chronic tests on sediment collected from 7 site locations, 2 background locations and control sediment. In the 10-day test, one site location, BS-5, located offshore of Building 15, showed a significant decrease in survival of the amphipod *Leptocheirus plumulosus* from the control sample. Survival in all other site and background samples was statistically consistent with the control samples. For the 28-day chronic test, survival of the annelid *Neanthes arenaceodentata* was significantly lower in one site sample (BS-7), taken near the sluice outfall, and one background sample (BS-8), located on the western shore of the river. Growth of *Neanthes* was affected at two locations, BS-2 (northwest area) and BS-7 (sluice outfall), indicating a sublethal effect.

Although the RI attempted to obtain some of the samples for toxicity testing from likely source areas, the analytical data indicates that this was not accomplished. As a result, areas of highest metals contamination were not tested for macroinvertebrate toxicity. Four of the seven test locations contained metals with concentrations similar to or less than the background and reference locations. The three site samples that demonstrated toxicity had metals concentrations (108, 192 and 198 ppm of copper) that were between the low effects level (ER-L) and severe effects level (ER-M). This indicates that moderate toxicity is occurring in site sediments with concentrations below the ER-Ms.

Population surveys of site and background sediments found a reduction of species diversity at three locations, BS-2 (northwest area), BS-4 (north boat slip) and BS-7 (sluice outfall).

Tissue samples from macroinvertebrates were analyzed to determine the degree of PCB bioaccumulation at lower levels of the food chain. To provide sufficient mass of tissue for analysis, specimens from areas of similar deposition characteristics and PCB levels were composited into a single sample, with the following results:

- Specimens collected from the old marina, northwest area, north and south boat slips contained 0.279 ppm of PCBs.
- Specimens collected from offshore of the sluice, Building 15 and the water tower areas contained 0.320 ppm of PCBs.
- Specimens collected from background locations contained 0.0784 ppm of PCBs.

Tissue samples of fish and crabs were collected from four site locations: the southern sluice outfall, near the south boat slip, near the north boat slip, and near the old marina. Specimens of white perch, mature striped bass (>6"), juvenile striped bass (<6"), blue crab and American eel were collected from each location. The results of these analyses are listed in Table 5 and summarized below.

- American eel contained the highest levels of PCB, ranging from 2.68 to 3.47 ppm. This compares to the Food and Drug Administration's (FDA's) tolerance of 2.0 ppm PCBs. The percentage of Aroclor 1260 in these samples was relatively high, ranging from 89 to 100 percent, indicating a high degree of site-specific impact.

- White perch contained the next highest levels of total PCBs, ranging from 2.48 to 3.08 ppm. Like eels, white perch have a high lipid (fat) content, which binds fat-soluble contaminants, such as PCBs, to their flesh. The percentage of site-related PCB, Aroclor 1260, was lower than for eels, ranging from 22 to 45 percent. This suggests less of a site-specific impact, which is consistent with the higher mobility of this species.

- Juvenile striped bass contained a higher level of PCBs than mature striped bass, 0.54 to 2.78 ppm versus 0.52 to 1.24 ppm. At three locations, the old marina, north and south boat slips, juvenile bass had a higher percentage of Aroclor 1260 (65% to 83%) than mature bass (34% to 37%). This indicates a greater degree of site-related contamination in the less mobile specimens. At the sluice location, where total PCBs were significantly lower (0.52 and 0.54 ppm) this pattern was reversed. Mature bass contained 82% Aroclor 1260 and juveniles contained 58%. This location is the farthest from the main PCB source area, and the impact on fish tissue is less.

- Blue crabs contained 0.79 to 1.11 ppm of PCB, of which 43 to 47 percent was Aroclor 1260.

5.2: <u>Interim Remedial Measures</u>

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. Several IRMs have been performed on OU#1, including an action at the southern end of the property to prevent further releases of contaminants to the Hudson River. However, no IRM has been conducted on OU#2.

5.3: <u>Summary of Human Exposure Pathways</u>:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the human exposure pathways can be found in the November 2002 "Risk Assessment", which can be found at the document repositories listed in Section 1.

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An 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.

The source of contamination is the location where contaminants were released to the environment (any waste disposal area or point of discharge). Contaminant release and transport mechanisms carry contaminants from the source to a point where people may be exposed. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (e.g., ingestion, inhalation, or direct contact). The receptor population is the people who are, or may be, exposed to contaminants at a point of exposure.

An exposure pathway is complete when all five elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future.

Although there is a potential for recreational users of the river to be exposed to site-related contaminants through the incidental ingestion of contaminated surface water and direct contact with contaminated sediments, the primary human exposure pathway is through the consumption of contaminated fish tissue.

The Harbor at Hastings site is located along the portion of the Hudson River that is south of the bridge at Catskill and north of the Upper Bay of New York. The NYSDOH issues health advisories that recommend limiting consumption of various fish species, blue crab and American eel from that segment of the Hudson River. For a small portion of the Catskill/Upper Bay river stretch between Dobbs Ferry and Greystone, the recommendation for American eel is more restrictive ("eat none"). The contaminants that led to these advisories are PCBs and, in the case of the recommendations regarding blue crab, PCBs and cadmium. To limit their exposure to these contaminants, the public is encouraged to follow the advisories, which are updated annually. The current advisories are available at the NYSDOH web site: (http://www.health.state.ny.us/nysdoh/environ/fish.htm). Advisories may also be requested by e-mailing BTSA@health.state.ny.us, or by calling the NYS DOH toll-free hotline at 1-800-458-1158 (ext. 27815).

5.4: Summary of Environmental Impacts

This section summarizes the existing and potential future environmental impacts presented by the site. Environmental impacts include existing and potential future exposure pathways to fish and wildlife receptors, as well as damage to natural resources such as aquifers and wetlands.

The Fish and Wildlife Impact Analysis, which is included in the RI Report, presents a detailed discussion of the existing and potential impacts from the site to fish and wildlife receptors. The following environmental exposure pathways and ecological risks have been identified:

- Toxicity of site sediments to sediment-dwelling organisms. Inorganic contaminant levels exceed screening levels for both low and severe impacts. Toxicity testing indicated variable acute and chronic toxicity at certain locations. Population surveys found a reduction in species diversity at impacted locations.

- Bioaccumulation of contaminants throughout the food chain, resulting in unacceptable levels in fish tissue, and risks to piscivorous wildlife. Both macroinvertebrates and resident fish species contained elevated levels of Aroclor 1260, the site-related PCB. An ecological risk assessment was performed on mink and great blue heron potentially exposed to contaminated fish, which resulted in a prediction of unacceptable reproductive effects.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- Unacceptable human exposures to PCBs in connection with the consumption of fish and shellfish, and the need to recommend that human consumption of fish and shellfish be limited;

- Unacceptable wildlife exposures to PCBs related to consumption of contaminated biota by fish-eating (piscivorous) wildlife;

- The toxicity of site sediments to sediment-dwelling organisms;

- The potential for recreational users of the river to be exposed to site-related contaminants through the incidental ingestion of contaminated surface water and direct contact with contaminated sediments; and

- Exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.

Further, the remediation goals for the site include attaining to the extent practicable:

- The surface water standard for PCBs that was promulgated to protect humans who may consume fish;

- The surface water standard for PCBs that was promulgated to protect piscivorous wildlife.

SECTION 7: <u>SUMMARY OF THE EVALUATION OF ALTERNATIVES</u>

The selected remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for Operable Unit #2 of the Harbor at Hastings Site were identified, screened and evaluated in the November 2002 "Feasibility Study" which is available at the document repositories identified in Section 1.

A summary of the remedial alternatives that were considered for this site are discussed below. The present worth represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved.

7.1: <u>Description of Remedial Alternatives</u>

The following potential remedies were considered to address the contaminated sediments, surface water and biota at the site.

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<u>Alternative 1 - No Action</u>

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

Present Worth:	$ 0
Capital Cost:	$ 0
Annual O&M:	$ 0

<u>Alternative 2a - Capping Areas of Surficial Sediment Contamination</u>

To prevent direct human and wildlife exposure to contaminated surface sediments (0 to 6 inches deep), a cap would be installed over areas where SCGs are exceeded. The top six inches of sediment represents the most biologically active zone and the zone for which human exposure is most likely.

The cap would be constructed of layers of clean sand totaling 24 inches, and a 6-inch erosion protection layer. The material used for erosion protection would vary with water depth and the associated erosional conditions. In areas less than 10 feet deep, where the current, wave forces, boat

traffic and ice impacts are the greatest, rip rap or other ecologically suitable material would be used. In areas between 10 and 30 feet deep, gravel would be placed. In areas greater than 30 feet, coarse sand would be used.
A geotechnical analysis of the conceptual cap design indicates that an initial application of 6 inches of sand is necessary to stabilize the soft sediment before the remaining cap is applied. Because this layer would compress into the existing sediment, the resulting cap thickness would be 24 inches. A cross section of the underwater cap is shown below.

The extent of the cap, where PCBs exceed 1 ppm and metals exceed their SCGs in the top 6 inches of sediment, would be approximately 18 acres. The cap would not be placed over areas where contaminated sediment is presently covered by at least 6 inches of clean sediment.

The underwater cap would require long term monitoring and maintenance to ensure that eroded cover material would be replaced and the cap remains effective.

Present Worth:	$ 8,800,000
Capital Cost:	$ 5,300,000
Annual O&M:	$ 227,000
Time to Implement	1 year

Alternative 2b - Capping all Areas of Contaminated Sediment

Cross Section of Underwater Cap

6"Erosion Protection Layer
24" Barrier Layer
6" Stabilization Layer (sand)
Existing Sediment

For this alternative, the potential for exposure to both shallow and deep contaminated sediment would be mitigated by capping over all areas of contamination. This would prevent direct exposure to existing contaminated surface sediment, and would also prevent subsurface soils from becoming exposed due to erosion and redistribution. The cap design would be the same as described in Alternative 2a. However, it would cover an estimated 39 acres where PCBs exceed 1 ppm and metals exceed their SCGs in both surface and subsurface sediment.

Present Worth:	$ 14,200,000
Capital Cost:	$ 10,700,000
Annual O&M:	$ 227,000
Time to Implement	1 year

Sediment Removal Alternatives

The remaining alternatives (3, 4, 5 and 6) involve varying degrees of sediment removal and off-site disposal, either alone or in combination with an underwater cap. The following discussion of conceptual sediment removal methods applies to all these alternatives.

Excavation and Dredging Methods

Sediments can be removed from waterbodies by two primary methods, mechanical excavation and hydraulic dredging. Mechanical excavation involves the use of clamshell-type buckets operated from cranes mounted on shore or on barges. Some buckets are specifically designed for environmental dredging applications, and feature watertight seals, flat bottomed cuts and precision positioning. Mechanical dredging may generate a large amount of re-suspended material, but is preferable in areas with large-sized rocks and debris. Mechanical excavation also produces a dredged material with a high solids content that requires less dewatering for shipment and disposal off site.

Hydraulic dredging is the process of removing sediment by creating a slurry mixture of sediment and water and pumping it through a watertight pipeline to a dewatering facility. Several types of vessel-mounted hydraulic dredges are available, including the horizontal auger dredge, which is commonly used for contaminated sediment remediation. When operated properly, the slurry pumping rate matches the rate of advance of the dredge, and re-suspension of contaminated sediment is minimized. Hydraulic dredging produces less particle re-suspension than mechanical dredging, but cannot operate effectively where debris or boulders are present. Hydraulic dredges require a minimum water depth for vessel access, and have difficulty holding position in windy or wave-impacted areas. Hydraulic dredging produces a low solids slurry that requires extensive dewatering, with high associated water treatment costs.

Recent advances in dredging technology have resulted in “specialty dredges”, which were developed to produce a higher solids slurry while minimizing re-suspension. Some of these dredges were developed and patented overseas, and have limited availability in the United States. These include the Pneuma Dredge™, which uses pneumatic (air) pressure to remove sediment and transfer it ashore to the treatment facility. The Pneuma Dredge™ was recently demonstrated on a reservoir dredging project in California, and was tested for remediation of Great Lakes (Canada) sediment contamination.

Containment Methods

Traditionally, contaminated sediments are excavated or dredged from within containment structures, such as silt curtains or sheet pile walls, to prevent the migration of contaminated particles that are re-suspended during removal. Because these structures serve as energy barriers to waves and currents, particles settle back to the sediment surface, and are removed by subsequent dredging or excavation.

Silt curtains are curtains made of synthetic geotextile fabric that are suspended from floats or booms at the top and held in place at the bottom with anchors or ballast chains. Curtains are often deployed in double rows; the outer curtain is designed to absorb current and wave energies, and the inner curtain is an impervious sediment containment fabric. Silt curtains are generally considered to be effective in flow velocities up to 1½ feet per second (ft/s). Based on flow measurements taken during the FS, silt curtains appear to be feasible within approximately 100 feet of the shoreline. However, this would be refined during the design phase by further flow studies and modeling.

Sheet pile walls, or cofferdams, are walls of interlocking steel sheeting that isolate the work area from the rest of the waterway. These walls must be designed to withstand the forces of current flow and fluctuating water levels, and must be embedded to a proper depth in a structurally sound soil layer. Sheet pile walls can fully encircle a work area, or can be installed as “wing walls”, to create a reduced energy area and enable the use of lower-cost silt curtains.

Areas of reduced energy can also be achieved using portable energy barriers such as moored deep draft barges or scows, or innovative methods such as Rapidly Installed Breakwater Systems™ (RIBS). The mobility of these barriers would enable them to be maneuvered to different work areas as work progresses. It is uncertain whether these methods would reduce the current sufficiently to enable the use of silt curtains beyond approximately 100' from the shoreline. The applicability of specific energy reduction measures would have to be evaluated by detailed flow modeling during the remedial design.

Another possible containment method is the use of specialized, pre-fabricated caissons. These are large diameter (12-20 feet) watertight chambers that are lifted into place using a barge-mounted crane and settle under their own weight into the soft sediments. After excavation, the caissons would be lifted out and moved to the next excavation area.

The use of caissons would be limited to small areas of moderate water depth, where debris or high levels of contaminants are present.

Several site-specific conditions present technical challenges to providing containment during sediment removal operations at the Harbor at Hastings site. These include the velocity of river currents (up to 4 ft/s), the daily tidal fluctuation in water level (up to 5 ft/day), and the great thickness (54-67 feet) of structurally unstable sediments. Based on these factors, a preliminary design of a sheet pile wall was prepared. The resulting design consists of 100-foot long, high strength steel sheets, costing an estimated $10,000 per linear foot of wall. Due to this very high cost, containment using sheet piling is only considered for critical areas of removal, where mechanical excavation is necessary, and contaminant levels are very high.

The following alternatives are described conceptually, and rely on different methods of removal and containment, depending on the area to be dredged. These areas are determined by the specific remedial goals for metals and PCBs, as discussed below. Alternatives that would remove highly contaminated sediments from the fill unit would use mechanical excavation within a sheet pile containment wall. Nearshore areas outside the containment wall would be contained with silt curtains where flow velocities are low, possibly in combination with energy barriers. After wooden piles and debris along the shoreline are removed mechanically, sediments would be removed by hydraulic dredging. Any offshore areas targeted for removal would be dredged with a hydraulic or specialty dredge either without containment, or within a specialized caisson.

Sediment Backfill

Certain portions of the dredged areas would be backfilled to retain the current sediment profile and preserve the associated habitat. Generally, shallow areas near the shoreline would be backfilled to current elevations. However the northwest corner, which is a currently a peninsula of submerged man-made fill material, would not be fully backfilled, but would instead be graded to blend into adjacent sediment areas. Deeper littoral zones, and areas of shallow removal (less than 1 foot) would rely on natural sedimentation to restore the surface elevations. The deposition rate in the boat slips and near shore areas is estimated to be 1-2 inches per year, based on radiological dating of sediment cores.

Areas designated for backfilling would be filled with sand to within 1 foot of the desired elevation. The remaining elevation would be gained by either natural sedimentation in depositional areas or backfill with a finer, more organic material that is suitable for habitat.

Treatment and Disposal

Sediment removed from the river, either by mechanical or hydraulic methods, would be dewatered on shore prior to transport to the disposal facility. Dewatering would be done mechanically, such as with filter presses, followed by stabilization with a binding agent such as lime. Water pressed from the sediment would be treated prior to discharge to the river in accordance with applicable regulations.

The disposal method for dewatered sediments would depend on the degree of contamination. Sediments containing less than 50 ppm of PCB and metals below their hazardous waste thresholds would be disposed at a permitted solid waste landfill. Sediments containing greater than 50 ppm PCB or metals that exceed their hazardous waste thresholds would be disposed at a facility permitted under the Toxic Substances Control Act (TSCA) and/or the Resource Conservation and Recovery Act (RCRA). Because copper does not have a hazardous waste threshold, and other metals are not present at high levels, the NYSDEC does not expect dewatered sediments to be hazardous due to their metals content. However, they would be tested to confirm this expectation.

Monitoring and Re-Evaluation

For alternatives that leave contaminated sediments in the river (Alternatives 2, 3, 4 and 6), long term monitoring would be conducted to evaluate the impacts of residual contamination and assess the long-term effectiveness of the remedy. This monitoring would track any changes in PCB and metals concentrations in surface sediment, sediment-dwelling organisms, fish, and the water column.

Surface sediment would be sampled annually to correlate the impacts of residual contamination on fish and benthic organisms. This sampling would also evaluate the degree of erosion and re-deposition of residual contaminated sediments. In conjunction with sediment monitoring, fish tissue samples would be collected to determine the degree of contaminant bioaccumulation. Benthic monitoring, including toxicity testing and population surveys, would also be conducted periodically to determine the level of toxicity associated with residual contaminant levels. The monitoring program would be designed to determine, in a statistically significant manner, if the local advisories concerning the human consumption of fish contaminated with PCBs could be lifted or reduced.

Based on the long-term monitoring data, the selected remedy would be reviewed periodically to determine if it is protective of human health and the environment, and meets the remedial goals for the project. The need for local fish consumption advisories would be reconsidered. If these could not be lifted or reduced, then an evaluation would be performed to determine whether additional remedial actions are feasible that would allow the advisories to be lifted or reduced. In a similar manner, the remedial review would also evaluate whether the other goals of the remedial program have been met, and whether or not additional remedial actions are feasible that would result in the other remedial goals being met. To determine which additional remedial actions would be considered if the goals of the proposed remedy are not met, a feasibility study would be performed in accordance with applicable guidance. Selection of any additional remedial actions would follow the NYSDEC remedy selection process, including provisions for public comment.

In addition to long-term monitoring, pre-construction and construction-phase monitoring would be conducted. Pre-construction monitoring would serve as a baseline for both construction-phase and long-term monitoring. Construction-phase monitoring would be conducted to determine the short-term impacts associated with implementation of the remedy and, if necessary, modification of construction methods to mitigate them.

Alternative 3 - Removal of Sediment to a Depth of 4 feet and Capping

Under this alternative, the contaminated sediment that is most available for erosion and redistribution would be removed and disposed off-site. Contaminated sediment would be removed until cleanup goals are achieved, or a maximum depth of 4 feet, whichever is less. Although definitive data is not available for the depth of existing sediment potentially disturbed during a storm event, a depth of 4 feet was selected based on a preliminary analysis.

Where removal of 4 feet of material would leave contaminated sediment behind, a cap would be placed, as described in Alternative 2a. Based on the expected consolidation of the cap material into the existing soft sediment, the cap thickness would be 24", and the resulting bottom elevation would be 2 feet lower than presently exists. The erosion protection layer of the cap would prevent future erosion and redistribution of the contaminated sediment beneath it.

The volume of contaminated sediments removed under this alternative would be 175,000 cubic yards, and the area to be capped would be 15 acres. These estimates are based on the areal extent of sediment which exceeds 1 ppm of PCB and background values for metals. The sediment removal area for this alternative would require some dredging beyond the limits of where silt curtains are believed to be feasible. Therefore dredging would be required either without containment, or using an innovative method.

Present Worth:	$ 61,400,000
Capital Cost:	$ 57,900,000
Annual O&M:	$ 227,000
Time to Implement	2 years

Alternative 4 Group:
Removal of Sediments with PCB > 10 ppm

Alternatives 4A and 4B were developed based on a PCB cleanup goal of 10 ppm, which is considerably higher than most of the ecologically-based cleanup guidelines listed in Table 2. This provides alternatives with higher residual values and lesser degrees of removal for consideration as part of the range of options. Similarly, the metals goal associated with Alternatives 4A and 4B is the severe effects threshold, which is associated with significant impacts to benthic life.

Alternative 4A - Removal of Sediment Containing PCBs > 10 ppm and Metals > ER-M

Under this alternative, sediments containing greater than 10 ppm PCBs and metals exceeding their severe effects level (ER-M) would be removed. The removal area corresponding to these levels would require dredging beyond the limits of where silt curtains are believed to be feasible. Therefore dredging would be required either without containment, or using an innovative method.

The volume of contaminated sediments removed would be 120,000 cubic yards over a 31-acre area. The maximum depth of sediment removed would be at least 22 feet in the northwest area.

Present Worth:	$ 71,100,000
Capital Cost:	$ 68,600,000
Annual O&M:	$ 163,000
Time to Implement	2 years

Alternative 4B - Removal of Sediment Containing PCBs > 10 ppm and Metals > ER-M and Capping

This alternative is a variation of Alternative 4A, with the addition of an underwater cap over areas where sediments containing residual concentrations of contaminants are not removed. These low levels correspond to PCBs between 1 and 10 ppm, and metals between background levels and their severe effects level (ER-M). The area to be capped would be 8 acres, all of which would be in water deeper than 30 feet.

Present Worth:	$ 73,900,000
Capital Cost:	$ 60,400,000
Annual O&M:	$ 227,000
Time to Implement	2 years

Alternative 5 Group:
Removal of Sediments with PCBs > 1 ppm

Alternatives 5A and 5B would remove sediments from the broadest area, corresponding to a cleanup level of 1 ppm PCBs. The two sub-alternatives provide a range of metal cleanup goals.

The removal area corresponding to these levels would require some dredging beyond the limits of the sheet pile containment wall discussed above, and beyond the areas where silt curtains are believed to be feasible (see "Containment Methods" above). Therefore, some dredging would be required either without containment, or using an innovative method in deeper water. Dredging would be performed by mechanical methods within the sheet pile containment area, and hydraulically elsewhere.

Alternative 5A - Removal of Sediment Containing PCBs > 1 ppm and Metals > PRG

For this alternative, all sediment containing greater than 1 ppm PCB and metals greater than the PRG would be removed and disposed off site. The resulting volume of sediments removed is estimated to be 540,000 cubic yards.

Present Worth:	$ 138,700,000
Capital Cost:	$ 136,200,000
Annual O&M:	$ 163,000
Time to Implement	3-4 years

Alternative 5B - Removal of Sediment Containing PCBs > 1 ppm and Metals > ER-M

For this alternative, all sediment containing greater than 1 ppm PCB and metals greater than their severe effect level (ER-M) would be removed and disposed off site. These cleanup levels would result in an excavated volume of 255,000 cubic yards of sediment.

Present Worth:	$ 101,000,000
Capital Cost:	$ 98,500,000
Annual O&M:	$ 163,000
Time to Implement	2-3 years

Alternative 6 Group:
Removal of Near Shore Sediments

Alternatives 6A, 6B, 6C and 6D specifically target contaminated sediments that can be removed using engineered controls for resuspended sediments. This includes both the sheet pile barrier wall around the fill unit, and silt curtains installed around the remaining area. Silt curtain installation is not recommended where current speeds exceed 1 knot (1.5 feet per second) or where water depths exceed 20 feet. As a result, Alternative 6 would limit removal to within approximately 100 feet offshore and within the sheet pile containment area. This area is delineated in Figure 10.

Additional flow study and modeling would be required during the design phase to confirm the areas where silt curtains are feasible. The feasibility of installing energy barriers to reduce the flow and extend the boundaries for silt curtain installation would also be evaluated. The result may be that the feasible limit for silt curtain installation is more or less than 100 feet from shore.

Alternatives 6A, 6B, 6C and 6D differ in the cleanup goals for both PCBs and metals within this removal area.

Because Alternative 6 would leave an extensive area of sediments with low levels of residual contamination, long-term monitoring and re-evaluation would be required. This residual contamination would remain in deeper water (greater than 20 feet).

Alternative 6A - Remove Nearshore Sediments Containing PCBs > 1 ppm and Metals > PRG

Alternative 6A provides the most protective cleanup levels for sediment removal within the nearshore area. Sediment containing greater than 1 ppm PCB and metals that exceed the Preliminary Cleanup Goal (PRG) would be removed. This corresponds to removal of 65,000 cubic yards of sediment.

Present Worth:	$ 51,400,000
Capital Cost:	$ 48,800,000
Annual O&M:	$ 163,000
Time to Implement	2 years

Alternative 6B - Remove Nearshore Sediments with PCBs > 1 ppm and Metals > MRG

Alternative 6B would remove sediments containing greater than 1 ppm of PCBs and metals that exceed their Modified Remedial Goals (MRGs). This corresponds to the removal of 57,000 cubic yards of sediment.

Present Worth:	$ 49,100,000
Capital Cost:	$ 46,600,000
Annual O&M:	$ 163,000
Time to Implement	2 years

Alternative 6C - Remove Nearshore Sediments with PCBs > 10 ppm and Metals > MRG

Alternative 6C would remove sediments containing PCBs greater than 10 ppm PCB and metals that exceed their Modified Remedial Goals (MRGs). This corresponds to 53,000 cubic yards of sediment.

Present Worth:	$ 48,000,000
Capital Cost:	$ 45,600,000
Annual O&M:	$ 163,000
Time to Implement	2 years

Alternative 6D - Remove Nearshore Sediments with PCBs > 10 ppm and Metals > ER-M

Alternative 6D provides the least protective cleanup goals of the alternatives under consideration for the nearshore area. Sediment containing PCBs greater than 10 ppm PCB and metals that exceed their Severe Effects Level (SEL) would be removed. This corresponds to 38,000 cubic yards of sediment.

Present Worth:	$ 45,700,000
Capital Cost:	$ 43,200,000
Annual O&M:	$ 163,000
Time to Implement	2 years

7.2 Evaluation of Remedial Alternatives

The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York State. A detailed discussion of the evaluation criteria and comparative analysis is included in Chapter 5 of the FS report.

1. Protection of Human Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the NYSDEC has determined to be applicable on a case-specific basis.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

7. Cost-Effectivness. Capital costs and operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. The costs for each alternative are presented in Table 7.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the NYSDEC will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

SECTION 8: SUMMARY OF THE PROPOSED REMEDY

The NYSDEC is proposing Alternative 6A, removal of nearshore sediment containing greater than 1 ppm PCBs and metals exceeding PRGs, long term monitoring, and periodic reviews as the remedy for this site. As discussed below, Alternative 6A provides the best balance of implementability, short term effectiveness, long term effectiveness and cost of the alternatives under consideration. The elements of this remedy are described at the end of this section.

The proposed remedy is based on the results of the RI and the evaluation of alternatives presented in the FS. Alternative 6A is being proposed because, as described below, it provides the best balance of environmental protection and long term effectiveness with short term impacts, implementability, and cost. It would achieve the remediation goals for the site by removing those sediments that contain the highest levels of contamination and which can be removed without creating additional impacts. All of the sediment removal alternatives under consideration would be difficult to implement. The most difficult sediment to remove is furthest from shore, where the water is deepest and the current is strongest. In deep water, silt curtains, energy barriers and portable caissons cannot be deployed effectively, and dredging without containment would be the only feasible option. Dredging without containment poses the greatest risk of short term release of contaminants and migration beyond the existing site boundaries. Generally, the highest levels of sediment contamination are located closest to shore, where containment structures and energy barriers are more feasible and short term impacts to the river can be minimized. By targeting areas of higher contamination, which are generally closer to shore, Alternative 6A would remove a significant portion of site contamination without creating an undue risk of short term release.

Table 6 provides a comparison of key technical factors for each of the remedial alternatives that were evaluated. These factors include the total mass of PCB and copper that would be removed under each alternative, and the percent removal for each. Copper was selected as the representative metal for this analysis because it is most associated with operations at the former Anaconda plant, and because most site-related metals are co-located with copper. Table 6 also includes estimates of the mass of PCB and copper removed for each cubic yard of sediment removed, as indicators of removal efficiency.

As shown on Table 6, Alternative 6A would remove 71% of PCBs and 75% of copper from the site. The higher cleanup levels associated with subalternatives 6B, 6C and 6D would remove significantly less PCB and metals from the nearshore area (54% to 57% of copper). Because Alternative 6A provides a higher degree of contaminant removal at a moderate increase in cost (approximately 5% more than alternative 6B), without creating additional risks of uncontrolled release, it is the preferred alternative. Although Alternatives 5A and 5B would provide the highest degree of environmental protection, the substantially increased cost ($139 million and $ 101 million, respectively), and risk of uncontrolled releases are not justified.

As shown on Figures 4 and 8, the mass of copper unremediated by Alternative 6A corresponds to a widespread area of sediment with concentrations between 34 ppm (ER-L) and 270 ppm (ER-M). This range corresponds to the reported toxicity of sensitive benthic species, and observed impacts in site samples, but is below the threshold for severe effects to the benthic community. In spite of this, the NYSDEC believes that attempting to remediate the remaining inorganics in an area where containment is not feasible would not justify the additional cost or the potential short term risks. As discussed below, long term monitoring and periodic re-evaluation of the remedy would be necessary to determine whether the remedial goals for the site have been met.

Alternatives that rely solely on capping (Alternatives 2A and 2B) do not offer a permanent remedy and have poor long term effectiveness because they require extensive long term monitoring and maintenance. Long term monitoring of the river bottom to detect any disturbance of the cap would be difficult to perform, as would any required periodic maintenance. Significant damage to the cap due to human activities or an extreme flow event could cause an immediate release of contaminants that could re-contaminate clean sediments or migrate beyond the current site boundaries.

With the capping alternatives, the upflow of groundwater through highly contaminated sediment and discharge into the Hudson River would continue to occur. The resulting desorption of PCBs into the water column, which presently results in the contravention of PCB surface water standards, would likely continue. Similarly, Alternative 3, which would remove a maximum of 4 feet of sediment, would leave behind the highest levels of PCBs in the fill unit. Groundwater discharge through this unit would continue to cause contravention of the PCB surface water standard.

Capping would be difficult to implement, both technically and administratively. Placing cap materials in the high flow conditions of the site would require installation of energy barriers or restricting placement of certain materials to slack tide periods. Placement of a cap would constitute the filling of a wetland habitat and navigable waterway, and the associated permits would be difficult to acquire if a reasonable alternative is available. Finally, long term protection of a cap would require an institutional control to prevent disruption from activities such as navigational dredging, anchoring, and installation of structures. This may be incompatible with navigation needs and the potential future development of the property.

Implementation of Alternative 6A may be sufficient to meet the remedial goals for the site. It is difficult to accurately predict future PCB concentrations in sediment, the water column, and fish in the Hudson River after removal of the targeted areas of contamination. However, removal of the highest levels of sediment contamination, in conjunction with control of the on-site source areas, are expected to substantially reduce the contaminant loading to the ecosystem.

Because some contaminated sediments would remain unremediated under Alternative 6A, some residual risk to human and environmental receptors would also remain. The risk to human health is currently addressed through the local fish consumption advisory. The degree to which low levels of residual contamination would result in continued contravention of ambient water quality standards and contribute to unacceptable human and wildlife exposures is uncertain. To determine whether the proposed removal is sufficient to meet the remedial goals, or whether additional action is necessary, a long term monitoring program with periodic reviews would be necessary.

The estimated present worth cost to implement the remedy is $ 51,400,000. The cost to construct the remedy is estimated to be $ 48,800,000 and the estimated average annual operation, maintenance, and monitoring costs is $ 163,000.

The elements of the proposed remedy are as follows:

4. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS would be resolved.

5. Removal of sediments and fill offshore of the northwest corner of the property that contain the elastic matrix and the highest levels of PCBs. Removal of these materials would likely occur within a temporary sheet pile containment area using mechanical excavation methods. Sediments within the containment structure would be removed to a cleanup goal of 1 ppm PCB.

6. Removal of sediments within approximately 100 feet of the shoreline that contain greater than 1 ppm PCBs and metals greater than their Preliminary Remediation Goal (PRG) values. Removal of soft sediments would be performed within an area in which sediment resuspension can be feasibly controlled using silt curtains, possibly in combination with energy reduction barriers. The extent of this area would be determined during the design phase of the project.

7. On-site dewatering of dredged and excavated sediments for off-site transportation and disposal. Water removed from sediment would be treated and discharged back to the river in compliance with regulatory requirements.

8. Since the remedy would result in contamination remaining in Operable Unit 2 of the Harbor at Hastings site, a long term monitoring program would be conducted. Elements of the monitoring program would include:

- Annual surficial sediment sampling;

- Annual biota sampling in the vicinity of the site and at reference locations;

- Surface water sampling in the vicinity of the site and at reference locations.

This monitoring program would be designed to measure PCB and metals levels and evaluate the long-term contaminant trends in the affected media (biota, sediment, water). One goal of the monitoring program would be to determine, in a statistically significant manner, if the local advisory concerning the human consumption of American eel contaminated with PCBs could be lifted or reduced. This program would monitor the effectiveness of the remedy in achieving the remedial goals established for the project, and would be a component of the monitoring and maintenance for the site.

6. Remedial reviews would be conducted periodically to determine if the remedy is protective of human health and the environment and meets the remedial goals for the project.

   If after the first periodic review the local American eel consumption advisory cannot be lifted or reduced, then an evaluation would be performed to determine whether additional remedial actions are feasible that would allow the advisory to be lifted or reduced. In a similar manner, the remedial review would also evaluate whether the other goals of the remedial program have been met, and whether or not additional remedial actions are feasible that would result in the other remedial goals being met.

   To determine what additional remedial actions would be considered if the goals of the proposed remedy are not met, a feasibility study would be performed in accordance with applicable guidance. Selection of any additional remedial actions would follow the NYSDEC remedy selection process, including provisions for public comment.

Table 1
Nature and Extent of Contamination
Samples Collected Between 1998[a] and 2001

SURFACE SEDIMENTS (0-6 inches)	Contaminants of Concern	Concentration Range Detected (ppm)[b]	SCG[c] (ppm)	Frequency of Exceeding SCG
PCBs	Total PCBs	ND[d] (0.033) - 5,200	See Table 2	See Table 2
Inorganics	Arsenic	ND (1.5) to 7.2	ER-L[e] 8.2 ER-M[e] 70	46 of 78 0 of 78
	Cadmium	ND (0.37) to 6.4	ER-L 1.2 ER-M 9.6	24 of 41 0 of 41
	Copper	ND (2.5) - 2560	ER-L 34 ER-M 270	63 of 78 4 of 78
	Lead	ND (15.3) - 2700	ER-L 47 ER-M 218	59 of 78 3 of 78
	Mercury	ND (0.018) - 1.4	ER-L 0.15 ER-M 0.71	68 of 78 45 of 78
	Nickel	ND (6.6) - 1390	ER-L 21 ER-M 52	54 of 78 2 of 78
	Silver	ND (0.05) - 4.0	ER-L 1.0 ER-M 3.7	51 of 78 2 of 78
	Zinc	ND (29.3) - 5710	ER-L 150 ER-M 410	41 of 78 3 of 78
SUBSURFACE SEDIMENTS (> 6 inches)	**Contaminants of Concern**	**Concentration Range Detected (ppm)[b]**	**SCG[c] (ppm)**	**Frequency of Exceeding SCG**
PCBs	Total PCBs	ND (0.33) - 5,500	See Table 2	See Table 2
Inorganics	Arsenic	ND (2.2) to 39.3	ER-L 8.2 ER-M 70	202 of 323 0 of 323

TABLE 1
Nature and Extent of Contamination (Continued)

SUBSURFACE SEDIMENTS (> 6 inches)	Contaminants of Concern	Concentration Range Detected (ppm)[b]	SCG[c] (ppm)	Frequency of Exceeding SCG
	Cadmium	ND (0.19) to 6.9	ER-L 1.2 ER-M 9.6	142 of 235 0 of 235
	Copper	ND (0.092) - 4310	ER-L 34 ER-M 270	159 of 323 43 of 323
	Lead	ND (3.0) - 573	ER-L 47 ER-M 218	151 of 323 8 of 323
	Mercury	ND (0.032) - 4.0	ER-L 0.15 ER-M 0.71	167 of 318 141 of 318
	Nickel	ND (0.042) - 497	ER-L 21 ER-M 52	196 of 323 4 of 323
	Silver	ND (0.043) - 6.5	ER-L 1.0 ER-M 3.7	112 of 323 25 of 323
	Zinc	ND (6.3) - 6450	ER-L 150 ER-M 410	128 of 323 21 of 323
SURFACE WATER	**Contaminants of Concern**	**Concentration Range Detected**	**SCG[c]**	**Frequency of Exceeding SCG**
PCBs	Total PCBs	18.0 to 57.0 ppt[b]	0.001 ppt	4 of 4
Inorganics	Lead	6.3 to 23.1 ppm	8.0 ppm	2 of 4

[a] Includes 43 locations sampled by ARCO in 1998 prior to the Remedial Investigation

[b] ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;
ppt = parts per trillion, which is equivalent to picograms per liter, pg/L, in water;

[c] SCG = standards, criteria, and guidance values.

[d]ND -Not detected at the detection limit listed in parentheses. Where detection limits vary for each contaminant, the lowest value is given.

[e]ER-L = Effects Range - Low and ER-M = Effects Range - Median. A sediment is considered to be contaminated if either of these criteria is exceeded. If both criteria are exceeded, the sediment is severely impacted. If only the ER-L is exceeded, the impact is considered to be moderate.

Table 2
PCB Screening Criteria for Alternate Levels of Protection

LEVEL OF PROTECTION	PCB SCREENING CRITERION	FREQUENCY OF EXCEEDANCE IN SURFACE SEDIMENT (0-6")	FREQUENCY OF EXCEEDANCE IN SUBSURFACE SEDIMENT (>6")
Human Health Bioaccumulation	0.015 ppb[a]	93 of 150	225 of 525
Wildlife Bioaccumulation	26.2 ppb	92 of 150	169 of 525
Benthic Aquatic Life Chronic Toxicity	774 ppb	57 of 150	128 of 525
Benthic Aquatic Acute Toxicity	258 ppm[a]	2 of 150	11 of 525
Maximum Background	1.2 ppm	48 of 150	116 of 525

These are site-specific values calculated based on the average measured organic carbon content of the sediment (1.87%).

[a] ppb = parts per billion, which is equivalent to micrograms per kilogram, ug/kg in sediment;
ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg in sediment;

Table 3
Cleanup Guidelines for Metal Contaminants

Contaminant	ER-L[a] (ppm)	Background (ppm)	PRG[b] (ppm)	MRG[c] (ppm) (Basis for MRG)	ER-M[a] (ppm)
Arsenic	8.2	11	11	17 (1.5 x background)	70
Cadmium	1.2	0.76	1.2	4.8 (4 x ER-L)	9.6
Chromium	81	63.4	81	122 (1.5 x ER-L)	370
Copper	34	88.7	88.7	178 (2 x background)	270
Lead	46.6	97.7	97.7	147 (1.5 x background)	213
Mercury	0.15	1.1	1.1	1.1 (1 x background)	0.71
Nickel	20.9	37.3	37.3	40 (1.1 x background)	51.5
Silver	n/a[d]	2.9	2.9	2.9 (1 x background)	n/a[d]
Zinc	150	260	260	260 (1 x background)	410

[a]ER-L = Effects Range - Low and ER-M = Effects Range - Median.
[b]PRG - Preliminary Remedial Goal (greater of ER-L or background)
[c]MRG - Modified Remedial Goal (multiple of PRG selected for evaluation in certain alternatives)
[d]n/a - Effects-based level is not available for silver in estuarine sediment

Table 4
Background Sediment Concentrations of Metals and PCBs

SURFACE SEDIMENTS (0-6 inches)	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)	Frequency of Exceeding SCG	Adjusted Maximum Background[c]
PCBs	Total PCBs	ND (0.061) - 1.2	1.0	1 of 10	
Inorganics	Arsenic	ND (0.6) - 11	ER-L 8.2	2 of 10	11.0
			ER-M 70	0 of 10	
	Cadmium	ND (0.056) - 0.64	ER-L 1.2	0 of 10	0.76
			ER-M 9.6	0 of 10	
	Copper	10.8 - 115	ER-L 34	8 of 10	88.7
			ER-M 270	0 of 10	
	Lead	13.9 - 142	ER-L 47	7 of 10	97.7
			ER-M 218	0 of 10	
	Mercury	0.41 - 2.5	ER-L 0.15	10 of 10	1.1
			ER-M 0.71	4 of 10	
	Nickel	4.1 - 37.3	ER-L 21	7 of 10	37.3
			ER-M 52	0 of 10	
	Silver	ND (0.14) - 3.5	ER-L 1.0	2 of 10	2.9
			ER-M 3.7	0 of 10	
	Zinc	26.7 - 260	ER-L 150	7 of 10	260
			ER-M 410	0 of 10	
SUBSURFACE SEDIMENTS (> 6 inches)	**Contaminants of Concern**	**Concentration Range Detected (ppm)[a]**	**SCG[b] (ppm)**	**Frequency of Exceeding SCG**	**Adjusted Maximum Background[c]**
PCBs	Total PCBs	ND (0.044) - 2.1	1.0	1 of 10	
Inorganics	Arsenic	6.1 - 14.9	ER-L 8.2	8 of 10	11.0
			ER-M 70	0 of 10	
	Cadmium	ND (0.42) - 2.7	ER-L 1.2	1 of 10	0.76
			ER-M 9.6	0 of 10	

Table 4
Background Sediment Concentrations of Metals and PCBs (continued)

SUBSURFACE SEDIMENTS (> 6 inches)	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)	Frequency of Exceeding SCG	Adjusted Maximum Background[c]
	Copper	7.7 - 204	ER-L 34	2 of 10	88.7
			ER-M 270	0 of 10	
	Lead	10.4 - 135	ER-L 47	2 of 10	97.7
			ER-M 218	0 of 10	
	Mercury	0.027 - 1.6	ER-L 0.15	2 of 10	1.1
			ER-M 0.71	2 of 10	
	Nickel	15.4 - 30.7	ER-L 21	6 of 10	37.3
			ER-M 52	0 of 10	
	Silver	ND (0.069) - 5.7	ER-L 1.0	2 of 10	2.9
			ER-M 3.7	1 of 10	
	Zinc	49.2 - 206	ER-L 150	1 of 10	260
			ER-M 410	0 of 10	

[a] ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil

[b] SCG = standards, criteria, and guidance values; SCGs for PCBs are listed as 1 ppm based on NYSDEC TAGM 4046 values for soil. A series of sediment screening SCGs are also listed in the NYSDEC's "Technical Guidance for Screening Contaminated Sediments". These are based on four different levels of protection, and are calculated based on the organic carbon content of the sediment. Using the average measured fraction of organic carbon (foc) in site sediment (1.87%), the resulting values are shown in Table 2.

[c] The adjusted maximum outlier concentration was determined by statistical analysis of the background data set and the identification and re-sampling of statistical outliers. For more details of this process, see the Feasibility Study.

Table 5 - Summary of Fish and Crab Tissue Data
Fall 1999

Location	Species	Total PCB (ppm)	% Aroclor 1260
Old Marina	White perch	2.48	45%
	Mature Striped bass	1.12	37%
	Juvenile Striped bass	2.78	83%
	Blue crab	1.05	47%
	American eel	2.68	90%
North Boat Slip	White perch	2.59	34%
	Mature Striped bass	0.65	34%
	Juvenile Striped bass	1.21	65%
	Blue crab	1.11	44%
	American eel	2.96	89%
South Boat Slip	White perch	2.73	22%
	Mature Striped bass	1.24	37%
	Juvenile Striped bass	1.06	69%
	Blue crab	1.04	43%
	American eel	3.47[1]	97%[1]
Sluice	White perch	3.08	40%
	Mature Striped bass	0.52	82%
	Juvenile Striped bass	0.54	58%
	Blue crab	0.79	46%
	American eel	3.06	100%

[1] - Average of 2 samples

Table 6:
Comparison of Sediment Removal and Capping Alternatives

Alternative #	Alternative 2a	Alternative 2b	Alternative 3	Alternatives 4A & 4B	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C	Alternative 6D
Components	Partial Cap	Full Cap	Remove Shallow Sediments (upper 4'); Cap Remainder	Remove PCBs >10 ppm, Metals > ER-Ms Cap Remaining (4B)	Remove all Sediment with PCBs >1 ppm Metals > PRGs	Remove Nearshore Sediment with PCBs > 1 ppm Metals > PRGs	Remove Nearshore Sediments with PCB > 1 ppm Metals > MRGs	Remove Nearshore Sediment with PCBs > 10 ppm Metals > MRGs	Remove Nearshore Sediment with PCBs > 10 ppm Metals > ER-Ms
Removal Volume	0	0	175,000 cy	120,000 cy	390,000 cy	65,000 cy	57,000 cy	53,000 cy	38,000 cy
Capping Area	18 acres	32 acres	15 acres	8 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Areas with uncapped Shallow Contaminants PCBs > 1ppm	14 acres	0 acres	2 acres	10 acres	0 acres	22 acres	22.2 acres	22.5 acres	22.9 acres
PCB Mass Removed**	0	0	1,900 lbs	5,500 lbs	6,200 lbs	4,400 lbs	4,300 lbs	3,400 lbs	3,400 lbs
% PCB Mass Removed***			31 %	89 %	> 99 %	71 %	69 %	55 %	55 %
PCB Mass Removed per Cubic Yard			0.01 lbs /cy	0.05 lbs/cy	0.02 lbs/cy	0.07 lbs/cy	0.08 lbs/cy	0.06 lbs/cy	0.09 lbs/cy
Copper Mass Removed**	0	0	27,000 lbs	33,000 lbs	61,000 lbs	46,000 lbs	35,000 lbs	35,000 lbs	33,000 lbs
% Copper Mass Removed***			44 %	54 %	> 99 %	75 %	57 %	57 %	54 %
Copper Mass Removed per Cubic Yard			0.15 lbs/cy	0.28 lbs/cy	0.16 lbs/cy	0.71 lbs/cy	0.61 lbs/cy	0.66 lbs/cy	0.87 lbs/cy

Alternative #	Alternative 2a	Alternative 2b	Alternative 3	Alternatives 4A & 4B	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C	Alternative 6D
Construction Seasons	1	1	2	2	2 to 3	2	2	2	2
Total Costs	$8.8 M	$14.2 M	$61.4 M	$71.1 M (4A) $73.9 M (4B)	$138.7 M	$51.4 M	$49.1 M	$48.0 M	$45.7 M
Unit Capping Costs	$295,000/ acre	$274,000/ acre	$333,000/ acre	$238,000/ acre (4B)					
Unit Removal/ Disposal Costs			$302/cy	$574/cy	$360/cy	$794/cy	$866/cy	$911/cy	$1,211/cy

Notes: Total Cost represents total present worth costs (capital and IM&M) calculated over 30 years with a 5% discount rate.
*The estimated lateral extent of shallow (0-0.5') contaminated sediments (PCBs >1 ppm, Metals > PRGs) is 32.2 acres.
**The contouring and weighted average concentration method used to estimate mass of PCBs and copper is estimated to have a 5-10% margin of error.
***Percentage of total mass present. Total mass of PCBs is estimated to be 6,200 lbs and copper is 61,000 lbs based on RAOs of PCB > 1 ppm and target metals > PRGs.
cy - cubic yards
lbs/cy - pounds per cubic yard
PRG - Preliminary Remediation Goal (Greater of background or Low Effects Level)
MRG - Modified Remediation Goal (Between PRG and ER-M, except for mercury)
ER-M - Effects Range - Median (Severe Effects Level)

Table 7
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
Alternative 1 - No Action	$ 0	$ 0	$ 0
Alternative 2a - Capping Areas of Surficial Sediment Contamination	$ 5,300,000	$ 227,000	$ 8,800,000
Alternative 2b - Capping all Areas of Contaminated Sediment	$10,700,000	$ 227,000	$ 14,200,000
Alternative 3 - Removal of Sediment to a Depth of 4 feet and Capping	$ 57,900,000	$ 227,000	$ 61,400,000
Alternative 4A - Removal of PCBs>10 ppm, Metals > ER-M	$ 68,600,000	$ 163,000	$ 71,100,000
Alternative 4B - Removal of PCBs>10 ppm, Metals > ER-M, Cap Remainder	$ 70,400,000	$ 227,000	$ 73,900,000
Alternative 5A - Removal of PCBs>1 ppm, Metals > background	$136,100,000	$ 163,000	$ 138,700,000
Alternative 5B - Removal of PCBs>1 ppm, Metals> ER-M	$ 98,500,000	$ 163,000	$ 101,000,000
Alternative 6A - Removal of Nearshore Sediments with PCBs > 1 ppm, Metals > PRG	$ 48,800,000	$ 163,000	$ 51,400,000
Alternative 6B - Removal of Nearshore Sediments with PCBs > 1 ppm, Metals > MRG	$ 46,600,000	$ 163,000	$ 49,100,000
Alternative 6C - Removal of Nearshore Sediments with PCBs > 10 ppm, Metals > PRG	$ 45,500,000	$ 163,000	$ 48,000,000
Alternative 6D - Removal of Nearshore Sediments with PCBs > 10 ppm, Metals > PRG	$ 43,200,000	$ 163,000	$ 45,700,000

List of Figures