Hudson River PCBs Superfund Site

New York

USEPA
Region 2
December 2000

MARK YOUR CALENDAR

December 12, 2000 to February 16, 2001: Public comment period on the Proposed Plan.

December 12, 2000 at 7:00 p.m.: Public meeting at Civic Center, Saratoga Springs, NY.

December 14, 2000 at 7:00 p.m.: Public meeting at the Sheraton Civic Center Hotel, Poughkeepsie, NY.

PURPOSE OF THE PROPOSED PLAN

This Proposed Plan describes the remedial alternatives considered for the Hudson River PCBs Superfund Site and identifies the preferred remedial alternative with the rationale for this preference.

The Proposed Plan was developed by the U.S. Environmental Protection Agency (USEPA) in consultation with the New York State Department of Environmental Conservation (NYSDEC). USEPA is issuing the Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The alternatives summarized here are described in the Feasibility Study and other documents contained in the Administrative Record file for this site. USEPA encourages the public to review these documents to gain a more comprehensive understanding of the site and Superfund activities that have been conducted at the site.

This Proposed Plan is being provided as a supplement to the Agency's Hudson River PCBs Reassessment reports, including the Feasibility Study, to inform the public of USEPA's preferred remedy, and to solicit public comments pertaining to the preferred alternative, as well as all the remedial alternatives evaluated.

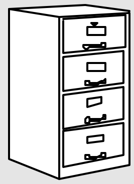
USEPA's preferred remedy consists of removal (targeted dredging) of 2.65 million cubic yards of contaminated sediment containing over 100,000 pounds of PCBs from the Upper Hudson River using environmental dredging techniques which minimize adverse environmental impacts, including the resuspension of sediments during dredging. The preferred remedy also includes Monitored Natural Attenuation (MNA) of the residual PCB contamination that remains in the dredged areas and the unremediated areas until the concentration of PCBs in fish tissue are at an acceptable level. Institutional controls such as fish consumption advisories and fishing restrictions will remain in place (although perhaps in a modified form) until these acceptable levels are achieved. Some of the dredged areas will be backfilled with approximately one foot of clean material to isolate residual PCB contamination and to replace habitat for biota. Dredged sediments will be dewatered and stabilized at treatment/transfer facilities and then transported via rail to off-site permitted disposal facilities outside of the Hudson River valley. A new landfill will not be constructed in the Hudson River Valley to receive the dredged sediments. The dredging will occur in conjunction with a separate Non Time Critical Removal Action (NTCRA) to be implemented to control upstream PCB sources in the vicinity of the General Electric Hudson Falls plant.

The remedy described in this Proposed Plan is the *preferred* remedy for the site. Changes to the preferred remedy or a change from the preferred remedy to another remedy may be made if public comments or additional data indicate that such a change will result in a more appropriate remedial action. The final decision regarding the selected remedy will be made after USEPA has taken into consideration all significant public comments. USEPA is soliciting public comment on all of the alternatives considered in the detailed analysis of the Feasibility Study because USEPA may select a remedy other than the preferred remedy.

Community Role in the Selection Process

USEPA relies on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, the Reassessment reports, including the Feasibility Study and the Proposed Plan, have been made available to the public for a public comment period which begins on December 12, 2000 and concludes on February 16, 2001.

A series of public meetings will be held during the public comment period to further elaborate on the reasons for recommending the preferred



The administrative record file, which contains the information upon which the selection of the response action will be based, is available at the following locations:

Crandall Library
City Park
Glens Falls, NY 12801
Phone 518-792-6508

Hours: Monday, Tuesday, Wednesday - 9 a.m. to 9 p.m.
Thursday & Friday- 9 a.m. to 6 p.m.
Saturday - 9 a.m. to 5 p.m.
Sunday - 1 p.m. to 5 p.m.

Adriance Memorial Library
93 Market Street
Poughkeepsie, NY 12601
Phone 845-485-3445

Hours: Monday thru Thursday - 9 a.m. to 9 p.m.
Friday & Saturday - 9 a.m. to 5 p.m.
Sunday - 1 p.m. to 5 p.m.

USEPA-Region 2
Superfund Records Center
290 Broadway, 18th Floor
New York, NY 10007-1866
(212) 637-4308

Hours: Monday-Friday, 9 a.m. - 5 p.m.

remedy and initiate the receipt of public comments. The first meeting will be at the Civic Center, Saratoga Springs, NY on December 12, 2000 at 7:00 P.M. A second meeting will be held on Thursday, December 14, 2000 at 7:00 p.m. at the Sheraton Civic Center Hotel in Poughkeepsie, NY. Additional public meetings/availability sessions will be held during the public comment period, after the public has had an opportunity to review and consider the preferred alternative and supporting documents. These additional public meetings will be announced by USEPA in the media to allow for participation by interested individuals.

Comments received at the public meetings, as well as written comments, will be documented and responded to in the Responsiveness Summary appended to the Record of Decision, the document that formalizes the selection of the remedy.

Written comments on this Proposed Plan should be addressed to:

Alison Hess/Doug Tomchuk
Hudson River PCBs Public Comment
U. S. Environmental Protection Agency
290 Broadway, 19th Floor
New York, NY 10007-1866

USEPA will accept comments postmarked by Friday, February 16, 2001.

SITE BACKGROUND

<u>Site Description</u>

The Hudson River flows in a generally southerly direction approximately 315 miles from its source at Lake Tear-of-the-Clouds on Mount Marcy in the Adirondack Mountains to the Battery in New York City. The Hudson River PCBs Superfund Site extends nearly 200 river miles (320 km) from the Fenimore Bridge in Hudson Falls (River Mile [RM] 197.3) to the Battery in New York City ([RM 0) at the tip of Manhattan Island. The Superfund site traditionally has been divided into the Upper Hudson River and the Lower Hudson River, based on physical and chemical characteristics. The Upper Hudson River extends from the Fenimore Bridge in Hudson Falls to the Federal Dam at Green Island in Troy (RM 153.9), a distance of about 43 river miles. The Lower Hudson River extends from the Federal Dam to the Battery (RM 0) (see Figure 1).

The Upper Hudson River was further divided into three sections in the Feasibility Study to evaluate remedial alternatives (see Figure 2). River Section 1 consists of the Thompson Island Pool, and extends about 6.3 miles from the former Fort Edward Dam (RM 194.8) to the Thompson Island Dam at RM 188.5.

The first 2.5 miles from the Fenimore Bridge to the former Fort Edward Dam are not a major focus of the Proposed Plan because the sediment PCB contamination has largely been addressed. This area consists primarily of rocky outcrops and little sediment, or areas of sediment that have already been remediated (i.e., the Remnant Deposits, which are discussed in greater detail in Site History). The area between the former Fort Edward Dam and the northern/upstream end of the Thompson Island Pool, a distance of 0.2 miles, contains shallow, fast moving water and primarily course-grained sediments that are believed to have minimal PCB inventory.

River Section 2 extends from the Thompson Island Dam to the Northumberland Dam (sometimes referred to as Lock 5) near Schuylerville (RM 183.4) an extent of about 5.1 river miles. River Section 3 extends from below the Northumberland Dam to the Federal Dam at Troy, an extent of about 29.5 river miles.

The mean annual flow of the Hudson River at Fort Edward is approximately 3,800 cubic feet per second (cfs). Downstream of Fort Edward, the river is joined by several tributaries; the largest in the Upper Hudson River is the Hoosic River near Schaghticoke. The combined total of the tributaries nearly doubles the flow of the Upper Hudson by the time it reaches Waterford, where the mean annual flow of the river is approximately 7,100 cfs.

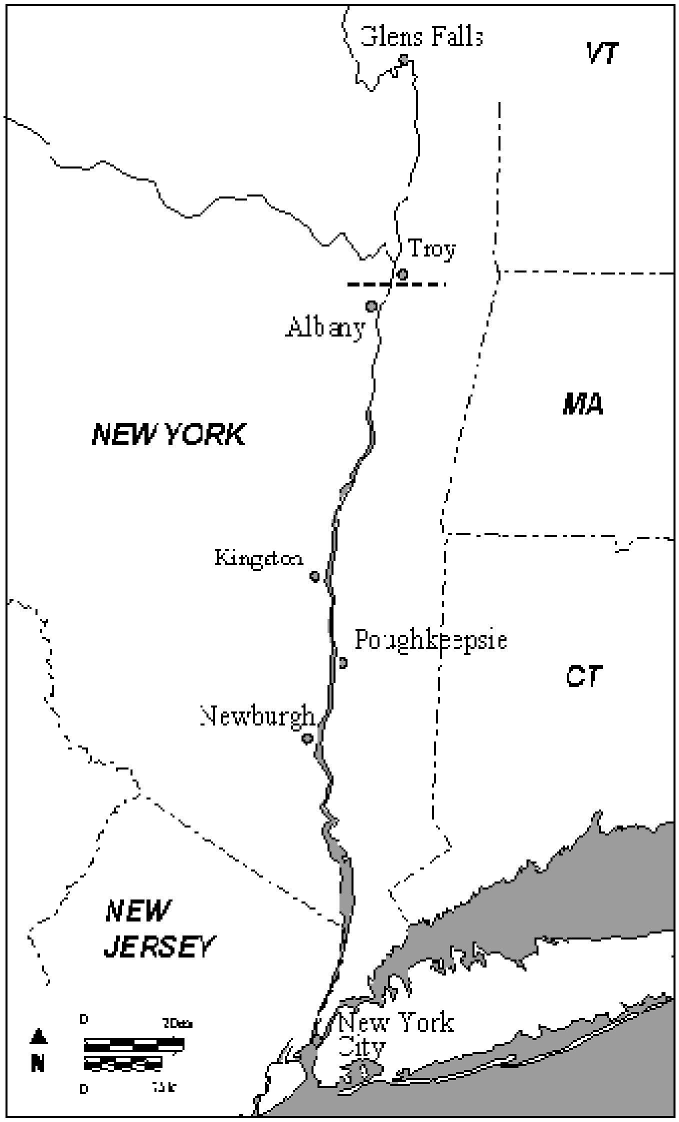


Figure 1

Within the Superfund site, there are eight dams with locks that form a series of pools in the Upper Hudson. The flow in the Upper Hudson is controlled by these dams and, to a lesser degree, by wetlands and backwaters in the vicinity of the river that act as buffers for high and low flow conditions. The flow in the Upper Hudson is also controlled by several reservoirs above Glens Falls, the most significant of which is Great Sacandaga Lake. The mean gradient of the Upper Hudson River is about 3 feet/mile. The gradient within each pool is smaller than the mean gradient for the Upper Hudson River overall, with elevation drops between the pools at the dams. The width of the Upper Hudson above Lock 4 in Stillwater is approximately 400 feet. The Upper Hudson has an average depth of less than 8 feet in the shoal areas and approximately 18 feet in the channel, with a maximum depth of more than 45 feet in a section below Thompson Island Dam. The total surface area of the Upper Hudson River is approximately 3,900 acres.

The Champlain Canal is coincident with portions of the Upper Hudson River, extending from Waterford (RM 158) on the Hudson to Whitehall at the southern end of Lake Champlain. The Champlain Canal is 60 miles long, including 37 miles of canalized Upper Hudson River from Waterford to Fort Edward and 23 miles of land-cut sections. The canal diverges from the river at Fort Edward just below Lock 7 and proceeds in a northeasterly direction to Lake Champlain. Additional land cut areas exist at Stillwater, Northumberland, and Fort Miller. The Hudson River between the Federal Dam at Troy and Lock 1 at Waterford is part of the Champlain Canal and the Erie Canal.

Bedrock, cut away to form the Champlain Canal, is exposed in some areas and lacustrine silts and clays of glacial age are exposed in other areas. Coarser-grained sediments have been observed in the channel and finer-grained sediments are more commonly seen in shallow slower-moving water. Wood chips are present in surface sediments in many locations as well as sediment mounds likely created by historic disposal of dredged spoils in the river.

Both federal and state freshwater wetlands exist throughout the Upper Hudson region. The 100-year floodplain ranges from approximately 400 to over 5,000 feet wide at places in the Upper Hudson.

Primary uses of the Hudson River include:

- *Public water supplies*: The cities of Waterford, Poughkeepsie, and Rhinebeck, as well as the Highland and Port Ewen Water Districts, obtain their water supplies directly from the Hudson River. In addition, a water intake near Chelsea, which is north of Newburgh, may be used to supplement New York City's water supply during periods of drought. Waterford is the only municipal water supply intake in the Upper Hudson River. The treatability study at Waterford Water Works, which was completed in 1990 pursuant to the 1984 Record of Decision, indicated that the treated water met standards applicable to public water supplies.

- *Industrial and commercial purposes*: Hudson River water is extensively used for hydroelectric and thermal power generation, as well as for manufacturing processes, cooling, and fire protection. A limited commercial fishery remains in the Lower Hudson River.

- *Domestic and agricultural purposes*: Hudson River water is also used for domestic purposes (watering lawns and gardens) and agricultural purposes (irrigating crops).

- *Transportation*: The Champlain Canal was a major transportation route in the past. Commercial traffic has declined significantly on the Canal over the last 30 years, but may experience some growth in the future through revitalization programs such as the American Heritage River initiative.

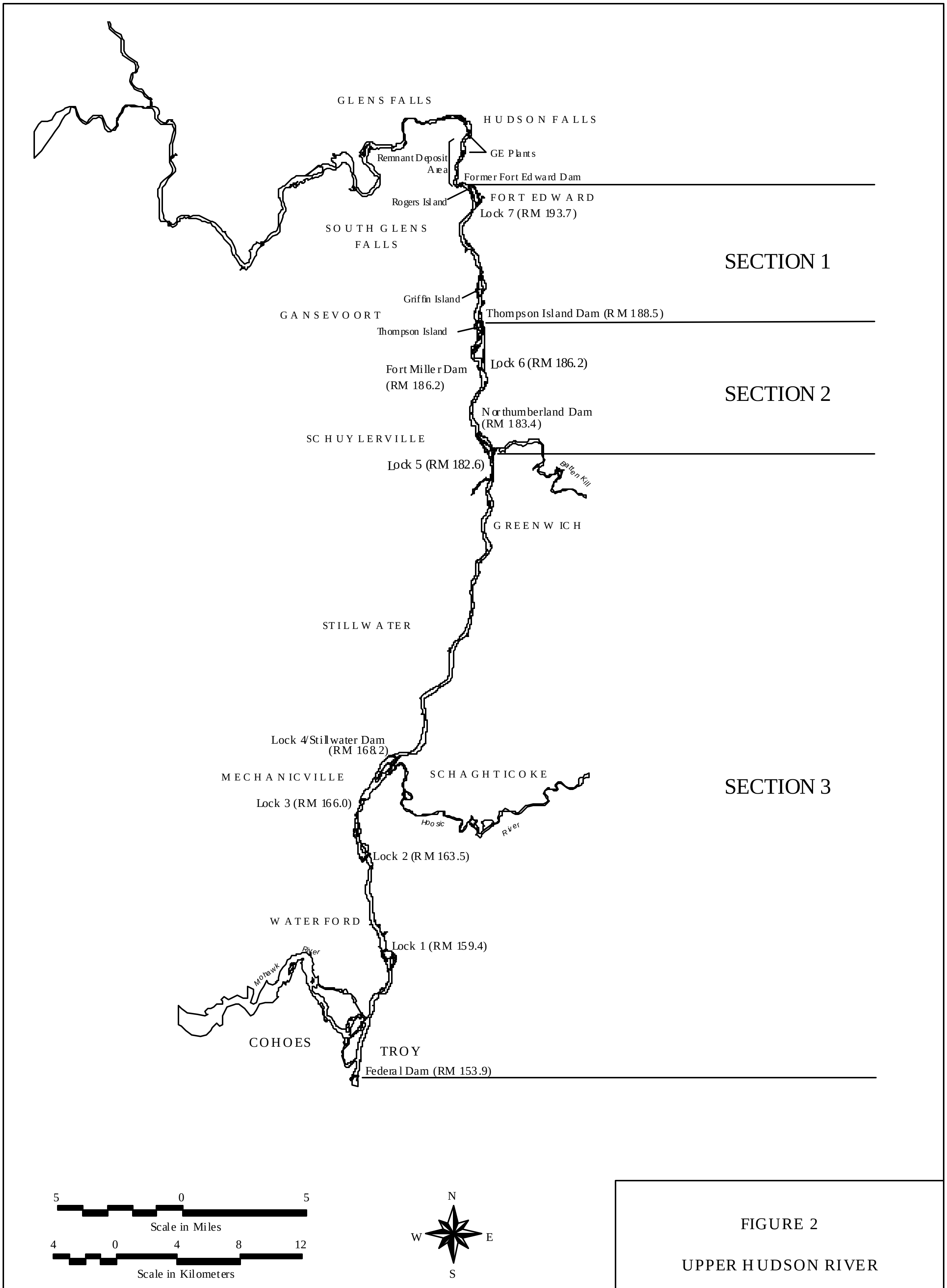


FIGURE 2

UPPER HUDSON RIVER

- *Recreation*: The Hudson River supports a variety of water-based recreational activities, which include sport fishing, waterfowl hunting, swimming, and boating.

- *Ecological Resources:* The Hudson River supports 206 species of fish as well as 143 species of resident and migrating birds. Sixty-four (64) species are listed as Threatened, Endangered, Rare or of Special Concern by federal and New York State authorities. There are 39 areas of significant habitat identified in the Lower Hudson River.

In addition, the Hudson River has been designated as an American Heritage River and has played a major role in the history, culture, and economy of the area.

Site History

General Electric Company (GE) operated a plant in Hudson Falls and still operates a plant in Fort Edward, New York. During an approximate 30-year period that ended in 1977, GE used polychlorinated biphenyls (PCBs) in the manufacture of electrical capacitors at both of these facilities. Excess PCB oils were discharged both directly and indirectly (particularly at the GE Hudson Falls plant) into the Hudson River. Estimates of the total quantity of PCBs discharged from the two plants into the river from the 1940s to 1977 range from 209,000 to 1,330,000 pounds (95,000 to 603,000 kg).

Many of the PCBs discharged to the river adhered to sediments and accumulated with the sediments as they settled in the impounded pool behind the Fort Edward Dam, as well as in other impoundments farther downstream. Because of its deteriorating condition, the Fort Edward Dam was removed in 1973. During subsequent spring floods, PCB-contaminated sediments from this area were scoured and transported downstream. These areas, which were surveyed by the NYSDEC in 1976-1978 and 1984, typically had average total PCB concentrations of 50 parts per million (ppm) or greater and are known as the NYSDEC-defined PCB *hot spots*. There were 40 NYSDEC-defined *hot spots*, located between RM 194 at Rogers Island and Lock 2 at RM 163. *Hot spots* 1 through 4 have been dredged by New York State for navigation purposes. In addition, not all the PCB-contaminated sediments behind the former Fort Edward Dam were scoured and transported downstream. Five areas of PCB-contaminated sediments were exposed due to lowering of the river water level when the Fort Edward Dam was removed. These five areas are known as the Remnant Deposits.

Legal action brought against GE by NYSDEC in 1975 resulted in a $7 million program for the investigation of PCBs and the development of methods to reduce or remove the threat of PCB contamination. In 1975, the New York State Department of Health (NYSDOH) began to issue health advisories recommending that people limit consumption of fish from the Upper Hudson River. In 1976, NYSDEC issued a ban on fishing in the Upper Hudson River from Hudson Falls to the Federal Dam at Troy, due to the potential risks from consumption of PCB-contaminated fish, and a ban on commercial fishing of striped bass, which migrate upriver into the Lower Hudson. NYSDEC replaced the ban against fishing in the Upper Hudson River with a catch-and-release fishing program in 1995. NYSDOH continues to recommend that people eat none of the fish in the Upper Hudson and that children under the age of 15 and women of child-bearing age eat none of the fish in the river for the entire length of the Superfund site. In addition, the commercial striped bass fishery in the Lower Hudson is still closed.

In 1974, the New York State Department of Transportation (NYSDOT) dredged approximately 250,000 cubic yards from the channels adjacent to Rogers Island for navigational purposes. The dredged materials were disposed of in Special Area 13, which is located along the west bank of the river just south of Rogers Island. Another 384,000 cubic yards of sediment were dredged from the east and west channels in 1974 and 1975 and disposed of in the Old Moreau Landfill, located on the west shore of the river opposite the southern end of Rogers Island (and just north of Special Area 13).

In 1977, the manufacture and sale of PCBs within the United States were generally prohibited under provisions of the Toxic Substances Control Act (TSCA). Although commercial uses of PCBs ceased in 1977, PCBs from GE's Fort Edward and Hudson Falls plants continued to contaminate the Hudson River, due primarily to erosion of the contaminated Remnant Deposits, discharges of PCBs via bedrock fractures from the GE Hudson Falls plant, and erosion from contaminated deposits above the water line near the GE Fort Edward plant outfall.

About 14,000 cubic yards of highly contaminated sediments were removed by NYSDEC from Remnant Deposit 3A in 1978 and were placed in a secure encapsulation site in Moreau, along with some 215,000 cubic yards of sediment that had been dredged by NYSDOT from the east channel of Rogers Island to clear the navigation channel just below the location of the former Fort Edward Dam. Unstable river banks of two of the Remnant Deposits were reinforced at that time. Three remnant sites were revegetated to prevent public contact with the sediments and to minimize erosion and release of PCBs into the environment.

No dredging in the Upper Hudson River has occurred since 1979, except for removal of coarse, uncontaminated sediments that periodically accumulate at the mouth of the Hoosic River, a tributary that empties into the Hudson River at RM 167.5 near Schaghticoke.

The site was proposed to the National Priorities List in 1983 and formally listed in 1984. The two GE capacitor manufacturing plants in Hudson Falls and Fort Edward are listed under the New York State Inactive Hazardous Waste Sites program.

In 1984, USEPA completed a Feasibility Study and issued a Record of Decision for the site. The Record of Decision did not address the PCBs-contaminated oil that is leaking through bedrock in the vicinity of the GE Hudson Falls plant, which was unknown at the time. USEPA recognized that PCB contamination in the Upper Hudson River sediments was a problem, but selected an interim No Action remedy for the contaminated sediments because, in the Agency's view, the reliability and effectiveness of remedial technologies available at that time were uncertain. The Record of Decision contained the following decisions:

- An interim No Action decision with regard to PCBs in the sediments of the Upper Hudson River;
- In-place capping, containment and monitoring of exposed Remnant Deposits (in the area of RM 195 to 196), stabilization of the associated river banks and revegetation of the areas; and
- A detailed evaluation of the Waterford Water Works treatment facilities, including sampling and analysis of treatment operations to see if an upgrade or alterations of the facilities were needed.

GE, under a 1990 Consent Decree with USEPA, conducted the in-place capping of the Remnant Deposits on the river bank (in the area of RM 195 to RM 196) from the former impoundment behind the Fort Edward Dam. The in-place capping of these Remnant Deposits included placement of a two-foot layer of soil and a manufactured geosynthetic clay liner, followed by grading and revegetating to minimize erosion. The river banks were stabilized with rock to prevent scouring. Cap construction and the erection of gates to limit site access were completed in 1991.

NYSDEC, with funding provided by USEPA, conducted a treatability study at the Waterford Water Works. The study was released in 1990 and found that PCB concentrations were below analytical detection limits after treatment and met standards applicable to public water supplies.

In December 1989, USEPA announced a reassessment of the interim No Action decision for the Upper Hudson River sediments as part of the five-year review required by CERCLA, and in consideration of advances in methodologies for sediment dredging technologies for PCB treatment/destruction, as well as a request for a reevaluation from NYSDEC. The Reassessment Remedial Investigation/Feasibility Study has been divided into three phases. Phase 1, consisting primarily of a review of existing data, was completed in August 1991. Phase 2, which included the collection and analysis of new data as well as modeling studies and human health and ecological risk assessments, began in December 1991 and concluded in November 2000. Phase 3, also known as the Feasibility Study, began in September 1998 with release of the Feasibility Study Scope of Work. The Feasibility Study is being released concurrently with this Proposed Plan.

As USEPA was beginning Phase 2 of the Reassessment in September 1991, GE detected an increase in PCB concentrations at the Upper Hudson River water sampling stations being monitored as part of the Remnant Deposits capping. GE ultimately attributed the higher levels to the collapse of a wooden gate structure within the abandoned Allen Mill located adjacent to the river bank at the GE Hudson Falls plant site. As reported by GE, the gate structure had diverted water from flowing through a tunnel cut into bedrock, thereby preventing oil-phase PCBs that had migrated to the tunnel via subsurface bedrock fractures from flowing into the river. From 1993 to 1995, GE removed approximately 45 tons of PCB-bearing oils and sediments from the tunnel under NYSDEC jurisdiction.

In 1994, GE documented the presence of PCB-contaminated oils in bedrock seeps at Bakers Falls adjacent to its Hudson Falls plant. GE has instituted a number of mitigation efforts that have resulted in a decline, but not total cessation, of PCBs entering the river through the seeps.

The GE Fort Edward plant 004 Outfall has also been a source of PCBs to the river. In January 2000, NYSDEC signed a Record of Decision that called for removal of PCB-contaminated soils and sediments near the 004 Outfall. NYSDEC is currently undertaking the Remedial Design of that remedy.

In 1998, USEPA conducted an evaluation of whether an early action would be warranted prior to completion of the Reassessment. This evaluation was prompted by findings of the Low Resolution Sediment Coring Report, in which USEPA determined that there were statistically significant losses of PCBs from the sediment to the water column. USEPA decided in December 1998 that no feasible and appropriate interim action was available, and the USEPA would complete the Reassessment as planned.

Extensive public involvement occurred during all phases of the Reassessment. In the early stages of the Reassessment, USEPA initiated the Community Interaction Program to involve interested citizens, government officials, environmental groups, and private interest groups in a unique effort to include their interests in the Reassessment. The foundation of the Community Interaction Program consists of four Joint Liaison Groups: Agricultural, Citizen, Environmental and Governmental. The Community Interaction Program also established the Steering Committee and the Oversight Committee, as well as the Scientific and Technical Committee, which is a group of researchers and scientists familiar with the site, PCBs, modeling, toxicity, and other relevant disciplines. All Reassessment reports have been reviewed by these groups as well as any individuals interested in the Reassessment.

USEPA has established and maintained 16 Information Repositories located in public buildings from Fort Edward to New York City and has placed copies of the Reassessment reports into these repositories. USEPA has held more than 65 public meetings during the course of the Reassessment. USEPA has responded to public comment on the Reassessment reports and has placed these Responsiveness Summaries in the Information Repositories as well.

Peer Review

In accordance with USEPA guidance and the *Peer Review Handbook*, the scientific work conducted for the Reassessment that is the basis for this proposed action has undergone external peer review. USEPA's major Phase 2 Reports have undergone external peer review by five panels of independent experts. These reports were the October 1996 Preliminary Model Calibration Report, the geochemistry reports (the February 1997 Data Evaluation and Interpretation Report and the July 1998 Low Resolution Sediment Coring Report), the August 1999 Human Health Risk Assessment, the August 1999 Ecological Risk Assessment, and the January 2000 Revised Baseline Modeling Report. Each peer review panel was asked to address specific questions, together called the "charge," regarding the methods USEPA used, the findings and conclusions of the report being reviewed, and controversial issues that were identified by the public prior to and during the peer review meeting. In addition, the panels were invited to address any other issues that were not specifically identified in the charge.

The peer reviewers generally agreed with the findings and conclusions of the reports, although they also requested revisions, including extensive revisions to the Ecological Risk Assessment. USEPA issued Responses to Peer Review Comments for each of the peer reviews as well as a Revised Human Health Risk Assessment and a Revised Ecological Risk Assessment, which include all changes made to address the peer review comments on those reports. Revisions were incorporated, as appropriate, into the Feasibility Study.

In addition, the Scientific and Technical Committee described previously, has provided peer input into the various documents USEPA prepared as part of the Reassessment.

What are PCBs?

The contaminant of concern at the Hudson River PCBs site is polychlorinated biphenyls (PCBs).

PCBs were widely used as a fire preventative and insulator in the manufacture of transformers and capacitors because of their ability to withstand exceptionally high temperatures.

PCBs are considered probable human carcinogens and are linked to other adverse health effects such as developmental effects, reduced birth weights and reduced ability to fight infection.

PCBs are a group of chemicals consisting of 209 individual compounds, known as ***congeners***. The congeners can have from one to ten chlorine atoms per molecule, each with its own set of chemical properties. When grouped by the number of chlorine atoms per molecule, the term ***homologue*** is used. PCBs were sold in mixtures containing dozens of congeners. These commercial mixtures were known in the U.S. as ***Aroclors***.

When released into the environment various processes can alter the pattern of PCBs from the original Aroclors. Analytical techniques vary and have improved over time. Congener-specific analyses were conducted for the Reassessment, but most of the older data was an interpretation of Aroclors. Therefore, a translation method was developed for the Reassessment to allow use of historic and recent datasets on a common basis. The parameter common to all data sets is known as ***Tri+ PCBs***, and represents the sum of PCBs with 3 to 10 chlorine atoms per molecule.

RESULTS OF REMEDIAL INVESTIGATION

Summary of Sampling Results

For its Reassessment Remedial InvestigationI/Feasibility Study, USEPA used data collected during its own sampling investigations, as well as data collected by many other agencies, institutions, and GE. The investigations include sediment surveys, river flow and water quality investigations, fish and biota sampling, air monitoring, and plant and crop uptake studies. USEPA's data collection for the Reassessment focused on the Upper Hudson River because that portion of the site is under consideration for possible remedial action. It was also the focus for the 1984 Record of Decision. PCB concentrations remain elevated in the Hudson River in the sediments, in the water column, and in the fish. Concentrations associated with the site generally decrease with distance down river.

Sediment

Areas of elevated concentrations of PCBs in sediment, i.e., *hot spots*, are found in depositional areas throughout the Upper Hudson (River Sections 1, 2, and 3).

River Section 1 (Thompson Island Pool) contains 20 of the 40 *hot spots* identified by NYSDEC in 1977 and 1984. The sediments exhibit a high degree of heterogeneity with respect to the distribution of PCBs. Historically, the highest concentrations of PCBs in sediments have been observed within the cohesive sediments of River Section 1, and generally lower PCB concentrations are found within the non-cohesive sediments. The maximum concentration measured was approximately 2000 mg/kg PCBs (or parts per million (ppm)). The average concentration in sediments (0 - 25 cm deep) in 1991 was approximately 42 mg/kg. It is estimated that there are approximately 34,000 lbs (15,400 kg) of PCB mass in the sediments in River Section 1.

River Section 2 (Thompson Island Dam to Northumberland Dam near Lock 5) contains 15 of the 40 NYSDEC-defined *hot spots*. The average concentration of PCBs in surface sediment (0 - 25 cm) in 1991 was approximately 26 mg/kg. The maximum concentration of PCBs in the Hudson, 4000 mg/kg, was found in this river section, in *Hot Spot* 28 in a thin slice of a sediment core.

River Section 3 (Northumberland Dam to Federal Dam at Troy) contains 5 of the 40 NYSDEC-defined *hot spots*. The average concentration in surface sediment (0 - 25 cm) in 1991 was approximately 9 mg/kg PCBs.

An assessment of concentrations of PCBs in sediments below Federal Dam is limited by the availabile data for this region (approximately 153 miles of the Lower Hudson River). An assessment of the Lower Hudson performed in the 1980s indicated that the average concentration of PCBs in sediment in New York Harbor was 0.8 mg/kg in 1970 and 0.5 to 0.7 mg/kg in the 1980s. USEPA estimates that approximately 50% of this contamination is attributable to the releases from the GE Hudson Falls and Fort Edward plants to the Upper Hudson.

Water Column

The dominant sources of PCBs to the water column of the Upper Hudson River may be separated into two groups: (1) PCB-contaminated sediments on the river bottom; and (2) PCB-contaminated oil from bedrock seeps from the GE Hudson Falls plant. There are other lesser discharges upstream of Rogers Island.

U.S. Geological Survey monitoring of PCBs in the water of the Upper Hudson River began in 1977. GE began monitoring of the Upper Hudson River in 1991. In River Section 1, PCB concentrations in the water column indicate that the sediments of the Thompson Island Pool are the major source of PCBs to the water column during low flow conditions, which are important as they coincide with the period of greatest biological activity.

During the summer of 1998 (June-September), the average concentration at the Thompson Island Dam-West station was 134 nanograms per liter (ng/L or parts per trillion). Concentrations from January 1996 through March 2000 averaged 90 ng/L. Five observations in excess of 300 ng/L were noted during the winter of 1999-2000.

Fish

PCB concentrations observed in fish are a result of exposure to PCBs in water and surface sediment, through either an aquatic food chain or a benthic food chain, respectively.

NYSDEC continues to collect and analyze fish tissue data from many locations in the Upper Hudson River. Converted to a Tri+ PCB basis, the concentrations in River Section 1 (Thompson Island Pool) in 1999 averaged about 21 mg/kg (wet weight) in largemouth bass and 13 mg/kg in brown bullhead. The maximum PCB concentrations measured were 114 mg/kg (wet weight) in largemouth bass and 31 mg/kg in brown bullhead.

Concentrations in River Section 3 (Stillwater) in 1999 averaged about 6 mg/kg (wet weight) in largemouth bass and 6 mg/kg in brown bullhead. The maximum PCB concentrations measured were 23 mg/kg (wet weight) in largemouth bass and 15 mg/kg in brown bullhead.

For comparison purposes, USEPA has determined that 0.05 mg/kg (wet weight in fish fillets) is an acceptable PCB concentration for Hudson River fish based on an annual consumption of 51 half-pound meals per year by an adult.

Because PCBs tend to accumulate in fatty tissues, it is also useful to examine PCB concentrations in fish on a lipid (fat) basis for analysis of trends. The lipid-based Tri+ PCB concentrations for 1998 are generally similar to those observed from 1995 to 1997 in both River Section 1 and River Section 3, with little evidence of a consistent decline.

Time trends of lipid-based Tri+ PCB concentrations for brown bullhead, largemouth bass, and pumpkinseed in River Section 3 for the Stillwater reach (RM 168.1) show that PCB concentrations in the fish appear to have been nearly stable in recent years.

USEPA's analysis of all the data indicate that the spatial variability of PCB concentrations in fish is determined primarily by distance downstream of the Thompson Island Pool.

Geochemistry and Modeling Conclusions

The Reassessment Remedial Investigation/Feasibility Study has evaluated PCB contamination at the site using a number of tools. These tools include geochemical analyses of the water and sediment, analyses of the biological monitoring data, and synthesis of the data in a complex mathematical (computer) model. The model was calibrated to a 21-year historical data set. The model is particularly useful in understanding general trends in PCB fate, transport, and bioaccumulation, and is the primary tool available to forecast future concentrations of PCBs in sediment, water, and fish. However, the other tools are sometimes more appropriate for understanding the system on a finer scale, as well as for providing insight into the model projections. The following summarize the key conclusions of the Reassessment Remedial Investigation.

- The PCBs were released from the two GE capacitor manufacturing plants in Hudson Falls and Fort Edward into the Hudson River. Once in the river, the PCBs adhered to sediments or were carried in the water column.

- PCBs in the fine-grained sediments are a continuing source of contamination to the water column and biota, through aquatic and benthic food chains and through processes that have been empirically measured but are not easily modeled.

- Because the river is a dynamic system, the PCB-contaminated sediments are not stable. Some PCB-contaminated sediment may be buried by deposition of cleaner sediments at some times, but in other places and at other times they may be redistributed by scouring. There is little evidence of widespread burial of PCB-contaminated sediment by cleaner sediment in the Thompson Island Pool sufficient to mitigate exposure to biota.

- As of 1994, there has been a statistically significant loss of PCB inventory from highly contaminated sediments in the Thompson Island Pool and a net loss of inventory from hot spot sediments between the Thompson Island Dam and the Federal Dam at Troy.

- High flow events (*e.g.*, spring floods) may increase the bioavailability of contaminants to organisms in the water column. Water column sampling from a high flow event in January 1998 showed elevated PCB concentrations.

- PCBs in sediments will not be naturally "remediated" via dechlorination. The extent of dechlorination is limited, resulting in probably less than ten percent mass loss of PCBs.

- The area of the site upstream of the Thompson Island Dam represents the primary source of PCBs to fish within the freshwater Hudson. This includes the GE Hudson Falls and Fort Edward plants, the Remnant Deposits, and the sediments of the Thompson Island Pool.

- The modeling showed that alleviating the upstream source is important to the long-term recovery of the river. The upstream source is expected to be the dominant source of PCBs in fish within several decades. Source control alone will not, however, reduce PCB concentrations to acceptable levels in a reasonable time frame, nor reduce the downstream transport of PCBs to acceptable levels unless source control is implemented along with remediation of contaminated sediments. In order to address the upstream source, USEPA has authorized an Engineering Evaluation and Cost Analysis (EE/CA) for a Non-Time Critical Removal Action (NTCRA) to address the on-going PCB source(s) in the bedrock that are still being released in the river near the GE Hudson Falls plant site. GE has discussed an approach with NYSDEC and USEPA to cut off these PCB releases by excavating a tunnel between the plant and the river and installing an oil collection system within it. Assuming that such a tunnel, or equivalent containment system, is a viable response action to address the GE Hudson Falls plant site source, USEPA believes, based upon these discussions, that a source control system can reasonably be expected to be in place and operating by January 1, 2005.

- PCBs are transported from the Upper Hudson River to the Lower Hudson River (*i.e.,* south of the Federal Dam at Troy). The mass of PCBs transported over the Federal Dam to the Lower Hudson declined from about 3,000 to 4,000 kg/year (6,600 to 8,800 lbs/year) in the late 1970s to about 150 to 500 kg/year (330 to 1,100 lbs/year) by the late 1980s to early 1990s. Based on 1998 data reported by GE, from a monitoring station at Schuylerville, 214 kg/year (471 lbs/year) of PCBs are being transported over the Federal Dam at Troy.

- PCB concentrations in fish, the primary pathway of concern, are still well above acceptable risk-based and advisory levels.

In sum, the PCB-contaminated sediments of the Thompson Island Pool strongly impact the water column, generating a significant water column PCB load and exposure concentration whose congener pattern can be seen throughout the Upper Hudson. Burial of contaminated sediment by cleaner material is not occurring universally, and the stability of the sediment deposits is not assured.

SUMMARY OF SITE RISKS

Based upon the results of the Reassessment, a baseline risk assessment was conducted for the site to estimate the risks associated with current and future site conditions. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate exposure to these hazardous substances.

Human Health Risk Assessment

A site-specific Human Health Risk Assessment for the Hudson River PCBs site was developed to quantitatively evaluate both cancer risks and non-cancer health hazards from exposure to PCBs. The Human Health Risk Assessment considers exposure to PCBs in the Upper and Mid-Hudson River beginning in 1999, assuming no remediation and no institutional controls, such as the fish consumption advisories and fishing restrictions currently in place.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substances releases from a site in the absence of any actions to control or mitigate these releases; it estimates the "baseline risk" in the absence of any remedial actions at the site under current and future land uses. To estimate this baseline risk at a Superfund site, a four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: The hazard identification step identifies the contaminants of concern at the site in various media (i.e., soil, groundwater, surface water, air, etc.) based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil. Factors relating to the exposure assessment include but are not limited to the concentrations that people might be exposed to and the potential frequency and duration of exposure. Using these factors, a "reasonable maximum exposure" (RME) scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: The toxicity assessment determines the types of adverse health effects associated with chemical exposures, and the relationship between the magnitude of exposure (dose) and severity of adverse effects (response). Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health effects such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health effects.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk for developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current federal Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk). For non-cancer health effects, a "hazard index" (HI) is calculated. An HI represents the sum of the individual exposure levels compared to their corresponding reference doses (RfDs). The key concept for a non-cancer hazard index is that a "threshold level" (measured as an HI of 1) exists below which non-cancer health effects are not expected to occur.

This section summarizes the results of the Human Health Risk Assessment and is based on the November 2000 Revised Human Health Risk Assessment. The November 2000 report combines into a single report the August 1999 report for the Upper Hudson River, the December 1999 report for the Mid-Hudson River, their respective Responsiveness Summaries issued in March 2000 and August 2000, and changes made to address the peer review comments, which are documented in the November 2000 Response to Peer Review Comments on the Human Health Risk Assessment for the Upper Hudson River.

Hazard Identification

PCBs, including dioxin-like PCBs, were identified as the contaminants of concern based on previous investigations and the site definition. The media evaluated were fish, sediment, surface water, and air. Current and future concentrations of PCBs in fish, sediments, river water and air are derived from USEPA's Reassessment database and Revised Baseline Modeling Report (RBMR).

Exposure Assessment

The cancer risks and non-cancer health hazards were evaluated for young children (aged 1 to 6 years old), adolescents (aged 7 to 18 years old); and adults (over 18). These individuals include anglers who eat fish from the Hudson River, recreators who swim, wade, or boat in the Hudson, and residents along the Hudson who may inhale volatilized PCBs or use the river as their source of drinking water.

Consistent with USEPA policy and guidance, cancer risks and non-cancer health hazards were evaluated for the reasonably maximally exposed (RME) individual and the central tendency individual. The RME is considered the maximum exposure that is reasonably estimated to occur at the site and is not a worst-case scenario. The central tendency exposure is the average exposure to an individual.

Fish Ingestion

For the fish ingestion pathway, USEPA developed a site-specific exposure duration for the angler based on population mobility for the counties surrounding the Upper and Mid-Hudson River from the 1990 Census and fishing durations reported in the state-wide 1991 New York Angler survey. The concentrations of PCBs in fish were calculated from the forecasts in the RBMR by considering the fish species preferentially eaten, accounting for the change in concentrations of PCBs in fish with river mile, and averaging over the total exposure duration.

Fish ingestion rates were based on ingestion rates for types of fish found in the Hudson River, as reported in the 1991 New York Angler survey. The rate derived for the RME adult is about one half-pound fish meal per week. USEPA believes that this ingestion rate addresses fish consumption of subsistence anglers in the Upper and Mid-Hudson River, based on a 1986 study of low-income families' consumption of freshwater fish in New York State. In addition, this ingestion rate is essentially the same as the rate used by the New York State Department of Health in establishing the fish consumption advisories for the Hudson River. USEPA's fish ingestion rate for the average, or central tendancy adult angler, is about one half-pound fish meal every two months.

USEPA also quantitatively evaluated cancer risks and non-cancer health hazards to recreators who swim, wade, or boat in the Hudson and residents along the Hudson who may inhale volatilized PCBs or use the river as their source of drinking water. The cancer risks and non-cancer health hazards from these exposure pathways were determined to be within or below acceptable levels under the federal Superfund program. Other pathways were evaluated qualitatively (e.g., exposure to PCBs in home-grown crops or dairy products) and determined to be below levels of concern.

Toxicity of PCBs

USEPA has determined that PCBs cause cancer in animals and probably cause cancer in humans. Serious non-cancer health effects have been observed in animals exposed to PCBs. Studies of Rhesus monkeys exposed to PCBs indicate a reduced ability to fight infection and reduced birth weight in offspring exposed *in utero*. In the Human Health Risk Assessment, USEPA used the current Agency consensus toxicity values for PCBs in determining cancer and non-cancer health effects.

Risk Characterization

The Human Health Risk Assessment shows that cancer risks and non-cancer health hazards to the RME individual associated with ingestion of PCBs in fish from the Upper and Mid-Hudson River are above levels of concern. Fish ingestion is the primary pathway for PCB exposure and for potential adverse health effects. Cancer risks and non-cancer health hazards from other exposure pathways in the Upper and Mid-Hudson River are generally within or below levels of concern. The table below shows the cancer risks and non-cancer health hazards for consumption of fish in the Upper and Mid-Hudson River beginning in 1999 (rounded to the nearest whole number) in the absence of remediation. Cancer risks from exposure to dioxin-like PCBs were comparable to the cancer risks presented in the table below.

In addition to these point estimate calculations, USEPA calculated the cancer risks and non-cancer health hazards for ingestion of fish in the Upper Hudson River using a probabilistic risk assessment analysis called a Monte Carlo analysis. The results of this approach support the results of the point estimate calculations.

Summary of Cancer Risks and Non-Cancer Health Hazards from Ingestion of Fish		
Upper Hudson River	Central Tendency	RME
Fish Ingestion - cancer Total (young child, adolescent, and adult exposure)	3×10^{-5} (3 in 100,000)	1×10^{-3} (1 in 1,000)
Fish Ingestion - non-cancer Adult Adolescent Young Child	 7 8 12	 65 71 104
Mid-Hudson River	Central Tendency	RME
Fish Ingestion - cancer Total (young child, adolescent, and adult exposure)	1×10^{-5} (1 in 100,000)	7×10^{-4} (7 in 10,000)
Fish Ingestion - non-cancer Adult Adolescent Young Child	 3 4 5	 32 35 49

The Human Health Risk Assessment shows that, under the baseline conditions, the cancer risks and the non-cancer health hazards from ingestion of fish from the Upper Hudson River are expected to be above USEPA's generally acceptable levels for the 40 year exposure duration beginning in 1999. The total cancer risk for the RME individual is 1,000 times higher than the goal for protection and 10 times higher than the highest risk level generally allowed under the federal Superfund law. Non-cancer health hazards for the RME young child, adolescent, and adult are 104, 71, and 65 times higher than the level considered to be protective of public health. Ingestion of just one half-pound fish meal every two months, the average ingestion rate, results in cancer risks to the central tendency individual that are above the goal for protection and results in non-cancer health hazards that are 7 to 12 times higher than the level considered to be protective. The cancer risks and non-cancer health hazards from ingestion of fish from the Mid-Hudson River are about half as high as those in the Upper Hudson, due to lower concentrations of PCBs in fish, but are also above levels of concern.

Ecological Risk Assessment

This section summarizes the results of the Ecological Risk Assessment and is based on the November 2000 Revised Ecological Risk Assessment. The November 2000 report combines into a single report the August 1999 Ecological Risk Assessment, the December 1999 Ecological Risk Assessment for Future Risks in the Lower Hudson River, their respective Responsiveness Summaries issued in March 2000 and August 2000, and changes made to address the peer review comments, which are documented in the November 2000 Response to Peer Review Comments on the Ecological Risk Assessment.

The process used for assessing site-related ecological risks for a reasonable maximum exposure scenario includes: *Problem Formulation*—a qualitative evaluation of contaminant release, migration, and fate; identification of contaminants of concern (COCs), receptors, exposure pathways, and known ecological effects of the contaminants; and selection of endpoints for further study; *Exposure Assessment*—a quantitative evaluation of contaminant release, migration, and fate; characterization of exposure pathways and receptors; and measurement or estimation of exposure point concentrations; *Ecological Effects Assessment*—literature reviews, field studies, and toxicity tests, linking contaminant concentrations to effects on ecological receptors; and *Risk Characterization*—measurement or estimation of both current and future adverse effects.

PCBs, including dioxin-like PCBs, are the contaminants of concern for the Ecological Risk Assessment based on the results of earlier investigations and the site definition. Ecological exposure to PCBs is primarily an issue of bioaccumulation through the food chain rather than direct toxicity. PCBs bioaccumulate in the environment by bioconcentrating (being absorbed from water and accumulated in tissue to levels greater than those found in surrounding water) and biomagnifying (increasing in tissue concentrations as they go up the food chain through two or more trophic levels).

The Hudson River PCBs site is home to a wide variety of ecosystems. The Upper Hudson River is a nontidal freshwater system, while the Lower Hudson River (i.e., south of the Federal Dam) is tidal with freshwater, brackish, and increasingly more saline water towards the Battery.

The Ecological Risk Assessment evaluates direct exposure to PCBs in Hudson River sediments and river water through ingestion and indirect exposure to PCBs *via* the food chain. Because PCBs are known to biomagnify, an emphasis was placed on indirect exposure at various levels of the food chain to address PCB-related risks at higher trophic levels. The assessment endpoints that were selected for the Hudson River are benthic community structure, which is a food source for local fish and wildlife, and sustainability (survival, growth, and reproduction) of local fish populations, insectivorous bird populations, waterfowl populations, piscivorous (fish-eating) bird populations, insectivorous mammal populations, omnivorous mammal populations, and piscivorous mammal populations. The bald eagle, a federally-listed and New York State-listed threatened species, was evaluated under the assessment endpoint for piscivorous birds.

Risks to the environment were evaluated for individual receptors of concern that were selected to be representative of various feeding preferences, predatory levels, and habitats (aquatic, wetland, shoreline). Receptors of concern selected for the Ecological Risk Assessment included the benthic macroinvertebrate community, seven species of fish as represented by the pumpkinseed (*Lepomis gibbosus*), spottail shiner *(Notropis hudsonius)*, brown bullhead *(Ictalurus, now Ameiurus nebulosus)*, white perch *(Morone americana)*, yellow perch (*Perca flavescens)*, largemouth bass *(Micropterus salmoides)*, and striped bass (*Morone saxatilis).* Five bird receptors were selected: the tree swallow (*Tachycineta bicolor*), mallard (*Anas platyrhychos*), belted kingfisher (*Ceryle alcyon*), Great blue heron (*Ardea herodias*), and bald eagle (*Haliaeetus leucocephalus*). Four mammal receptors were selected: the little brown bat *(Myotis lucifugus),* raccoon (*Procyon lotor*), mink (*Mustela vison*), and river otter (*Lutra canadensis*).

Complete exposure pathways and exposure parameters (*e.g.,* body weight, prey ingestion rate, home range) used to calculate the concentrations or dietary doses to which the receptors of concern may be exposed were obtained from USEPA references, the scientific literature, and directly from researchers. Site-specific fish, invertebrate, sediment, and surface water data and model forecasts were used to estimate PCB concentrations.

Measures of toxicological effects were selected based on

Lowest Observed Adverse Effects Levels (LOAELs) and/or No Observed Adverse Effects Levels (NOAELs) from laboratory and/or field-based studies as reported in the scientific literature. Reproductive effects (*e.g.,* egg maturation, egg hatchability, and survival of juveniles) were generally the most sensitive endpoints for animals exposed to PCBs.

The Ecological Risk Assessment indicates that piscivorous receptors are at risk from adverse reproductive, growth, or survival effects from exposure to PCBs in prey. The major findings of the report include:

- Birds and mammals that eat PCB-contaminated fish from the Hudson River, such as the bald eagle, belted kingfisher, great blue heron, mink, and river otter, are at risk. Piscivorous birds are at risk at least at the individual level and piscivorous mammals are at risk at the population level. PCBs may adversely affect the survival, growth, and reproduction of these species.

- Piscivorous fish, such as the largemouth bass and striped bass, in the Hudson River are at risk at the individual level. Population level effects are unlikely to be seen.

- Fragile populations of threatened and endangered species, represented by the bald eagle, are particularly susceptible to adverse effects from PCB exposure.

- PCB concentrations in water and sediments in the Upper Hudson River generally exceed standards, criteria, and guidelines established to be protective of the environment.

- Piscivorous birds and mammals are expected to be at considerable risk through 2018 (the entire forecast period).

- Ecological receptors were found to be at risk on both a total PCB and dioxin-like PCB basis. Risks are greatest in the Upper Hudson River, particularly in River Section 1 (Thompson Island Pool), and decrease in relation to decreasing PCB concentrations down river.

Based upon the results of the Remedial Investigation and the risk assessments, USEPA has determined that actual or threatened releases of hazardous substances from the site, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to human health and the environment.

SCOPE AND ROLE OF ACTION

The primary objective of this action is to address the PCB-contaminated sediments in the Upper Hudson River. Removal of the PCB-contaminated sediments will reduce PCB concentrations in fish tissue, thereby minimizing potential future human health and ecological risks. In addition, remediation will control a source of PCBs to the water column which contributes to fish tissue concentrations, and transports PCBs downstream.

The Reassessment Feasibility Study is focused on the approximately 40 river miles from the northern end of Rogers Island to the Federal Dam at Troy. While the Superfund site covers both the Upper and the Lower Hudson River, the Reassessment Feasibility Study evaluates options to address the PCB-contaminated sediments of the Upper Hudson River only, because this portion contains all of the historical PCB hot spots.

In conjunction with the remedy for the sediments of the Upper Hudson River, as previously described in this Proposed Plan, USEPA will evaluate and either implement or require implementation of source control measures to reduce PCBs that continue to be released into the Hudson River at Bakers Falls through bedrock underlying the GE Hudson Falls plant.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs) and risk-based levels established using the risk assessments. There are no federal or New York State cleanup standards for PCB-contamination in sediment. The following remedial action objectives have been established for the site:

- Reduce the cancer risks and non-cancer health hazards for people eating fish from the Hudson River by reducing the concentration of PCBs in fish. The risk-based Preliminary Remediation Goal for the protection of human health is 0.05 mg/kg PCBs in fish fillet based on the reasonable maximum exposure adult fish consumption rate of one half-pound meal per week. Other target concentrations are 0.2 mg/kg PCBs in fish fillet, which is protective at a fish consumption rate of one half-pound meal per month, and 0.4 mg/kg PCBs in fish fillet, which is protective of the average angler who consumes one half-pound meal every two months. These targets of higher concentrations in fish represent points at which fish consumption advisories and fishing restrictions might become less stringent (*e.g.* the “eat none” advisory for the Upper Hudson could be relaxed as conditions improve).

- Reduce the risks to ecological receptors by reducing the concentration of PCBs in fish. The Preliminary Remediation Goal for the ecological exposure pathway is a range from 0.3 to 0.03 mg/kg total PCBs in fish (whole body), which corresponds tp PCB concentrations of 0.12 to 0.012 mg/kg in fish fillets. The ecological Preliminary Remediation Goal is based on the Lowest Observed Adverse Effect Level and the No Observed Adverse Effect Level for consumption of whole fish by the river otter, an upper trophic level piscivorous mammal;

- Reduce PCB levels in sediments in order to reduce PCB concentrations in river (surface) water that are above surface water ARARs. The ARARs for surface water are:

  1×10^{-6} ug/l (one part per quadrillion) total PCBs, the New York State ambient water quality standard for the protection of health of human consumers of fish,

  1.2×10^{-4} ug/l, the New York State standard for protection of wildlife,

  1×10^{-3} ug/l, the federal ambient water quality criterion for navigable waters,

  0.09 ug/l, the New York State standard for protection of human health and drinking water sources, and

  0.0005 mg/l (0.5 ug/l), the federal maximum contaminant level for PCBs in drinking water;

- Reduce the inventory (mass) of PCBs in sediments that are or may be bioavailable; and
- Minimize the long-term downstream transport of PCBs in the river.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA § 121(b)(1), 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants and contaminants at a site. CERCLA § 121(d), 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA § 121(d)(4), 42 U.S.C. § 9621(d)(4).

> Principal threat wastes are those source materials that act as a reservoir for the migration of contamination. Principal threat wastes are those source materials considered to be highly toxic and present a significant risk to human health or the environment should exposure occur, or are highly mobile such that they, generally, cannot be reliably contained. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of alternatives, using the remedy selection criteria that are described below in the EVALUATION OF ALTERNATIVES section of this Proposed Plan. This analysis provides a basis for making a statutory finding as to whether the remedy employs treatment as a principal element.

Sediments which may contribute to the PCB levels in fish, both now and in the future, are considered principal threats. The determination of the significance of the sediment contribution to fish is based primarily on model projections, in conjunction with geochemical analyses. The model projections indicate that the significance of the sediment contribution varies by river section, therefore the sediment levels that are considered principal threats will correspondingly vary by river section. The PCB-contaminated sediment concentrations considered to be principal threats, as represented by mass per unit area measurements, are 3 g/m^2 in River Section 1 and 10 g/m^2 in River Section 2. The mass per unit area approach is explained in the Screening section of the Summary of Remedial Alternatives, below.

Screening

The process used to develop and screen appropriate technologies and alternatives to address the PCB-contaminated sediments in the Upper Hudson River can be found in the Feasibility Study. The technologies that were carried forward after the initial screening are:

- No Action (without upstream source control)
- Monitored Natural Attenuation (MNA) (assuming upstream source control)
- Capping (assuming upstream source control) followed by MNA
- Removal (assuming upstream source control) followed by MNA

Capping alternatives considered an engineered cap (including a bentonite layer) of approximately 1-1/2 foot total thickness. However, because the addition of this material would greatly alter the geometry of the river (shoreline) in shallow areas, areas with less than 6 feet average depth would first require dredging to compensate for the 1-1/2 foot raising of the river bottom. The terms “dredging” or “removal” mean environmental dredging in the remainder of this Proposed Plan. In addition, because the river is used for navigational purposes, it is impractical to cap the channel (which later may require navigational dredging). Removal is the only active remediation that would be performed in the channel.

Due to the high variability of PCB sediment concentrations, mass per unit area (MPA), rather than concentration, was identified as the most useful measure of the potential contribution of an area to PCBs in surface water and fish. PCB inventory in sediment is represented by MPA measurements (*i.e.*, grams of PCBs per square meter), which indicate the total mass of PCBs within the sediment. MPA was plotted against area of non-cohesive sediment for the Thompson Island Pool (and against PCB mass remediated) to determine breakpoints where a small change in MPA would mean a large increase in sediment area or mass to be remediated. This provides an evaluation of the efficiency of remediation by comparing the mass of PCBs remediated to the amount of the sediment surface that would require remediation. Breakpoints were found at approximately 3 g/m^2 and 10 g/m^2. For a core with a depth of one foot, 3 g/m^2 is equivalent to a concentration of 10 mg/kg and 10 g/m^2 is equivalent to approximately 30 mg/kg. Therefore, the screening of alternatives evaluated Monitored Natural Attenuation (no sediment remediation) plus source control, 10 g/m^2, 3 g/m^2, and 0 g/m^2 (full section), for River Sections 1 and 2. In River Section 3, the 0 g/m^2 scenario was excluded because it would have required remediation of an unreasonably large area (over 2,800 acres). Similarly, a cleanup level such as 1 mg/kg (as sometimes used at other sites) would have targeted unreasonably large areas in Section 3**.** The target levels are defined as:

0 g/m^2	Full Section Remediation
3 g/m^2	Expanded Hot Spot Remediation
10 g/m^2	Hot Spot Remediation

Modeling was conducted to evaluate the impact of remediation for combinations of the target levels for each river section. It was found that remediation in River Section 1, the Thompson Island Pool, had the greatest benefit with respect to lowering PCB levels in fish and surface water. The model did not show substantial benefits from remediation in River Section 3. However, data show increased water column concentrations in this reach resulting from tributary high flow events that caused scour in the main part of the Hudson, thereby elevating the water-column PCB concentrations. Therefore, certain areas in Section 3, *i.e.*, NYSDEC *hot spots* 36, 37, and the southern portion of 39, were selected for remediation based on PCB inventory and signs of potential loss of PCB inventory. For example, a comparison of 1977 and 1994 sediment data showed that over two thirds of the PCB inventory was lost from *Hot Spot* 37.

During the screening analysis, it was also determined that if a remedy that included dredging were to be selected, it would not be administratively feasible to dispose of that material in a locally-sited landfill. Therefore, only off-site disposal options were carried through into the Detailed Analysis.

Treatment technologies, such as thermal desorption, are technically feasible; however, the associated costs would be significantly greater than off-site landfill disposal, and a locally-sited thermal treatment facility would not be expected to be administratively feasible.

Detailed Analysis

Detailed descriptions of the remedial alternatives for addressing the contamination associated with the site can be found in the Feasibility Study. The construction time for each alternative reflects only the time required to construct or implement the remedy and does not include the time required to design the remedy, negotiate performance of the remedy with the responsible parties, or procure contracts for design and construction. The present-worth costs for the alternatives discussed below are calculated using a discount rate of seven percent and a 30-year time interval.

The remedial alternatives are:

Alternative 1: No Action (no Upstream Source Control)

The No Action alternative consists of refraining from the active application of any remediation technology to sediments in all three sections of the Upper Hudson River. The No Action alternative also does not assume any source control removal action (*i.e.*, the NTCRA) near the GE Hudson Falls plant, any administrative actions (including institutional controls, such as fish consumption advisories and fishing restrictions, which are considered to be limited action under the NCP), and any monitoring. A review of site conditions would be conducted at five-year intervals, as required by CERCLA and the costs of monitoring sediment, water and fish which is necessary to support the five-year reviews is included in the table below.

Capital Cost	$0
Operation and Maintenance Cost:: (present worth)	$140,000
Present-Worth Cost:	$140,000
Construction Time:	0 years

Alternative 2: **Monitored Natural Attenuation (MNA) with Upstream Source Control**

The Monitored Natural Attenuation (MNA) alternative relies on naturally occurring attenuation processes to reduce the toxicity, mobility and volume of the contaminants in the Upper Hudson River sediments and assumes a separate source control removal action (NTCRA) near the GE Hudson Falls plant. Natural attenuation processes may include biodegradation, biotransformation, bioturbation, diffusion, dilution, adsorption, volatilization, chemical reaction or destruction, resuspension, downstream transport, and burial by clean material. Long-term monitoring would be conducted in sediments, in the water column, and in fish to confirm that contaminant reduction is occurring and that the reduction is achieving Remedial Action Objectives.

Monitoring will include measurements of PCB concentrations in river water, dated sediment cores, PCB inventory in sediment, sediment physical properties (geophysics), and bioaccumulation in resident fish. Reductions in PCB concentrations and the PCB inventory could be documented by historical trends or PCB concentration distributions that show a reduction in the total mass of PCBs in sediments, water, and/or biota, or by the presence of degradation products in sediments. The monitoring data would also be used as input parameters in the mathematical models to evaluate progress of the natural attenuation processes against the original predictions.

Capital Cost	$417,000
Operation and Maintenance Cost:: (present worth)	$38,000,000
Present-Worth Cost:	$39,000,000
Construction Time:	0 years

These costs do not include the capital cost nor the operation and maintenance costs of the NTCRA. The capital cost associated with MNA includes the costs of developing and running the mathematical models; this cost is included with the following alternatives as well because they contain MNA as a necessary component.

Institutional controls would be implemented as long-term control measures as part of the MNA alternative, including continuation of fish consumption advisories and fishing restrictions, which are currently in place. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Alternative 3: CAP 3/10/Select - Capping, with Removal to Accommodate Cap, followed by MNA, with Upstream Source Control

This alternative includes remediation by capping (after removal of more than 1.73 million cubic yards, in areas that either cannot be capped (navigation channels) or required sediment removal to allow for placement of the cap) of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 1, sediments with an MPA of 10 g/m^2 PCBs or greater in River Section 2, and select sediments within high concentration PCB target areas in River Section 3 (NYSDEC *hot spots* 36, 37 and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to implement the remediation and allow normal boat traffic during remediation. The total area of sediments to be remediated is 493 acres, of which approximately 207 acres would be capped. The estimated volume of sediments to be removed is 1.73 million cubic yards, which is estimated to contain 33,100 kg (73,000 lbs) of PCBs. It would take approximately 3 years to design and 5 years to implement this remedy. This alternative assumes a separate source control removal action (*i.e.*, NTCRA) near the GE Hudson Falls plant and also relies on naturally occurring attenuation processes to reduce the toxicity, mobility, and volume of the remaining PCBs in the Upper Hudson River sediments after the construction is completed. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Capital Cost	$344,000,000
Operation and Maintenance Cost:: (present worth)	$24,000,000
Present-Worth Cost:	$370,000,000
Construction Time:	5 years

As with Alternative 2, these costs do not include the capital cost or the operation and maintenance costs of the NTCRA.

Capping involves placement of an engineered cap consisting of low permeability material on top of the PCB-contaminated sediment, including a top layer of fill. The low permeability material prevents or retards the movement of contaminated pore water into the water column and minimizes exposure of benthic organisms to the PCB-contaminated sediments. The selected process option for containment is AquaBlok^{tm} (or a similar material), a manufactured product consisting of a composite of gravel particles encapsulated with bentonite. Once deployed through the water column, the heavy center of the composite material carries the bentonite bearing particles to the bottom where the bentonite absorbs water and expands to form a continuous impermeable mat.

A 12-inch layer of AquaBlok^{tm} was selected for the conceptual approach in the Feasibility Study for several reasons. The proposed thickness would have a higher probability of withstanding damage from ice scour and navigational incidents, as well as erosion due to normal or storm-induced flows, without exposing the high concentrations of PCBs that currently exist in the surface sediments at some locations.

A 6-inch benthic substrate layer would be placed on top of the AquaBlok^{tm} layer to prevent bioturbation of the cap material and to serve as a clean habitat for the benthic organisms to repopulate. This material would also serve as a sacrificial layer in the event of erosion or damage, possibly allowing repairs to be conducted before further damage occurs.

Placement of 18 inches (1.5 feet) of capping material over the existing surface, especially in shallower areas, could affect the hydraulics of the river, as well as actually move the shoreline toward the channel by as much as 25 to 50 feet in some areas. Therefore, in order to prevent changing the configuration of the river, 1.5 feet of sediment would be removed prior to the placement of the cap in shallow areas.

Sediment removal would be accomplished with similar equipment described for the removal alternatives below.

Production rates and sediment processing facilities would be similar, but with appropriate quantity changes.

After construction is completed, this alternative relies on institutional controls, such as the fish consumption advisories and fishing restrictions, and perhaps restrictions on activities that could compromise the integrity of the cap, and MNA, in areas not remediated until the Remedial Action Objectivess are achieved. A long-term monitoring program would be required to verify the integrity of the cap and to assess the effectiveness of the cap and natural attenuation processes in achieving the Remedial Action Objectives. If any portion of the cap has been eroded, it would require replacement. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Alternative 4: REM-3/10/Select - Removal followed by MNA, with Upstream Source Control

This alternative includes remediation by removal of all sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 1, removal of all sediments with an MPA of 10 g/m^2 PCBs or greater in River Section 2, and removal of select sediments with high concentrations of PCBs in River Section 3 (NYSDEC *hot spots* 36, 37, and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to implement the remediation. The total area of sediments targeted for removal is approximately 493 acres. The estimated volume of sediments to be removed is 2.65 million cubic yards which is estimated to contain 45,600 kg (100,600 lbs) of PCBs. It would take approximately 3 years to design and 5 years to implement this remedy. This alternative assumes a separate source control removal action (i.e., NTCRA) near the GE Hudson Falls plant. After construction is completed, this alternative relies on institutional controls, such as the fish consumption advisories and fishing restrictions (although perhaps in a modified form), and MNA in areas not remediated until the Remedial Action Objectives are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Capital Cost	$448,000,000
Operation and Maintenance Cost:: (present worth)	$13,000,000
Present-Worth Cost:	$460,000,000
Construction Time:	5 years

As with Alternatives 2 and 3, these costs do not include the capital cost or the operation and maintenance costs of the NTCRA.

Alternative 5: REM-0/0/3 - Removal followed by MNA with Upstream Source Control

This alternative includes Full Section remediation by removal in River Sections 1 and 2, and removal of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 3. This alternative also includes sediment removal in the navigation channel as necessary to implement the remediation. The total area of sediments targeted for removal is approximately 964 acres. The volume of sediments to be removed is estimated to be 3.82 million cubic yards which is estimated to contain more than 70,150 kg (155,000 lbs) of PCBs. It would take approximately 3 years to design and 7 years to implement this remedy. This alternative assumes a separate source control removal action (i.e., NTCRA) near the GE Hudson Falls plant. After construction is completed, this alternative relies on institutional controls, such as the fish consumption advisories and fishing restrictions, and MNA in areas not remediated until the Remedial Action Objectives are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Capital Cost	$556,000,000
Operation and Maintenance Cost:: (present worth)	$13,000,000
Present-Worth Cost:	$570,000,000
Construction Time:	7 years

As with Alternatives 2 through 4, these costs do not include the capital cost or the operation and maintenance costs of the NTCRA.

General Removal Information (applicable to Alternatives 3 (in part), 4 and 5)

Removal by targeted dredging is the principal component of the two REM alternatives and a major component of the CAP alternative. The criteria for selection of targeted areas are based primarily on mass per unit area (e.g., 3 g/m^2, 10 g/m^2) and PCB concentrations in surface sediment, as well as engineering considerations, such as minimum areas targeted (50,000 square feet).

Of the various dredging technologies reviewed for the Feasibility Study, both mechanical systems and hydraulic systems appear to be applicable to conditions found in the Upper Hudson River. Dredging productivity, sediment in-river transport/conveyance, and sediment processing would vary between mechanical and hydraulic systems. Both methods have been considered in the development and evaluation of alternatives to preserve options in the remedial design.

Within the target areas, the goal is to remove all of the PCB-contaminated sediment, leaving a residual of approximately 1 mg/kg or less. Subsequent to removal, approximately one foot of backfill would be placed where appropriate (excluding the navigation channels) over the residual layer, which would further reduce the available PCB concentration at the surface and provide an appropriate substrate for biota. In addition, the backfill will help stabilize bank areas after dredging and minimize hydraulic changes to the river.

The dredged sediments would be transported to land-based sediment processing facilities. At these facilities the sediment would be dewatered to the extent practicable. Portland cement would be added to the solids portion to stabilize it before loading onto rail cars. The sediments would be disposed of at an existing licensed TSCA or solid waste landfill outside of the Hudson Valley. Siting of a local landfill was screened out due to community objection. Another solids disposal option involves beneficial use of non-TSCA dredged material.

The water that is separated will undergo treatment to remove fine sediment particles and dissolved PCBs. Ultimately, the water will be discharged back into the Hudson River in compliance with substantive New York State Pollutant Discharge Elimination System requirements, which are ARARs for this site.

EVALUATION OF ALTERNATIVES

In selecting a remedy for a site, USEPA considers the factors set forth in CERCLA § 121, 42 U.S.C. § 9621, by conducting a detailed analysis of the viable remedial alternatives pursuant to the NCP, 40 CFR § 300.430(e)(9), USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies, OSWER Directive 9355.3-01, and USEPA's A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

A comparative analysis of these alternatives based upon the evaluation criteria (see box below) follows.

The comparison of the effectiveness of alternatives is based on the results of modeling each remedial alternative as well as data projections. Comparisons of the model outputs to recent data trends suggest that the model may be overly optimistic with regard to the rate of PCB decline in fish predicted for the No Action (no source control) and Monitored Natural Attenuation (assuming source control) alternatives. This occurs because the model predictions are averaged over larger spatial scales than the foraging range of many resident fish species. Under the modeled remedial alternatives, this over-optimism is eliminated wherever PCBs are removed or capped, because projected rates of decline are replaced by specified concentrations in the remediated areas. Consequently, the benefits of remediation based on comparisons of the active remediation alternatives to the No Action and Monitored Natural Attenuation alternatives are likely underestimated by the models.

In order to bound this uncertainty in the No Action and MNA alternatives, an estimated upper bound was also calculated. Assuming that the over-optimism in the model projections stems from the uncertainty surrounding the PCB concentration in surface sediment calculated by the model, an alternative method was used to calculate surface sediment values based on certain fish data. PCB

NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protection of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

concentrations in brown bullhead, which are affected primarily by concentrations of PCBs in surface sediment, were used to back-calculate concentrations of PCBs in surface sediment that would produce the decline seen in the data. The newly calculated concentrations of PCBs in surface sediment were then used in the model as an upper bound estimate instead of the model-calculated surface sediment values. Therefore, both the upper bound estimates and the model calculated values for No Action and MNA were used as points of comparison in the evaluation of effectiveness of the capping and removal alternatives.

1. <u>Overall Protection of Human Health and the Environment</u>

Protection of Human Health

Alternative 1 (No Action) would not be protective of human health and the environment because it would not address the PCBs in the sediment, or from the upstream source, which result in risks to humans, birds, fish, and mammals that are above levels of concern under the federal Superfund program.

USEPA evaluated overall protection of human health in two primary ways. The first is the time that it would take under each of the alternatives to reach the fish Preliminary Remediation Goal and the other target concentrations. The second is the relative reduction in cancer risks and non-cancer health hazards under the five remedial alternatives. Each approach is discussed below.

<u>Time to Reach Fish Target Levels</u>

The fish Preliminary Remediation Goal is 0.05 ppm (or mg/kg) PCBs (wet weight) in fillet. In addition, USEPA considered a target concentration of 0.2 ppm PCBs (wet weight) in fillet based on one half-pound meal per month, and a target concentration of 0.4 ppm based on the average (central tendency) consumption rate of one half-pound meal every 2 months. The target concentrations correspond to points at which the fish consumption advisories could be relaxed from the current "eat none" recommendation in the Upper Hudson River to one of limited fish ingestion.

In River Sections 1 and 2, and for the Upper Hudson River as a whole, none of the alternatives meets the human health Preliminary Remediation Goal of 0.05 ppm PCBs within the modeling time frame (to 2067), unless the upstream source is virtually eliminated. However, even if source control measures cannot completely eliminate the upstream source, significant reductions in risk can still be achieved by implementation of one of the active remedies. In River Section 3, all of the active remediation alternatives meet the Preliminary Remediation Goal of 0.05 ppm PCBs. The MNA alternative also reaches it, although it takes longer to achieve. The No Action alternative does not meet the Preliminary Remediation Goal within the modeling time frame.

Years to Reach Target Concentration in Fish Averaged Over Entire Upper Hudson River

	0.05 ppm	0.2 ppm	0.4 ppm
No Action	>67	>67	>67
MNA	>67	60 to >67	34 to >67
CAP-3/10/Select	>67	35	21
REM-3/10/Select	>67	35	20
REM-0/0/3	>67	26	11

Note: ">" = greater than

As can be seen in the table above, the three active remediation alternatives are projected to significantly reduce the time necessary to reach the 0.2 ppm and 0.4 ppm fish target levels. The most aggressive alternative analyzed, REM-0/0/3, would reduce the time to reach fish target levels by the greatest amount. These projected improvement differentials are believed to be on the conservative side due to the previously discussed model over-optimism related to No Action and MNA.

<u>Relative Reductions in Cancer Risks and Non-Cancer Health Hazards</u>

The years included in the exposure calculation were calculated on a river section-specific basis using different long-term period starting dates, depending on the construction schedule for each remedial alternative. The long-term exposure period was considered to start immediately after a one-year equilibration period beyond the completion of work in a given section. For example, if the construction schedule for an alternative requires three years to complete in River Section 1, given a start date in 2004, the construction would be complete at the end of 2006, equilibration would occur during the year 2007, and the long-term period for calculation of cancer risks and non-cancer health hazards would start on January 1, 2008.

Cancer risks and non-cancer health hazards for the entire Upper Hudson River under the active remedial alternatives were then compared separately (to the appropriate time frame) to the No Action and MNA alternatives, including their estimated upper bounds, to estimate the reduction in cancer risks and non-cancer health hazards achieved by each alternative.

The fish concentrations used are the species-weighted average, based on relative species consumption reported in the 1991 state-wide New York Angler survey. The species-weighted average represents the relative intake of the three modeled fish species consumed by anglers and their families: largemouth bass (47 percent); brown bullhead (44 percent); and yellow perch (9 percent). Exposure durations were the same as those presented in the Human Health Risk Assessment (cancer: 40 years RME and 12 years central tendency; non-cancer, 7 years RME and 12 years central tendency). The 7 year time frame for non-cancer health hazards reflects a chronic dose for non-cancer health effects as well as the declining PCB concentrations with time.

Upper Hudson River (RMs 194.5 - 154)

Non-Cancer Health Hazards

Reductions of from 61% to 90% in the RME adult non-cancer health hazard indices are achieved by all active alternatives, compared to the No Action and MNA alternatives (including estimated upper bounds). The MNA alternative achieves a 25% to 35% reduction compared to the No Action alternative, but only an 11% to 14% reduction compared to the estimated upper bound for the No Action alternative. The CAP-3/10/Select alternative achieves a 71% to 81% RME risk reduction compared to No Action and a 61% to 78% RME risk reduction compared to MNA. The REM-3/10/Select alternative achieves a 75% to 84% RME risk reduction compared to No Action and a 67% to 82% RME risk reduction compared to MNA. The REM-0/0/3 alternative achieves a 84% to 90% RME risk reduction compared to No Action and a 77% to 88% RME risk reduction compared to MNA.

Cancer Risks

Substantial (54% to 91%) reductions in RME adult cancer risk are achieved by all active remediation alternatives, compared to the No Action and MNA alternatives (including estimated upper bounds). The MNA alternative achieves a 31% to 52% reduction compared to the No Action alternative, but only a 13% to 18% reduction compared to the estimated upper bound for the No Action alternative. The CAP-3/10/Select alternative achieves a 76% to 87% RME risk reduction compared to No Action and a 54% to 84% RME risk reduction compared to MNA. The REM-3/10/Select alternative achieves a 79% to 88% RME risk reduction compared to No Action and a 58% to 86% RME risk reduction compared to MNA. The REM-0/0/3 alternative achieves a 84% to 91% RME risk reduction compared to No Action and a 66% to 89% RME risk reduction compared to MNA.

Overall Protection of the Environment

Ecological risks were calculated for the river otter and the mink. The river otter is a fish-eating (piscivorous) mammal and was the receptor found to be at greatest risk at the site due to the high proportion of fish in its diet. The mink is a piscivorous mammal and is known to be sensitive to PCBs. Other species, such as the bald eagle, were also considered but are at less risk than the river otter. Similar to the overall protection of human health, the long-term exposure period for the river otter and mink is considered to start immediately after a one-year equilibration period beyond the completion of work in a given section.

River Otter

The implementation of active remediation alternatives results in 63% to 87% reduction in risk to the river otter compared to the modeled No Action alternative and an 82% to 93% reduction in risk compared to the upper bound estimate for the No Action alternative, except in River Section 3, which does not show a difference between the active alternatives and the MNA alternative.

Mink

The implementation of the active remediation alternatives results in 64% to 87% reduction in risk to the mink compared to the No Action alternative and a 81% to 93% reduction in risk compared to the estimated upper bound for the No Action alternative, excluding River Section 3, which does not show a difference between the No Action and MNA alternatives.

Transport of PCBs over Federal Dam

Reduction of the PCB load transported over the Federal Dam and into the Lower Hudson is also a gauge of the overall protectiveness of a remedy. Reduced PCB loading from the Upper Hudson into the Lower Hudson will ultimately reduce concentrations of PCBs in sediment, water, and fish and resulting human health and ecological risks within the Lower Hudson. The REM-0/0/3 alternative results in a 53% reduction of PCB loading in the year following completion of remediation (2011) in comparison with the MNA alternative. Both of these alternatives assume source control upstream. For the REM-3/10/Select alternative, the PCB loading to the Lower Hudson in 2011 would be reduced by 42% as compared to MNA. For the CAP-3/10/Select alternative, the PCB loading to the Lower Hudson in 2011 would be reduced by 38% as compared to MNA. The comparison of the active remedies to the No Action alternative would exhibit even greater PCB loading reductions, since the No Action alternative does not assume source control.

2. Compliance with ARARs

The chemical-specific ARARs for PCBs in the water-column are 0.5 ug/L (500 ng/L) federal Safe Drinking Water Act MCL; 0.09 ug/L (90 ng/L) NYS standard for protection of human health and drinking water sources; 1 ng/L federal Ambient Water Quality Criterion; 0.12 ng/L NYS standard for protection of wildlife; and 0.001 ng/L NYS standard for protection of human consumers of fish.

Two chemical-specific ARARs for the surface water would be met by all five remedial alternatives, while the remaining three chemical-specific ARARs for the surface water are not expected to be met by any of the five alternatives for the 70-year forecast period. Evaluation of the projected PCB concentration in the water column by river section shows that the source control action near the GE Hudson Falls plant affects the difference (separation) between the rate of decline for the No Action and MNA alternatives. However, the benefits of active remediation of the sediments are readily apparent in the differences in the rate of decline for the MNA alternative and those for the active remediation alternatives. As expected, the water quality is best for the REM-0/0/3 alternative and substantially improved for the CAP and REM-3/10/Select alternatives, compared to MNA. These differences are most apparent for the first 20 years (between 2005 and 2024) of the forecast period. However, even towards the end of the forecast period (in 2067), there is a very substantial difference between the water quality for the No Action alternative (approximately 30 ng/L at Thompson Island Dam and Schuylerville and 10 ng/L at Federal Dam) and the other four alternatives (approximately 5 ng/L at Thompson Island Dam and Schuylerville and 1.7 ng/L at Federal Dam).

Because there is no active remediation associated with the sediments for the No Action and MNA alternatives, action-specific and location-specific ARARs do not apply. The three active remedial alternatives would comply with action-specific ARARs (*e.g.*, Clean Water Act Sections 401 and 404; Toxic Substances Control Act; Section 3004 of the Resource Conservation and Recovery Act; Section 10 of the Rivers and Harbors Act; New York State ECL Article 3, Title 3 and Article 27, Titles 7 and 9) and location-specific ARARs (*e.g.*, Endangered Species Act; Fish and Wildlife Coordination Act; Farmland Protection Policy Act; National Historic Preservation Act; and New York State Freshwater Wetlands Law. Analysis of potential effects on wetlands and floodplains associated with the preferred remedial alternative will be performed during remedial design, as necessary, to ensure compliance with Executive Orders 11990 and 11988 for wetlands and floodplains, respectively.

3. Long-Term Effectiveness and Permanence

Reduction of Residual Risk

The No Action and MNA alternatives result in a continuation of the degraded condition of the surficial sediments and surface water quality of the Upper Hudson River, especially in the Thompson Island Pool, for several decades, regardless of any reduction in the upstream water quality PCB loadings. These alternatives remove no PCBs from the River and effect no active reduction in PCB levels in fish, other than through naturally occurring processes. The MNA alternative, for purposes of the Feasibility Study, does include upstream source control, and therefore, will show reduced risks when compared to the No Action alternative.

For the CAP-3/10/Select alternative, residual risk is reduced through the capping of 207 acres of PCB-contaminated sediments and removal of 1.73 million cubic yards of sediments containing 73,000 lbs (33,100 kg) PCBs. The total area remediated (capped plus removed) via this alternative encompasses 493 acres, and the total quantity of PCBs remediated totals 100,600 lbs (45,600 kg). The reduction in cancer risks through fish consumption ranges from 76% to 87% compared to the No Action alternative and from 54% to 84% compared to the MNA alternative. The reduction in non-cancer health hazards ranges from 71% to 81% compared to the No Action alternative and from 61% to 78% compared to the MNA alternative.

For the REM-3/10/Select alternative, residual risk is reduced through the removal of 2.65 million cubic yards of sediments containing 100,600 lbs (45,600 kg) PCBs over an area of 493 acres. The reduction in cancer risks through fish consumption ranges from 79% to 88% compared to the No Action alternative and from 58% to 86% compared to the MNA alternative. The reduction in non-cancer health hazards ranges from 75% to 84% compared to the No Action alternative and from 67% to 82% compared to the MNA alternative.

For the REM-0/0/3 alternative, residual risk is reduced through the removal of 3.82 million cubic yards of sediments containing more than 145,000 lbs (63,500 kg) PCBs over an area of 964 acres. The reduction in cancer risks through fish consumption ranges from 84% to 91% compared to the No Action alternative and from 66% to 89% compared to the MNA alternative. The reduction in non-cancer health hazards ranges from 84% to 90% compared to the No Action alternative and from 77% to 88% compared to the MNA alternative.

Based on the above analysis, the three active remedial alternatives are far superior to the No Action and MNA alternatives in terms of this criterion due to the significant differences in risk reduction and mass of PCBs removed from the river. The three action alternatives are similar in terms of risk reduction; however, the two removal alternatives rank higher than the capping alternative due to the quantities of PCBs removed from the river and the permanence of such removal versus the long-term operation and maintenance required by capping of a portion of the PCB-contaminated sediments.

Adequacy of Controls

The No Action and MNA alternatives do not provide for engineering controls on the river sediments. The MNA alternative does assume source control near the GE Hudson Falls plant and institutional controls. NYSDOH’s 1996 study of anglers in the Upper and Lower Hudson found that about 18% of the Upper Hudson respondents had fish in their possession when interviewed and 11% had more than one fish. Most of the fish were largemouth bass, smallmouth bass, and bluegill, species that are often eaten; in the Mid-Hudson region, about 8% actually had fish in their possession when interviewed. Therefore, the existing institutional controls, which rely heavily on voluntary compliance, are not adequate in reducing exposure to PCBs due to consumption of contaminated fish. In addition, institutional controls are inadequate for protection of the environment.

The CAP-3/10/Select alternative provides for select removal of some PCB-contaminated sediments in target areas and placement of an engineered cap over the remaining target areas. Like the MNA alternative, this alternative also provides for institutional controls, such as the fish consumption advisories and fishing restrictions (although perhaps in a modified form), and other site use restrictions in capped areas (e.g., sediment disturbance activities such as waterfront improvements by private residences or commercial/industrial establishments along the shoreline).

The REM-3/10/Select and REM-0/0/3 alternatives provide for removal of PCB-contaminated sediments in target areas. These two alternatives also provide for institutional controls, such as the fish consumption advisories and fishing restrictions (although perhaps in a modified form), but they are unlikely to require additional site use restrictions after removal activities are completed.

Reliability of Controls

Sediment capping, sediment removal (dredging and excavation), habitat replacement/backfilling, and off-site disposal/treatment of removed sediments are all reliable and proven technologies. However, for the CAP-3/10/Select alternative, proper design, placement, and maintenance of the cap in perpetuity are required for its effectiveness, continued performance, and reliability. The cap integrity monitoring and maintenance program planned for the CAP-3/10/Select alternative provides for reasonable reliability. Also, the fish consumption advisories and fishing restrictions will continue to provide some measure of protection of human health until PCB concentrations in fish are reduced to the point where the fish consumption advisories and fishing restrictions can be relaxed or lifted.

In general, the REM-3/10/Select and REM-0/0/3 are the most reliable, as there is little or no long-term maintenance or residual risk associated with the remedial work. Of the removal alternatives, REM-0/0/3 is the most reliable, as it permanently removes the greatest amount of sediment (leaving the least amount of PCBs in the river) and achieves the greatest reduction of the potential scour-driven resuspension of PCB-contaminated sediments south of the confluence with the Hoosic River. The CAP-3/10/Select alternative does not achieve the same degree of reliability due to the potential for damage to the cap, thereby reducing its effectiveness, and would still require all of the sediment handling, processing, and disposal required for the removal alternatives. The No Action alternative is the least reliable. Although the MNA alternative is better than the No Action alternative, the institutional controls associated with this alternative do not protect ecological receptors, and human risk reduction relies on knowledge of and voluntary compliance with the fish consumption advisories and fishing restrictions.

4. <u>Reduction in Toxicity, Mobility, or Volume Through Treatment</u>

The No Action and MNA alternatives do not involve any containment or removal of contaminants from the Upper Hudson River sediments. Because the MNA alternative assumes a separate source control (NTCRA) near the GE Hudson Falls plant, the PCB load to the water column upstream of the Thompson Island Pool is expected to be reduced from 0.16 kg/day to 0.0256 kg/day by January 1, 2005. The No Action and MNA alternatives rely on natural attenuation processes such as burial by cleaner sediments, biodegradation, bioturbation, and dilution to reduce concentrations of PCBs in sediments and surface water. Biodegradation processes may partially convert some of the more highly chlorinated PCB congeners to less-chlorinated congeners and biphenyls, and thereby reduce their toxicity. Concentrations of PCBs in fish will respond slowly over time to slow natural decreases in concentrations in sediments and surface water.

For the CAP-3/10/Select alternative, the mobility of the PCBs in capped areas (approximately 207 acres) is reduced because these PCBs are sequestered under the bentonite cap. However, capping does not satisfy the CERCLA statutory preference for treatment. In addition, there is no reduction in the toxicity or volume of the PCBs under the cap. Under this alternative, the mass of PCBs and the volume of contaminated sediments within the Upper Hudson River are permanently reduced because approximately 1.73 million cubic yards of sediment, which contain an estimated 73,000 lbs (33,100 kg) of PCBs, are removed. A total of 100,600 lbs (45,600 kg) would be removed or isolated from the ecosystem by this alternative. Because the CAP-3/10/Select alternative also assumes source control (NTCRA) near the GE Hudson Falls plant, the PCB load to the water column is expected to be reduced from 0.16 kg/day to 0.0256 kg/day by January 1, 2005. In addition, after construction of the remedy is completed, natural attenuation processes will provide further (but slower) reductions in the toxicity of PCBs in the remaining sediments and surface water.

For the REM-3/10/Select and REM-0/0/3 alternatives, the mass of PCBs and volume of contaminated sediments in the Upper Hudson River are permanently reduced because sediment volumes from 2.65 to 3.82 million cubic yards, respectively, containing a mass of PCBs from 100,600 lbs (45,600 kg) (REM-3/10/Select) to an estimated mass of greater than 140,000 lbs (63,500 kg) (REM-0/0/3) are removed from the ecosystem. Because these removal alternatives also assume source control near the GE Hudson Falls plant, the PCB load to the water column is expected to be reduced from 0.16 kg/day to 0.0256 kg/day by January 1,

2005. Also, as stated for the CAP-3/10/Select alternative, after construction of the remedy is completed, natural attenuation processes will provide further (but slower) reductions in the toxicity of PCBs in the remaining sediments and surface water.

In all three active remediation alternatives, the sediments that are removed undergo limited treatment (stabilization with Portland cement) prior to landfill disposal. A different treatment process may be employed for the beneficial use option. However, the action alternatives do remove large volumes (and therefore significantly reduce mobility and toxicity) of PCBs from the river.

5. <u>Short-Term Effectiveness</u>

Protection of the Community During Remedial Actions

No construction activities are associated with the remediation of sediments for the No Action and MNA alternatives, so neither alternative increases the potential for direct contact with or ingestion and inhalation of PCBs from the surface water and sediments.

Transfer facilities and treatment areas present potential short-term risks to the community under the active alternatives. Therefore, access to these areas will be restricted to authorized personnel. In addition, monitoring and engineering controls will be employed to minimize short-term effects due to material processing activities. Increased traffic will also present an incremental risk to the community. The potential for traffic accidents may increase marginally as additional vehicles are on the road. These effects are likely to be minimal because most transportation of sediments for disposal will be accomplished by rail. In addition to vehicular traffic, there will be increased river traffic. Work areas in the river will be isolated (access-restricted), with an adequate buffer zone so that pleasure craft and commercial shipping can safely avoid such areas. Finally, the increased in-river barge traffic will be monitored and controlled to minimize, to the extent possible, adverse effects on the commercial or recreational use of the Upper Hudson River. Targeted dredging will be sequenced and directed to ensure that the navigation channel is not closed due to construction activities.

Protection of Workers During Remedial Actions

For the No Action alternative, occupational risks to persons performing the sampling activities (for the 5-year reviews) will be unchanged from current levels. There is an increase in occupational risk associated with the MNA alternative due to the greater degree of sampling involved in the river (and for the source control activities near the GE Hudson Falls plant). For the three active remediation alternatives (CAP-3/10/Select, REM-3/10/Select and REM-0/0/3), potential occupational risks to site workers from direct contact, ingestion, and inhalation of PCBs from the surface water and sediments, and routine physical hazards associated with construction work and working on water, are significantly higher than for the No Action and MNA alternatives. For these alternatives, as well as the No Action and MNA alternatives, personnel will follow a site-specific health and safety plan, OSHA health and safety procedures, and wear the necessary personal protective equipment.

Potential Adverse Environmental Impacts during Construction

No construction activities associated with the river sediments are conducted for the No Action and MNA alternatives. Neither continuation of the existing limited sampling activities for the No Action alternative nor the increased monitoring program for the MNA alternative is anticipated to have any adverse effect on the environment, beyond that already caused by the PCB contamination of the sediments in the Upper Hudson River.

For the three active remediation alternatives (CAP-3/10/Select, REM-3/10/Select and REM-0/0/3), the release of PCBs from the contaminated sediments into the surface water during construction (dredging and cap placement), as well as the resuspension of sediment, will be controlled by operational practices (*e.g.*, control of sediment removal rates, use of environmental dredges, and use of sediment barriers). Although precautions to minimize resuspension will be taken, it is likely that there will be a temporary increase in suspended PCB concentrations in the water column, and possibly in fish PCB body burdens. Studies at other sites, such as the Fox River Demonstration Project, have shown that such effects are controllable, small, and transient, and that longer-term improvement is seen.

Remedial activities may also result in short-term temporary impacts to aquatic and wildlife habitat of the Upper Hudson. Habitat replacement/backfilling measures will be implemented to mitigate these impacts. A monitoring program will be established to verify the attainment of the habitat replacement objectives. Although the degree of impact will be directly related to the area remediated and volume dredged, these differences among the alternatives are not considered to be significant due to their temporary nature and the mitigation measures which will be utilized.

For the CAP-3/10/Select alternative, there is the additional potential transient impact from the temporary exposure of deeper, potentially highly PCB-contaminated sediments during the interval between excavation and cap placement. This impact will be minimized by placement of the cap as soon as practicable after the removal operations are complete, assumed to be no more than 30 days. Therefore, this impact is not considered a significant difference between CAP-3/10/Select, REM-3/10/Select and REM-0/0/3 alternatives.

The magnitude of the short-term impacts discussed above varies with the overall scope of the alternative, in terms of volume of material excavated and area remediated. The implementation times for the active alternatives are 5 years for CAP-3/10/Select and REM-3/10/Select, and 7 years for REM-0/0/3.

6. Implementability

Technical Feasibility

Both the No Action and MNA alternatives are technically feasible as no active measures are being taken for the PCB-contaminated sediments. The implementability of the source control measures will be evaluated as part of the EE/CA for the NTCRA near the GE Hudson Falls plant.

Technical feasibility for the active remediation alternatives, which are all technically feasible, is discussed below in terms of the main components of the alternatives.

Transfer facilities - It is expected that transfer facilities will be established at two locations along the river to process the sediments generated by removal operations. Development of two transfer facilities, a northern facility adjacent to River Section 1 (Thompson Island Pool) and a southern facility near Albany, both with river frontage and rail access, is considered technically feasible. These transfer facilities will be temporary in that they are expected to be removed after completion of the active remedial activities.

Removal - The bulk of removal work under the CAP-3/10/Select and REM-3/10/Select and REM-0/0/3 alternatives will be performed by mechanical or hydraulic dredges. In difficult-to-access areas, there may be a need to modify the selected equipment or, alternatively, employ different equipment.

Capping - An evaluation of the AquaBlok^{tm} system is currently in progress at several remedial sites (e.g., Ottawa River, Ontario; Fort Richardson, AK). The implementability and long-term performance of the system have not yet been established, but it is expected that considerable performance data will become available in the near future. However, the principal component of this system is bentonite, which is considered a very stable, low-permeability barrier. Bentonite has been used in multimedia and clay capping systems for many years and has demonstrated effectiveness for the long-term encapsulation of contaminants.

In-river and rail transportation - Development of transportation systems to implement the active remedial alternatives is considered feasible. While the volume of material that must be handled is large, it is well within the capabilities of the waterborne and rail systems to handle the stabilized dredged sediments.

REM-3/10/Select is more implementable from a technical feasibility perspective than REM-0/0/3 due to the smaller volume of material to be dredged and handled, as well as the accessibility of the areas to be dredged. Both removal alternatives are more technically implementable than the CAP 3/10/Select alternative due to the combination of capping and dredging issues associated with the capping alternative.

Administrative Feasibility

Local Landfill - Establishment of a permanent local landfill was eliminated in consideration of the opposition from local citizens, which would likely make the siting of a local landfill administratively infeasible.

Both No Action and MNA require no active measures, therefore they are the most implementable from an administrative feasibility perspective. Active remedial measures are slightly more difficult to implement from an administrative feasibility perspective due to access agreements and making necessary arrangements to utilize the river with minimal interruption of boat traffic.

For the active remediation alternatives (CAP-3/10/Select, REM-3/10/Select, and REM-0/0/3), it is expected that the two transfer facilities, constructed on land adjacent to the river will be considered "on-site" for the purposes of the permit exemption under CERCLA Section 121(e), although any such facilities will comply with the substantive requirements of any otherwise necessary permits. Operations under these alternatives will have to be performed in conformance with substantive requirements of regulatory programs implemented by the U.S. Army Corps of Engineers under Section 10 of the Rivers and Harbors Act and Sections 401 and 404 of the Clean Water Act. In addition, discharges during remediation will conform to NYS regulations related to maintenance of Hudson River water quality. Habitat replacement/backfilling will be implemented in accordance with federal and State requirements. In addition, it is expected that contract documents for any of the active remediation alternatives will contain substantial restrictions on construction activity including controls on the types of dredging and capping equipment to be used, restrictions on the speed of operations, constraints on barge filling practices, and controls on temporary storage of contaminated dredge spoils. Construction activities will also be coordinated with the Canal Corporation, which operates the Locks on the Upper Hudson River from May through November. Finally, requirements of any other regulatory programs will be incorporated as necessary on the basis of design information developed during subsequent phases of the project.

Availability of Services and Materials

For the No Action and MNA alternatives, all needed services and materials are available. For the CAP-3/10/Select, REM-3/10/Select, and REM-0/0/3 alternatives, the principal deficit in services and materials relates to barges and towboats.

Because commercial operations on the Champlain Canal system have largely ceased, this equipment may no longer be available in the project vicinity. However, it is expected that the contractors will obtain the needed equipment for a project of the scale envisioned under these alternatives.

7. Cost

The discussions of the alternatives below do not include any costs for source controls measures that will be taken at the GE Hudson Falls plant as part of the NTCRA. See table below of comparison of alternatives.

Net Present Worth.

The net present worth (year 2000 dollars) of the remedial alternatives ranges from $140,000 for No Action to $570,000,000 for REM-0/0/3. The net present worth of REM/3/10/Select is $460,000,000, which is $110,000,000 less than REM-0/0/3. For the active remedial alternatives (CAP-3/10/Select, REM-3/10/Select and REM-0/0/3), these costs are based on the use of mechanical dredging techniques to remove PCB-contaminated sediments from the Upper Hudson River, and assume the disposal of all dredged materials at licensed TSCA and non-TSCA landfills located outside of the Hudson River Valley. For the option where the non-TSCA material is utilized for beneficial uses, the net present worth of the active remedial alternatives ranges from $338,000,000 for CAP-3/10/Select to $496,000,000 for REM-0/0/3. These beneficial use option costs are also based on the use of mechanical dredging techniques. There is no significant difference in the net present worth costs for the option where hydraulic dredging techniques are utilized to remove PCB-contaminated sediments.

Capital Cost

The No Action alternative has no capital cost. The MNA alternative has a present worth capital cost of $417,000 for further refining the mathematical model for the Upper Hudson River. The present worth of the capital costs for the active remedial alternatives ranges from $344,000,000 for CAP-3/10/Select to $556,000,000 for REM-0/0/3. The net present worth of the capital costs for REM-3/10/Select is $448,000,000, some $108,000,000 less than the net present worth of the capital costs for REM-0/0/3. For these active remediation alternatives, the present worth of the capital costs includes the disposal of the stabilized dredged materials at licensed TSCA and non-TSCA landfills, and assumes the use of mechanical dredging techniques to remove PCB-contaminated sediments from the river.

For the option where the non-TSCA material is utilized for beneficial uses, the present worth of the capital costs for the active remedial alternatives ranges from $314,000,000 for CAP-3/10/Select to $483,000,000 for REM-0/0/3. The net present worth of the capital costs of REM-3/10/Select under the beneficial use option is $399,000,000. These beneficial use option costs are also based on the use of mechanical dredging techniques. There is no significant difference in the present worth of capital costs for the option where hydraulic dredging techniques are utilized to remove PCB-contaminated sediments.

O & M Cost

Due to the varying frequency of different elements of the monitoring program, and the five-year reviews required by the NCP, O&M costs will vary on an annual basis. The present worth of the O&M costs for the No Action alternative is $140,000 and for the MNA alternative is $38,000,000. The net present worth of the O&M costs for CAP-3/10/Select is $24,000,000, for REM-3/10/Select is $13,000,000 and for REM-0/0/3 is $13,000,000. For the active remediation alternatives, this present worth of the O&M costs assumes the use of mechanical dredging techniques to remove PCB-contaminated sediments from the Upper Hudson River, and disposal of the stabilized dredged materials at remote TSCA and non-TSCA landfills.

For the option in which the non-TSCA material is utilized for beneficial uses, the present worth of the O&M costs for the active remedial alternatives ranges from $13,000,000 for REM-0/0/3 to $24,000,000 for CAP-3/10/Select. These

Alternative	Area Remediated (Acres)	Area Capped (Acres)	Volume Removed (CY)	Estimated PCB Mass Remediated (kg)	Estimated PCB Mass Removed (kg)	Cost ($Million - present worth)
No Action	-	-	-	-	-	0.14
Monitored Natural Attenuation	-	-	-	-	-	39
CAP 3/10/Select	493	207	1,732,800	45,600	33,100	370
REM 3/10/Select	493	-	2,651,700	45,600	45,600	460
REM 0/0/3	964	-	3,823,100	>63,500	>63,500	570

beneficial use costs are also based on the use of mechanical dredging techniques. There is no significant difference in the present worth of the O&M costs for the option in which hydraulic dredging techniques are utilized to remove PCB-contaminated sediments.

8. State Acceptance

The NYSDEC has not yet submitted its determination on the preferred alternative but has indicated that it is in favor of an active remedial alternative for the Hudson River.

9. Community Acceptance

While there has been significant controversy concerning dredging, community acceptance of the preferred remedy will be assessed in the Record of Decision following review of the public comments received during the public comment period on the Reassessment Remedial Investigation/Feasibility Study reports and this Proposed Plan. It should be noted that the use of a local landfill to dispose of dredged material was screened out based on community opposition. The Upper Hudson River Communities, as well as environmental groups, previously expressed opposition to such a landfill.

PREFERRED REMEDY

The preferred alternative is the removal (targeted dredging) Alternative REM-3/10/Select in conjunction with source control at the GE Hudson Falls plant to be accomplished via a separate Non-Time Critical Removal Action. This alternative includes the dredging of approximately 2.65 million cubic yards of PCB-contaminated sediment from the Upper Hudson River. The associated present worth costs are approximately $460 million. The REM-3/10/Select alternative includes the following components:

- Removal of all sediments based primarily on an MPA of 3 g/m^2 PCBs or greater (approximately 1.56 million cubic yards of sediments) from River Section 1;

- Removal of all sediments based primarily on an MPA of 10 g/m^2 PCBs or greater (approximately 0.58 million cubic yards of sediments) from River Section 2;

- Removal of select sediments with high concentrations of PCBs (NYSDEC *hot spots* 36, 37, and the southern portion of 39)(approximately 0.51 million cubic yards) from River Section 3;

- Dredging of the navigation channel as necessary to implement the remedy and to avoid hindering existing canal traffic during implementation. Approximately 341,000 cubic yards of sediments will be removed from the navigation channel (included in values in the first three bullets, above), but some portion of this is associated with the areas targeted for remediation;

- Within the areas targeted for remediation, the goal is to remove all of the PCB-contaminated sediments within these areas, leaving a residual of approximately 1 mg/kg;

- Monitored Natural Attenuation of PCB contamination that remains in the dredging residual and in unremediated areas;

- Use of environmental dredging techniques that will minimize and control resuspension of sediments during dredging; transport of dredged sediments via barge or pipeline to treatment/transfer facilities for dewatering and stabilization;

- Backfill of dredged areas with approximately up to one foot of clean material to isolate residual PCB contamination and replace habitat, where appropriate;

- Rail transportation of dewatered, stabilized sediments to the appropriate licensed off-site landfill(s). If a beneficial use of some portion of the dredged material is arranged, then an appropriate transportation method will be determined (rail, truck, or barge);

- Monitoring of fish, water, and sediment to determine when Preliminary Remediation Goals are reached and implementation (or modification) of appropriate institutional controls such as fish consumption advisories and fishing restrictions, until goals are met; and,

- In order to preserve flexibility during the remedial design, the preferred alternative does not specify the type of dredge. The Feasibility Study considered both mechanical and hydraulic environmental dredges with respect to implementability and cost. The design for the project will plan for a construction period of five years. It is anticipated that it will take three years for remedial design and mobilization, so that dredging will begin in 2004.

- In addition, during remedial design USEPA will consider whether there are any new treatment options for the dredged sediment that would improve the cost effectiveness of the remedy.

- Because contamination will remain on-site above health-based levels, five-year reviews are required.

RATIONALE FOR SELECTION OF PREFERRED ALTERNATIVE

The selection of the preferred alternative is accomplished through the evaluation of the nine criteria as specified in the NCP. USEPA has evaluated the alternatives against the first seven criteria. State and community acceptance will be evaluated after the release of the Proposed Plan and associated public comment period, although opposition to a local landfill has already been factored into the preferred alternative. The NYSDEC has not yet submitted its determination on the preferred alternative but has indicated that it is in favor of an active remedial alternative for the Hudson River.

The preferred alternative is protective of human health and the environment. Risk is reduced through removal of PCB-contaminated sediment, followed by Monitored Natural Attenuation. The preferred alternative is protective of human health and the environment because it will significantly reduce the risks from consumption of fish in River Sections 1, 2, and 3, as well as in the Lower Hudson. The modeling projects that the target concentration of 0.4 mg/kg, which is protective of the average adult who consumes one fish meal every two months, is attained in River Sections 1 and 2 within 20 years of active remediation. The target of 0.2 mg/kg, protective of an adult who consumes one fish meal per month, is attained in River Section 2 within 32 years of active remediation. These time periods are significantly shorter than the time periods projected for attaining the 0.4 mg/kg and 0.2 mg/kg targets under either the No Action alternative or the MNA alternative.

According to USEPA's model projections for the Upper Hudson River, the preferred alternative will meet the Preliminary Remediation Goal for human consumption of fish, which is 0.05 mg/kg, in River Section 3 within 43 years after completion of the active remediation. As a result, the Preliminary Remediation Goal of 0.05 mg/kg also is expected to be attained in the majority of the Lower Hudson River within this time frame, due to the lower initial concentration of PCBs in the Lower Hudson compared to the Upper Hudson. Due to the continuing PCB load of 2 ng/L assumed after implementation of the source control action in the vicinity of the GE Hudson Falls plant, the PCB concentration in fish averaged over the Upper Hudson is expected to be reduced to a range of 0.09 to 0.14 mg/kg, within the 70-year modeled time period, which is slightly above the Preliminary Remediation Goal of 0.05 mg/kg. However, the protectiveness of the preferred alternative is further enhanced through implementation of institutional controls, such as the fish consumption advisories and fishing restrictions.

The preferred alternative is also protective of the environment, because the preferred alternative will reduce PCB concentrations in fish averaged over the entire Upper Hudson, and in the Lower Hudson, to levels that are at or within the range of 0.3 to 0.03 mg/kg in whole fish (equivalent to 0.12 to 0.012 mg/kg in fish fillet) within the 70-year modeled time period, which is the Preliminary Remediation Goal for ecological exposure. Thus, the preferred alternative is protective of the birds, fish and mammals that live in and near the Hudson River.

The preferred alternative, REM-3/10/Select, is more cost-effective than the REM-0/0/3 alternative. The preferred alternative is $110 million less expensive than REM-0/0/3, without substantial differences in the amount of ecological or human health risk reduction. This is supported by the following tables, which show the projected ecological and human health risks for each of the alternatives.

The Reasonable Maximum Exposure cancer risks and non-cancer health hazards for adult anglers for each alternative averaged over the entire Upper Hudson River are shown in the top table on the following page.

Ecological risks for the mink and river otter for each of the three river sections are shown in the bottom table on the following page.

Moreover, as noted previously, USEPA's comparison of the relative effectiveness of the alternatives is based on the results of modeling each remedial alternative as well as data projections. Comparisons of the model outputs to recent data trends suggest that the model may be overly optimistic with regard to the rate of PCB decline in fish predicted for the No Action (no source control) and Monitored Natural Attenuation (assuming source control) alternatives. Consequently, the relative benefits of remediation are likely to be greater than suggested by the models.

The preferred alternative will comply with the location-specific and action-specific ARARs identified, as well as two of the five chemical-specific ARARs for the site. However, although the preferred alternative will approach these numbers, three of the chemical-specific ARARs are not expected to be met because the PCB contamination entering the Upper Hudson River from above Rogers Island (even after source control at the GE Hudson Falls plant) will likely exceed those ARARs. Therefore, it is expected that technical impracticability ARAR waivers will be required for three chemical-specific ARARs (1 ng/L federal Ambient Water Quality Criterion; 0.12 ng/L New York State standard for protection of wildlife; and 0.001 ng/L New York State standard for protection of human consumers of fish). Even the most aggressive removal alternative, REM-0/0/3, would require these same waivers.

The preferred alternative is effective in the long term and in the short term. Consideration of the statutory requirement for permanent remedies, to the maximum extent practicable, favors the removal alternatives (which are permanent) over the capping alternative (which also has significant long-term maintenance concerns).

Cancer Risks and Non-Cancer Health Hazards for Adults from Fish Ingestion Averaged over the Entire Upper Hudson River

Risk or Hazard	No Action	MNA	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3
HI-RME (2009-2015)	53-80	40-71	15	13	
HI-RME (2011-2017)	48-75	34-66			8
HI-CT (2009-2020)	5.0-7.7	3.4-6.7	1.3	1.2	
HI-CT (2011-2022)	4.5-7.3	2.9-6.3			0.7
Cancer risk - RME (2009-2048)	7.8×10^{-4} to 1.4×10^{-3}	4.0×10^{-4} to 1.2×10^{-3}	1.8×10^{-4}	1.7×10^{-4}	
Cancer risk - RME (2011-2050)	7.3×10^{-4} to 1.3×10^{-3}	3.5×10^{-4} to 1.1×10^{-3}			1.2×10^{-4}
Cancer risk - CT (2009-2020)	1.7×10^{-5} to 2.6×10^{-5}	1.2×10^{-5} to 2.3×10^{-5}	4.5×10^{-6}	4.0×10^{-6}	
Cancer risk - CT (2011-2022)	1.5×10^{-5} to 2.5×10^{-5}	$1.0 \times 10^{-5}$to $2.1\ 10^{-5}$			2.4×10^{-6}

Ecological Toxicity Quotients - River Otter and Mink (Average of 25-Year Time Frame)

		No Action start year 2008	**No Action** start year 2009	**MNA** start year 2008	**MNA** start year 2009	**CAP-3/10/Select**	**REM-3/10/Select**	**REM-0/0/3**
River Section 1 (RM 189) Modeling Time frame is 2008-2032 for CAP-3/10/Select and REM-3/10/Select and 2009-2033 for REM-0/0/3								
Mink	LOAEL	4.6-5.3	4.5-5.2	1.7-2.6	1.6-2.5	0.94	0.95	0.70
	NOAEL	46-53	45-52	17-26	16-25	9.4	9.5	7.0
River Otter	LOAEL	24-30	23-29	9.7-15	9.1-14	5.3	5.2	3.7
	NOAEL	240-300	230-290	97-150	91-140	53	52	37
River Section 2 (RM 184) Modeling Time frame is 2009-2033 for CAP-3/10/Select and REM-3/10/Select and 2011-2035 for REM-0/0/3								
Mink	LOAEL	1.5-2.7	1.3-2.6	0.94-2.5	0.79-2.4	0.36	0.31	0.19
	NOAEL	15-27	13-26	9.4-25	7.9-24	3.6	3.1	1.9
River Otter	LOAEL	14-27	12-26	9.2-24	7.8-23	3.5	2.9	1.8
	NOAEL	140-270	120-260	92-240	78-230	35	29	18
River Section 3 (RM 154) Modeling Time frame is 2010-2034 for CAP-3/10/Select and REM-3/10/Select and 2012-2036 for REM-0/0/3								
Mink	LOAEL	0.21	0.20	0.11	0.09	0.07	0.08	0.06
	NOAEL	2.1	2.0	1.1	0.9	0.75	0.75	0.55
River Otter	LOAEL	2.4	2.3	1.2	1.1	0.87	0.86	0.62
	NOAEL	24	23	12	11	8.7	8.6	6.2

Notes: Toxicity Quotient above 1.0 indicate the potential for ecological risk.
NOAELs and LOAEL are discussed in section on the Ecological Risk Assessment.
Range of years calculated using bounding estimates are presented for the No Action and MNA alternatives.

Implementation of the preferred alternative will greatly reduce the amounts of PCBs in the sediments and lower the average PCB concentration in surface sediments, which in turn will reduce PCB levels in the water column and fish, and the corresponding levels of risk. Reduced amounts of PCBs and surface sediment concentrations will also reduce the long-term transport of PCBs from each river section to the next and from the Upper Hudson River to the Lower Hudson River. For example, there is at least a 40 percent reduction of the PCB load that is transported into the Lower Hudson River in the 10 years following remediation as compared to MNA alone (with upstream source control).

The preferred alternative results in the targeted removal of 2.65 million cubic yards of contaminated sediments containing approximately 100,600 lbs (45,000 kg) of PCBs from the river environment. This results in a long-term reduction in the toxicity, mobility, and volume of PCBs in the river, even though treatment is not a principal element of the remedy. However, after the sediments are dredged from the river, these sediments will be stabilized by blending them with Portland cement, which is a form of limited treatment.

The preferred alternative is technically and administratively feasible and implementable. All of the necessary personnel, equipment, and services required are expected to be readily available or reasonably arranged.

The preferred alternative, REM-3/10/Select, is similar to the REM-0/0/3 alternative in terms of reduction of risks to human health and the environment.

In summary, the REM-3/10/Select alternative was chosen as USEPA's preferred alternative based on the need for active remediation in order to protect human health and the environment. The REM-3/10/Select alternative fulfills the statutory requirement for permanent remedies, to the maximum extent practicable, whereas capping does not, and the REM-3/10/Select alternative is more cost-effective than the REM-0/0/3 alternative.

The need to remediate a substantial portion of the contamination in the river sediments is not based on a single analytical tool. Instead, it is drawn from a weight of evidence approach in which several analytical tools and factual databases all point to the same conclusion, each in its own way strengthening the others.

Historical information collected over the past 20 years indicates that large quantities of PCBs are present within the sediments in relatively high concentrations. Within the Upper Hudson River, fish tissue sampling indicates that PCB levels in brown bullhead in the Thompson Island Pool do not show any significant reduction attributable to natural attenuation of PCBs in sediment over the past five years. Geochemical analyses tell us that, while the river is net depositional, contaminated sediments are not being significantly buried or sequestered in the river. Water-column sampling at both ends, and throughout the Thompson Island Pool, shows a sharp increase (over three times) in PCB water-column concentration as the river flows through this 6.3 mile stretch. PCB congener fingerprinting demonstrates that the sediment is the source. Projections from the models developed for the river, which have undergone external peer review, show that fish within the Upper Hudson will be substantially less contaminated sooner through active remediation. As a result, human and ecological risks will be substantially reduced below current unacceptable levels to a degree that will be real and measurable.

GLOSSARY OF TERMS

Specialized terms used in this Proposed Plan are defined below:

Applicable or relevant and appropriate requirements (ARARs) - the Federal and State environmental laws that a selected remedy will meet. These requirements may vary among sites and alternatives.

Aroclor - a term used in commerce to denote a PCB type; typically followed by a 4-digit number, the last 2 designating percent chlorine weight.

Central Tendency (CT) - the average exposure expected to occur at a site.

Congener - one of the 209 different configurations of a PCB molecule resulting from multiple combinations of hydrogen and chlorine positions on the PCB molecule.

Consent Decree - a legal document, approved by a judge, that formalizes an agreement between USEPA and one or more potentially responsible parties (PRPs) outlining the terms by which the response action will take place. A Consent Decree is subject to a public comment period prior to its approval by a judge and is enforceable as a final judgment by a court.

Ex situ - the removal of a medium (for example, water or soil) from its original place, as through excavation, in order to perform the remedial action.

Lipids - a biochemical term for fat; most commonly used with respect to the percent contained in fish.

LOAEL - Lowest observed adverse effect level. The lowest concentration at which an adverse effect is seen in field or laboratory toxicity studies.

MPA (mass per unit area) - a representation of the total mass of PCBs within a sediment core or within an area represented by sediment cores.

NOAEL - No observed adverse effect level. The highest concentration in a field or laboratory toxicity study at which no adverse effect is seen.

PCB Inventory - the total mass of PCBs contained within a area of sediment; relates to the mass per unit area (MPA) value.

Present Worth Analysis - a method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. When calculating present worth costs for Superfund sites, capital and operation and maintenance costs are included.

Safe Drinking Water Act Maximum Contaminant Level (SDWA MCL) **-** the maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Reasonable Maximum Exposure (RME) - the highest exposure that is reasonably expected to occur at a site.

Reassessment - The evaluation conducted by USEPA to reconsider the interim No Action alternative selected in USEPA's 1984 Record of Decision. The Reassessment is also referred to as the Reassessment Remedial Investigation and Feasibility Study (Reassessment RI/FS).

TEQ - a subset of PCB congeners that are structurally similar to dibenzo-p-dioxin and cause dioxin-specific biochemical and toxic responses.

***Tri*+ PCBs -** a representation of the sum of PCBs with 3 to 10 chlorine atoms per molecule.

TSCA - the Toxics Substances Control Act. This law regulated the handling and disposal of PCBs.

printed on recycled paper