Department of Environmental Conservation

Division of Environmental Remediation

Record of Decision

Irvington Waterfront Park
Environmental Restoration Project
Village of Irvington, Westchester County
Site Number B-00004-3

March 1998

New York State Department of Environmental Conservation
GEORGE E. PATAKI, *Governor* JOHN P. CAHILL, *Commissioner*

DECLARATION STATEMENT
ENVIRONMENTAL RESTORATION RECORD OF DECISION

Irvington Waterfront Park Environmental Restoration Project
Westchester County
Site No. B-00004-3

Statement of Purpose and Basis

The Record of Decision (ROD) presents the selected remedial action for the Irvington Waterfront Park Environmental Restoration Project, which was chosen in accordance with the New York State Environmental Conservation Law (ECL).

This decision is based upon the Administrative Record of the New York State Department of Environmental Conservation (NYSDEC) for the the Irvington Waterfront Park Environmental Restoration Site and upon public input to the Proposed Remedial Action Plan (PRAP) presented by the NYSDEC. A bibliography of the documents included as a part of the Administrative Record is included in Appendix B of the ROD.

Assessment of the Site

Actual or threatened release of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, presents a current or potential threat to public health and the environment.

Description of Selected Remedy

Based upon the results of the Site Investigation/Remedial Alternatives Report (SI/RAR) for the the Irvington Waterfront Park and the criteria identified for evaluation of alternatives, the NYSDEC has selected a soil cover, shoreline protection and long-term monitoring. The components of the remedy are as follows:

- Construction of a soil cover with a 12" barrier layer of low permeability (10^{-5} cm/s) soil, or an engineered equivalent, and sufficient surface grades and subsurface drainage to provide at least 70% runoff of incident precipitation. Improvement of site drainage structures to minimize the ponding water on the cover and to divert upland flows around the site.

- Replacement and/or rehabilitation of the existing bulkhead with shoreline protection that provides structural support for the cover and prevents the release of fill into surface water and sediments. Implementation of erosion control and stormwater management plans during bulkhead replacement to minimize construction-phase releases.

- Excavation of the 100 Bridge Street leach fields with off-site disposal of contaminated soil.
- Long-term groundwater monitoring to verify the NYSDEC's expectation that contaminants in the fill will not migrate.

New York State Department of Health Acceptance

The New York State Department of Health concurs with the remedy selected for this project as being protective of human health.

Declaration

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective.

3/10/98
Date

Michael J. O'Toole, Jr., Director
Division of Environmental Remediation

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SECTION 1: SITE LOCATION AND DESCRIPTION

The Irvington Waterfront Park is made up of the former 29 and 100 Bridge Street properties located in the Village of Irvington. Together, these properties comprise approximately 12 acres of land along the Hudson River waterfront. The site is owned jointly by the Village of Irvington and Scenic Hudson Land Trust, Inc. As shown on Figure 1, the site is bounded on the north by the Bridge Street Properties commercial development, on the east by the Metro North/Amtrak railroad tracks, and on the west and south by the Hudson River. The site is currently vacant and access to the site is controlled by a fence and gate across the Bridge Street entrance.

SECTION 2: SITE HISTORY

2.1: Operational/Disposal History

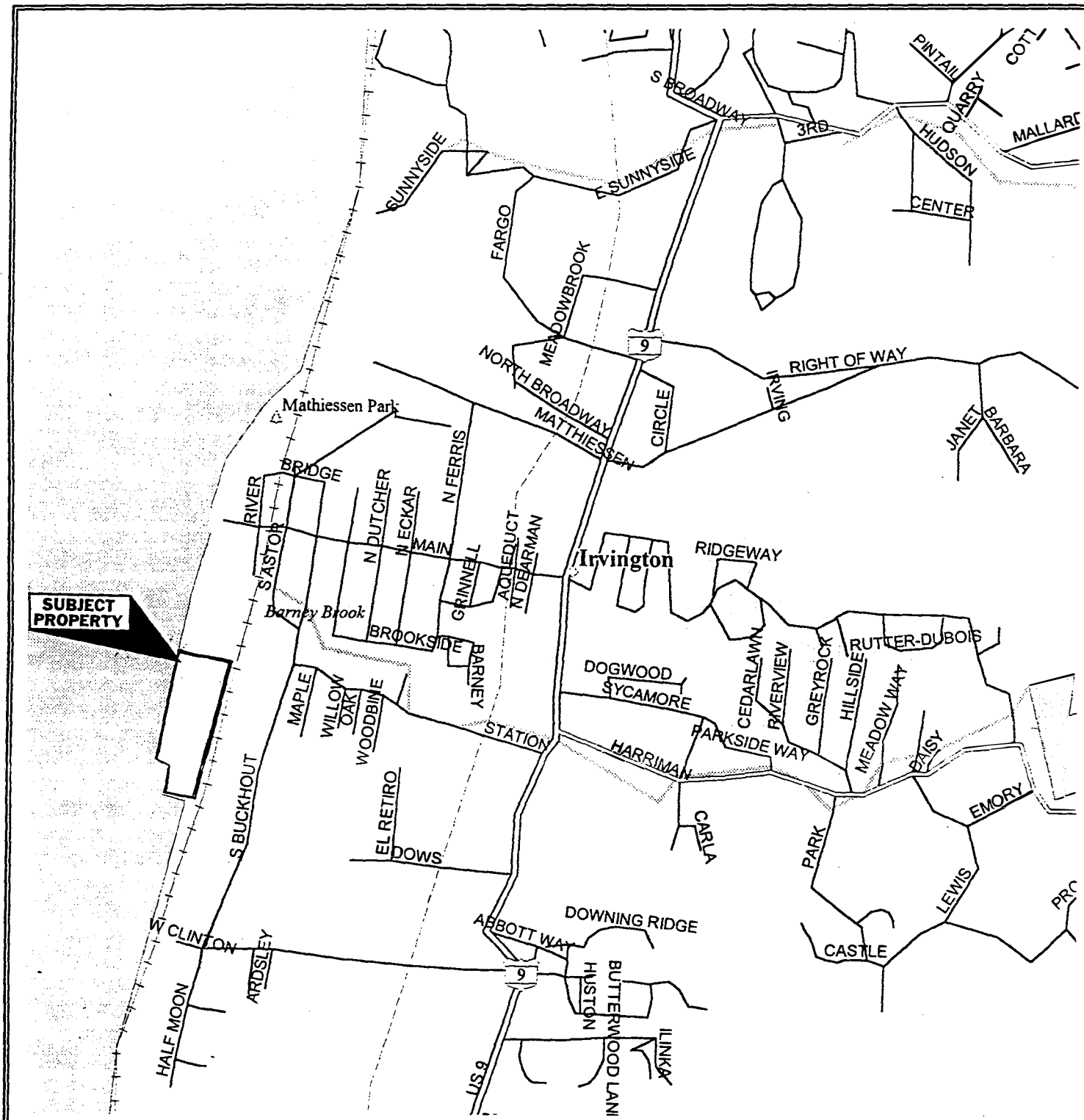
The site is situated on land which was created by filling into the Hudson River. Historic records indicate that from 1890 through 1940, various sections of the site were created. Specific sources of fill material are unknown; however, common practice was to use demolition debris, ash and furnace slag as riverfront fill.

Until 1980, the site was used by the Weyerhaeuser Company for lumber storage and distribution. In 1980 the property was split into two parcels and the 100 Bridge Street property continued to operate as a lumber yard until October 1997. Since 1980, the 29 Bridge Street property was used for bus maintenance, furniture refinishing, stage set construction and document storage.

2.2: Environmental Restoration History

In 1995, six underground petroleum storage tanks located at the 29 Bridge Street parcel were removed, along with associated petroleum-contaminated soils. This was performed under a Stipulation Agreement with the former owner, One-Nineteen Development Associates, under the NYSDEC Spill Response Program. Because contaminant levels in soils remaining at the site were above cleanup guidelines, a remediation system was installed to treat them in place. This consisted of a passive bioventing system, in which air is introduced into the subsurface soils to enhance the action of naturally-occurring soil microbes in breaking down the petroleum hydrocarbons. When the 29 Bridge Street parcel was purchased by Downriver Associates later in 1995, they entered into a Voluntary Agreement with the DEC to continue this work.

In February 1997, the Village of Irvington and Scenic Hudson entered into a Voluntary Cleanup Agreement with the NYSDEC to investigate and remediate contamination on the 29 Bridge Street property. In May 1997, the Village of Irvington entered into a State Assistance Contract with the NYSDEC to investigate the entire site, including the 100 Bridge Street parcel, as an Environmental Restoration Project. This contract also enabled the Village to receive state funding for up to 75% of the costs of the investigation under the 1996 Clean Air / Clean Water Bond Act. In August 1997, Scenic Hudson and the NYSDEC agreed to modify the February 1997 Voluntary Agreement to include their ownership of the 100 Bridge Street parcel.



MAP FROM DELORME'S MAP EXPERT, FREEPORT, ME.

Site Location Map

29-100 Bridge Street

Village of Irvington, Westchester County, New York

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ESI File Number: IB9718.40

June 1997

Figure 1

SECTION 3: CURRENT STATUS

To determine the nature and extent of any contamination by hazardous substances of this environmental restoration site, the Village of Irvington and their consultants, Ecosystems Strategies, Inc., performed a Site Investigation and Remedial Alternatives analysis (SI/RA).

3.1: Summary of the Site Investigation

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

The SI was conducted in one phase between August and October 1997. A Site Investigation Report has been prepared which describes the field activities and findings of the SI in detail.

The SI included the following general activities:

- Installation of soil borings to characterize the depth, chemical nature and structural properties of the fill beneath the site.
- Installation and sampling of groundwater monitoring wells to determine water quality and flow conditions beneath the site.
- Sampling the surface water and sediment of the Hudson River to determine the extent of off-site migration of contaminants.

To determine which media (soil, groundwater, etc.) contain contamination at levels of concern, the SI analytical data was compared to environmental Standards, Criteria, and Guidance values (SCGs). Groundwater and surface water SCGs for the site are based on NYSDEC Ambient Water Quality Standards and Guidance Values. For soils, NYSDEC TAGM 4046 provides cleanup guidelines for soil which are determined based on the protection of groundwater, background conditions, and health-based direct exposure scenarios. Guidance values for evaluating contaminants in sediments are provided by the NYSDEC "Technical Guidance for Screening Contaminated Sediments."

Based on the Site Investigation results, in comparison to the SCGs and potential public health and environmental exposure routes, certain areas and media of the site require remediation, as summarized below and in Table 1.

Chemical concentrations are reported in parts per billion (ppb) and parts per million (ppm). For comparison purposes, SCGs are given for each medium.

3.1.1 Nature of Contamination:

As described in the SI Report, many soil, groundwater and sediment samples were collected at the site to characterize the nature and extent of contamination. The main categories of contaminants which exceed their SCGs are inorganics (metals) and semivolatile organic compounds (SVOCs). No SCG

exceedances were found in any medium for volatile organic contaminants (VOCs) or PCBs (See Table 1).

The inorganic contaminants of concern are the metals arsenic, chromium, lead, mercury and selenium. These metals are associated primarily with the ash and furnace slag that comprises much of the fill beneath the site. Arsenic and chromium may also be related to the storage of pressure-treated wood at the lumber yards which operated at the site.

The SVOCs found in site soils and fill are all Polycyclic Aromatic Hydrocarbons (PAHs), such as pyrene, chrysene, and benzo-substituted anthracenes and fluoranthenes. These PAHs are commonly associated with coal tars, ash, heavy petroleum oils and products of incomplete combustion.

Groundwater samples exceeded the standard for lead in two site wells, one of which also contained arsenic, barium, and selenium at levels above standards. Groundwater also exceeds the fresh water standard for chloride, but this is attributed to the salt water of the Hudson River, which is in contact with groundwater beneath the site. No volatile organic contaminants (VOCs), or semivolatile organic contaminants (SVOCs) were found in the groundwater at levels exceeding standards.

3.1.2 Extent of Contamination

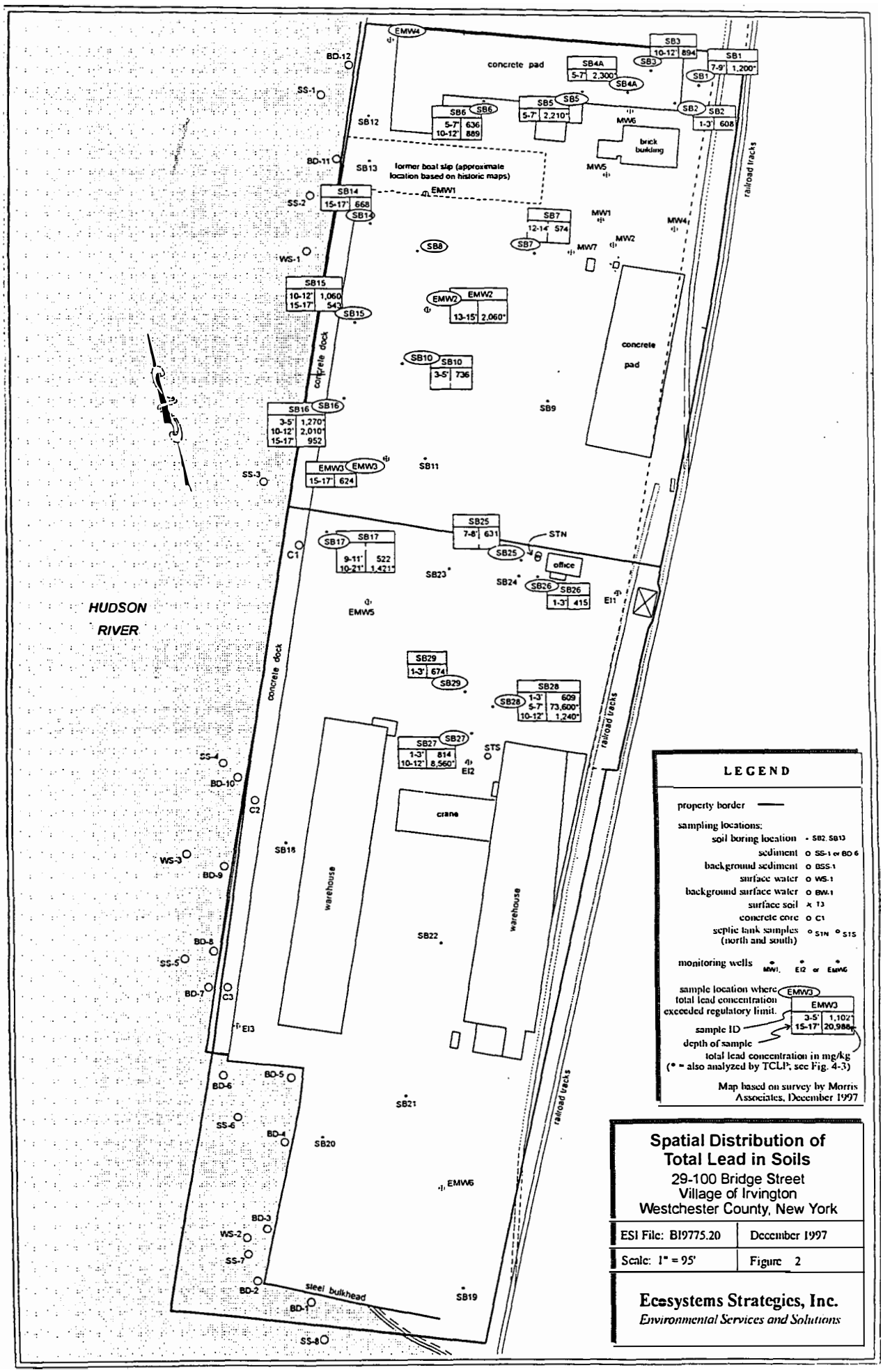
Table 1 summarizes the extent of contamination for the contaminants of concern in groundwater, soil, sediments and surface water and compares the data with the proposed remedial action levels (SCGs) for the Site. The following are the media which were investigated and a summary of the findings of the investigation.

Soil/Fill

Fill material was encountered in all but one boring, ranging in depth from 0 to 31 feet across the site. Samples of this fill were found to be contaminated with a number of inorganic and semivolatile contaminants.

The primary contaminant of concern is lead, which is present at a maximum concentration of 7.4% in one sample and at concentrations ranging from 0.1% to 0.2% in several others. The soil cleanup guideline for lead is in the range of 400-500 ppm, or 0.04-0.05%. The highest lead concentrations were found in the leach field of the 100 Bridge Street parcel, where concentrations of 0.8% and 7.4% were found. Lead levels exceeded the cleanup guideline at most locations in the northern half of the site, as shown in Figure 2. The significantly higher levels found in the 100 Bridge Street leach field (SB-27 and SB-28 in Figure 2) indicate that a concentrated source of lead, perhaps paint wastes, may be present there.

To evaluate the potential costs for off-site disposal of excavated fill, samples were analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for lead. Seven of the ten fill samples were found to exceed the 5 ppm threshold which would classify them as a hazardous waste if they were excavated. There was no correlation between the total lead content of a sample and its corresponding TCLP value. The highest total lead value (7.4%) corresponded to a TCLP value of 2.1 ppm, which is not considered to be a hazardous waste. The highest TCLP value (564.4 ppm), corresponded to the tenth highest total



LEGEND

property border

sampling locations:

- soil boring location • SB2, SB13
- sediment o SS-1 or BD-6
- background sediment o BSS-1
- surface water o WS-1
- background surface water o BW-1
- surface soil x T3
- concrete core o C1
- septic tank samples (north and south) o STN o STS
- monitoring wells MW1, EI2 or EMW6
- sample location where total lead concentration exceeded regulatory limit. EMW3
- sample ID EMW3
- depth of sample 3-5' 1,102*
- total lead concentration in mg/kg 15-17' 20,988
- (* = also analyzed by TCLP; see Fig. 4-3)

Map based on survey by Morris Associates, December 1997

Spatial Distribution of Total Lead in Soils

29-100 Bridge Street
Village of Irvington
Westchester County, New York

ESI File: BI9775.20	December 1997
Scale: 1" = 95'	Figure 2

Ecosystems Strategies, Inc.
Environmental Services and Solutions

lead value of 1,200 ppm. These results indicate that the fill matrix is highly variable in its potential for leaching or binding lead. The TCLP test simulates leaching under the mildly acidic conditions of a municipal landfill, and overestimates the leaching potential of the fill under the neutral conditions found at the site.

Other inorganic contaminants were found in the soil and fill at levels which exceeded their respective cleanup guidelines: arsenic (7.5 ppm) in 59% of samples, mercury (0.1 ppm) in 43%, chromium (10 ppm) in 30% and selenium (2 ppm) in 22%.

Generally, samples taken from the southern portion of the site had levels of contaminants below cleanup guidelines or only slightly above them. For this discussion, the southern portion of the site is all areas south of location SB28, including the two warehouses on the 100 Bridge Street parcel (see Figure 2). In this portion of the site, lead was not present above its cleanup guideline, and other metals, particularly arsenic, were present at less than 5 times their cleanup guidelines.

Semivolatile organic contaminants (SVOCs) were also present above their cleanup guidelines in samples from the 29 Bridge Street parcel and in the 100 Bridge Street leach field. The most common and highest level SVOC was pyrene, found in 56% of samples to a level of 91 ppm, or more than 900 times its cleanup guideline. The highest levels of all SVOCs were found in the shallow soil sample (0-2') from SB-6, located at the bottom of a sloped asphalt loading area of the former 29 Bridge Street warehouse. This contamination may be due to runoff from the asphalt and parking area.

Sediments

Guidance values for lead in marine and estuarine sediments are established at two thresholds: the Lowest Effect Level (LEL) of 47 ppm and the Severe Effect Level (SEL) of 218 ppm. The LEL indicates a level that can be tolerated by the majority of benthic (sediment-dwelling) organisms, but which still causes toxicity to a few species. The SEL indicates the concentration at which pronounced disturbance of the sediment-dwelling community can be expected. Lead concentrations between the LEL and SEL (47 and 218 ppm) are considered to be contaminated, with moderate impacts to benthic life.

Lead levels in sediments adjacent to the site exceeded the lowest effects level in most samples, but did not exceed the severe effects level. Because lead is a common contaminant in urban and industrial areas, two background sediment samples were taken upriver of the site for comparison to the on-site samples. This comparison was used to distinguish between regional and site-related sources of lead contamination.

Background levels of lead ranged from 146 to 163 ppm in surface sediments, and from 123 to 179 ppm in deeper sediments (4" to 12"). Sediment samples taken adjacent to the site exceeded these background levels at two locations, both in the 4" to 12" sample depth. The lead levels in these two samples were 182 ppm and 218 ppm, as compared to the highest background level of 179 ppm.

These results indicate that although a moderate impact is occurring to sediment-dwelling organisms, potential site-related impacts cannot be distinguished from background and historical sources.

Groundwater

The depth of groundwater beneath the site was found to range from approximately 1.5 feet to 6.5 feet below the ground surface. Groundwater levels in wells near the Hudson River were found to vary with the tidal fluctuations of the river.

Samples collected from wells screened in the fill material were found to be contaminated with the metals lead, arsenic, barium, and selenium. Lead exceeded the standard in 3 of the 15 groundwater samples collected during the SI, arsenic in 2 of 13 samples, and selenium and barium exceeded standards in one sample each (see Table 1).

All exceedances of groundwater standards were detected in samples which contained a high level of suspended particles (turbidity), and which were not filtered prior to analysis. Turbidity values in the three wells where the lead standard was exceeded were 180, 580, and 190 Turbidity Units (NTUs), as compared to the NYSDEC guideline of 50 NTUs. When filtered portions of the same samples were analyzed, no exceedances of groundwater standards were detected. This indicates that the contaminants are present in particles suspended in the samples, and are not dissolved in the groundwater.

Although the NYSDEC does not generally accept the suitability of filtered samples for comparison to groundwater standards, several site-specific factors led to their acceptance for certain wells sampled during this investigation. First, the wells were screened in very fine-grained fill material, rather than in native soils. Due to the high fines content of this fill, which included ash, several wells could not be developed to achieve the 50 NTU turbidity guideline. An attempt was made to redevelop two of the wells (EMW-2 and EMW-3), which reduced both the turbidity level and total lead concentrations, although the 50 NTU guideline was still not achieved. After a thorough review of the well installation and development procedures with respect to DEC guidance (TAGM 4015), the filtered results were accepted. During this review, the results from two pre-existing wells (MW-4 and MW-6) were rejected due to their unknown construction integrity and very high turbidity levels (>999 NTUs).

Surface Water

In four surface water samples, one sample contained selenium at 14 ppm, which exceeded its water quality standard of 10 ppm. No other exceedances were found.

3.2 Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the health risks can be found in Section 6.0 of the SI Report.

An exposure pathway is how an individual may come into contact with a contaminant. The five elements of an exposure pathway are 1) the source of contamination; 2) the environmental media and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements may be based on past, present, or future events.

Pathways which are known to or may exist at the site include:

- Ingestion of contaminated soil
- Inhalation of contaminated dust
- Ingestion of contaminated sediment.

Due to the presence of the asphalt surface across the site, there is presently little possibility of exposure to contamination by ingestion of soil or inhalation of dust. Similarly, the existing bulkhead has prevented the release of contaminated fill into Hudson River sediments, so that exposure to site-related contaminants is not presently occurring. However, because both the asphalt and bulkhead are deteriorating, these routes of exposure are a concern for future activities at the site.

Short-term exposure to contaminants in the fill is also a concern for workers involved in construction activities that require excavation of site soils. Dust inhalation and ingestion of soil particles are the primary routes of exposure for construction workers.

3.3 Summary of Environmental Exposure Pathways:

Samples of surface water and sediment collected from the Hudson River indicate that the site is not presently causing contaminant levels to significantly exceed background sediment concentrations or surface water quality standards. However, because the existing bulkhead is deteriorating, there may be a potential for future releases of contaminated fill into the river. Although it is not presently occurring, control of this potential migration is included as a remedial goal for the project.

SECTION 4: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past owners and operators, waste generators, and haulers.

Investigation and remediation of the site is being performed by the Village of Irvington pursuant to the May 1997 State Assistance Contract. Scenic Hudson Land Trust, as co-owner of the site, has entered into Voluntary Agreements with the NYSDEC dated February 11, 1997 and August 29, 1997 for the 29 and 100 Bridge Street parcels, respectively. In these agreements, the NYSDEC has acknowledged that the Village of Irvington and Scenic Hudson Land Trust are not responsible for the presence of contamination at the site.

Since no viable PRPs have been identified, there are currently no ongoing enforcement actions. However, legal action may be initiated at a future date by the State to recover State response costs should PRPs be identified. The Village of Irvington will assist the State in its efforts by providing all information to the State which identifies PRPs. The Village of Irvington will also not enter into any agreement to recover response costs without the approval of the NYSDEC.

SECTION 5: SUMMARY OF THE REMEDIATION GOALS AND FUTURE USE OF THE SITE

Goals for the remedial program have been established through the remedy selection process outlined in 6 NYCRR Part 375-1.10. The overall remedial goal is to protect human health and the environment and to meet all Standards, Criteria, and Guidance values (SCGs).

At a minimum, the selected remedy should eliminate or mitigate all significant threats to the public health and to the environment presented by the hazardous substances disposed at the site through the proper application of scientific and engineering principles.

The proposed future use for the Irvington Waterfront Park is a public park. Based on this use, the goals selected for this site are:

- Eliminate the potential for direct human or animal contact with contaminated soils and fill at the site.
- Reduce, control, or mitigate, to the extent practicable, the contamination present within the soils/fill on site.
- Eliminate the threat to surface waters by preventing surface run-off from the contaminated soils and fill at the site.
- Eliminate the threat to sediments by preventing the surface and subsurface discharge of contaminated fill material into the Hudson River.
- Prevent, to the extent possible, migration of contaminants in the fill to groundwater.
- Provide for attainment of SCGs for groundwater quality at the limits of the site, to the extent practicable.

SECTION 6: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy should be protective of human health and the environment, be cost effective and comply with other statutory laws. Potential remedial alternatives for the Irvington Waterfront Park were identified, screened and evaluated in the Remedial Alternatives Report. A summary of the detailed analysis follows.

6.1: Description of Alternatives

The remedies presented and evaluated below were designed to address the contaminated fill and potentially contaminated groundwater and sediments at the site.

The cost of each alternative is presented as the capital cost, annual operation and maintenance (O&M) cost, and total present worth cost. Present worth is defined as the amount of money currently required (in 1998 dollars at 5% interest) to fund the capital cost and 30 years of the O&M costs.

As presented below, the "Time to Implement" reflects only the time required to construct and operate each remedy, and does not include the time required for design or for procurement of contracts for design and construction.

Alternative 1: No Remedial Action

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

For the Waterfront Park site, the No Remedial Action Alternative envisions that the existing asphalt pavement, concrete slabs and small vegetated areas would remain. Although the NYSDEC recognizes that a public park will be built at the site, no detailed design plans are presently available to incorporate into the No Remedial Action Alternative.

The infiltration analysis presented in the RAR estimates that currently 44% of rainfall and snowfall infiltrates through the site cover materials and passes through the fill material. As the existing asphalt would continue to deteriorate, this infiltration is expected to increase.

Under this alternative, annual costs would be incurred for maintenance of the existing site fencing and placards. A long term monitoring plan would be developed and implemented to monitor potential impacts to the environment.

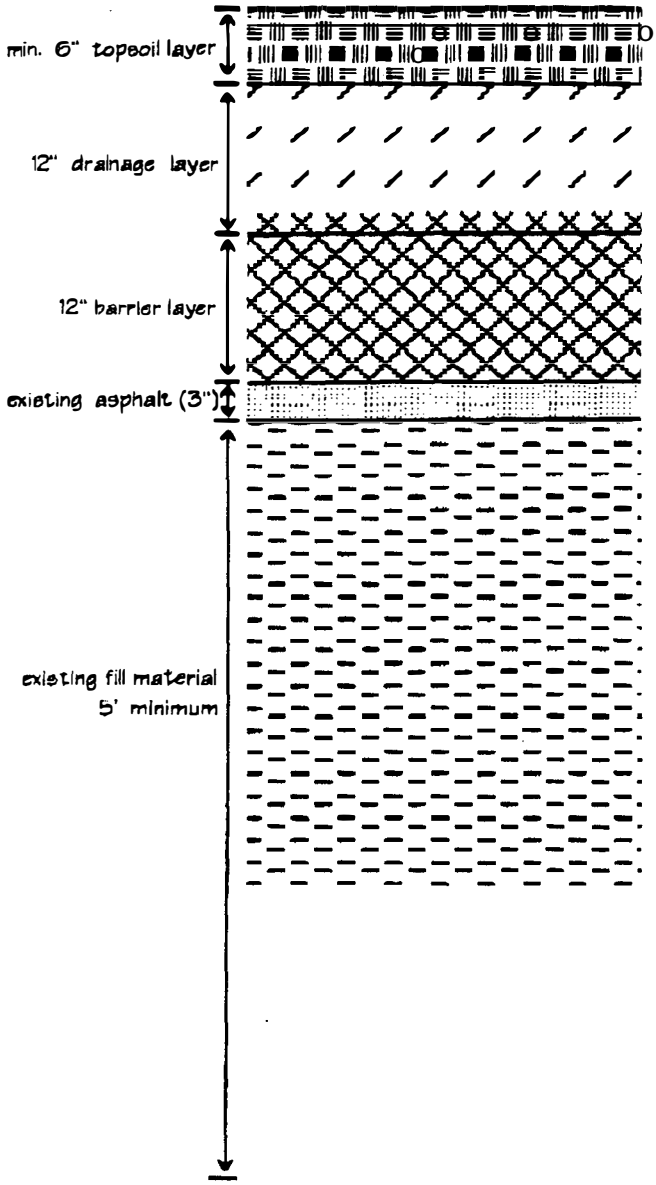
Present Worth:	$ 215,180
Capital Cost:	$ 0
Annual O&M:	$ 14,000
Time to Implement	1 Month

Alternative 2: Soil Cover

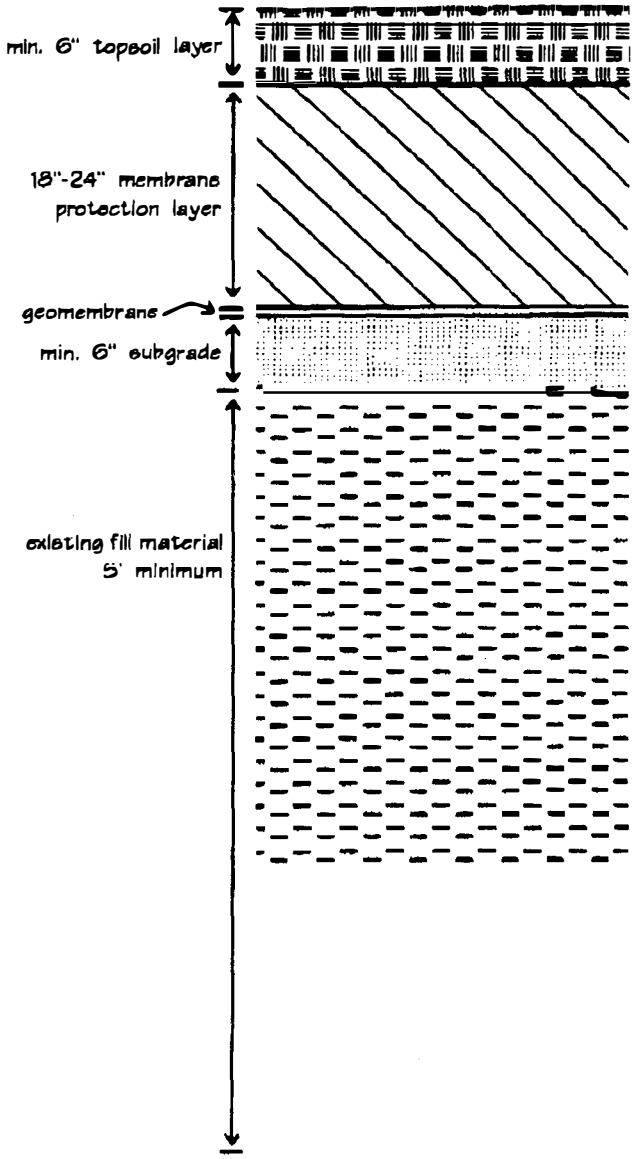
Under this alternative, a soil cover would be placed over the site to prevent direct contact with the fill and to reduce infiltration through it. Conceptually, the lower layer of this cover system would be 12 inches of low permeability soil, with an maximum permeability of 10^{-5} cm/sec. Over this layer a 12-inch drainage layer and 6 inches of topsoil would be placed. The surface of this cover would be sloped to ensure that surface water would run off the site, and not percolate through the fill. A cross section of this cover is shown in Figure 3. An estimated 41,800 cubic yards of soil would be required for this cover. The cover system would be designed to ensure that at least 70% of precipitation is collected before it reaches the fill.

In addition to the soil cover, the existing bulkhead would be rehabilitated or replaced with effective shoreline protection. This shoreline protection would be designed to prevent the release of contaminated fill particles into the Hudson River and to provide structural support for the soil cover. This could be accomplished with either rip rap armoring underlain by a filter fabric, or with a sheet pile bulkhead. Rip

Cross Section of Soil Cover
Figure 3



Cross Section of Geomembrane
Figure 4



Cross Section Details

29 - 100 Bridge Street
Village of Irvington
Westchester County, New York

ESI File:	BI9775.20
January 1998	
Figures 3	

rap armoring is included in this alternative as the minimum protective measure, but alternative designs would be considered based on recreational needs and permitting restrictions.

To verify the effectiveness of the soil cover, a long-term groundwater and sediment monitoring plan would be developed and implemented.

Present Worth:	$ 3,834,450
Capital Cost:	$3,783,729
Annual O&M:	$ 3,300
Time to Implement	3 months

Alternative 3: Impermeable Membrane Cover System

This alternative would involve the installation of a synthetic membrane over the fill to minimize the amount of percolation through it. The membrane would be covered by 3 feet of drainage material, barrier protection soil and topsoil. These layers would protect the integrity of the membrane from future activities at the site, provide drainage for stormwater, and sustain vegetative growth. An estimated 54,700 cubic yards of soil would be required for these layers. To provide a proper bedding layer for the membrane, the existing asphalt layer would be removed or broken up and covered with a layer of smooth sand. A cross section of the membrane cap is shown in Figure 4. The membrane cover is estimated to be at least 95% effective in preventing rainfall and snowfall from infiltrating through the fill.

To preserve the integrity of the membrane layer, restrictions would be placed on the types of structures and vegetation that could be placed at the site. Alternatively, additional barrier protection fill and non-conventional construction methods would be required for tree plantings and building foundations.

In addition to the membrane cap, the existing bulkhead would be rehabilitated or replaced with effective shoreline protection. This shoreline protection would be designed to prevent the release of contaminated fill particles into the Hudson River and to provide structural support for the soil cover. This could be accomplished with either rip-rap armoring underlain by a filter fabric, or with a sheet pile bulkhead. Rip-rap armoring is included in this alternative as the minimum protective measure, but alternative designs would be considered based on recreational needs and permitting restrictions.

To verify the effectiveness of the membrane cap, a long-term groundwater and sediment monitoring plan would be developed and implemented.

Present Worth:	$ 5,363,260
Capital Cost:	$ 5,312,539
Annual O&M:	$ 3,300
Time to Implement	6 months

6.2 Evaluation of Remedial Alternatives

The criteria used to compare the potential remedial alternatives are defined in the regulation that directs the remediation of environmental restoration project sites in New York State (6 NYCCR Part 375). For each of the criteria, a brief description is provided, followed by an evaluation of the alternatives against

that criterion. A detailed discussion of the evaluation criteria and comparative analysis is contained in the Remedial Alternatives Report.

The first two evaluation criteria are called "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance.

The primary SCGs considered in the evaluation of alternatives are groundwater standards and guidance values, soil cleanup guidelines, and sediment quality guidance values.

As discussed in Section 3.1.2 above, filtered groundwater presently meets water quality standards, and sediments adjacent to the site do not exceed the Severe Effects Level for lead. Soil cleanup guidelines, which are based on direct human exposure and protection of groundwater, are exceeded for several metals and semivolatile organic contaminants.

Under the No Action alternative, continued deterioration of the site pavement and bulkhead would cause contaminated fill to be released to the air, groundwater, surface water and sediments. As a result, the SCGs for these media would not be met. Under Alternatives 2 and 3, the soil barrier and membrane cap would provide sufficient containment that no migration of contaminated fill would occur, and these SCGs would be met. For all three alternatives, contaminant concentrations in the fill would continue to exceed the soil cleanup guidelines, but the routes of exposure to humans and the environment would be eliminated in Alternatives 2 and 3.

2. Protection of Human Health and the Environment. This criterion is an overall evaluation of the health and environmental impacts to assess whether each alternative is protective.

Although there are presently no routes of public or environmental exposure to site contaminants, the NYSDEC expects that the existing asphalt cover will continue to deteriorate if no action is taken. Because exposure to site contaminants could occur if contaminated fill is exposed or released to the air and surface water, the No Action alternative would not be protective in the long term. Alternatives 2 and 3 would be protective because they would prevent public exposure to the fill, and would control the migration of contaminants through groundwater.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

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

The No Action Alternative would not involve construction, and so would not cause any short term impacts and could be implemented immediately. Alternative 2 would generally involve placement of

cover soil on top of the existing asphalt, and little exposure to the underlying fill would occur. To implement Alternative 3, the existing asphalt layer may have to be removed to provide a smooth surface for the membrane, and the potential would exist for short-term exposure to contaminants in the fill.

No Action would be the quickest remedy to implement because it requires only the development of a long-term monitoring and maintenance plan. Alternative 2 would require 3 months to construct the soil cover. Alternative 3 would require the longest period, 6 months to construct the membrane cap.

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

None of the alternatives under consideration would provide a permanent remedy because contaminants would remain on site and would require long-term management. The alternatives under consideration rely on containment to prevent exposure to and migration of site contaminants. The No Action alternative is not expected to provide long-term effectiveness because both the asphalt pavement and concrete bulkhead would continue to deteriorate over time. The likelihood of direct public exposure and release to the environment would increase in the long term. Both cover alternatives (Alternatives 2 and 3) would provide effective containment in the long term The reliability of these cover technologies is good, and the magnitude of the risks associated with them are small.

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

None of the alternatives under consideration would reduce the toxicity or volume of contamination at the site. Alternative 2 would reduce contaminant mobility by limiting the amount of precipitation that would pass through the fill and mobilize contaminants. Alternative 3 would reduce this mobility to a somewhat greater degree by nearly eliminating the infiltration of rainfall and snowfall through the fill. However, under all three alternatives, much of the fill would remain saturated by groundwater and potentially subject to migration by groundwater flow and tidal action.

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

The No Action alternative would be readily implementable. Both the soil cover and membrane cap would be moderately difficult to construct. The membrane cap would be somewhat more difficult due to the need for specialized personnel to place the membrane, seam the panels, and perform the necessary quality control testing. The membrane cap would also require greater volumes of material to be delivered to the site. The administrative feasibility of both cover alternatives would not be difficult.

7. Cost. Capital and operation and maintenance costs are estimated for each alternative and compared on a present worth basis. Although cost is the last balancing criterion evaluated, where two or more

alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for the final decision. The costs for each alternative are presented in Table 2.

This final criterion is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance - Concerns of the community regarding the SI/RA reports and the Proposed Remedial Action Plan have been evaluated. The "Responsiveness Summary", included as Appendix A presents the public comments received and the Department's response to the concerns raised. In general, the public comments received were supportive of the soil cover as the primary element of the selected remedy.

Comments submitted by the Village of Irvington raised concerns about the amount of truck traffic associated with bringing barrier soil, drainage soil, and topsoil to the site. To reduce potential traffic impacts, the Village requested that a Geosynthetic Clay Liner (GCL) be considered as a substitute for the 12-inch soil barrier layer. Scenic Hudson Inc. commented that the use of GCL should be subjected to the same detailed evaluation as the soil cover before it is approved. The NYSDEC agrees that a GCL is a potentially viable equivalent to a 12" soil barrier layer. The selected remedy specifies a 12" barrier soil layer or the engineered equivalent to accommodate the use of this material. An evaluation of the engineering equivalence of GCL and soil barriers is provided in the Responsiveness Summary.

Scenic Hudson also commented that the selection of bulkhead restoration method should be subject to the same detailed evaluation of criteria that was performed for the soil cover. Although the NYSDEC believes that selection of specific shoreline protection methods is a design-phase decision, an evaluation of these criteria is provided in the Responsiveness Summary.

SECTION 7: SUMMARY OF THE SELECTED REMEDY

Based upon the results of the SI/RA, and the evaluation presented in Section 7, the NYSDEC is selecting a Soil Cover (Alternative 2) as the remedy for this site. A soil cover will protect public health by preventing contact with the contaminated fill, and will provide better long-term protection of the environment than the existing deteriorating asphalt. The soil cover alternative has less of a short-term impact than the membrane cap, and is more readily implementable. A soil cover will provide these protections in a cost-effective manner and will not place undue restrictions on the development of the Waterfront Park.

Groundwater monitoring results from the Site Investigation indicate that contaminants are not currently dissolving into groundwater at levels of concern. Therefore, a soil cover which performs at least as well as the current asphalt cover will provide sufficient public and environmental protection. This soil cover will be constructed and maintained to be effective in the long term at reducing the infiltration of rainfall and snowfall through the fill.

Although the membrane cap would prevent less rainfall and snowfall contacting the fill, most of the fill will remain saturated by groundwater regardless of the cover system chosen. Because fill was placed at

the site to create land from the river, only the upper few feet of this fill is above the level of the river. Below this level, the flow of water through the fill is dominated by the regional flow of groundwater toward the Hudson River, and by the tidal fluctuations of the river itself. As a result, a membrane cap would provide an insignificant level of additional environmental protection.

In addition to providing a soil cover, the remedy requires that the bulkhead be replaced or rehabilitated with shoreline protection that prevents the release of contaminated fill particles into the Hudson River and provides structural support for the soil cover. At a minimum, this would be provided by rip-rap armoring underlain by a filter fabric. Alternatively, a sheet pile bulkhead would also provide sufficient containment and structural support. Sections of the existing sheetng may also be amenable to rehabilitation by coating with concrete or jacketing. The specific design of the shoreline protection will be developed during the design phase, in coordination with the overall park design, and will ensure that losses of riverbottom are minimized. Stormwater management and erosion control plans will be implemented during bulkhead replacement to minimize construction-phase releases. Also, health and safety plans will be implemented to protect workers who may come in contact with the fill during the construction of all park facilities.

During the construction of park facilities, it may be necessary to excavate portions of the fill for building foundations, a swimming pool, or other structures. Under the recommended alternative, the NYSDEC's preference is to relocate the excavated material on the site and to cover it with the specified soil cover. However, future development of the park may occur after the soil cover has been placed, and it may not be possible to accommodate additional excavated material under the cover. In this case, the excavated material will be transported and disposed off site. If off-site disposal is necessary, the material would be tested and managed in accordance with applicable regulations.

The estimated present worth cost to implement the remedy is $ 3,834,450 The cost to construct the remedy is estimated to be $3,783,729 and the estimated average annual operation and maintenance cost for 30 years is $ 3,300.

The elements of the proposed remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the SI/RA will be resolved.

2. Construction of a soil cover with a 12" barrier layer of low permeability (10^{-5} cm/s) soil or engineered equivalent and sufficient surface grades and subsurface drainage to provide at least 70% runoff of incident precipitation. Improvement of site drainage structures to minimize the ponding water on the cover and to divert upland flows around the site.

3. Replacement and/or rehabilitation of the existing bulkhead with shoreline protection that provides structural support for the cover and prevents the release of fill into surface water and sediments. Implementation of erosion control and stormwater management plans during bulkhead replacement to minimize construction-phase releases.

4. Excavation of the 100 Bridge Street leach fields with off-site disposal of contaminated soil.

5. Since the remedy results in untreated hazardous substances remaining at the site, a long term monitoring program will be instituted. Groundwater will be sampled periodically to verify the NYSDEC's expectation that contaminants in the fill will not migrate. Sediments will be sampled after construction of the bulkhead to verify whether releases were controlled during construction, and whether the bulkhead effectively contains the fill. This program will allow the effectiveness of the soil cover and bulkhead to be monitored and will be a component of the operation and maintenance of the site.

SECTION 8: HIGHLIGHTS OF COMMUNITY PARTICIPATION

As part of the Irvington Waterfront Park environmental restoration process, a number of Citizen Participation (CP) activities were undertaken in an effort to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted for the site:

- A repository for documents pertaining to the site was established.
- A site mailing list was established which included nearby property owners, local political officials, local media and other interested parties.
- A public meeting was held on June 25, 1997 to present the SI/RA Work Plan to the community.
- A Fact Sheet was prepared in January 1998 which summarized the results of the Site Investigation and Analysis of Alternatives, discussed the proposed remedy for the site, and announced the public meeting and comment period. The Fact Sheet was distributed to all Village residents, to the public contact list, and was posted on the Internet Web Site for the project.
- A public meeting was held on February 11, 1998 to present the Proposed Remedial Action Plan to the community and to receive comments on it. An opportunity for the public to provide written comments was provided between January 16, 1998 and March 2, 1998.
- In March 1998 a Responsiveness Summary was prepared and made available to the public, to address the comments received during the public comment period for the PRAP.

Table 1
Nature and Extent of Contamination

MEDIUM	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCG	SCG (ppb)
Groundwater (unfiltered)	Inorganic Contaminants	Lead	2.9 - 615	3 of 15	50
		Arsenic	NDt- 32.5	1 of 13	25
		Barium	36.7 - 1,030	1 of 13	1,000
		Selenium	ND - 15	2 of 13	10
		Chloride	1920 - 5,270,000	12 of 13	250,000
	Semivolatile Organic Contaminants	Benzo (a) Anthracene	NDt- 12	1 of 13	0.002 (GV)
		Benzo (a) Pyrene	ND - 17	1 of 13	ND (GV)
		Benzo (b) Fluoranthene	NDt- 13	1 of 13	0.002 (GV)
		Benzo (k) Fluoranthene	ND - 12	1 of 13	0.002 (GV)
		Chrysene	ND - 12	1 of 13	0.002 (GV)
		Ideno (1,2,3) Pyrene	NDt- 10	1 of 13	0.002 (GV)
Soils	Inorganic Contaminants	Lead (Total)	NDt- 73,600,000	27 of 98	400,000
		Lead (TCLP)	0.2 - 56.4 ppm	7 of 10	5 ppm
		Chromium	NDt- 19,400	10 of 37	10,000
		Mercury	NDt- 2,900	16 of 37	100
		Arsenic	NDt- 290,000	22 of 37	7,500
		Selenium	NDt- 11,600	8 of 37	2,000
	Semivolatile Organic Contaminants (SVOCs)	Benzo (a) Anthracene	NDt- 39,000	12 of 36	224
		Benzo (a) Pyrene	NDt- 31,000	12 of 36	61
		Benzo (b) Fluoranthene	NDt- 54,000	8 of 36	1,100
		Benzo (k) Fluoranthene	NDt- 7,800	2 of 36	1,100
		Chrysene	NDt- 36,000	12 of 36	400

MEDIUM	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCG	SCG (ppb)
Soils (continued)	Semivolatile Organic Contaminants (continued)	Indeno (1,2,3) Pyrene	ND - 18,000	2 of 36	3,200
		Phenanthrene	ND - 66,000	1 of 36	50,000
		Pyrene	ND - 91,000	20 of 36	100
Sediments	Inorganic Contaminants	Lead	7.3 - 218 ppm	30 of 34	47 ppm (LEL)[1]
		Lead	7.3 - 218 ppm	0 of 34	218 ppm (SEL)[2]
Surface Water	Inorganic Contaminants	Selenium	ND - 14.2	1 of 4	10

GV - Guidance Value
ND - Not Detectable

[1] LEL - Lower Effects Level (GV)
[2] SEL - Severe Effects Level (GV)

Table 2
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
No Action	$0	$ 14,000	$ 215,180
Soil Cover	$ 3,783,729	$ 3,300	$ 3,834,450
Membrane Cap	$ 5,312,539	$ 3,300	$ 5,363,260

Appendix A:
Responsiveness Summary

During the public comment period, written comments were received from the Village of Irvington and Scenic Hudson, Inc. These comments, and the DEC's response to them, are attached. The following is a compilation of the verbal comments that were received during the February 11, 1998 public meeting.

Question/Comment: The site does not seem to pose a current threat. Why is it necessary to spend $3.78 million on the remedy?

Response: Although the site does not currently pose a health or environmental threat, the levels of contaminants in the fill material are high enough that a threat would exist if a route of exposure developed in the future. It is necessary to spend this amount to ensure that the public can safely use the site as a park and that the sediment and water quality of the Hudson River is not impacted by the site.

Question/Comment: A more detailed breakdown of the remediation cost should be provided. Is most of the cost associated with replacing the bulkhead?

Response: The following table provides a more detailed cost estimate. Additional detail can be found in the Remedial Alternatives Report, which is on file in the document repositories.

Item	Soil Cover (Alt. 2)	Membrane Cap (Alt. 3)
Site Preparation & Drainage	$56,000	$56,000
Septic System Closure	$88,000	$88,000
Cover System	$1,672,450	$2,946,360
Shoreline Protection	$1,364,000	$1,364,000
Subtotal	$3,180,450	$4,454,360
Contingency (20%)	$636,090	$890,872
Total	$3,816,540	$5,345,232

The $1.36 million cost for providing shoreline protection represents about 43% of the soil cover subtotal cost and 30% of the membrane cover subtotal.

Question/Comment: Although the commenter agreed with the proposed remedy, he felt that the park design must be considered in selecting the site remedy. For instance, a playground area should not be installed over an area with high lead contamination because children can easily dig through 30 inches of soil and could be exposed to lead.

Response: The selected remedy will protect public health and the environment under all potential future uses of the site. The NYSDEC agrees that it would be preferable to have a well-defined park design available as the selected remedy is designed. This would ensure that proper site grading, drainage and shoreline protection details are developed that fulfill the environmental and public health protection requirements of the ROD. The Village of Irvington agrees with the need to coordinate the park design with the shoreline protection and soil cover designs, and is conducting periodic coordination meetings between the various consulting firms.

With respect to a potential playground with a sandbox, the conceptual design of the soil cover shows that the existing asphalt layer will be left in place as the bottom layer of the cover system. One purpose of this would be to serve as a warning layer that contact with the fill is imminent. The asphalt would also be difficult to penetrate by casual digging.

Question/Comment: The area in which shoreline protection will be replaced should be indicated. Does this include a boat launch? Will rip-rap and filter fabric be used for this shoreline protection?

Response: Shoreline protection will be provided along the western and southern boundaries of the site. No specific plans for a boat launch have been proposed; however, a properly designed boat launch would be compatible with the environmental protection requirements for shoreline protection.

Question/Comment: How much material will be excavated from the septic leach fields, and what is the potential for exposure to contaminated dust during this work? How long will this work take, and what dust control measures will be implemented? If this work will be done in the summer, will it be necessary to limit people being outdoors during the work?

Response: An estimated 270 cubic yards of contaminated soil will be removed from the septic system leach fields, which is expected to require one week to perform. The excavated soils would be stockpiled briefly at the site while laboratory testing is performed to determine the proper disposal method. During excavation, continuous air monitoring for dust will be performed in the work zone and at the site boundary to ensure that health-based action levels are not exceeded. If the action level is exceeded, dust control measures such as watering and temporary suspension of work will be implemented to reduce dust to an acceptable level. Stockpiled soils will be covered to prevent dust emissions and stormwater contact. These measures are known to effectively control dust, and there will be no reason to limit outdoor activities during this work.

Question/Comment: The commenter agreed that the membrane cap is not necessary. Will it be possible to plant trees on the soil cover?

Response: It will be possible to plant some trees on the site, provided that the location of trees is identified early in the soil cover design. Trees can be planted in "wells" created in the fill and lined with low permeability soil. Trees and shrubs could also be planted on berms of thicker fill placed above the soil barrier layer. The location of wells and berms must be known when the barrier layer is designed, so that proper drainage can be provided.

Appendix B:
Administrative Record Index

1. Index

2. Record of Decision, March 1998, NYSDEC

3. Proposed Remedial Action Plan, January 1998, NYSDEC

4. Public Meeting Transcript, February 11, 1998

5. State Assistance Contract, NYSDEC/Village of Irvington, May 13t, 1997

6. Voluntary Cleanup Agreement, NYSDEC/Village of Irvington/Scenic Hudson, February 11, 1997

7. Voluntary Cleanup Agreement Modification, NYSDEC/Village of Irvington/Scenic Hudson, August 29, 1997

Reports

8. Site Investigation Report - Volume I, Ecosystems Strategies Inc., March 1998

9. Site Investigation Report - Volume II, Ecosystems Strategies Inc., March 1998

10. Site Investigation Report - Volume III, Ecosystems Strategies Inc., March 1998

11. Remedialt AlternativestReport, Ecosystems Strategies Inc., March 1998

12. Workplan for Site Investigation Activities, Ecosystems Strategies Inc., July 1997

Correspondence

13. Letter to Michael O'Toole from G. Anders Carlson, March10, 1998, (ROD Concurrence)

14. Letter to Michael O'Toole from G. Anders Carlson, January 15, 1998, (PRAP Concurrence)

15. NYSDEC Fact Sheet, January 1998

16. Letter to Paul Ciminello from George Heitzman, December 11, 1997, (Filtration of Groundwater Samples)

17. Letter to Stephen McCabe from George Heitzman, July 21, 1997, (Work Plan Approval)

18. Letter to George Heitzman from Margery Groten, February 26, 1998 (Scenic Hudson's comments on the PRAP)

19. Letter to George Heitzman from Stephen McCabe, February 27, 1998 (Village of Irvington's comments on the PRAP)

20. Letter to George Heitzman from Dennis Padron, March 3, 1998 (Preliminary cost estimates for shoreline protection)

21. Memorandum to George Heitzman from Paul Ciminello, March 4, 1998 (Preliminary cost estimates for on-site management of excavated fill associated with shoreline protection)

VILLAGE OF IRVINGTON
NEW YORK

INCORPORATED 1872

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VILLAGE ADMINISTRATOR

LAWRENCE S. SCHOPFER
VILLAGE CLERK-TREASURER

KEVIN J. PLUNKETT, ESQ.
VILLAGE ATTORNEY

February 27, 1998

George W. Heitzman P,E.
New York State Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-7010

Re: Irvington Waterfront Park Located at 29-100 Bridge Street
Village of Irvington, Westchester County, New York

Dear Mr. Heitzman:

The Village of Irvington is submitting the following comment in response to the Proposal Remedial Action Plan (PRAP) prepared by your Department and presented to the public on February 11, 1998.

The Village understands the proposed remedial alternatives prepared for the Irvington Waterfront Park and supports the soil cover alternative. During the course of our SEQRA review and upon review of the PRAP, we have a concern about the amount of truck traffic generated by the transport of cover soil. According to the SI/RA issued by Ecosystems Strategies, Inc. an estimated 41,070 cubic yards of soil. Part II of the EAF for the SEQRA review estimated that over 3,100 truckloads of fill would be necessary during a 4 month period (this includes the barrier layer, drainage layer and topsoil).

In response to our concern about truck traffic, the Village is continuing to explore the utilization of barge or rail for the transport of soil. However, it has come to our attention that a material exists know as a Geosynthetic Clay Liner (GCL). We understand that this material has many advantages over soil including added protection and reduced cost. We recommend that this material be considered as a substitute for the barrier layer (12") in the Record of Decision.

Sincerely,

Stephen A. McCabe
Village Administrator

TELEPHONE: (914) 591-7070 — FAX: (914) 591-4072
85 MAIN STREET — IRVINGTON, N.Y. 10533

SCENIC HUDSON INC.

February 26, 1998

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George W. Heitzman, P.E., Senior Engineer
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
New York State Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-7010

Re: Irvington Waterfront Park
Proposed Remedial Action Plan

Dear Mr. Heitzman:

The Scenic Hudson Land Trust, Inc. (Scenic Hudson) is submitting these comments as the property owner and partner with the Village of Irvington on the development of the waterfront park that is the subject of a Proposed Remedial Action Plan (PRAP) prepared by the Department. Working with the Village and the Department in the acquisition and remediation of this property has been very gratifying--a model of outstanding teamwork, with all the members of the project team working towards a common goal.

We commend you on your presentation at the Village of Irvington Board meeting on February 11. The complex technical data from the PRAP was presented in a form that was accessible and meaningful for the community. We appreciate your thoughtful and responsive approach to the remediation issues on this site.

Scenic Hudson has reviewed the PRAP and understands the approach that the Department has taken to the recommendations for remedial alternatives. The comparison of the cover alternatives is clearly articulated. Cover alternatives were evaluated for: their protection of human health and the environment; short-term effectiveness; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; implementability; cost; and community acceptance.

However, it is not yet clear that a similar analytic process has occurred for the selection of bulkhead alternatives. Section 6 of the PRAP includes the following goals for the site:

- Eliminate the threat to surface waters by preventing surface run-off from the contaminated soils and fill at the site.
- Eliminate the threat to sediments by preventing the surface and subsurface discharge of contaminated fill material into the Hudson River.

We understand that the cost estimates for the remediation alternatives were based on the assumption that a rip-rap bulkhead with a filter fabric behind it would replace the deteriorating bulkhead. Scenic Hudson wishes to assure that consideration is given to the same criteria set forth in the PRAP used to evaluate the cover alternatives in the evaluation of the bulkhead alternatives. It would seem appropriate to provide documentation that the recommended bulkhead alternative would protect the river from sedimentation from the contaminated fill, or future failure of the cover remediation due to failure of the bulkhead. It is possible the department has experience with bulkhead alternatives and has determined that the rip-rap bulkhead is adequate to protect the public health and the river in the long-term. In that case, it would be useful to provide information on that analysis in the revised RAP.

In submitting these comments, it is Scenic Hudson's intention to assure that the bulkhead, which is subject to the stresses of exposure to river currents, ice, the impacts of river traffic, and weather, fulfills the objectives identified in Section 6 of the PRAP and are listed above.

Our combined efforts are focused on the creation of a fine community park with public access to the river. With that in mind, we are pleased that the PRAP does not preclude the installation of trees on the site. While the selection of plant material must meet certain criteria and special measures must be taken in their installation, it is important that this feature of the park be given special consideration. We are pleased that the Village is clearly committed to landscaping the park appropriately.

It has come to our attention that consideration is being given to a refinement of the soil cover alternative involving a geosynthetic clay liner (GCL) which meets the permeability criteria of the Department. While, on first review, the GCL appears to have advantages over the soil barrier layer, it is essential that this new variation be subjected to the same detailed review given the soil barrier and the geomembrane, including an evaluation of the seven criteria described above. If indeed the GCL is determined to be the superior alternative after a thorough comparative analysis, it could prove to be the alternative of choice.

We look forward to the realization of the Irvington Waterfront Park, which will result in remediation of the site and the development of an important public riverfront park in the Village of Irvington.

Sincerely,

Margery D. Groten

Margery D. Groten
Land Projects Manager

/rp
cc: Steve McCabe

DB

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-7010

John P. Cahill
Commissioner

March 10, 1998

Ms. Margery D. Groten
Land Projects Manager
Scenic Hudson Land Trust
40 Vassar Avenue
Poughkeepsie, NY 12601

Re: Irvington Waterfront Park (Project # B-00004-3)
Proposed Remedial Action Plan

Dear Ms. Groten:

Thank you for your February 26, 1998 letter commenting on the NYSDEC's Proposed Remedial Action Plan (PRAP) for the Irvington Waterfront Park. Your letter raises important issues that the DEC agrees should be addressed in the Record of Decision (ROD) for the project. This response to your comments will be incorporated into the Responsiveness Summary, which is attached to and made part of the ROD.

The DEC agrees that the PRAP did not fully justify how the proposed shoreline protection would meet the criteria required for remedy selection. That evaluation is presented in the enclosed analysis. Note that the DEC does not consider the various methods of shoreline protection (stone revetment, new sheet piling and rehabilitation of existing sheeting) to be "alternatives" in the same sense as the soil cover and membrane cap are alternatives. Rather, we consider these methods to be potentially viable options that fulfill the selection criteria, as discussed below.

There are presently a number of technical uncertainties that must be addressed before a specific method or methods are selected. For instance, it is presently uncertain how much of the existing bulkhead can be rehabilitated. At least half of the bulkhead lies beneath the concrete slab which projects over (and into) the water, which could not be safely inspected during the Site Investigation. A limited inspection of accessible bulkhead sections indicated that no holes are present (Appendix G, page 9), suggesting that rehabilitation may be feasible. However, this cannot be confirmed until the concrete slab is removed and a full inspection is performed during the design phase.

For the above reasons, and to preserve the clarity of the cover analysis, the detailed evaluation will not be incorporated into the Analysis of Alternatives section of the ROD. Since all three methods fulfill the environmental goals for the project, the PRAP and ROD will provide flexibility for the Village of Irvington to select the shoreline protection based on recreational and aesthetic needs and technical feasibility. As the technical uncertainties are addressed and the park design evolves, decisions will be made as to the specific methods of shoreline protection to be

constructed at the site. The Village of Irvington and the DEC are committed to involving Scenic Hudson in these critical decisions.

It is also important to note that the effectiveness and integrity of the shoreline options rely on their proper design, which will occur subsequent to the ROD. The DEC will thoroughly review the engineering plans and specifications to ensure that these features are designed and constructed in a manner that protects the environment. I encourage Scenic Hudson to participate in that review.

With regard to your comment on the Geosynthetic Clay Layer (GCL), the DEC considers this material to be a variant within the general category of a soil barrier layer, and not a distinct alternative requiring evaluation. Nevertheless, this material must fulfill the specific health and environmental protection functions that have been established for the project. The enclosed "Equivalent Design Analysis" demonstrates the ability of a GCL to perform the equivalent function as a 12-inch soil barrier, with additional environmental benefits. In that analysis, salient aspects of the 7 detailed evaluation criteria are also discussed.

Thank you for your constructive comments on the PRAP. I look forward to your continued participation and to successful completion of this important project.

Sincerely,

George W. Heitzman, P.E.
Senior Environmental Engineer
Division of Environmental Remediation

enclosures

cc: S. McCabe (w/enclosures)
P. Ciminello (w/enclosures)
J. Akins (w/enclosures)
D. Padron (w/enclosures)

EVALUATION OF SHORELINE PROTECTION OPTIONS

Description of Shoreline Protection Options

Stone Revetment (Rip Rap) Protection

Shoreline protection can be achieved by armoring the shoreline with stone revetment underlain by filter fabric. The revetment cross section consists of a cover layer of graded armor stone (capstone), an underlayment layer of fill stone, and a layer of geotextile fabric placed over the fill. The fill would be regraded from its current vertical face to a slope that is stable for the fill and each overlying material. Fill material excavated for this purpose would be placed elsewhere on the site and covered with the specified soil cover. The toe of the revetment will not extend beyond the current bulkhead line, ensuring that no river bottom is lost. A constructed example of stone revetment can be seen in Matthiessen Park to the north of the Waterfront Park.

The design of the revetment stone will be based on anticipated storm energies, wave heights, ice impacts and other technical factors that constitute sound engineering practice. Minimum and maximum stone sizes will be specified. The geotextile filter fabric will be selected based on a comparison of its Apparent Opening Size (AOS) with the grain size distribution of the fill material.

Sheet Pile Bulkhead

The conceptual sheet pile design is for an anchored sheet pile wall installed a small distance (less than 18") outside the existing bulkhead. The sheet pile wall would extend 15' above the river bottom and would be embedded an estimated 40' into the river sediments. This is described in more detail at the end of Appendix G of the Remedial Alternatives Report.

Steel sheeting is not totally impervious to groundwater flow. Water pressure behind the sheeting is relieved as it weeps through the hinges and joints between the articulated steel panels. Although these openings could be constructed to be more watertight, the resulting difference in water pressure could cause structural instability of the wall if the pressure is not relieved by other means. While the effective size of the hinges and joints cannot be determined, the flow velocities are expected to be small, and particle transport through them is not expected to be significant. However, this cannot be determined with as much engineering certainty as for the revetment option.

Rehabilitation

If the existing bulkhead is corroded but structurally sound, and no holes penetrate the steel sheeting, it can be coated or jacketed with a cement compound to prevent further corrosion. This may be enhanced by providing cathodic protection to minimize the electrochemical potential for corrosion.

Comparative Evaluation of Shoreline Protection Options

Compliance with Standards, Criteria and Guidance Values (SCGs)

All three shoreline protection options will effectively prevent the release of contaminated fill into the Hudson River. As a result, sediment quality guidance values will be equally achieved. Because little or no river bottom will be lost by either option, State Freshwater Wetlands regulations and Section 404 of the Clean Water Act would also be equally met. Both options are likely to be consistent with the policies of the Coastal Zone Management Program of the Department of State.

Protection of Public Health and the Environment

Because all options prevent the release of fill, they both protect public health and the environment.

Long Term Effectiveness and Permanence

All options are expected to have a design life of at least 50 years, and will therefore provide good long-term effectiveness. Maintenance of the stone revetment to preserve its effectiveness may be necessary if weather conditions exceed the design storm event (100 year storm). Such maintenance would consist of replacing any armor stone that is loosened or underlayment stone that is undermined. Maintenance of the sheet pile bulkhead will be necessary in the very long term due to corrosion of the steel. Concrete facing of existing sheeting, combined with cathodic protection, is also expected to provide at least 50 years of effective protection.

Because all options are containment technologies, none of them provides a permanent remedy for contaminants in the fill.

Short Term Effectiveness

Because a certain amount of fill must be excavated and relocated to construct the revetment option, the potential for short-term exposure would exist. During this excavation, a working face of fill material would also be exposed to the waters of the Hudson River. Although the existing sheeting would be left in place during this operation, the potential for releases of fill into the river would exist. These potential exposures would have to be controlled during construction by silt control measures and implementation of a construction health and safety plan. It may also be necessary to pump water from the excavation area to maintain an inward flow gradient.

As a worst-case scenario, the volume of fill requiring excavation was calculated based on cutting the existing bulkhead at the sediment line, 13' below ground surface, and installing a 5 foot thick stone revetment. For the entire 1700-foot perimeter, this would result in a volume of 9,500 cubic yards of material requiring handling. It may be possible to leave a short section of the existing bulkhead in place above the sediment line, which would reduce the volume of excavated material and the amount of the working face below the waterline. That determination cannot be made until a structural analysis is performed on the existing bulkhead by the design engineer.

Because much of the fill requiring excavation lies below the water table, it would require dewatering prior to placement upland on the site. The dewatered material would then be graded to form a topographic feature or features (hills, berms, etc) for the park. This material would be covered by the soil cover specified in the ROD. Water removed from the material would be

discharged to the sanitary sewer for treatment.

Because no fill would be exposed during installation of a new sheet pile bulkhead, or during rehabilitation of the old one, no short-term exposures to on-site workers or the Hudson River would occur.

Reduction of Toxicity, Mobility or Volume

Because all three options prevent the release of fill into the Hudson River, they equally reduce the mobility of contaminants. No option reduces the toxicity or volume of contaminants.

Implementability

All options use readily available construction technologies and materials. Administratively, all options will require approvals from the NYSDEC freshwater wetlands program for construction in or adjacent to the Hudson River, and from the U.S. Army Corps of Engineers. These approvals should be readily obtainable for structures that do not result in the loss of river bottom habitat. Rehabilitation or replacement of the bulkhead may qualify for Nationwide Permit authorizations by the U.S. Army Corps of Engineers.

Cost

The cost of stone revetment is estimated to be $1020 per linear foot of shoreline, which includes excavation, dewatering and re-placement of fill, and installation of filter fabric and revetment stone. The cost of installing a new sheet pile bulkhead is estimated to be $2000 per linear foot. No cost is presently available for rehabilitation of the existing bulkhead, but it is expected to be the least cost option. Over the 1700 feet of shoreline requiring protection, the total cost of stone revetment is $ 1,734,000 and the cost of sheeted bulkhead is $ 3,400,000. An additional cost of $600 per linear foot is estimated for all three options for removal of the partially collapsed 970-foot concrete platform and supporting piles.

Other Factors

The rehabilitation and new sheeting options would minimize the loss of area of the park, and would provide potential mooring sites for boats. The revetment option would increase the effective area of river bottom (at the expense of park area) and the stone matrix may provide some enhanced habitat for aquatic organisms. Fill that is regraded to install the revetment would provide some desirable terrain features for the park.

Summary

In conclusion, the three options provide equal levels of environmental protection, compliance with SCGs, long term effectiveness, and reduction in mobility of contaminants. All are equally implementable. The primary balancing criteria for this comparison are short term effectiveness, cost, and other factors.

The most desirable option is to rehabilitate the existing bulkhead, which has no short term impact and is expected to have the lowest cost. The remaining analysis does not provide a clear recommendation, particularly with the technical uncertainties that remain. The stone revetment has potential short term impacts that must be prevented. However, the significantly lower baseline cost means that stringent control measures may be implemented and revetment would still be cost-effective. Stone revetment provides better aquatic habitat and terrain features, but at the expense of upland park area.

EQUIVALENT DESIGN ANALYSIS
Geosynthetic Clay Liner (GCL)

Background

The Village of Irvington has recommended that the NYSDEC consider the use of a Geosynthetic Clay Liner (GCL) material as a substitute for the 12-inch soil barrier specified in the Proposed Remedial Action Plan (PRAP). The Village cites reduced truck traffic and lower cost as significant advantages of this material. The analysis which follows is to determine whether the environmental and public health protection factors provided by the 12-inch soil layer would be equivalently met by a GCL.

A GCL is defined as:

> "A factory-manufactured hydraulic barrier typically consisting of clay or other low permeability materials, supported by geotextiles and/or geomembranes which are held together by needling, stitching, or chemical adhesives."

Common brands of GCL use a layer of sodium bentonite encapsulated between layers of geotextile which are needle punched together. The material is delivered to the jobsite in rolls which are unrolled over a smooth foundation layer. Panels are overlapped, usually by 12", at their edges to provide a seal between them.

Protection of Health

Public health is protected in part by the 12-inch soil barrier layer by prevention of exposure to contaminated fill by skin contact, dust inhalation, and incidental ingestion. The soil barrier layer, in conjunction with the existing asphalt below and 18" of drainage and topsoil above, provides physical separation from the fill and eliminates all routes of direct exposure.

Substitution of a GCL would reduce the total cover thickness from 30" to 18". However, this thickness would still be sufficient to eliminate the direct routes of exposure. The geotextile layers would serve as a "warning layer" to potential unanticipated digging through the cover that would not be provided by the soil barrier. However the asphalt layer would provide the most effective physical barrier to direct contact with the fill under both options.

In summary, public health would be equally protected by the use of a GCL.

Protection of the Environment

Protection of the environment is provided by the soil barrier by the reduction of infiltration of rainfall and snowfall through the contaminated fill. This results in lower levels of contaminants dissolved in groundwater, and less transport of contaminated fill particles through the subsurface. These reductions result in less overall release of contaminants to the Hudson River.

The soil barrier specified in the PRAP consists of 12 inches of a material with a maximum

permeability of 10^{-5} cm/s. This is the equivalent of a silty fine sand and corresponds to a 30% rate of infiltration of rainfall and snowfall through the fill.
The permeability of a GCL varies with the amount of material placed above it, and the corresponding confining stress. In a landfill cap application, which is an equivalent scenario to the Waterfront Park in terms of overburden pressure, the permeability of the Bentomat^R GCL is reported to be 5×10^{-9}. The application of Darcy's Law to describe the flux of water across a unit area in a unit time is used to compare the soil cover to the GCL:

$$v = k \frac{H + T}{T}$$

where
v - flux of water
k - hydraulic conductivity (soil barrier - 10^{-5} cm/s, GCL - 5×10^{-9} cm/s)
T - thickness of the layer (soil barrier - 305 mm, GCL - 7 mm)
H - depth of liquid above the layer (assumed to be 6" or 152 mm)

results in a flux of 1.5×10^{-6} cm^2/s for the soil cover and 1.1×10^{-8} cm^2/s for the GCL. This analysis shows that the soil barrier is more than 100 times more permeable than the GCL, and the GCL provides superior reduction of infiltration through the contaminated fill.

As a result of providing equivalent, or better, reduction in infiltration, the GCL provides equivalent long-term effectiveness, protection of the environment and expected compliance with Standards, Criteria and Guidance.

Other Factors

The GCL provides better implementability because it requires less trucking than the soil barrier, and it is easier to install. The GCL could be delivered on 20 flat bed trailers, while the soil barrier material would require an estimated 1,200 truck loads. Preliminary indications are that it is also a lower cost option. Because it would reduce the height of the cover system by 12", it may be more aesthetically pleasing by reducing the mounding of the cover.

Summary

Because a GCL would provide equal or superior performance in the protection of public health and the environment, it will be considered as an engineered equivalent in the remedial design. The Record of Decision will allow the use of an engineered equivalent of the soil barrier for all or part of the cover system.