Draft Feasibility Study Report

Pfohl Brothers Landfill

Cheektowaga, New York
Site Number 9-15-043

Prepared for:

New York State
Department Of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

Division Of Hazardous Waste Remediation

Michael J. O'Toole, Jr., P.E.
Director

Camp Dresser & McKee
New York, New York

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SEP 13 1991

Cheektowaga North Branch Library
735 Maryvale Drive
Cheektowaga, New York 14225

Re: Pfohl Brothers Landfill, Cheektowaga, Erie County, New York, Site No. 09-15-043

The Cheektowaga North Branch Library was designated as the document repository for information related to the Pfohl Brothers Landfill inactive hazardous waste site.

Please add the following report to the Pfohl Brothers Landfill files:

Draft Feasibility Study Report

Thank you for your cooperation in continuing to make the information on this site available to the public.

Sincerely,

A. Joseph White

A. Joseph White, P.E.
Remedial Section A
Bureau of Western Remedial Action
Division of Hazardous Waste Remediation

AJW/td
Enclosure

EXECUTIVE SUMMARY

This Feasibility Study has been prepared for the New York State Department of Environmental Conservation (NYSDEC) under contract D-001894 for the Pfohl Brothers Landfill site in Cheektowaga, New York. This site is listed by NYSDEC as a Class 2 site, indicating there is a significant threat to human health or the environment and remedial action is required.

The Feasibility Study identified and evaluated a total of 10 remedial alternatives for the site. The recommended alternative (Alternative 10) includes landfill capping and ground water containment and collection with onsite treatment and offsite disposal.

The Baseline Human Health Risk Assessment, summarized in Section 1.0 of this report, identifies several present-use scenarios that significantly contribute to excess lifetime cancer risks. These include both dermal exposure and ingestion of landfill soils by children and workers and dermal exposure by workers to the leachate seeps. Under the future-use scenario, in which residences are constructed on the landfill and the ground water is used for potable purposes, the principle contributors to risk are ingestion of ground water from the bedrock aquifer and ingestion and dermal exposure to ground water from the unconsolidated aquifer.

In order to establish Remedial Action Objectives (RAOs) for the site, contaminants of concern (COCs) were identified. COCs are chemical constituents that were identified in the Baseline Human Health Risk Assessment as contributing significantly to risk. These compounds are then compared to Applicable or Relevant and Appropriate Standards (ARARs), Section 2.0 of this report.

The remedial action objectives established for the site, as discussed in Section 3.0 of this report, include:

- remediate the site to be protective of human health and the environment by treatment of all media to protective levels and/or limiting exposure to COCs.

- reduce organic and inorganic loads to the surface water streams from leachate seeps and ground water to assist in meeting Class B and D in-stream standards.

- reduce carcinogenic and noncarcinogenic risks caused by dermal exposure to leachate seeps.

- reduce carcinogenic risks caused by dermal absorption and ingestion of sediments.

- prevent migration of contaminants from sediments that would result in surface water contamination in excess of Class B or D in-stream standards.

- reduce carcinogenic and non-carcinogenic risks caused by ingestion and dermal contact of landfill soils and solids.

- reduce risks of exposure to ground water via ingestion and dermal contact.

- minimize migration of contaminants into uncontaminated ground water.

Section 4.0 of this report describes the development of technology types and process options for meeting the remedial action objectives established for each of the contaminated medium. The general response actions include no action, institutional controls, containment, removal/collection, treatment, and disposal/discharge. A conservative estimate indicates approximately 2.3 million cubic yards of solids media from areas B and C and approximately 15 million cubic feet of ground water require some form of remediation.

In Section 5.0 of this report, remedial alternatives were developed by assembling the selected representative process options into various combinations. Ten alternatives were formulated by combining the most technically feasible process options for each contaminated medium and were then subsequently screened based on their ability to meet the RAOs, short- and long-term effectiveness, and implementability. Table ES-1 presents a comparative summary of each of the ten alternatives.

TABLE ES-1

SUMMARY COMPARISON OF REMEDIAL ALTERNATIVES

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Assessment Factors	• No Action • Long-term ground water monitoring • Maintenance of existing fence	• On-site well prohibition • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, public education	• **Capping** (single barrier) • **Passive ground water collection.** On-site treatment and discharge to POTW or surface waters • On-site well prohibition • Long-term ground water monitoring • Off-site wetland replacement • Zoning and deed restrictions, fencin and warning signs, public education • **Select soil excavation** in peripheral areas	• **Capping** (single barrier) • On-site well prohibition • Long-term ground water monitoring • Off-site wetland replacement • Zoning and deed restrictions, fencing and warning signs, public education • **Select soil excavation** in peripheral areas	• **Passive ground water collection** on-site treatment, and discharge to POTW or surface waters • On-site well prohibition • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, public education
Attainment of Remedial Action Objectives	No	No	No	No	No
Short- and Long-Term Effectiveness	LOW Not effective in protecting human health and the environment.	LOW-MEDIUM Institutional controls will not reduce or eliminate the source and subsequent spread of contamination. Offers little effectiveness in eliminating possible exposure pathways.	MEDIUM Very effective in protecting human health and environment from landfill soils and moderately effective in reducing risks from all other possible exposure pathways.	MEDIUM Very effective in protecting human health and environment from landfill soils, but only moderately effective in preventing the migration of contaminated ground water and surface water/sediments.	MEDIUM Moderately effective in protecting human health from exposure to landfill soils and ground water but is not effective for other possible exposure pathways.
Implementability	HIGH Easily implemented - requires long-term ground water monitoring and periodic maintenance of existing fences	HIGH Easily implemented - as with all alternatives considered, (with exception of Alt 1) difficulties may be encountered in implementing institutional controls.	HIGH Easily implemented since required approvals for the cap are expected to be easily obtained.	HIGH Easily implemented since approvals for the cap and both the ground water and landfill access institutional controls are expected to be easily obtained.	HIGH Easily implemented since approvals for ground water use restriction institutional controls and leachate collection system are expected to be easily obtained.

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TABLE ES-1 (cont.)

SUMMARY COMPARISON OF REMEDIAL ALTERNATIVES

	Alternative 6	Alternative 7	Alternative 8	Alternative 9	Alternative 10
Assessment Factors	• **Capping**(single barrier) • **Ground water containment** slurry wall • **Select soil excavation** in peripheral areas • Surface water collection and discharge to POTW or surface water • On-site well prohibition • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, public education • Off-site wetland replacement	• **Ground water containment** - slurry wall • On-site well prohibition • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, pubic education	• **Ground water containment**-slurry wall • Ground water and leachate collection, on-site treatment and discharge to POTW or surface water • On-site well prohibition • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, public education	• **Ground water containment** - slurry wall and extraction wells, on -site treatment and discharge to POTW or surface water • Long-term ground water monitoring • Zoning and deed restrictions, fencing and warning signs, public education	• **Capping** - (single barrier) • **Ground water containment** - slurry wall and extraction wells, on-site treatment and discharge to POTW or surface water • Off-site wetland replacement • **Select soil excavation in** peripheral areas • Zoning and deed restrictions, fencing and warning signs, public education
Full Attainment of Remedial Action Objectives	YES	NO	NO	NO	YES
Short- and Long-Term Effectiveness	MEDIUM-HIGH Very effective in protecting human health and environment from landfill soils and effective in minimizing the migration of contaminated groundwater and leachate contamination of surface water.	MEDIUM Not effective in protecting human health and environment from landfill soils. Moderately effective in reducing risks from contaminated ground water and surface water sediments.	MEDIUM Moderately protective of human health and environment from ground water and leachate but not protective of continued risk from exposure to landfill soils.	MEDIUM Relatively high degree of effectivenss in protecting human health and environment from contaminated ground water. Not effective in protecting human health and environment from exposure to landfill soils.	HIGH Highly effective in minimizing risks from all exposure pathways.
Implementability	MODERATE-HIGH Construction of slurry wall may encounter potential difficulties w/underground piping and high water table. Approvals for slurry wall and ground water are expected to be obtained relatively easily.	MODERATE-HIGH Construction of slurry wall may encounter potential difficulties w/underground piping and high water table. Approvals for slurry wall are expected to be obtained relatively easily.	MODERATE-HIGH See comments under Alternative 7.	MODERATE-HIGH See comments under Alternative 7.	MODERATE-HIGH See comment under Alternative 6.

Table ES-2

COMPARISON OF SELECTED REMEDIAL ALTERNATIVES

Assessment Factor	Remedial Alternatives Which Underwent Detailed Evaluation		
	Alternative 1	Alternative 6	Alternative 10
	• Long term ground water monitoring • Maintenance of existing fence	• Capping • Groundwater containment • Select soils excavation • Surface runoff collection and off-site disposal • On-site institutional controls • Off-site wetland replacement	• Capping • Groundwater containment • Surface runoff collection and off-site disposal • Select soils excavation • Extraction wells, on site treatment and discharge to POTW or surface water • Off-site wetland replacement • On-site institutional controls
1. Compliance with ARARs	Does not meet chemical-specific ARARs. Action and location-specific ARARs do not apply.	Meets chemical-specific ARARs for all media except potable water. Health-based risks from landfill soils and sediments are acceptable. Location-specific ARARs for wetlands and floodplains are met. Action-specific ARARs will be met.	Meets all chemical-specific ARARs for all media. Health based risks from landfill soils and sediments are acceptable. Location- and action-specific ARARs are met, as in Alternative 6.
2. Protection of Human Health and the Environment	No reduction in risks to human health and the environment.	Greatly reduces risk from all exposure pathways. The magnitude of residual risk at the site is moderate since contamination is still present and failure of the cap or slurry wall could result in exposure to contamination.	Same as Alternative 6.
3. Short-term effectiveness.	Only minimal risk to workers and the community during ground water sampling.	Potential risks are associated with airborne contaminants during construction but mitigation measures would minimize risks. Contaminated sediments entering surface waters, temporary loss of wetland habitats and possible contamination of aquifer during installation of slurry walls may be anticipated. Most impacts could be mitigated. Requires approximately 6 months to design and 2.5 years to implement.	Same as Alternative 6. Requires approximately 6 months to design and 3.5 years to implement.
4. Long-term effectiveness and permanence.	High residual risk. Risk control through groundwater sampling is minimal.	Risk from landfill soils would remain low since design life of cap is 30 years. Risks associated with the migration of contaminated groundwater are marginally adequate because the integrity of slurry wall and bottom barrier is unknown. Long-term monitoring offers minimal risk control.	Risk from landfill soils would remain low since design life of cap is 30 years. Control of the migration of contaminated groundwater would be adequate due to groundwater extraction technologies. If cap or slurry walls failed, pumping rates could be increased to compensate for increased ground water recharge.
5. Reduction in Toxicity, Mobility and Volume	There is no treatment process involved and subsequently no reduction in toxicity, mobility and volume of contaminated media.	Does not reduce toxicity of the contamination; contaminant mobility is reduced by the cap and slurry wall; volume of contaminants is unaffected.	Reduces toxicity of the contamination through groundwater treatment. Maximum reduction in contaminant mobility; considerable reduction in the volume of contaminated ground water.
6. Implementability	Necessary equipment and labor force readily available. Coordination and approvals from regulatory agencies should not be difficult to obtain.	Necessary equipment and labor force are readily available. Success in implementation of slurry wall relies on presence of clay/till layers at the site. Specialized equipment will be required due to hummucky nature of landfill. Once in place, the cap, slurry wall and groundwater monitoring offer reliable technologies.	Same as Alternative 6. In addition, installation of well points, piping collection and treatment systems would be reasonably easy.
7. Cost	$560,000	$45,194,000	$53,789,000

A total of 3 alternatives for remediation were carried through the screening process and underwent detailed evaluation. These include:

- Alternative 1 - No Action
- Alternative 6 - Capping (Select Solids/Soils Excavation with Onsite Disposal) and Ground Water Containment
- Alternative 10- Capping (Select Solids/Soils Excavation with Onsite Disposal) and Ground Water Containment and Collection with Onsite Treatment and Offsite Disposal

In Section 6.0 of this report, each of the three alternatives was screened against seven criteria established by NYSDEC. A comparison of each alternative to the seven criteria is summarized in Table ES-2. Alterative 10 was ranked the highest against all criteria considered and was subsequently chosen as the recommended remedial alternative to implement at the Pfohl Brothers Landfill site.

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Section 1

1.0 INTRODUCTION AND PROJECT OVERVIEW

1.1 PURPOSE AND ORGANIZATION OF REPORT

As part of the State of New York's program to clean up inactive hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) entered into a contract with Camp Dresser & McKee to undertake a Remedial Investigation and Feasibility Study (RI/FS) for the Pfohl Brothers landfill (PBL) site located in the town of Cheektowaga, Erie County, New York. The site is a 147-acre inactive landfill that received both municipal and industrial wastes. The RI/FS for this site is being performed with funds allocated under the New York State Superfund Program.

The RI portion of the study has already been completed (CDM 1991). It discusses the nature and extent of contamination at the site, the sources of contamination, and the risk to public health and the environment.

The objective of this Feasibility Study (FS) is to use the data from the RI to develop a range of remedial alternatives for the site which protect human health and the environment. This information then allows decision-makers to select the most appropriate remedial action or actions for the site. The FS is conducted in three phases in accordance with the State of New York's Technical and Administrative Guidance Memorandum for the Selection of Remedial Actions at Inactive Hazardous Waste Sites (TAGM) and the Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA (EPA 1988c) and the National Contingency Plan (NCP) (March 1990). These phases include:

- DEVELOPMENT - identification and development of remedial action alternatives.
- SCREENING - refinement of the alternatives and selection of alternatives for detailed analysis.
- DETAILED ANALYSIS - detailed analysis of the selected remedial alternatives.

A flow diagram outlining the steps in each of these phases is given in Figure 1.1-1.

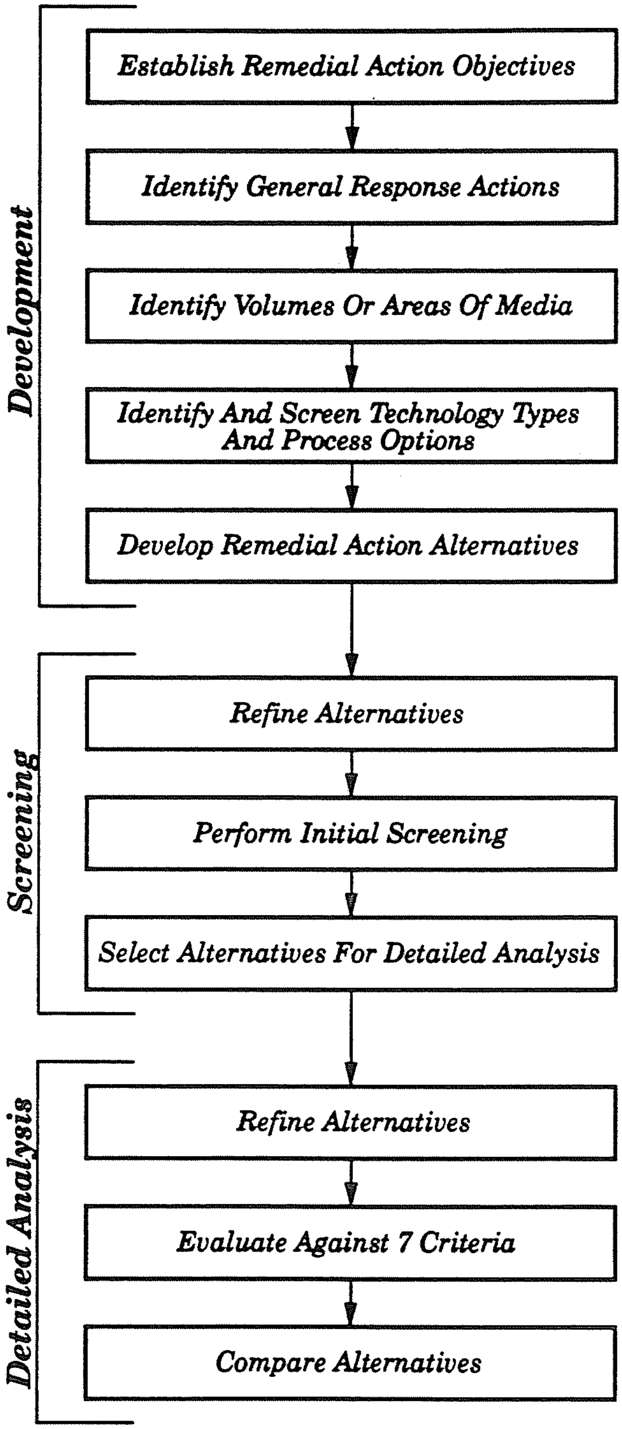

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Figure 1.1-1
Development Of Remedial Action Alternatives
Flow Diagram

Draft Feasibility Study
Pfohl Brothers Landfill, Cheektowaga, New York

1.1.1 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

The purpose of the first phase of the FS is to develop a set of remedial action alternatives which will satisfy the remedial action objectives for the site. This process involves a number of steps which are described in the following subsections.

Establish of Remedial Action Objectives

Remedial action objectives are defined in terms of a contaminant of concern (COC) in a specific medium, an exposure route and receptor, and an acceptable contaminant level for the exposure route. Acceptable contaminant levels are determined by the Baseline Human Health Risk Assessment (CDM 1991) and identification of Applicable or Relevant and Appropriate Regulations (ARARs) and NYS Standards, Criteria and Guidelines. The identification of these requirements are found in Section 2.0 and the Remedial Action Objectives for the site are presented in Section 3.0.

Identify General Response Actions

General response actions are developed to satisfy the remedial action objectives. The actions are also medium-specific and may include institutional controls, containment/collection, removal/disposal, and treatment. No action is always included for comparative purposes. General response actions are presented in Section 4.1.

Identify Volumes or Areas of Media

The volumes and/or areas of contaminated media are discussed in Section 4.2. Consideration is given to remedial action objectives and chemical and geological characteristics.

Identify and Screen Technology Types and Process Options

Section 4.3 documents the identification and screening of technology types and process options. Several technology types may exist for a given general response action. For example, the technology types for the treatment response action may include biological, physical/chemical, and/or thermal treatments. At this stage of the FS, screening of technology types is based solely on their technical feasibility in addressing site-specific problems.

The process options associated with technology types determined to be implementable are then identified and screened based on their ability to meet medium-specific remedial action objectives, their short- and long-term effectiveness, and their implementability. The primary focus of the evaluation is on the effectiveness of a process option with respect to the technology that it represents. Each process option is considered with respect to the other process options within the technology and is judged as low, medium or high. The intent of this step is to select one representative process option for each technology, although more than one may be retained if they are sufficiently different in their performance.

Develop Remedial Action Alternatives

All of the evaluation criteria utilized to this point in the FS have been applied to medium- or area-specific problems and not to the entire site. The final step in the development stage of the FS is to assemble all of the retained technology types and representative process options into remedial action alternatives which address all aspects of site contamination, if possible. Alternatives are formulated by combining the various response actions and technology process options. The alternatives will include a wide range of treatment technologies, as well as no action, collection, containment and disposal technologies. The description of assembled alternatives is found in Section 5.1.

1.1.2 SCREENING OF REMEDIAL ACTION ALTERNATIVES

The purpose of the second stage of the FS, found in Section 5.0, is to select remedial action alternatives that merit analysis in greater detail during the third, or detailed analysis phase of the FS. The selection of remedial action alternatives is accomplished by refining the alternatives and evaluating them in terms of effectiveness, implementability, and cost.

Refine Alternatives

The refinement of alternatives requires knowledge of the volumes of the contaminated media to be remediated or contained. This allows the technology process options to be better defined in terms of size, treatment flow rates, space requirements, and permit requirements. Interaction among media with respect to technology evaluation and site-wide protectiveness are also examined during the refinement of alternatives.

Perform Initial Screening of Remedial Alternatives

The refined remedial alternatives may then be evaluated based on their short- and long-term effectiveness and implementability. Effectiveness is judged primarily in terms of protecting human health and the environment. The technical feasibility of constructing and operating a specific alternative and the administrative ability to gain institutional approval from the necessary agencies are the two components of implementability. Initial screening is presented in Section 5.4. Tables provided in the TAGM were used in the screening process, in addition to other criteria, such as meeting remedial action objectives.

Select Alternatives for Detailed Analysis

The final step in the second phase of the FS is to select the remedial action alternatives which will be considered in greater detail during detailed analysis. A goal of initial screening of alternatives is to preserve the range of technologies originally developed, within the practical limits of the requirements for detailed analysis. The number of alternatives retained for detailed analysis greatly depends on the site and generally is less than four. The summary of retained alternatives is presented in Section 5.5.

1.1.3 DETAILED ANALYSIS OF SELECTED REMEDIAL ACTION ALTERNATIVES

The purpose of the third, or detailed analysis phase of the FS, is to provide enough detailed information to allow selection of the remedial action alternative which will be implemented at the site. There are three components of this phase; further refinement of the alternatives, if necessary, evaluation of each alterative against seven specific criteria, and comparison of the alternatives with respect to each of the criterion. The detailed analysis of alternatives is presented in Section 6.0.

Refine Alternatives

The remedial action alternatives selected in this phase are further described and refined with respect to volumes of contamination, technology selection, and performance requirements of the technologies. If treatability study results are available, this information is also considered during the refinement step.

Evaluate Alternatives

The second component of the detailed analysis of alternatives involves evaluation against seven criteria. These criteria, summarized below, are part of the NYS TAGM.

- Compliance with applicable New York State Standards, Criteria, and Guidelines (SCGs) and applicable or relevant and appropriate regulations (ARARs).
- Overall protection of human health and the environment.
- Short-term effectiveness - effectiveness of alternatives in protecting human health and the environment during construction and initial implementation of the remedial actions.
- Long-term effectiveness and permanence - effectiveness of the remedial action alternatives following completion of the remedial action construction and start-up.
- Reduction of toxicity, mobility and volume - performance of the specific treatment technologies of the remedial action alternatives.
- Implementability - technical and administrative feasibility of the remedial action alternatives.
- Cost - capital and operation and maintenance costs of implementing the remedial action alternatives, and future capital costs. A present worth analysis is performed for each alternative with costs presented within a range of -30 to +50 percent. If necessary, a cost sensitivity analysis is also performed.

Compare Alternatives

The final stage in the detailed analysis phase of the FS is a comparison amongst the alternatives of the relative performance of each alternative with respect to the evaluation criteria described in the previous subsection. This comparative analysis results in an identification of advantages and disadvantages of each alterative relative to the other alternatives. The most appropriate remedial action alternative for the site is then recommended for final selection by the appropriate regulatory agencies.

1.1.4 COMMUNITY ASSESSMENT

This assessment incorporates public comment into the selection of a remedial action alternative. The New York State Department of Environmental Conservation will solicit public comments on the alternatives and the recommended action.

1.2 BACKGROUND INFORMATION

1.2.1 SITE LOCATION AND DESCRIPTION

The Pfohl Brothers site is a 147 acre inactive landfill that was formerly used for the disposal of municipal and industrial wastes, including hazardous wastes. It is located in the Town of Cheektowaga, northeast of the Buffalo International Airport in Erie County, New York (see Figure 1.2-1). The landfill has been classified by New York State Department of Environmental Conservation (NYSDEC) as a Class 2 site. A Class 2 site indicates there is a significant threat to human health or the environment and remedial action is required.

The landfill was operated by the Pfohl family from 1932 to 1971. The quantity of waste material and nature of all of the wastes disposed of at the site are unknown; however, in addition to municipal waste, industrial wastes such as phenolic tars, waste solvents, paints, thinners, pine tar, pitch, and rubber and scrap metal are known to have been deposited within the landfill. There is also documentation that the landfill accepted sludges, capacitors with polychlorinated biphenyls (PCBs), and phenol tars with chlorinated benzenes and dioxins.

For purposes of this study, the landfill has been divided into three geographical areas. These are areas A, B and C as shown in Figure 1.2-2 and discussed below.

Area A, located north of Aero Creek, including areas north and south of the NYS Thruway exit ramp, is largely occupied by a private trucking firm that has placed fill material over a large portion

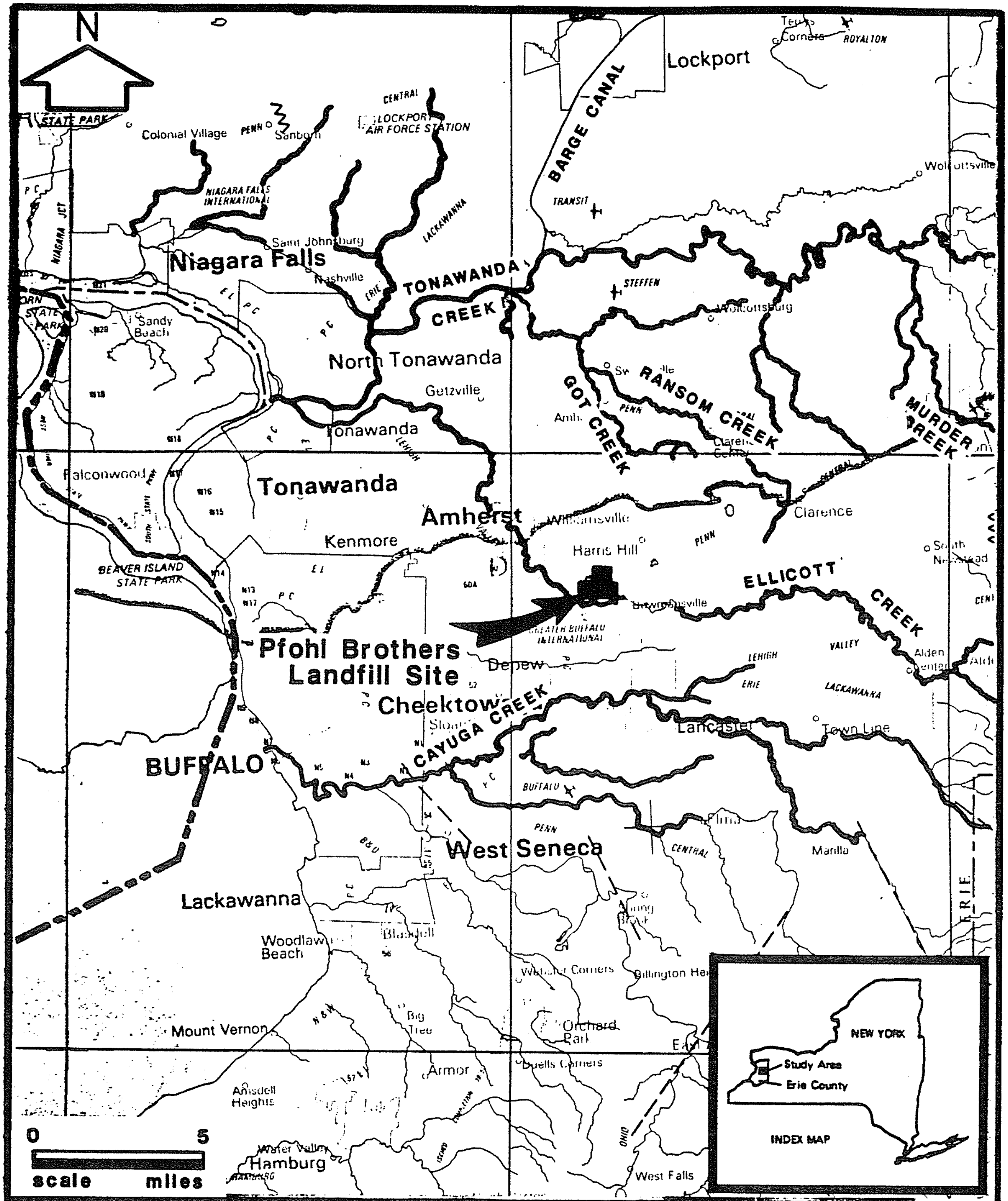

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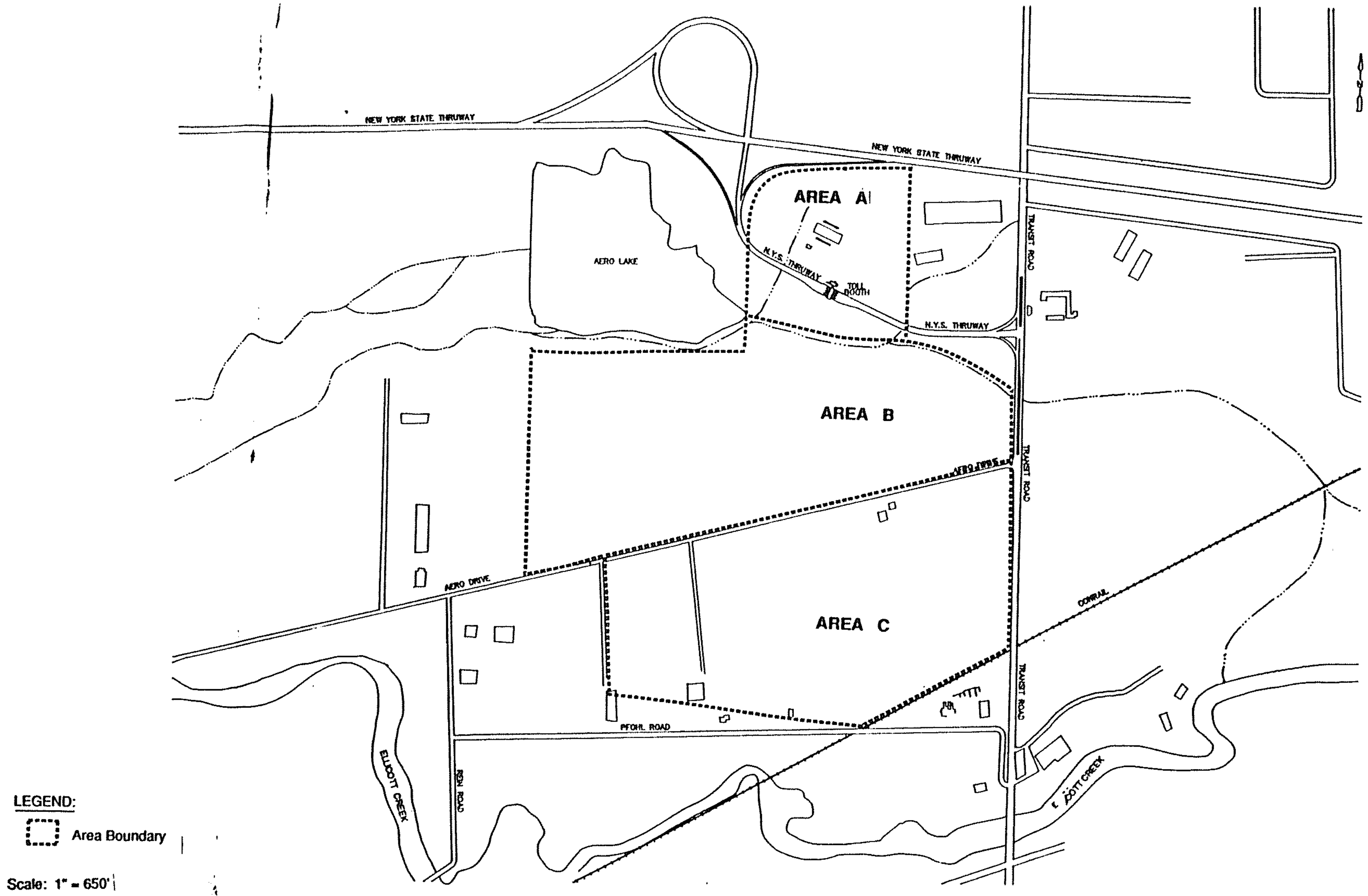
Figure 1.2-1

Location Plan

Pfohl Brothers Landfill, Cheektowaga, New York



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New York, New York 10005

Figure 1.2–2
Pfohl Brothers Landfill Site

Pfohl Brothers Landfill, Cheektowaga, New York

of the area to elevate the land surface (Figure 1.2-2). A large metal building is located north of the access ramp along with a number of tractors and trailers.

Area B, located south of Area A, is situated between Aero Creek and Aero Drive and west of Transit Road (Figure 1.2.2). This portion of the site consists of undulating terrain with thick underbrush, phragmite weeds and thorny-stemmed bushes. Small secondary growth trees are present. The area is littered with bottles, household refuse, tires, tubing, scrap metal, refrigerators, construction materials and rusted sections of car bodies. Several drum disposal areas exist, in which many of the drums are rusted, corroded, and crushed. During wet portions of the year, leachate seeps appear along the perimeter of the landfill. These seeps range from red to brownish-orange in color. Many seeps also have a sheen that is most likely attributable to oil and metals. Oil slicks have been noted on the water surface in the wetland area parallel to Aero Drive near the intersection with Transit Road. An unnamed stream flows along the northern perimeter of Area B (hereafter referred to as Aero Creek). Aero Lake is located off-site, north of this stream and to the west of Area A. This 40-acre lake originated from a borrow pit excavated for fill material during the construction of the New York State Thruway. The lake is currently used by local residents for fishing, boating, and occasionally swimming.

Area C is situated south of Aero Drive, north of Pfohl Road and west of Transit Road (Figure 1.2-2). The area closely resembles Area B with respect to terrain and the distribution and occurrence of drums, sludge, and debris. Leachate seeps are also present along the southeastern perimeter of Area C in early spring. A truck repair company is situated in Area C, approximately 975 feet west of the intersection of Transit Road and Aero Drive. South of Area C are several private residences. Ellicott Creek, a major tributary to the Erie-Niagara Basin, is located approximately 1,000 feet south of Area C. The creek is primarily used for primary contact recreation and fishing.

The entire landfill, except for an area along the northern perimeter of Area B and southeast corner of Area C, is fenced. "No Trespassing" and "Hazardous Waste Area" signs are posted along the border of the site.

The elevation of the landfill ranges between 3 to 4 feet above the natural, pre-landfill elevation of 690 feet. Most of the native soils have been removed and replaced with other soil types.

The Pfohl Brothers Landfill site is predominantly an upland area. However, two freshwater wetlands regulated by the NYSDEC are located within and adjacent to the site. The wetlands along with the vegetation communities, wildlife, and overall ecology at the site, are described in the Remedial Investigation Report (CDM, 1991) and are shown in Figure 2-8 of the RI Report. Other wetland areas, unregulated by NYSDEC, have been reported to occur in certain areas of the site. These sites may be impacted by certain remedial activities proposed for the landfill.

1.2.2 SITE HISTORY

The Pfohl Brothers landfill was operated between 1932 and 1971 in the three discrete areas--A, B, and C, as discussed above. There are no historic records indicating that hazardous substances were disposed of in Area A. Soil from this area was used primarily by the New York State Transit Authority for fill material. Areas B and C included a cut-and-fill operation with overland dumping.

Drums which were filled with substances that could be spilled out were emptied and then salvaged. Cells were prepared by removing the topsoil and placing it in a separate storage area. A bulldozer then pushed the remaining fill and clay into a berm approximately 15 feet high around the perimeter of the dumping area. Each excavation was approximately two feet deep and approximately 150 feet in diameter. At the end of each day, the bulldozer ran back and forth over the area to compress the material. When the area was full, fly ash and fill material were spread over it.

Aerial photographs taken during the 1950s, 60s, and 70s, document to some extent, the timing and location of excavation and dumping at the site. Very little information, however, is available concerning the types of waste actually dumped and the companies generating and transporting that waste.

Reports indicate that, in addition to domestic and commercial waste, the site is suspected to have received sizable amounts of industrial waste. Among the firms whose wastes were reportedly disposed of in the landfill are steel and metal manufacturers, chemical and petroleum companies, utilities, manufacturers of optical and furnace-related materials, and other large manufacturing and processing concerns.

1.2.3 PREVIOUS INVESTIGATIONS

In June 1982, the United States Environmental Protection Agency (EPA) contracted with Fred C. Hart Associates to perform a hazardous ranking of the site. Ten water and four sediment samples were obtained at various seep locations, drainage ditches, and domestic wells and were analyzed for organics, inorganics, sulfide, cyanide, and ammonia. The contaminants detected in water samples obtained from a spring flowing into a drainage ditch along the south side of Aero Lake were most notably chlorobenzene, benzene and N-nitrosodiphenylamine at concentrations of 85, 34, and 11 parts per billion (ppb), respectively.

In February 1984, the property owner's law firm, Hodgson, Russ, Andrews, Woods and Goodyear, commissioned Ecology and Environment, Inc., to perform an additional investigation of the site. The objective of the investigation was to determine if the landfill at the time posed, or had the potential to pose, either an environmental or public health threat according to Superfund and related State legislation and regulations. As part of the investigation, ground water, sediment, and leachate seep samples were collected and analyzed for volatile organics, semi-volatile organics, heavy metals, phenols, PCBs, and oil and grease.

In the western portion of Area B, barium concentrations of 49,600 ppm were detected in a leachate seep sample, and concentrations of chrysene, anthracene, and nickel were detected in the soil at 2.74, 2.08, and 94.1 ppm, respectively. Soil samples obtained at the southeastern corner of Area A had concentrations of fluoranthene and pyrene at 5.21 and 2.39 ppm, respectively. Acenaphthene was detected in the soil at the southeastern corner of Area C at a concentration of 76 ppm. Phenols and oil and grease were detected, but generally at low concentrations. Metal concentrations were high in many of the wells. Elevated concentrations of barium, lead, chromium, and cadmium were detected.

In November 1986, samples of leachate, soil, and waste from surface drums that contained a tar-like material were collected and analyzed. The contaminants detected in the waste samples from the drums were fluorene and phenanthrene at concentrations of 5,500 and 790 ppm, respectively. Within Area B, along the south side of Aero Lake the PCBs arochlor 1248 and arochlor 1254 were also found in the soil samples at concentrations of 0.07 and 0.03 ppm, respectively. Various heavy metals were also found in the soil, such as arsenic (38.9 ppm), barium (7,400 ppm), cadmium (48 ppm), chromium (60 ppm), lead (1,760 ppm), and mercury (1.4 ppm) (NYSDOH 1986).

In 1990, CDM conducted the Remedial Investigation for the Pfohl Brothers Landfill site. The investigation consisted primarily of six major field activities. These included:

- Geophysical Survey
- Surface Water, Leachate Seep, and Sediment Sampling
- Gamma Survey - Phases I and II
- Test Pit Investigation
- Soil Boring Investigation
- Ground Water Investigation

Additional studies performed by NYSDEC and/or NYSDOH include:

- Lead Screening Survey
- Sampling and Analysis of Contaminants in Fish
- Radon Sampling of Homes
- Surface Soil Sampling
- Residential Sump Sampling
- Cancer Incidents Investigation
- Health Survey

Additionally, NYSDEC and the NYSDOH collected supplemental data on ground water, surface water, surface soil and sediment quality from April 1989 through June 1990. A list of interm reports are presented in Table 1.2-1.

1.2.4 NATURE AND EXTENT OF CONTAMINATION

As a result of the RI, areas of contamination have been defined and characterized for drummed waste, soils, shallow ground water, bedrock aquifer, and leachate seepage and sediment samples. Complete laboratory results are reported in the Remedial Investigation Report (CDM 1991). The following subsections describe the extent of contamination in each of these media.

Table 1.2-1

LIST OF INTERIM REPORTS ON REMEDIAL INVESTIGATIONS AT THE PFOHL BROTHERS LANDFILL SITE

Camp Dresser & McKee. 1989. Report on the Phase I Walk Over Gamma Radiation Survey at the Pfohl Brothers Landfill, Cheektowaga, New York. Camp Dresser & McKee, New York, New York. Report prepared for the New York State Department of Environmental Conservation, Albany, New York.

Camp Dresser & McKee. 1990. Interim Report of Leachate. Surface Water and Sediment Investigation, Pfohl Brothers Landfill, Cheektowaga, New York. Camp Dresser & McKee, New York, New York. Report prepared for the New York State Department of Environmental Conservation, Albany, New York.

Camp Dresser & McKee. 1990. Interim Report on the Phase II Radiation Investigation, Pfohl Brothers Landfill, Cheektowaga, New York. Camp Dresser & McKee, New York, New York. Report prepared for the New York State Department of Environmental Conservation, Albany, New York.

New York State Department of Health and New York State Department of Environmental Conservation. 1989. Radiochemical Analysis, Pfohl Brothers Landfill, Cheektowaga, New York.

New York State Department of Health and New York State Department of Environmental Conservation. 1990. Radiochemical Analysis Addendum No. 1: Groundwater, Pfohl Brothers Landfill, Cheektowaga, New York.

New York State Department of Health and New York State Department of Environmental Conservation. 1990. Radiochemical Analysis Addendum No. 2: Soil/Waste Sampling, Pfohl Brothers Landfill, Cheektowaga, New York.

New York State Department of Health and New York State Department of Environmental Conservation. 1990. June 1990 Supplemental Sampling, Pfohl Brothers Landfill, Cheektowaga, New York.

New York State Department of Environmental Conservation. 1991. Pfohl Brothers Landfill, Cheektowaga, N.Y., Erie County. Final Report. Contaminant Concentrations in Fish from Waters Associated with Pfohl Brothers Landfill.

New York State Department of Health. 1991. Cancer Incidences in the Cheektowaga/Ellicott Creek Area, Erie County, New York.

New York State Department of Health. 1991. Summary of Survey Results: Pfohl Brothers Landfill.

New York State Department of Health. 1990. Pfohl Brothers Landfill Residential Sump Sampling.

TABLE 1.2-1 (Cont.)

New York State Department of Health. 1990. Pfohl Brothers Landfill Surface Soil Sampling.

Camp Dresser & McKee. 1990. Interim Report on the Drum Investigation, Pfohl Brothers Landfill, Cheektowaga, New York. Camp Dresser & McKee, New York, New York. Report prepared for the New York State Department of Environmental Conservation, Albany, New York.

Camp Dresser & McKee. 1990. Interim Report on the Soil Borings and Ground Water Investigation. Camp Dresser & McKee, New York, New York. Report prepared for the New York State Department of Environmental Conservation, Albany, New York.

Technos Inc. 1988. Geophysical Survey of the Pfohl Brothers Landfill, Cheektowaga, New York. Technos Inc., Consultant in Applied Earth Sciences, Miami, Florida. Report prepared for Camp Dresser & McKee.

1.2.4.1 Drummed Waste

The materials found in the drums do not reflect any significant pattern in waste disposal practices or source material. No drums were observed in Area A. However, drums were observed at and below the surface of the landfill in areas B and C.

Analysis of the waste drummed material indicates that a wide variety of organic compounds were disposed of at the landfill. Elevated levels of volatile organics, primarily a variety of aromatic and chlorinated aliphatic hydrocarbons were observed in the waste samples. In addition, a wide variety of semi-volatile organic compounds were detected in the drums. These principally include phenols and dibenzofuran. Pesticides, PCBs, phthalates and polynunclear aromatic hydrocarbons (PAHs) were also detected at elevated concentrations in a portion of the drums. Almost all of the inorganics analyzed for were found at concentrations in excess of background soil sample levels. The concentrations of barium, cadmium, chromium, cobalt, copper, iron, lead, nickel, silver, sodium, and zinc exceeded background concentrations most frequently. Arsenic, mercury, and vanadium were observed in many samples well above background concentrations.

The dioxin compound 2,3,7,8-TCDD was detected at concentrations ranging from 100 to 370 ppb in the drum and waste samples collected during the test pit investigation. Of the 18 samples tested, 50 percent of the samples revealed the presence of this compound. No pattern of drum disposal was observed in either area B or C.

1.2.4.2 Soils

The detection of only small amounts of a few organic compounds throughout Area A suggests that Area A is not a major source of organic contamination. However, many of the same organic compounds detected in the drums were also present in the soil samples in areas B and C. In some cases, the organic compounds present in the drums were detected at higher concentrations in the soil samples.

Most of the inorganics detected in the soil samples from areas B and C exceeded background concentrations in one or more samples. In some cases, more inorganic constituents were found at greater concentrations in areas B and C than in samples from Area A. Several of the inorganics were detected at higher concentrations in the soil samples as opposed to the drum samples.

The dioxin compound 2,3,7,8-TCDD was detected in residential surface soils at concentrations ranging from 0.0003-0.0009 ppb. Concentration ranges of 0.00026-0.00053 ppb and 0.45-1.8 ppb were detected in Aero Lake path surface soils and drainage ditch sediments, respectively. One sample collected from the property of the truck repair company situated in area C revealed a 2,3,7,8-TCDD concentration of 110 ppb.

The radiologic gamma survey indicated detections several times background levels in isolated locations. NYSDEC and NYSDOH (1990) have reported that the radiological analysis of soils and other objects indicate that radiologic hot spots are disseminated through areas B and C but that a large majority of the elevated gamma readings are in discrete areas of only a few square feet. Furthermore, the radioactive waste material has become stabilized on the surface and subsurface of the landfill and does not present an airborne environmental hazard (NYSDEC/NYSDOH, 1990). The large variations in radionuclide concentrations present at the site suggest that while there are areas of higher soil activity, it is not uniformly spread throughout the area. The radiological results are thought to be related to radionuclide compounds precent in the fly ash that was used as a daily cover material during landfill operations.

1.2.4.3 Ground Water of Unconsolidated Aquifer

Organic compounds detected in the drum, wastes and soil samples were also detected, for the most part, in the unconsolidated ground water aquifer. Detected compounds include: halogenated hydrocarbons, aromatics, phenols, dibenzofuran, and several phthalates and PAHs. In addition, one pesticide and PCB isomer were detected in one and two samples, respectively. Many inorganic constituents were detected in the unconsolidated aquifer above background concentrations and several, including antimony, barium, cadmium, copper, iron, lead, magnesium, manganese, mercury, and sodium were detected above ground water quality standards. In addition, common landfill leachate inorganic parameters were found to be elevated above background concentrations.

Several organic constituents exceeded ARARs in the shallow aquifer. These included aromatics, halogenated hydrocarbons, phenol, phthalates, and the PCB arochlor 1232.

Iron, magnesium, manganese, and sodium exceeded ARARs most frequently, followed by antimony, barium, cadmium, chromium, copper, lead and mercury.

1.2.4.4 Ground Water of Bedrock Aquifer

Generally concentrations of compounds in the bedrock aquifer were lower than the overlying unconsolidated aquifer. The bedrock aquifer revealed the presence of several organic contaminants including aromatics, halogenated hydrocarbons, phenol, a pesticide and phthalate ester. With the exception of the phthalate ester, the remaining organic constituents exceeded ARARs in only a few of the wells.

Inorganics that were detected at levels above background concentrations in approximately 50 percent of the bedrock wells include aluminum, calcium, iron, nickel, and potassium. In addition, antimony, chromium, sodium, and vanadium were detected at concentrations greater than two times background but in fewer samples.

Iron, sodium, antimony, and chromium concentrations in some bedrock wells exceeded ARARs.

1.2.4.5 Leachate Seepage and Sediments

The leachate seep samples revealed organic contamination similar to that found in the drum, soil, and shallow ground water samples. The organic compound classes primarily include halogenated hydrocarbons, aromatics, phenols, dibenzofuran, PAHs, and phthalates. The concentrations of the phthalates were indicative of field/laboratory contamination. Several pesticides that were found in one or more of the other media were also detected in the leachate seep samples. Except for dieldrin, the pesticides detected in the leachate seep samples were not detected in the corresponding sediment samples. All of the inorganic constituents analyzed were detected significantly above background levels with the exception of antimony, thallium, and selenium. Suspended solids present in these samples may be contributing significantly to the elevated metals concentrations found in them.

Several groups of organic constituents exceeded ARARs, including aromatics, a halogenated hydrocarbon and phthalate, phenol, pesticides, and PAHs. Magnesium, manganese, and sodium exceeded ARARs most frequently. Cadmium, copper, iron, lead and zinc exceeded ARARs at slightly lower frequencies, followed by barium, mercury, selenium, chromium, and beryllium.

Three volatiles organic compounds, methylene chloride, acetone, and chlorobenzene, were detected in the leachate seep sediments. Of these, only chlorobenzene was detected in the leachate seep samples. Other organic compounds detected in the seep sediments include various PAHs, dibenzofuran, two phthalates esters, five pesticides, and PCB isomers, all of which were either detected in the drum or soil samples. Fly ash that was used as cover material during the landfill operation may be the source of PAHs and metals. All of the inorganics were detected above background levels in one or more samples, except for antimony. The locations of the samples where the highest concentration of specific inorganic constituents were detected are in very different sections of the site, indicating widespread and varied contamination by metals.

1.2.4.6 Surface Water and Sediments

Low levels (relative to the seep samples) of two volatiles and one semivolatile were detected in a limited number of drainage ditch/intermittent streams surface water samples, including acetone, 1,2-dichlorobenzene, and di-n-octyl phthalate. None of the organics were detected at concentrations exceeding ARARs.

Iron exceeded ARARs most frequently in the surface water drainage ditches; cadmium and mercury also exceeded ARARs, only to a lesser degree.

Except for antimony, chromium, selenium, silver, thallium, and cyanide, which were not detected, the remaining inorganics were detected in at least one sample above background levels.

As with acetone in the drainage ditches/intermittent stream surface water samples, acetone and methylene chloride were, in general, in the corresponding sediments at levels that were similar to those in the trip and/or method blanks and would be attributable to either laboratory or field contamination. Dibenzofuran and a phthalate ester were also detected. Various PAHs were detected primarily in the ditches along the roadways. Three pesticides were detected that were also found in the seep sediment samples and other site media. All inorganics except for silver, thallium, and selenium were detected above background in at least one sample.

Only one organic compound, bis(2-ethylhexyl)phthalate, was detected in surface water samples from Aero Lake at concentrations that could be attributable to laboratory and/or field contamination. Except for barium, mercury, potassium, and cadmium, inorganics were either not detected or were not detected above background. Mercury was the only constituent (either organic or inorganic) in the surface water that exceeded ARARs.

Acetone, 2-butanone, and methylene chloride were the only organics detected in the sediment samples collected from Aero Lake. Except for the sample collected from the middle of the lake, most of the inorganics were detected below or equal to background levels. All of the inorganic constituents, except for beryllium, calcium, copper, lead, and zinc were found at levels above background in this sample.

A total of six surface water samples were collected from Ellicott Creek. Bis(2-ethyhexyl) phthalate and Di-n-butylphthalate were detected in the samples. However, chlorobenzene, 1,2-dichlorobenzene, 1,2-dichloroethene, and 2,4-dimethylphenol were detected in the drainage ditch that feeds Ellicott Creek. Seven metals (aluminum, cadmium, calcium, iron, lead, potassium, and zinc) were detected at concentrations above those found in the background samples.

Chlorobenzene was the only organic constituent detected in the surface water of a tributary to Ellicott Creek at a concentration exceeding ARARs. Iron and zinc exceeded ARARs most frequently. Aluminum, cadmium, and lead also frequently exceeded ARARs.

Both acetone and methylene chloride were detected in the sediments of Ellicott Creek. The concentration of these compounds, however, were at levels that are typically attributable to laboratory/field contamination. Three PAHs were detected in concentrations below background and within those typically found in urban environments. Diethyphthalate and beta-BHC were detected in the drainage ditch sample only. A wide variety of inorganic constituents were detected in the sediments that exceeded background levels.

No 2,3,7,8-TCDD (Dioxin) was detected in the shallow or deep ground water wells, leachate seep sediments, or surface water sediment samples. It should be noted, however, that these data were qualified during the data validation process due to non-compliant initial and continuing calibration, low surrogate recoveries, and/or the ending column performance check was outside of 12 hours.

Data for the background sample (SE-01) does not rigorously support the non-detect results reported, although it is likely that 2,3,7,8-TCDD is not present.

1.3 FATE AND TRANSPORT

The primary sources of contamination at the Pfohl Brothers Landfill site are wastes deposited within the landfill through the dumping of liquid or solid materials, wastes present in drums both within or at the surface of the landfill, and wastes deposited at the landfill surface. Migration of components of the wastes placed in the landfill can occur through several media and mechanisms. For the Pfohl Brothers Landfill site, it is possible for chemicals to be transported as follows:

- To the ground water through percolation of rainwater through the soils and wastes and transport of contaminated leachate.
- To the surrounding surface water bodies through the discharge of contaminated ground water and/or leachate, or through run-off from the site carrying contaminated particulates.
- To the atmosphere through the volatilization of organic compounds (through lateral or vertical migration) or through the generation of dust from contaminated soils or wastes via wind erosion or mechanical disturbances of soils/wastes.

1.3.1 MIGRATION INTO AND WITHIN GROUND WATER

Because the Pfohl Brothers Landfill does not have an impermeable cover, rainwater that infiltrates through the deposited wastes can carry contaminates vertically to the ground water. The percentage of the leachate that does not discharge laterally as seeps can migrate vertically and can contaminate the ground water. Chemicals that reach the unconsolidated aquifer can be transported horizontally in the direction of ground water flow or vertically to the underlying bedrock aquifer, unless an impermeable barrier such as the clay or till layers present at the base of the unconsolidated aquifer restricts such transport.

Some organic and inorganic compounds detected in the subsurface and in the waste drums have been transported to the ground water. To date, more contaminants have been found in the shallow aquifer than in the deeper bedrock aquifer. This may be due to the low permeability clay and till layers that are present at the base of the shallow aquifer, as observed in several of the borings installed at the site. However, these low permeability layers are not continuous. For example, a test pit was installed in the northeast portion of Area B to confirm the presence of a trench identified in a 1964 aerial photograph. Landfill waste was found down to bedrock, a depth of 8 feet, and the clay layer that was observed in many of the other test pits and borings was not found. The fact that waste was directly in contact with the bedrock indicates that there are potential "windows" or conduits for contaminants to directly enter the bedrock aquifer at some locations.

The chlorinated aliphatic and the aromatic volatile organic compounds have relatively high water solubilities and low K_{oc} (organic carbon partion coefficient) values. The physiochemical properties of these compounds would indicate that these chemicals are mobile and would be expected to be present in the ground water. These compounds were present in six of the shallow ground water wells and in two of the bedrock wells.

Although the concentrations present in the ground water and the conceptual model of contaminant transport indicate that ground water contamination is continuing to occur, overall concentrations in most of the groundwater samples were small compared to the values found in several of the subsurface soil samples and in the drum samples. This may indicate one or more of the following:

- That many chemicals present in the landfill solids are being bound to the soils or wastes.
- That infiltration and subsequent transport is limited.
- That release from the drums still has not occurred.
- That transport of these chemicals beyond the landfill boundaries or in other areas that were not sampled has occurred.
- That a significant amount of weathering (including biodegradation) has/is taking place.

Phenol and several phenolic compounds were detected in the wells. Most of the detections of these compounds in the ground water were along the eastern side of the landfill and to the southeast of the landfill. This class of compounds would be expected to be weakly adsorbed to surface soils based on the K_{oc} values. In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction is likely to be present in the soil-water phase and to be transported with flowing ground water (U.S. Air Force 1985). Based on the concentrations found in the ground water compared to the concentrations found in the subsurface soil and drum samples, only limited contamination of the ground water by this group of compounds appears to have occurred. This may be due to the fact that the phenolic compounds were disposed of as phenolic tars and that the complexation of the tars may be significantly altering the sorption properties thereby rendering them less mobile.

PBCs were detected in two wells and endosulfan II, aldrin, and dibenzofuran were found in one well each. These compounds are typically not found in ground water due to their low water solubilities and high K_{oc} values. However, it is possible that these compounds were transported to the ground water through decreased soil adsorption and corresponding higher mobility arising from the presence of organic solvents in the surface soils.

The migration of inorganic chemicals through soil to the ground water is influenced by soil characteristics and water movement. Contamination of the shallow wells by inorganics has occurred, however contamination of the bedrock aquifer by inorganics appears to be more limited.

1.3.2 MIGRATION INTO AND WITHIN SURFACE WATER

Surface water at the site can be adversely impacted by contaminants present in leachate seeps, shallow ground water and overland runoff. Some of the leachate is derived from the landfill discharges at the margins of the fill. This leachate can discharge into the wetlands surrounding the site, as well as to the drainage ditches and the surrounding surface water bodies. Volatiles, phenols, dibenzofuran, PAHs, pesticides, and heavy metals were found in several leachate samples collected at or adjacent to the landfill. Shallow ground water at the site may discharge into Aero Lake and Ellicott Creek.

Precipitation, either through rain or snow events, could result in significant surface run-off of chemicals in surface soils either in the dissolved phase or in the solid phase (i.e. compounds adsorbed to sediments). According to individuals who were responsible for landfilling operations, wastes deposited into the landfill were covered with materials after the cell was filled. These cover materials included such items as native soil and fly ash. Wastes in drums, debris and other rubbish, as well as several piles of waste are present at the landfill. Contaminants, such as volatiles, dibenzofuran, PAHs, pesticides, PCBs, and inorganics were detected in the leachate seep sediments. Volatiles, phenol, phenolic compounds, dibenzofuran, and several heavy metals were found in the exposed and ruptured drums present at the surface of the landfill. Thus, surface soils/wastes at the landfill may be a significant source of contaminant transport during precipitation events.

Based on the data collected to date, contamination of Aero Lake and Ellicott Creek by the landfill appears to be limited. It is noted, however, that mercury was detected in all shallow water samples collected from Aero Lake and that above average concentrations of inorganics were detected in the sediment samples collected from the middle of the lake. In addition, several metals were found above background concentrations in the sediment samples collected from Ellicott Creek. However, the above-background concentration of metals were not found consistently in the Ellicott Creek samples.

1.3.3 MIGRATION INTO AND WITHIN AIR

Landfill-related contaminants could migrate into the air either by volatilization or by entrainment with fugitive dust.

Volatilization. Of the compounds detected at the Pfohl Brothers Landfill, both the chlorinated aliphatics and the aromatic compounds (simple and chlorinated) could be expected to volatilize if present at or near the surface of the landfill. Atmospheric sampling for volatile organic compounds was not performed as part of the CDM scope of work. However, air monitoring with an organic vapor analyzer (OVA) or a photoionization analyzer (HNu) was performed by CDM personnel during the field activities. Readings above background were only detected when the OVA or the HNu was placed directly into drums that contained materials or during some on-site intrusive activities. It is therefore expected that contaminant migration into the air via volatilization is minor.

Fugitive Dust Emissions. Chemicals sorbed to soil particulate can be transported into the air in the form of fugitive dust as a result of wind erosion or human activities such as vehicles traveling on unpaved surfaces or through soil excavations. This would include compounds such as the PAHs and dibenzofuran. According to past reports, the cells within the landfill were covered with native soil, fly ash, and other landfill materials. Ground vegetation has developed over most of the site which should minimize the erosion of the surface soils and reduce the transport of soil particulate to the atmosphere. The wetland conditions and the leachate seep areas would be expected to preclude the release of fugitive particulates into the air from these areas when the ground is moist or when standing or flowing water is present.

1.4 FINDINGS OF THE PUBLIC HEALTH EVALUATION

Exposure scenarios have been evaluated in the Human Baseline Risk Assessment (HBRA, CDM-1991) and include the following components: media (i.e., groundwater, soil), exposure routes/pathways (i.e., ingestion of domestic water supply, dermal absorption while showering), the receptors (i.e., children, workers), and the site uses (i.e., present use or potential future uses of the site). Target cleanup levels are defined in this section as the chemical-specific ARAR per guidance of NYSDEC.

Exposure scenarios which link the exposure routes and media for present and for future site use, are discussed in detail in the HBRA. Scenarios identified for present uses for surface water are ingestion and dermal absorption while swimming in Aero Lake and dermal absorption by children playing in Ellicott Creek/drainage ditches; for leachate seeps are dermal absorption by children playing and workers clearing brush on the landfill site; for sediments are ingestion and dermal adsorption by children playing in drainage ditches/Aero Creek; and for landfill soils are ingestion and dermal absorption by children playing on the site.

Future use, as defined in the HBRA, is the development of a residence over the existing landfill and use of the ground water aquifer for a potable water supply. For future use, surface water and sediment exposure scenarios, and therefore the risk, are the same as for present uses. Future use exposure scenarios for landfill soils are ingestion and dermal adsorption by children. For groundwater exposure scenarios include dermal absorption and inhalation of airborne contaminants while showering, plus ingestion of groundwater water.

Section 2

2.0 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES

As described in the NYSDEC Technical Assistance Guidance Manual (TAGM), Selection of Remedial Action Alternatives at Inactive Hazardous Waste Sites requires consideration of applicable or relevant and appropriate New York State Standards, Criteria, and Guidelines (SCGs) for the Pfohl Brothers Site. SCGs or ARARs for the Pfohl Brothers Site were previously identified in the Phase I RI Report (CDM 1989). This section summarizes the criteria that were utilized during development of alternatives. A brief description of the terminology is presented below.

2.1 TERMINOLOGY

- Applicable requirements. These pertain to those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law specifically addressing a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site. In particular, the Safe Drinking Water Act (SDWA) maximum contaminant levels, Clean Water Act (CWA) water quality criteria, and Resource Conservation and Recovery Act (RCRA) alternative concentration limits are identified as applicable requirements.

- Relevant and appropriate NYSSCGs. These pertain to those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under New York state law that, while not "applicable," address problems or situations sufficiently similar to those encountered at a Superfund site.

SCGs must be determined on a site-by-site basis, and are identified with increasing certainty as the remedial investigation/feasibility study for the site progresses. For this identification process, it is useful to group SCGs into three general categories:

- Chemical-specific. These requirements are usually health- or risk-based numbers limiting the concentration or amount of a chemical that may be discharged into the ambient environment. They are independent of the location of the discharge, but may be related to the intended use of the environmental medium.

- Action-specific. These requirements will be triggered by the remedial actions selected for the site. They are based upon the implementation and limitations of particular technologies or actions.

- Location-specific. These restrictions are generally placed upon chemical concentrations or releases, or activities solely because they are in a particular location.

2.2 POTENTIAL ARARs/SCGs

Chemical-Specific SCGs

Several federal and state chemical-specific criteria are applicable for the Pfohl Brothers site. Table 2.2-1 summarizes the chemical-specific ARARs and SCGs considered during this FS. Criteria considered include regulations pertaining to both solid and liquid media. Of importance to Pfohl Brothers site are cleanup criteria and guidelines established by New York State for groundwater, surface water, soils and sediments.

Action-Specific SCGs

All the remedial alternatives to be evaluated for this project have been analyzed for compliance with action-specific SCGs developed for the Pfohl Brothers site. Table 2.2-2 summarizes action-specific SCGs that were reviewed and their applicability to Pfohl Brothers site. Table 2.2-2 includes SCGs for all the various media of concern at this site. Action-specific SCGs address not only regulations to consider during the actual implementation of the remedial plan but also include secondary actions such as wetlands mitigation and wildlife preservations which could play an important role during implementation.

Location-Specific SCGs

Depending on the location of the site, several SCGs require consideration during remedial alternative evaluation. These SCGs often provide criteria that give protection for any sensitive flood plains, and wetlands and natural reserves with endangered species. Table 2.2-3 summarizes the SCGs that were considered and their applicability to this site. Of primary concern at this site, are the wetlands encountered in this area.

Table 2.2-1
Potential Chemical Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comment
National Secondary Drinking Water Standards	40 CFR Part 143	Applicable to the use of public water systems; controls contaminants in drinking water that primarily effect the aesthetic qualities relating to public acceptance of drinking water.	See above; unless natural background levels exceed these standards.
SDWA MCL Goals	40 CFR 141.50 50 FR 46936	Established drinking water quality goals, set at levels of anticipated adverse health effects with an adequate margin of safety.	These MCLs maybe appropriate in the deep aquifer at the point of use as drinking water. The shallow aquifer discharges to surface water bodies, therefore NYS surface water criteria are applicable.
New York State			
• Soil			
NYSDEC Soil Cleanup Goals	NYSDEC memorandum from A. Shroff to A. Joseph White, 02/28/90.	Applicable to the cleanup of contaminatedsoils. Cleanup goals recommentded based on human health criteria, ground water protection, background levels, and laboratory quantatation levels.	NYSDOH is currently reviewing these recommended goals. May be applicable to the landfill soils.
• Air			
None			
• Surface Water			
NYSDEC Water Quality Regulations	6 NYCRR Part 702	Applicable to existing surface water quality and the discharge of landfill runoff and contaminated ground water into surface waters.	Ellicott Creek is classified as a Class B water body and Aero Lake is classified as a Class D (pending) water body.
• Ground Water			
NYSDEC Ground Water Quality Regulations	6 NYCRR Part 703	Applicable to the ground water quality of both the shallow and deep aquifers; sets forth criteria for the consumption of potable water.	The deep aquifer is classified as Class GA potable ground water supply. Because shallow ground water discharges primarily to surface water bodies, these limits will only be considered for the deep aquifer.
• NYSDOH State Sanitary Code Drinking Water Supplies	10 NYCRR Support 5-1	Applicable for consumption of potable water from public water supplies.	See above; maybe applicable for the deep aquifer at the point of use in a public supply system.

Table 2.2-1
Potential Chemical Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
Federal			
• Soil			
Toxic Substances Control Act	15 U.S.C. 2605	Applicable to storage and disposal of PCB - contaminated material.	PCBs have been detected in the soils and sediments in and adjacent to the landfill.
• Air			
None			
• Surface Water			
Clean Water Act (CWA)	33 U.S.C. ss 1251-1376	Applicable for alternatives involving treatment with point-source discharges to surface water.	
	40 CFR Part 129	Applicable to the discharge of toxic pollutants into navigable waters.	
Water Quality	40 CFR Part 131	Sets criteria for water quality goals and serves as regulatory basis for establishing water quality-based treatment and control beyond technology-based levels of treatment.	Criteria available for water and fish ingestion, and fish consumption for human health. State criteria are available.
• Ground Water			
Safe Drinking Water Act (SDWA)	Pub. L. 95-523, as amended by Pub. L. 96502, 42 U.S.C. 300 f et seq.		
National Primary Drinking Water Standards	40 CFR Part 141	Applicable to the use of public water systems; establishes maximum contaminant levels, monitoring requirements and treatment techniques.	These MCLs maybe appropriate in the deep aquifer at the point of use as drinking water. The shallow aquifer discharges to surface water bodies, therefore NYS surface water criteria are applicable.

Table 2.2-2
Potential Action Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
Federal			
• Clean Water Act	42 U.S.C. 7401	Applicable where alternatives will impact ambient air quality (i.e., incineration).	Relevant if remedial action causes air pollution above primary or secondary ambient air quality standards.
National Ambient Air Quality Standards	40 CFR Part 50	Applicable to alternatives that may emit pollutants to the air; establishes standards to protect public health and welfare.	May be relevant and appropriate if treatment of groundwater, leachate, or soils involves air emissions.
Standards for Performance of New Stationary Sources	40 CFR Part 60	Applicable where alternatives will emit pollutants from new or modified industrial facilities.	Same as for 40 CFR Part 50
Resource Conservation and Recovery Act (RCRA)	42 USC as 6901-6987 40 CFR Part 264 RCRA subtitle C Hazardous and Solid Waste Amendments	Applicable to the treatment, storage, transportation and disposal of hazardous waste and wastes listed under 6 NYCRR Part 371.	May be required for waste/oil disposal or treatment options. Testing of landfill material to determine hazardous characteristics needs to be performed.
	40 CFR Part 264 RCRA Subtitle D	Applicable to the management and disposal of non-hazardous wastes.	
	40 CFR Part 265	Interim standards for owners of hazardous waste facilities	Includes design requirements for capping, treatment, and post closure care.
	40 CFR Parts 262 and 263	Applicable to generators and transporters of hazardous waste.	Applicable to off-site disposal or treatment of hazardous material.
	40 CFR Part 268	Applicable to alternatives involving off-site disposal of hazardous wastes, and requires treatment to diminish a waste's toxicity and/or minimize contaminant migration.	May be required for waste/soil disposal or treatment options. Drum wastes and soils containing 2,3,7,8 TCDD are prohibited from land disposal.
• CERCLA/SARA/NCP	40 CFR Part 300	Applicable to remedial actions at CERCLA and NYS Superfund Sites.	The Pfohl Brothers Landfill designated a NYS Superfund site.

Table 2.2-2
Potential Action Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
• CERCLA/SARA/NCP (cont.)	40 CFR 270, 124	EPA administered hazardous waste permit program	Covers the basic permitting, application, monitoring, and reporting, requirements for offsite hazardous waste management facilities.
• Clean Water Act	33 U.S.C. 1251	Restoration and maintenance of the chemical, physical and biological integrity of the nation's water.	
• Effluent Limitations	Section 301	Technology-based discharge limitations for point sources of conventional, nonconventional toxic pollutants.	Applicable for treatment options requiring discharge either to surface water bodies or to POTWs.
• Water Quality Standards and Effluent Limitations	Section 302	Protection of intended uses of receiving waters (e.g., public water supply, recreational uses).	Same as above.
• Water Quality Standards and Implementation Plans	Section 303	Requires State to develop water quality criteria.	Same as above.
• Toxic and Pretreatment Effluent Standard	Section 307	Establish list of toxic pollutants and promulgate pretreatment standards for POTWs discharge.	Same as above.
• National Pollutant Discharge Elimination System (NPDES)	Section 402	Issue permits for discharge into navigable waters.	Same as above.
• Wetlands Permit	40 CFR Part Section 404 40 CFR Part 232	Applicable to remedial actions in and around wetlands.	Applicable to remedial actions that result in the loss or alteration of both regulated and non-regulated wetlands.
* Safe Drinking Act Underground Injection	40 CFR Parts 144 and 146	Applicable to waste water treatment alternatives involving underground injections that may endanger drinking water sources.	

Table 2.2-2
Potential Action Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
• Occupational Safety and Health Act	29 CFR Part 1910 and 300.38	Applicable to workers and the work place during remediation of the site.	Applies to all response activities under the NCP.
• Hazardous Materials Transportation Act	49 USC ss 1801-1813, 49 CFR Parts 107, 171	Applicable to transporters of hazardous materials.	May be relevant if action results in sludge, waste, or soil being transported offsite.
New York State			
• Air Regulations	(6 NYCRR Parts 200 through 207 210, 211, 212 and 219)*		
	6 NYCRR Part 212	General process emission sources.	Sets allowable emissions for remedial options resulting in air emissions.
	6 NYCRR Part 201, 202	Permits for construction/operations of air pollution sources.	Discusses permit requirements to construct and operate the ablve options.
	6 NYCRR Part 219	Particulate emission limits.	Limits are based on the refuse charged (lb/hr) for the above options.
	6 NYCRR Part 211	Regulates fugitive dust emissions.	Requires control of fugitive dust emissions from excavations and transport.
	6 NYCRR Part 257	Air quality standards.	Requires control for on-site treatment resulting in air emissions.

Table 2.2-2
Potential Action Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
• State Pollution Discharge Elimination System	6 NYCRR Parts 750-757, 701.5	Permit requirements, applications, standards, compliance schedule, duration, reissuances, monitoring, recording, and reporting of SPDES permitting process.	Specifies requirements and outlines discharge limits; also presented in TOGS document 1.1.1.
• NYS Uniform Procedures	6 NYCRR Part 621	Applicable to projects requiring permits, such as discharge to surface waters.	Applicable to projects requiring a SPDES permit and to the construction/operation of hazardous waste treatment facilities.
• Hazardous Waste Management	6 NYCRR Part 371	Identification and listing of hazardous wastes.	May be required for waste/soil disposal, storage and treatment option.
	6 NYCRR Part 373	Standards for owners of hazardouse waste facilities.	Includes design requirements for waste/soil capping and treatment options, and post closure care.
• Solid Waste Management	6 NYCRR Part 360	Solid waste management facilities requirements.	Covers basic permitting, application design criteria and monitoring for facilities handling and treatment of non-hazardous solid waste, and construction and demolition debris landfills.
• Transportation of Hazardous Material	6 NYCRR Part 364	Regulates transportation of hazardous materials.	May be relevant if action results in off-site transport of hazardous materials.

Table 2.2-3
Potential Chemical Specific ARARs/SCGs
Pfohl Brothers Landfill

Standard, Requirement Criteria or Limitation	*Citation or Reference*	*Description*	*Comment*
Federal			
• Fish and Wildlife Coordination Act	16 USC	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	Ellicott Creek and Aero Lake support aquatic life and could be influenced by site remediation.
• Endangered Species Act	40 CFRs 6.302 (g)	Requires Federal agencies to ensure that actions they authorize, fund or carry out are not likely to jeopardize the continued existence of endangered/threatened species or adversely modify or destroy the critical habitats of such species.	No endangered species are believed to be present in the study area.
• Executive Order On Floodplain Management	Executive Order No. 11988 40 CFRs 6.302 (b) and appendix A	Requires Federal agencies to evaluate the potential affects of actions that may take place in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	A portion of the site is within the 100 year flood plain.
• Wetland Executive Order	Executive Order No. 11990	Details requirements for the preservation of wetlands.	The site is associated with wetlands which could be impacted by remedial action.
• Clean Water Act	Section 404 40 CFR 230 33 CFR 320-330	Prohibits discharge of dredged or fill material into wetlands without a permit. Preserves and enhances wetlands.	Extensive wetlands are associated with the site which could be impacted by remedial action if dredging or fill material was involved.
• Farmlands Protection	7 USC 4201 et. seq.	Protects significant or important agricultural lands from irreversible conversion to uses which result in loss as an environmental or essential food production resource.	Area does not contain environmentally significant agricultural lands.

2.3 IDENTIFICATION OF CRITERIA FOR CONTAMINANTS OF CONCERN

Chemical-specific SCGs play a vital role in developing remedial alternatives since these SCGs identify cleanup criteria to be met which in turn determines technology options available and level of effort and costs required for cleanup. Based on the chemical-specific criteria shown on Table 2.2-1 and parameters of concern identified in the Public Health Evaluation, numerical values for chemical-specific SCGs have been established. Table 2.3-1 provides a compilation of SCGs developed for landfill soils, solids and sediments for Pfohl Brothers site. Observed contaminant ranges and NYSDEC guideline values for landfill soils/solids and sediments are summarized in Table 2.3-2.

A compilation of numerical values for SCGs related to ground water, leachate and surface waters is shown in Table 2.3-3. Contaminants of concern, and observed concentration ranges for ground water and leachate are identified in Table 2.3-4. It has been assumed that ground water and leachate quality will need to meet NYSDEC discharge criteria for Class GA ground water.

These numerical criteria have been utilized while remedial alternatives were evaluated.

TABLE 2.3-1

COMPILATION OF NUMERICAL SCGs FOR SOILS, SEDIMENTS AND LANDFILL SOLIDS

PARAMETER	SCGs
Acetone	-
Chlorobenzene	5.5
1,2-Dichlorobenzene	1.0
1,4-Dichlorobenzene	1.0
Methylene Chloride	-
Trichloroethylene	1.0
Bis(2-ethyl hexyl) phthalate	4.35
Butylbenzyl phthalate	2.0
Di-n-butyl phthalate	8.0
Diethyl phthalate	7.0
N-nitrosodiphenylamine	
Acenaphthene	1.6
Acenaphthylene	-
Anthracene	7.0
Benzo(a) anthracene	-
Benzo(b) fluoranthene	0.33
Benzo(b,k) fluoranthene	0.33
Benzo(g,h,i) perylene	80.0
Benzo(a) pyrene	0.33
Chrysene	0.33
Dibenzo(a,h) anthracene	0.33
Dibenzofuran	2.0
Fluoranthene	19.0
Indeno(1,2,3-cd) pyrene	0.33
Naphthalene	1.0
Phenanthrene	2.2
Phenol	0.33

TABLE 2.3-1 (Cont.)

COMPILATION OF NUMERICAL SCGs FOR SOILS, SEDIMENTS AND LANDFILL SOLIDS

PARAMETER	SCGs
Pyrene	6.65
Aldrin	0.041
Beta - BHC	0.010
Gamma-chlordane	0.20
Dioxins/Furans	-
PCBs	10 a
Arsenic	7.5
Barium	300 or S.B.
Beryllium	0.14
Cadmium	1.0
Chromium	10.0
Copper	25.0
Lead	32.5 or S.B.
Manganese	S.B.
Mercury	0.1
Nickel	13.0
Silver	200.0
Vanadium	150 or S.B.
Zinc	20.0
Cyanide	-

NOTES:

All units in mg/kg or ppm.
a Value shown is subsurface soil guideline values. Value for surface soil criteria is 1 ppm.
S.B. Site Background
SCGs shown are based on draft soil cleanup criteria issued by Technology Section, Bureau of Program Management, Division of Hazardous Waste Remediation, NYSDEC and are guideline values, only.

TABLE 2.3-2

OBSERVED CONTAMINANT RANGES AND GUIDELINE VALUES FOR SOILS AND SEDIMENTS

Parameter	Range of Detected Concentrations in Landfill Soils	Range of Detected Concentrations in Sediments	SCGs
Acetone	21 - 950	15 - 770	—
Chlorobenzene	18 - 2200	10 - 23	5.5
Methylene Chloride	5 - 690	9 - 150	—
Bis(2-ethyl hexyl) phthalate	51 - 100,000	—	4.35
Diethyl phthalate	150	—	7.0
Di-n-butylphthalate	—	250	8.0
Acenaphthylene	—	310	—
Anthracene	39 - 1900	370 - 2,500	7.0
Benzo(a) anthracene	55 - 24,000	150 - 6,000	—
Benzo(b) fluoranthene	70 - 32,000	—	0.33
Benzo(g,h,i) perylene	68 - 300	1,500 - 2,500	80.0
Benzo(a) pyrene	92 - 21,000	280 - 6,000	0.33
Chrysene	53 - 25,000	170 - 7,500	0.33
Dibenzofuran	120 - 1,900,000	2,400 - 13,000	2.0
Fluoranthene	120 - 67,000	160 - 13,000	19.0
Indeno(1,2,3-cd) pyrene	65 - 390	200	0.33
Phenanthrene	5 - 32,000	200 - 10,000	2.2
Pyrene	100 - 49,000	240 - 15,000	6.65
Aldrin	5 - 9	—	0.041
Beta - BHC	9.0	22 - 75	0.010
Gamma-chlordane	4.8 - 9	—	0.20
Dioxins/Furans		—	—
PCBs	3,700 - 8,700	4,000 - 7,700	10 a
Arsenic	3.1 - 575	3.0 - 29.9	7.5
Barium	34.9 - 12,500	95.5 - 2,220	300 or S.B.
Beryllium	0.17 - 2.3	0.23 - 0.63	0.14
Cadmium	1.3 - 39.4	2.2 - 18.5	1.0

TABLE 2.3-2 (cont.)

OBSERVED CONTAMINANT RANGES AND GUIDELINE VALUES FOR SOILS AND SEDIMENTS

Parameter	Range of Detected Concentrations in Landfill Soils	Range of Detected Concentrations in Sediments	SCGs
Chromium	7.8 - 18,100	9.4 - 43.1	10.0
Copper	—	14.8 - 270	25.0
Lead	12 - 36,200	27.8 - 985	32.5 or S.B.
Manganese	198 - 4,430	132 - 1,770	S.B.
Mercury	0.14 - 4.4	0.18 - 1.2	0.1
Nickel	0.0061 - 565	10.0 - 125	13.0
Silver	0.68 - 11.2	—	200.0
Zinc	64 - 35,300	69.1 - 2,770	20.0
Cyanide	0.74 - 33.4	1.5 - 8	—

NOTES: All units in mg/kg or ppm.
SCGs shown are based on draft soil cleanup criteria issued by Technology Section, Bureau of Program Management, Division of Hazardous Waste Remediation, NYSDEC.

[a] Value shown is subsurface soil guideline values. Value for surface soil criteria is 1 ppm.

TABLE 2.3-3

PFOHL BROTHERS - FEASIBILITY STUDY
COMPILATION OF NUMERICAL ARARs/SCGs FOR GROUND WATER, LEACHATE AND SURFACE WATERS

PARAMETER	NYSDEC CLASS GA GW	NYSDEC CLASS B SW	NYSDEC CLASS D SW	NYSDOH MCLs (C)	EPA NIPOWR	SDWA MCLG	NYS MCL	7-DAY NAS SNARLS	FWQC (W & FISH INGEST.)
Benzene	ND(2)	6	6	5	-	ZERO	ND(5)	250	0.66
Chlorobenzene	5	5	50	5	-	-	5	-	-
Chloroethane	-	-	-	5	-	-	-	-	-
1,2-Dichlorobenzene				5	-	600	-	300	-
1,4-Dichlorobenzene	4.7	5	50	5	-	75	-	300	400
1,3-Dichlorobenzene	5			5	-	600	-	300	400
1,1-Dichloroethane	5	-	-	5	-	-	-	-	400
1,1-Dichloroethylene	5	-	-	5	-	7	-	-	-
trans-1,2-Dichloroethylene	5	-	-	5	-	-	-	-	-
Ethylbenzene	5	-	-	5	-	700	-	-	1400
Trichloroethylene	5	11	11	5	-	ZERO	-	15000	2.7
1,1,1-Trichloroethane	-	-	-	5	-	200	-	70000	0.6
Toluene	5	-	-	5	-	2000	-	-	14300
Xylenes	5	-	-	5(each)	-	10000	-	11200	-
2-Chlorophenol	-	-	-	50	-	-	-	-	-
2,4-Dimethylphenol	-	-	-	50	-	-	-	-	-
2-Methylphenol	-	-	-	50	-	-	-	-	-
4-Methylphenol	-	-	-	50	-	-	-	-	-
N-nitrosodiphenylamine	50	-	-	50	-	-	-	-	0.0008

TABLE 2.3-3 (Cont.)

PFOHL BROTHERS - FEASIBILITY STUDY
COMPILATION OF NUMERICAL ARARs/SCGs FOR GROUND WATER, LEACHATE AND SURFACE WATERS

PARAMETER	NYSDEC CLASS GA GW	NYSDEC CLASS B SW	NYSDEC CLASS D SW	NYSDOH MCLs (C)	EPA NIPOWR	SDWA MCLG	NYS MCL	7-DAY NAS SNARLS	FWQC (W & FISH INGEST.)
Phenol	1 a	5 b	5 b	50	-	-	-	-	30
Dibenzofuran	-	-	-	50	-	-	-	-	-
Diethylhexylphthalate (DEHP)	50	0.6	-	50	-	ZERO	-	-	-
Aldrin	ND(0.05)			-	-	-	-	-	0.074
Dieldrin	ND(0.05)	0.001	0.001	-	-	-	-	-	.000071
DDD	ND(0.05)	0.001	0.001	-	-	-	-	-	-
Endrin	NC(0.005)	0.002	0.002	0.0002	0.2	2	0.0002	-	1
Endosulfan II	-	0.009	0.22	50	-	-	-	-	-
PAHs	-	-	-	-	-	-	-	-	0.0028
PCBs	0.1	0.001	0.001	-	-	-	-	50	.000079
Aluminum	-	100	-	-	-	-	-	5000	-
Arsenic	25	190	360	-	50	ZERO	50	-	2.2
Barium	1000	-	-	-	1000	5000	1000	4700	1000
Beryllium	3	11,1100	-	-	-	ZERO	-	-	0.004
Cadmium	10	1.7	7	-	10	10	10	5	10
Chromium	50	318?	-	-	50	100	50	-	50
Cobalt	-	5	29	-	-	-	-	-	-
Copper	200	18.5	2688	-	-	1300	1000	-	170000
Lead	25	6.3	160.5	-	50	ZERO	50	-	50

TABLE 2.3-3 (Cont.)

PFOHL BROTHERS - FEASIBILITY STUDY
COMPILATION OF NUMERICAL ARARs/SCGs FOR GROUND WATER, LEACHATE AND SURFACE WATERS

PARAMETER	NYSDEC CLASS GA GW	NYSDEC CLASS B SW	NYSDEC CLASS D SW	NYSDOH MCLs (C)	EPA NIPOWR	SDWA MCLG	NYS MCL	7-DAY NAS SNARLS	FWQC (W & FISH INGEST.)
Endosulfan II	-	0.009	0.22	50	-	-	-	-	-
PAHs	-	-	-	-	-	-	-	-	0.0028
PCBs	0.1	0.001	0.001	-	-	-	-	50	.000079
Aluminum	-	100	-	-	-	-	-	5000	-
Arsenic	25	190	360	-	50	ZERO	50	-	2.2
Barium	1000	-	-	-	1000	5000	1000	4700	1000
Beryllium	3	11,1100	-	-	-	ZERO	-	-	0.004
Cadmium	10	1.7	7	-	10	10	10	5	10
Chromium	50	318?	-	-	50	100	50	-	50
Cobalt	-	5	29	-	-	-	-	-	-
Copper	200	18.5	2688	-	-	1300	1000	-	170000
Lead	25	6.3	160.5	-	50	ZERO	50	-	50
Manganese	300	-	-	-	-	-	300	-	50
Mercury	2	0.2	0.2	-	2	2	2	-	0.144
Nickel	-	142	2748	-	-	100	-	-	13.4
Selenium	10	1.0	-	-	10	50	10	-	10
Silver	50	0.1	10	-	50	-	50	-	50
Vanadium	-	14	190	-	-	-	-	-	-
Zinc	300	30	497	-	-	-	5000	-	5000
Cyanide	100	5.2	22	-	-	200	-	-	200

NOTES:

a - Includes penta and 2,4-dichlorophenols
b - Total unchlorinated phenols
c - Total organics not to exceed 100 μg/L
d - New Jersey DEP criteria for total volatile organic compounds - 10 μg/L
ZERO - Implies nondetect criteria
FWQC - Federal Water Quality Criteria
Effluent limits from 6NYCRR, Parts 702 and 703
MCLG - Maximum Contaminant Limit Goal
SNARLS - Suggest No Adverse Response Levels

TABLE 2.3-4

GROUND WATER AND LEACHATE SEEPS: COMPARISON OF OBSERVED CONCENTRATION RANGES WITH CLASS GA STANDARDS

Parameter	Range of Detected Concentrations in Shallow Ground Water	Range of Detected Concentrations in Bedrock Ground Water	Range of Detected Concentrations in Leachate Seeps	Class GA Standards
Benzene	2.7 - 290	23	3 - 8	ND(2)
Chlorobenzene	1,200 - 11,000	—	2 - 140	5
Chloroethane	900	3.7	1 - 31	—
1,2-Dichlorobenzene	4	—	4 - 57	
1,4-Dichlorobenzene	2 - 240	—	2 - 6	4.7
1,3-Dichlorobenzene	82	—	4 - 89	5
1,1-Dichloroethane	5.6 - 4900	4.1	2.3 - 4.9	5
1,1-Dichloroethylene	240	—		5
trans-1,2-Dichloroethylene	9.2	9.2	64 - 85	5
Ethylbenzene	—	—	6	5
1,1,1-Trichloroethane	26 - 15,000	—	—	—
Toluene	3 - 43	3	—	5
Xylenes	400	—	—	5
2-Chlorophenol	13	—	—	—
2,4-Dimethylphenol	630 - 940	—	30	—
2-Methylphenol	72	—	—	—
4-Methylphenol	75	—	—	—
Phenol	6 - 4,000	16	7 - 10	1 a
Dibenzofuran	15 - 20	—	20 - 63	—
Diethylhexylphthalate (DEHP)	3 - 66	3 - 42	9 - 60	50
Endosulfan II	0.69	—	0.032 - 0.054	—
PCBs	110	0.05	—	0.1
PAHs	—	—	2 - 39	—
Aldrin	—	—	0.007 - 0.008	ND(0.05)
Dieldrin	—	—	0.007 - 0.028	ND(0.05)
DDD	—	—	0.011	ND(0.05)
Endrin	—	—	0.028	ND(0.05)

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TABLE 2.3-4 (cont.)

GROUND WATER AND LEACHATE SEEPS: COMPARISON OF OBSERVED CONCENTRATION RANGES WITH CLASS GA STANDARDS

Parameter	Range of Detected Concentrations in Shallow Ground Water	Range of Detected Concentrations in Bedrock Ground Water	Range of Detected Concentrations in Leachate Seeps	Class GA Standards
Aluminum	224-74,000	56.1 - 1,630	39 - 303,000	—
Arsenic	2.1 - 22.3	2.4 - 4.7	2.2 - 16.7	25
Barium	52.2 - 1,530	24.9 - 240	80.3 - 10,000	1000
Cadmium	1.3 - 12	1.1 - 4.2	3.7 - 122	10
Chromium	2 - 196	2.4-728	3.5 - 426	50
Cobalt	2 - 46.9	7.1	3.4 - 157	—
Copper	2.7 - 3,060	3.7 - 28.4	13.9 - 784	200
Lead	2.3 - 369	2.3 - 6.8	6.7 - 1,640	25
Manganese	62.1 - 3450	5.9 - 428	123 - 16,100	300
Mercury	0.23 - 3.3	0.48	0.25 - 4.7	2
Nickel	11.8 - 141	10.7 - 198	20.4 - 521	—
Silver	2.1 - 23.7	2	3.4 - 16.6	50
Vanadium	1.4 - 124	1.4 - 35.3	3.3 - 471	—
Zinc	7.5 - 1490	1.4 - 44	66 - 8,270	300
Cyanide	30	—	18 - 31	100

NOTES: Effluent limits from 6NYCRR Parts 702 and 703.
All units in micrograms per liter ($\mu g/L$).

Section 3

3.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of medium-specific goals for protecting human health and the environment and focus on the contaminants os concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route.

Because RAOs are established to preserve or restore a resource, the environmental objectives are expressed in terms of the medium of interest and target cleanup levels, whenever possible. The final acceptable exposure levels will be determined on the basis of the results of the baseline risk assessment and the evaluation of the expected exposures and associated risks for each alternative.

The remedial action objectives established for the site include:

- remediate the site to be protective of human health and the environment by treatment of all media to protective levels and/or limiting exposure to contaminants of concern (COCs).
- reduce organic and inorganic loads to the surface water streams from leachate seeps and ground water to assist in meeting Class B and D in-stream standards.
- reduce carcinogenic and noncarcinogenic risks caused by dermal exposure to leachate seeps.
- reduce carcinogenic risks caused by dermal absorption and ingestion of sediments.
- prevent migration of contaminants from sediments that would result in surface water contamination in excess of Class B or D in-stream standards.
- reduce carcinogenic and non-carcinogenic risks caused by ingestion and dermal contact of landfill soils and solids.
- reduce risk of exposure to ground water via ingestion and dermal contact.
- minimize migration of contaminants into uncontaminated ground water.

Table 3-1 identifies those compounds detected in various media at the Pfohl Brothers site exceeding a medium-specific ARAR. Contaminants of concern (COCs) are those chemical constituents that have been identified in the Baseline Human Health Risk Assessment as contributing significantly to risk. These compounds are also compared to corresponding ARARs. Carcinogenic risks for a given media and pathway which were above or near a 10^{-6} risk were considered to contribute significantly to the total carcinogenic risk. If the total Hazard Index was greater than one, those media and pathways which contributed 0.1 or more to the total Hazard Index were considered significant, as were incremental blood lead levels of 5 ug/dl or greater.

Table 3-1

ARAR VALUES:
CHEMICALS EXCEEDING ARARs AND/OR CONTRIBUTING SIGNIFICANTLY TO RISK

Media	Exposure Pathway	Chemicals contributing to significant risk	ARAR	Chemicals exceeding ARARs (ppb)	ARAR
Surface Water (Ellicott Creek & Aero Lake)	• Ingestion of surface water and dermal contact with Aero Lake surface water while swimming • Dermal adsorption of drainage ditch surface waters and Ellicott Creek surface water			Chlorobenzene	5^a
				Aluminum	100^a
				Cadmium	$1.7^a/7^b$
				Iron	$300^a/300^b$
				Lead	6.3^a
				Zinc	30^a
				Mercury	$0.2^a/0.2^b$
Leachate Seeps	• Dermal exposure by children and workers	Bis (2-ethylhexyl)phthalate	50^c	1,2 trans dichloroethene	5^c
		PAHs (Carc)	0.8^d	phenol	1^c
				1,2 dichlorobenzene	4.7^c
				Aldrin	0.05^c
				Endrin	0.05^c
				4,4 - DDD	0.05^c
				Barium	$1,000^c$
				Beryllium	3^c
				Cadmium	10^c
				Chromium	50^c
				Copper	200^c
				Iron	300^c
				Lead	25^c
				Magnesium	$35,000^c$
				Manganese	300^c
				Zinc	300^c

TABLE 3-1 (cont.)

ARAR VALUES:
CHEMICALS EXCEEDING ARARs AND/OR CONTRIBUTING SIGNIFICANTLY TO RISK

Media	Exposure Pathway	Chemicals contributing to significant risk	ARAR	Chemicals exceeding ARARs (ppb)	ARAR
Drainage Ditches, Aero Creek & Ellicott Creek Sediments	• Dermal absorption • Ingestion	PAHs (carc)	1.32^{f} mg/kg		
Landfill Soils	• Dermal absorption • Ingestion	PAHs (carc)	1.32^{f}mg/kg	Chlorobenzene	
		PCBs	1^{g}	BEHP	5.5^{g}
		2,3,7,8 TCDD TEQ	0.001^{g}	PAHs (noncarc)	4.4^{g}
		Arsenic	7.5^{g}	b-BHC	114.8^{g}
		Lead	32.5^{g}	Chlordane	0.01^{g}
					0.2^{g}
Groundwater (Unconsolidated Aquifer)	• Ingestion of drinking water • Dermal contact • Inhalation of airborne contaminants	Benzene	2^{c}	Xylenes	5^{c}
		1,4 dichlorobenzene	4.7^{c}	Chromium	50^{c}
		Bis(2-ethylhexyl)phthalate	50^{c}	Iron	300^{c}
		PCBs	0.1^{c}	Magnesium	$35,000^{c}$
		Arsenic	25^{c}	Sodium	$20,000^{c}$
		Chlorobenzene	5^{c}		
		1,1,1-Trichloroethene	5^{e}		
		2,4 dimethylphenol	50^{e}		
		Barium	100^{c}		
		Manganese	300^{c}		
		1,4 dichlorobenzene	4.7^{c}		

TABLE 3-1 (cont.)

ARAR VALUES:
CHEMICALS EXCEEDING ARARs AND/OR CONTRIBUTING SIGNIFICANTLY TO RISK

Media	Exposure Pathway	Chemicals contributing to significant risk	ARAR	Chemicals exceeding ARARs (ppb)	ARAR
- Bedrock Aquifer	• Ingestion of drinking water • Dermal contact while showering • Inhalation of airborne contaminants while showering	Benzene	2[c]		
		Bis(2-ethylhexyl) phthalate	50[c]		
		Aldrin	0.05[c]		
		Arsenic	25[c]		
		Barium	1,000[c]		
		Cadmium	10[c]		
		Nickel	100[h]		
		Vanadium	14[a]		
		Lead			

[a] Class B Standards

[b] Class D Standards

[c] 6NYCRR Part 703.5 Class GA Standards/BA TOGS

[d] EPA 1990: Drinking Water Regs and Health Advisories

[e] NYSDOH MCL

[f] Guideline Values from Technology Section Division of Hazardous Waste

[g] Draft Soil Cleanup Guideline Values (TBC's) issued by Technology Section, Division of Hazardous Waste Remediation, NYSDEC.

[h] SDWA MCLG

Section 4

4.0 DEVELOPMENT OF TECHNOLOGY TYPES AND PROCESS OPTIONS

4.1 GENERAL RESPONSE ACTIONS

General Response Actions are categories of activities which are applied toward remediation of contaminated sites. The remedial action objectives developed for a site dictate which general response actions should be undertaken. Within each general response action (other than No Action) are several technology types and process options.

The general response actions identified for the Pfohl Brothers Landfill site which will meet the remedial action objectives for the site or will provide a baseline against which actions may be compared consist of the following:

No Action - This response is always identified for the purpose of establishing a baseline with which to compare other general response actions. There are no preventative or corrective actions taken as a result of this general response action, however, monitoring of the contamination may be prescribed.

Institutional Controls - These utilize actions which control contact with the contamination rather than remediating the contamination itself. These actions may be physical, such as fences or barriers, or legal such as deed restrictions, zoning changes or security restricted access.

Containment - As a general response action, containment prevents risk to human health and the environment by restricting contact to or migration of the contaminants via the soil, water or air pathways. A number of technologies and different materials are available for use in establishing migration barriers.

Removal/Collection - This response action physically removes or collects the existing contaminated media from the site. Other response actions are usually necessary in order to achieve remedial action goals and objectives for the removed or collected media. Collection and removal of solids/soils media is often associated with source control activities and eventually reduces contaminant concentrations in the surrounding surface water, ground water, biota and air media. Collection or removal actions in water and air media do not prevent continued migration of contaminants in those media, but do typically intercept the most contaminated portions of those media. Collection actions which completely intercept their respective media would be considered containment general response actions.

Treatment - These actions involve removal of the contaminant from the contaminated media or alteration of the contaminant. The result is a reduction in mobility, volume or toxicity of the contaminant. This general response action is usually preferred unless site or contaminant-specific characteristics make it unrealistic.

Disposal/Discharge - This general response action involves the transfer of contaminated media, concentrated contaminants, related or treated materials to a site reserved for long term storage of such materials or to an appropriate location. Disposal sites are strictly regulated in operation and the types of materials that they may accept.

The general response actions presented above provide the basis for identifying technology types and process options specific for the site, which are subsequently screened for technical feasibility.

4.2 DETERMINATION OF THE VOLUMES AND AREAS OF CONTAMINATED MEDIA

In order to apply the general response actions, an initial assessment of the quantity of contaminated media is necessary. This section describes the methods used to estimate quantities of soil/solids/sediments and groundwater/leachate/surface water.

4.2.1 LANDFILL SOILS/SOLIDS/SEDIMENTS

Based on information presented in the RI Report, it appears that contaminated soils and solids are located throughout the landfill. Thus, in calculating the volume of contaminated landfill soils and solids, it was assumed that all of the fill material is contaminated.

Sheet No. 1 in the RI report shows an AutoCAD-generated contour map depicting the depth of fill in the landfill based on soil boring data collected during the installation of the monitoring wells and excavation of test pits. This map was used in developing fill volumes and areas; the AutoCAD software package was used to calculate areas. Then based on the area and average depth, volumes of fill material were determined within each contour interval and then totaled. Total area for each geographical subdivision, average thickness of fill material, and total volumes of fill material, are presented in Table 4.1-1.

TABLE 4.1-1

ESTIMATED VOLUME OF CONTAMINATED LANDFILL SOLIDS AND SOILS

	Area (acres)	Ave Thickness (ft)	Volume (cy)
Area B	75	11.7	1,410,110
Area C	47	12.4	937,460
Total	122		2,347,570

Volumes of contaminated sediments from Aero Creek and the drainage ditches are expected to be a fraction of the contaminated soils and are estimated at an additional 200 cubic yards. This volume estimate is based on assuming that sediments are contaminated to a depth of 0.5 feet and three feet wide over a combined creek and ditch length of 3,600 feet.

4.2.2 GROUND WATER/LEACHATE/SURFACE WATER

Based on ground water sampling results collected to date, no significant/concentrated ground water plumes have been identified in the area. Data collected under the proposed Phase II Remedial Investigation will allow for a determination to be made on the volume of contaminated ground water. It is currently estimated that the volume of water within the site is 15,000,000 cubic feet.

4.3 CRITERIA FOR SCREENING OF GENERAL RESPONSE TECHNOLOGIES AND PROCESS OPTIONS

For each of the general response actions identified in Section 4.1, there exists a number of potentially effective technologies applicable to each medium of interest. These remedial technologies and associated process options are identified in the following sections and are initially screened on the basis of technical feasibility.

The evaluation of the technical feasibility of a technology or process option is based primarily upon the site conditions and the characteristics of the waste on the site. A technology/process option that cannot be implemented based on these criteria is eliminated from further evaluation.

4.3.1 LANDFILL SOLIDS/SOILS AND SEDIMENTS

Table 4.3-1 summarizes the general response technologies and process options identified for the landfill solids/soils and sediments media, provides a brief description of each technology/process option, and lists the results of the technical feasibility screening.

4.3.2 GROUND WATER AND LEACHATE

Table 4.3-2 summarizes the general response technologies and process options identified for the ground water and leachate media, provides a brief description of each technology/process option, and lists the results of the technical feasibility screening.

4.4 IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

In Section 4.3, the technical feasibility of the general response technologies were determined. In this section, the process options associated with these technically feasible technologies are evaluated relative to each other and screened in terms of their ability to meet medium-specific remedial action objectives, their short- and long-term effectiveness, and their implementability. Each of the evaluation criterion is described below:

Ability to meet remedial action objectives - Specific process options that have been identified should be evaluated on their ability to meet remedial action objectives relative to other process options within the same technology type.

TABLE 4.3-1
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
LANDFILL SOLIDS/SOIL AND SEDIMENTS

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
NO ACTION	No remediation of hazards present on site. Monitoring may occur.	Technically Implementable	This option required by the NCP and is retained for comparison with other alternatives.
INSTITUTIONAL CONTROLS			
• Land Use Controls			
- Deed Restrictions	Restrictive covenants on deeds to the landfill property. Includes limitations on excavation and basements in contaminated solids/soils areas.	Technically Implementable	May be difficult to administer for this site.
- Zoning Change	Zoning change, administrative consent order, or judicial order prohibiting certain land uses.	Technically Implementable	
• Fencing	Restrict general public from on-site hazards	Technically Implementable	Already in place around most of landfill.
• Written Warnings	Place warning signs in area to warn local citizens of landfill hazards	Technically Implementable	Already in place around most of landfill.
CONTAINMENT ACTIONS			
• Capping			
- Native Soil Cap	Reduce exposure to, and migration of contaminated materials through use of a native soil cap.	Technically Implementable	Allows most of the existing infiltration to reach the landfill solids. Surface runoff likely to contain high sediment content, which would require detention basins prior to final discharge.
- Single Barrier Cap	Utilizes a single layer of media for the barrier; such as clay, flexible membrane liner, asphalt or concrete-based material.	Technically Implementable	Allows for some infiltration. Meets NYSDEC capping criteria.
- Composite Barrier Cap	Utilizes multiple layers of media for the barrier, such as soil, synthetics, and concrete.	Technically Implementable	Minimizes infiltration of existing precipitation. Creates relatively high volume of clean runoff. Meets NYSDEC capping criteria.

TABLE 4.3-1 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
LANDFILL SOLIDS/SOIL AND SEDIMENTS

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
• Surface Controls			
- Grading	Modifies topography to manage surface water infiltration, run-on and runoff.	Technically Implementable	
- Revegetation	Stabilizes soil surface of landfill and promotes evapotranspiration.	Technically Implementable	
REMOVAL ACTIONS			
• Excavation	Physical removal of materials via backhoe or other suitable equipment.	Technically Implementable	Appropriate for isolated areas such as "hot spots" and areas where thickness of landfill deposits is low.
TREATMENT ACTIONS			
• Biological Treatment			
- Aerobic	Degradation of organics using acclimated microorganisms in an aerobic environment.	Technically Unimplementable	Although degradation of PAHs has been demonstrated and proven, degradation of PCBs may be difficult and has not been tried on a full scale. Inorganics would be unaffected by the process.
- Anaerobic	Degradation of organics using microorganisms in an anaerobic environment.	Technically Unimplementable	Not applicable to inorganic and some organic contaminants.
• Stabilization/Fixation	Contaminated soil mixed with a variety of stabilizing agents (cement-based, pozzolanic- or silicate-based, thermoplastic-based, or inorganic polymer-based) to reduce the mobility of hazardous constituents.	Technically Implementable	Bench scale testing would be required to develop the effective stabilizing mixture. Non-uniform composition of landfill solids makes the process difficult to implement as sorting of waste materials prior to treatment may be necessary. Treatment of homogeneous areas may be more implementable.

TABLE 4.3-1 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
LANDFILL SOLIDS/SOIL AND SEDIMENTS

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Supercritical Water Oxidation	Breaks down suspended and dissolved oxidizable inorganic and organic materials by oxidation in a high-temperature, high pressure, aqueous environment.	Technically Unimplementable	Waste must be pumpable.
- Low Temperature Thermal Desorption	Involves the volatilization of organics from soil without achieving soil combustion temperatures. Volatiles can be destroyed in an afterburner.	Technically Implementable	The technology has been developed for treating soils containing PCBs and PAHs. Non-volatile compounds are not removed. Must be used in combination with a vapor collection system.
• Physical/Chemical Treatment			
- Air Stripping/ Mechanical Aeration	Mechanical aeration of soils to remove volatile organics	Technically Unimplementable	Non applicable to inorganics and non volatiles, which are the primary contaminants of concern on the site.
- Soil Washing	Organic solvents are mixed with soils to extract organic contaminants. Liquid waste is produced.	Technically Implementable	Can remove PCBs and PAHs, however low concentrations in the soil may result in low removal efficiencies. Non-uniform composition of landfill solids makes the process difficult to implement as sorting of waste materials prior to treatment may be necessary. Treatment of homogeneous areas may be more implementable.
- Dechlorination	Use of potassium polyethylene glycolate (KPEG) and dimethyl sulfoxide to dechlorinate halogenated organic compounds, creating large numbers of nontoxic products.	Technically Unimplementable	Will not detoxify PAHs or inorganics.

TABLE 4.3-1 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
LANDFILL SOLIDS/SOIL AND SEDIMENTS

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
INSITU TREATMENT			
• Physical/Chemical			
- Vapor Extraction/and Thermally Enhanced Vapor Extraction	Vertical or horizontal vents used to extract contaminated soil gas and volatilize contaminant residuals from soils. Steam/hot gas can be used to enhance volatilization.	Technically Unimplementable	Not ammenable to non-volatile organics and inorganic contaminants or to contaminants mixed with trash/debris.
- Radio Frequency (RF)/ Microwave Heating	Electrodes are placed in contaminated soils. RF energy field heats soils and volatilizes contaminants which are collected in vents or at the surface.	Technically Unimplementable	Although system would vaporize volatile and semi-volatile contaminants, non-volatile and inorganic constituents would not be addressed. Applicability to contaminants mixed with trash/debris is limited and unproven.
- Vitrification	Electrodes are placed in soil and current is passed through soil to create resistive heating. Soil eventually melts, organics are volatilized or destroyed and inorganics are dissolved within vitrified mass.	Technically Unimplementable	Contaminants mixed in with trash and other demolition debris could limit the effectiveness of this process. Technology effectiveness in landfill media is unproven. Requires uniform composition of soil.
- Soil Flushing	Surfactant solution is percolated through contaminated soils and elutriate is brought to the surface for removal, recirculation or on-site treatment and reinjection. Amenable for removal of some organics.	Technically Unimplementable	Limited applicability to wastes mixed with trash/demolition debris due to inability to distribute solution to contaminated areas. Also requires effective collection system to prevent contaminant migration; fractured bedrock does not provide for effective recovery. Because of the variety of contaminants present, no one type of surfactant would remove all contaminants of concern. Lack of hydraulic control may create problems. Possible contamination due to surfactants used.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Bottom Sealing	Prevent vertical migration of contaminants using a horizontal layer of impermeable material injected beneath contaminated area.	Technically Implementable	To be implemented in areas where natural clay underlying landfill is absent. May be difficult to implement at the site since the areas are unknown and difficult to identify.
- Capping	Install a properly designed cap over the site. Cap could be asphalt/concrete, clay, synthetic or multi-layered.	Technically Implementable	Would minimize infiltration into landfill materials, thereby reducing leachate seep discharge and decrease downward hydraulic gradient between alluvial and bedrock aquifers.
COLLECTION ACTIONS			
• Hydraulic Collection			
- Passive Drainfields	Water is collected in a trench containing perforated pipe and gravel, and is pumped to the surface.	Technically Implementable	Construction difficulty increases with depth below water table surface. Worker health and safety may be a concern during construction in waste material.
- Extraction Wells	An array of wells is used to pump out ground water.	Technically Implementable	Can collect water over a large area. Pumping rates on individual wells can be varied to focus collection efforts in desired areas.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
CONTAINMENT ACTIONS			
• Hydraulic Controls			
- Passive Drainfields	Use of an interceptor trench containing perforated pipe and gravel for collection of ground water or leachate which is pumped to the surface. Trench is located downgradient of site.	Technically Implementable	Collected water must be treated prior to discharge. Existing underground utilities could pose problems. May not be technically feasible to install system deep enough within aquifer. Worker health and safety may be a concern during construction.
- Extraction Wells	Capture ground water in the shallow aquifer using a series of pumping wells which pump at high enough rates to reverse existing hydraulic gradient.	Technically Implementable	Collected water must be treated prior to discharge. Requires on-site studies to determine well capture zones. Requires constant monitoring to maintain system effectiveness.
• Physical Controls			
- Slurry Walls	Bentonite-filled trench. Reduces permeability and restricts ground water flow.	Technically Implementable	Provides consistent barrier to lateral flow. Does not address vertical migration of contaminants.
- Grout Curtain	Inject grout into soil to harden soils and form an impermeable wall.	Technically Implementable	Difficult to completely seal a large area. Does not address vertical migration of contamination.
- Sheet Piling	Metal sheets are driven into bedrock to form an impermeable wall.	Technically Implementable	Difficult to install in rocky soils or at depths greater than 30 feet.

TABLE 4.3-2
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
NO ACTION	No removal or reduction of risks from ground water or leachate. Continue monitoring of ground water and leachate.	Technically Implementable	This option has been retained for comparison with other alternatives, as required by NCP.
INSTITUTIONAL ACTIONS			
• Water Use Controls			
- Well Permit Regulation	Regulate drilling of new wells in contaminated shallow aquifer.	Technically Implementable	Applicable and feasible in this area since alternate water sources exist.
- Inspect and Seal Existing Wells	Voluntary abandonment of existing shallow wells in contaminated areas. Properly seal bedrock wells to prevent downward contaminant migration.	Technically Implementable	Could affect several private wells located off-site. Potentially important in protecting bedrock aquifer.
- Point of Use Treatment	Provide individual water treatment systems to all potentially affected well water systems.	Technically Implementable	Must be used with other institutional actions to prevent human contact with ground water.
• Public Education	Increase public awareness of site conditions and remedies through meetings, written notices, and news releases.	Technically Implementable	Provide forum for open discussion and may prevent unintended exposures.

TABLE 4.3-1 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
LANDFILL SOLIDS/SOIL AND SEDIMENTS

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Photolysis/UV	Photochemical reactions requiring the absorption of light energy, generally from sunlight in natural conditions. Because light does not penetrate very far into soils, photodegradation of contaminated soils is limited to soil surfaces.	Technically Unimplementable	Only applicable for surface soil contamination. Non-uniform composition of landfill solids makes the process difficult to implement as sorting of waste materials prior to treatment may be necessary. Treatment of homogeneous areas may be more implementable.
• Biological Treatment			
- Aerobic	Nutrients and cosubstrates, such as methane, are injected into soils to stimulate biological destruction of contaminants.	Technically Unimplementable	Proven in aqueous laboratory reactors, but unproven for soils application. Will not degrade chlorinated organics.
- Anaerobic	Cosubstrate such as acetate is added to subsurface. Anaerobic bacteria are stimulated to degrade chlorinated organics.	Technically Unimplementable	Will degrade chlorinated organics, but incomplete degradation forms vinyl chloride. Difficult to maintain anaerobic conditions insitu.
DISPOSAL ACTIONS			
• Offsite			
- RCRA Subtitle C	Disposal of contaminated soil at offsite RCRA "C" Landfill.	Technically Implementable	Soil may require treatment prior to disposal due to Land Ban restrictions. Radioactive and/or dioxin contaminated soils may require separate handling and disposal.
- RCRA Subtitle D	Disposal of treated solids/soils at an RCRA "D" landfill.	Technically Implementable	Requires treatment prior to disposal. Radioactive and/or dioxin contaminated soils may also require separate handling and disposal due to Land Ban Restrictions.
• Onsite	Involves the construction of an onsite containment vessel (RCRA landfill) or a Subtitle D vessel for the disposal of contaminated materials.	Technically Implementable	Contaminated material would be required to be excavated. Existing site structures may need to be removed. Would be difficult to implement in areas with a high water table or location within 100-year flood plain.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
TREATMENT ACTIONS			
• Biological			
- Activated Sludge	Treat ground water/leachate using bacteria and other microbes in an aerated tank with biomass recirculation.	Technically Unimplementable	Organic compound concentrations are too weak to support a viable microbial population. Does not completely address inorganic removal.
- Activated Sludge and Powdered Activated Carbon	Treat ground water/leachate with microbes and powdered activated carbon in the same reactor.	Technically Unimplementable	Potentially applicable for treating organic contaminants. Does not completely address treatment of inorganic constituents.
- Aeration Tank	Biological treatment by microbes in an aerated tank with no recirculation.	Technically Unimplementable	Extremely difficult to sustain sufficient microbial population.
- Aerobic Fixed Film	Microbes attached to an inert media provide organic contaminant removal under aerobic conditions.	Technically Implementable	Possible application even for low strength waters. Incidental metals removal.
- Anaerobic Fixed Film	Microbes attached to an inert media provide organic contaminant removal under anaerobic conditions.	Technically Implementable	Generally not used for removal of low level organic compound concentrations.
- Aerobic/Anaerobic Fixed Film	Microbes attached to an inert media provide organic contaminant removal under spatially segregated aerobic and anaerobic zones.	Technically Unimplementable	Not applicable for waters with low organic compound concentrations.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Anaerobic Digester/Tank	Organic contaminants are removed in an anaerobic digester.	Technically Unimplementable	Applicable for sludge; not applicable for ground water or leachate.
- Combined Biological	Both aerobic and anaerobic microbes are used for treatment.	Technically Unimplementable	Ground water/leachate organic compound concentrations too low to sustain a viable population.
- Fluidized Bed Reactor	Microbes attached to a fluidized bed of inert media provide organic contaminant removal.	Technically Implementable	Potentially applicable for ground water/leachate treatment. Does not address inorganic constituents.
- In-situ Biodegradation	Microbes present in the soil are used for biodegradation.	Technically Unimplementable	Not applicable for low concentration waters encountered at this site. Difficult to control environment in the fill material/soil found at this site.
- Land Treatment	Ground water/leachate is applied to land. Microbes present in soil provide treatment.	Technically Unimplementable	Potential for creating additional contamination. Potential RCRA Land-ban restrictions. Must be used in combination with a vapor collection system.
- Rock Reed Filters	Contaminants are absorbed in wetlands environment (natural or artificial).	Technically Implementable	Potentially applicable as a polishing stage when treated ground water/leachate is discharged to surface waters.
- Sequencing Batch Reactors	Ground water/leachate is treated under aerobic conditions in a sequencing batch reactor configuration.	Technically Unimplementable	Ground water and leachate concentrations are too weak to support a viable microbial populations. Does not completely address inorganic removal.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Trickling Filters	Similar to a fixed film aerobic process.	Technically Implementable	Possible application for removing some of the organics. Not applicable for inorganics.
• Physical/Chemical			
- Activated Carbon	Granular activated carbon is used to adsorb organic contaminants. Spent carbon is regenerated and concentrated. Contaminants are destroyed or treated.	Technically Implementable	Proven technology for removal of most organics. Methylene chloride is poorly adsorbed. Metals removal is incidental.
- Air Stripping/Steam Stripping	Air or steam is used to strip volatile organic compounds from ground water/leachate. Vapor phase streams are treated for concentrated contaminant removal or destruction.	Technically Implementable	Proven technologies for removal of certain organic compounds, especially volatile organics.
- Alkaline Destruction	Remove inorganic constituents by raising pH to high values.	Technically Unimplementable	Not a proven technology and is not applicable for all inorganic constituents.
- Centrifugation	Remove inorganic constituents by raising pH to high values.	Technically Unimplementable	Not applicable for ground water/leachate with low solids contents. Can be used for sludge dewatering but minimal sludge processing is anticipated at this site.
- Chelation	Chelating agents are used for heavy metal removal.	Technically Unimplementable	Technology is not proven for such applications. Only some inorganics are treated.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Ion Exchange	Heavy metals are exchanged with sodium or hydrogen ions and removed from water as pass through an ion exchange column.	Technically Implementable	Potentially applicable and proven technology for heavy metals removal.
- Low Temperature Stripping	Volatile organic contaminants are removed from water through addition of heat and air.	Technically Implementable	Possible application for volatile organics removal.
- Magnetic Separation	Magnetic forces are used for removal of suspended metals which are magnetic.	Technically Unimplementable	Not applicable to non-magnetic nor dissolved ground water/leachate contaminants at the site. No organics removal.
- Mechanical Aeration	Organics are volatilized through aeration provided by mechanical mixers.	Technically Unimplementable	Very limited applicability to ground water/leachate at this site due to low concentrations.
- Neutralization	pH adjustment is made for treating waters outside the range of normal pH.	Technically Unimplementable	pH for ground water/leachate at this site is normal (within the range 6-9)
- Oil/Water Separation	Free floating oil or other phases are separated from water.	Technically Unimplementable	Applicable only when free product is found. No such products exist at this site.
- Oxidation/Reduction	Oxidation/reduction reactions are used to remove metals.	Technically Unimplementable	Limited application for selective metals only. No organics removal.
- Phases Separation	Immiscible phases are separated physically.	Technically Unimplementable	Multiple phases are not present at this site.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Ion Exchange	Heavy metals are exchanged with sodium or hydrogen ions and removed from water as pass through an ion exchange column.	Technically Implementable	Potentially applicable and proven technology for heavy metals removal.
- Low Temperature Stripping	Volatile organic contaminants are removed from water through addition of heat and air.	Technically Implementable	Possible application for volatile organics removal.
- Magnetic Separation	Magnetic forces are used for removal of suspended metals which are magnetic.	Technically Unimplementable	Not applicable to non-magnetic nor dissolved ground water/leachate contaminants at the site. No organics removal.
- Mechanical Aeration	Organics are volatilized through aeration provided by mechanical mixers.	Technically Unimplementable	Very limited applicability to ground water/leachate at this site due to low concentrations.
- Neutralization	pH adjustment is made for treating waters outside the range of normal pH.	Technically Unimplementable	pH for ground water/leachate at this site is normal (within the range 6-9)
- Oil/Water Separation	Free floating oil or other phases are separated from water.	Technically Unimplementable	Applicable only when free product is found. No such products exist at this site.
- Oxidation/Reduction	Oxidation/reduction reactions are used to remove metals.	Technically Unimplementable	Limited application for selective metals only. No organics removal.
- Phases Separation	Immiscible phases are separated physically.	Technically Unimplementable	Multiple phases are not present at this site.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Coagulation/flocculation	Coagulating agents and flocculants are used for collecting precipitated metals to facilitate separation from waters.	Technically Implementable	Applicable and proven technology for assisting in removal of some inorganic constituents.
- Dechlorination/ Dehalogenation	Organic compounds are dechlorinated or dehalogenated using chemical addition.	Technically Unimplementable	Not effective in media with a wide range of organic constituents. No metals removals.
- Distillation	Organic constituents are removed from ground water/leachate	Technically Unimplementable	Not applicable to ground water with several contaminants and low concentrations of organics. No metals removal.
- Electrodialysis	Ion separation is achieved using electrodialysis techniques.	Technically Unimplementable	Only applicable for ion separation. Does not remove precipitates and most organics.
- Electrochemical	Electrochemical properties exhibited by heavy metals are used for separating them from waters.	Technically Implementable	Has been proven in pilot scale testing. Potentially applicable for metals removal. No organics removal.
- Evaporation	Dissolved solids are separated from water using evaporation. Volatile constituents are also removed.	Technically Unimplementable	Not applicable for treatment of dilute waters in the cool, humid conditions at the site.
- Filtration	Precipitated solids containing metals are filtered out.	Technically Implementable	Potential application as a secondary process during metals removal.
- Freeze Crystallization	Various organic constituents are separated from water by freezing.	Technically Unimplementable	Not proven for such large volumes and dilute concentrations. Metals removal incidental.
- Hydrolysis	Contaminants are hydrolyzed and destroyed.	Technically Unimplementable	Not a proven technology.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Trickling Filters	Similar to a fixed film aerobic process.	Technically Implementable	Possible application for removing some of the organics. Not applicable for inorganics.
• Physical/Chemical			
- Activated Carbon	Granular activated carbon is used to adsorb organic contaminants. Spent carbon is regenerated and concentrated. Contaminants are destroyed or treated.	Technically Implementable	Proven technology for removal of most organics. Methylene chloride is poorly adsorbed. Metals removal is incidental.
- Air Stripping/Steam Stripping	Air or steam is used to strip volatile organic compounds from ground water/leachate. Vapor phase streams are treated for concentrated contaminant removal or destruction.	Technically Implementable	Proven technologies for removal of certain organic compounds, especially volatile organics.
- Alkaline Destruction	Remove inorganic constituents by raising pH to high values.	Technically Unimplementable	Not a proven technology and is not applicable for all inorganic constituents.
- Centrifugation	Remove inorganic constituents by raising pH to high values.	Technically Unimplementable	Not applicable for ground water/leachate with low solids contents. Can be used for sludge dewatering but minimal sludge processing is anticipated at this site.
- Chelation	Chelating agents are used for heavy metal removal.	Technically Unimplementable	Technology is not proven for such applications. Only some inorganics are treated.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Photolysis (UV)	UV energy is used to degrade organic contaminants.	Technically Unimplementable	Not applicable to the organic contaminants found at this site. Incomplete destruction of certain volatile organics.
- Precipitation	Heavy metals are precipitated out using chemical addition.	Technically Implementable	Proven and applicable technology used in metals removal process.
- Reverse Osmosis	Selective membranes utilize osmotic pressures for separation of organic and inorganic constituents.	Technically Implementable	Possible application as a polishing step depending on the treatment limits to be met. Only practical for achieving very low effluent dissolved solids.
- RF/Microwave In-situ	Microwave energy is used for destruction of contaminants.	Technically Unimplementable	Not applicable for ground water/leachate.
- Sedimentation	Settleable solids are separated from water in tanks.	Technically Implementable	Retained only as a technology in the metals removal process.
- Solvent Extraction	Solvents are used for removal of contaminants from water.	Technically Unimplementable	Concentration of various organics are too low to make this a viable technology.
- Supercritical Fluid Extraction	Solvents are used under supercritical conditions for contaminant removal.	Technically Unimplementable	Concentration of various organics are too low to make this a viable technology.
- UV/Hydrogen Peroxide/ Ozone Reactors	Contaminants are oxidized and dechlorinated using oxidizers in the presence of UV light.	Technically Implementable	Innovative technology. Effective for removal of some organic compounds.
- Ultrafiltration	Contaminants are removed from water using ultrafiltration membranes or columns.	Technically Implementable	May be applicable as a polishing step depending on the level of treatment required.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
- Vacuum/Vapor Extraction	Vacuum or vapors are used for extracting contaminants from water.	Technically Unimplementable	Concentration of various organics are too low to make this a viable technology.
- Wet Air Oxidation	Thermal energy is used for destruction of contaminants.	Technically Unimplementable	Technology is too energy intensive. Not applicable for waters with insufficient organics and thermal values.
• Thermal Treatment Technologies	Heat energy is used to destroy organic and inorganic contaminants.	Technically Unimplementable	Not efficient and applicable for dilute ground water/leachate.
• In-Situ Treatment Technologies	Ground water/leachate is treated in place using biological or physical/chemical processes.	Technically Unimplementable	Not proven on a large scale, nor with the suite of compounds present at the site. Certain compounds resistant to degradation.
DISPOSAL TECHNOLOGIES			
• On-Site			
- Ground Water Reinjection	Inject treated ground water back into aquifer using injection wells.	Technically Implementable	Useful in flushing out additional contamination and in dilution. Potential plugging problems.
- Infiltration Trenches	Recharge treated ground water/leachate into the aquifer through gravel filled trenches.	Technically Implementable	Less plugging problems than with reinjection wells. Needs permeable soils. Underground utilities may limit locations; verification of locations required.
- Discharge to Surface Waters	Discharge to Elliott Creek after treatment.	Technically Implementable	Treatment standards are dictated by Class B surface water criteria. Permits needed.

TABLE 4.3-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES
GROUND WATER AND LEACHATE

RESPONSE ACTION • Remedial Technology - Process Option	Description	Screening Status	Comments
	Discharge to Aero Lake after treatment.	Technically Implementable	Treatment standards are dictated by Class D surface water criteria. Permits needed.
• Off-Site			
- Ground Water Reinjection	Inject treated ground water back into aquifer using injection wells.	Technically Implementable	Useful in flushing out additional contamination and in dilution. Potential plugging problems.
- Infiltration Trenches	Recharge treated ground water/leachate into the aquifer through gravel filled trenches.	Technically Implementable	Less plugging problems than with reinjection wells. Needs permeable soils. Underground utilities may limit locations.
- Discharge to Surface Waters	Discharge to off-site surface water.	Technically Implementable	Appropriate permits needed. Treatment standards dictated by appropriate surface water criteria.
- Discharge to Sewers	Discharge to Buffalo Sewer Authority sanitary sewer system.	Technically Implementable	Pretreatment criteria established by the authority must be met. Requires local permits.

Long-term effectiveness - This evaluation focuses on:

1) The performance of the remediation;
2) The magnitude of the remaining risk;
3) The adequacy of the controls implemented to manage waste left on the site; and
4) The long-term reliability of the controls left on site.

Short-term effectiveness - This evaluation focuses on:

1) The protection of the community during the remedial action;
2) The environmental impacts from the implementation of the remedial action;
3) The time until remedial action objectives are achieved; and
4) The protection of workers during remedial actions.

Implementability - The implementability criteria encompasses both the technical and institutional feasibility of implementing a technology process.

Screening of the process options using these criteria was conducted to select one process option that is representative of each remedial technology. More than one process option may be selected for a remedial technology if the processes are sufficiently different in their performance.

The screening process is presented in Tables 4.4-1 for the Landfill Solids/Soils and Sediment, and Table 4.4-2 for Ground Water and Leachate. The remedial technologies and process option that were evaluated in Section 4.3 as being technically feasible are presented. Each process options was evaluated against the four criteria and, when compared to the other process options within their technology type as presented on the tables, were given a relative High, Moderate, or Low rating based on their performance in meeting each criteria. It is important to note that the ratings are only indicative of each process option's performance relative to the other process options within each technology type that were retained in the screening tables.

The process option within each technology type receiving the highest performance ratings for the four evaluation criteria was retained for possible incorporation into one or more remedial action alternatives, and the other process options within the technology type are eliminated, unless noted otherwise in the tables. It should be noted that any of the process options contained in Tables 4.4-1 and 4.4-2 could be

TABLE 4.4-1
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

REMEDIAL ACTION PROCESS OPTIONS EVALUATION
LANDFILL SOLIDS/SOIL AND SEDIMENTS

Response Action	Remedial Technology	Process Option	Achieve Remedial Action Objectives[a]	Long-Term Effectiveness[a]	Short-Term Effectiveness[a]	Implementation[a]	Evaluation Result
No Action	Monitoring	Monitoring	Low	N/A[b]	N/A[b]	N/A[b]	Retain
Institutional Controls	Land Use Restrictions	Deed Restrictions	Low	Low	Moderate	Low	Retain, because sufficiently different
		Zoning Change	Low	Moderate	Low	Moderate	Retain, because sufficiently different
		Fencing	Moderate	Moderate	Moderate	Moderate	Retain because sufficiently different
	Public Education	Written Warnings	Low	Low	Low	High	Retain
Containment	Capping	Native Soil Cap	Low	Low	High	High	Not retained
		Single Barrier	High	Moderate	High	Moderate	Retained
		Composite Barrier Cap	High	High	Low	Low	Not Retained
	Surface Controls	Grading	Low	Low	Moderate	Moderate	Not retained
		Revegetation	Low	Low	Low	High	Retain
Removal	Excavation	--	High	High	Moderate	Low	Retain for isolated regions
Treatment	Stabilization/ Fixation	--	N/A[b]	N/A[b]	N/A[b]	N/A[b]	Reject since hot spots being remediated separately
	Thermal Treatment	Rotary Kiln	High	High	High	High	Reject since hot spots being remediated separately
		Circulating Fluidized Bed	Moderate	Moderate	Moderate	Moderate	Not retained
		Multiple Hearth	Moderate	Moderate	Moderate	Low	Not retained
		Infrared Thermal Treatment	Moderate	Low	Low	Low	Not retained
		Low Temperature Thermal Desorption	Low	Low	Low	Low	Not retained
	Physical/Chemical Treatment	Soil Washing	Low	N/A[b]	N/A[b]	N/A[b]	Reject since hot spots being remediated separately

TABLE 4.4-1 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

REMEDIAL ACTION PROCESS OPTIONS EVALUATION
LANDFILL SOLIDS/SOIL AND SEDIMENTS

Response Action	Remedial Technology	Process Option	Achieve Remedial Action Objectives[a]	Long-Term Effectiveness[a]	Short-Term Effectiveness[a]	Implementation[a]	Evaluation Result
Disposal	Off-Site	RCRA Subtitle "C"	High	High	Low	Low	Retain for material requiring RCRA "C" disposal
		RCRA Subtitle "D"	Moderate	Moderate	Moderate	Moderate	Retain for material meeting RCRA "D" disposal requirements
	On-Site	--	Low	N/A[b]	N/A[b]	N/A[b]	Retain

[a] Process options were evaluated relative to only other process options within the same remedial technology according to the following:

Ability to achieve remedial action objectives.
Long Term Effectiveness:
1) Performance of the remediation
2) Magnitude of the remaining risk
3) Adequacy of controls
4) Reliability of controls
Short Term Effectiveness:
1) Protection of the community during remedial actions
2) Environmental impacts
3) Time until remedial objectives are achieved
4) Protection of workers during remedial actions
Implementability:
1) Technical feasibility
2) Administrative feasibility

[b] N/A = Evaluative ranking not applicable either because only one option exists for the technology or because the options were not comparable. See text for details.

Note that all of the above process options may be incorporated into alternatives during detailed design.

TABLE 4.4-2
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
REMEDIAL ACTION PROCESS OPTIONS EVALUATION
GROUND WATER AND LEACHATE

Response Action	Remedial Technology	Process Option	Achieve Remedial Action Objectives[a]	Long-Term Effectiveness[a]	Short-Term Effectiveness[a]	Implementation[a]	Evaluation Result
No Action	Monitoring	Monitoring	Low	N/A	N/A	N/A	Retain
Institutional Controls	Water Use Controls	Well Permit Regulation	Low	Moderate	Low	Moderate	Retain because sufficiently different
		Inspect/Seal Existing Wells	Low	Moderate	High	Moderate	Retain because sufficiently different
		Point of Use Treatment	Moderate	Moderate	High	High	Retain because sufficiently different
	Public Education	Written Warnings	Low	Low	Low	High	Retain
Containment	Hydraulic Controls	Drainfields	High	High	Moderate	Moderate	Retain
		Extraction Wells	Moderate	Moderate	High	Moderate	Not retained
	Physical Controls	Slurry Walls	High	Moderate	High	Moderate	Retain
		Grout Curtain	Moderate	Low	Moderate	Moderate	Not retained
		Sheet Piling	Moderate	Low	Moderate	Moderate	Not retained
		Bottom Sealing	Moderate	Low	Moderate	Low	Not retained
		Capping	High	Moderate	Moderate	Moderate	Retain because sufficiently different
Collection	Hydraulic Collection	Passive Drainfields	High	High	Moderate	High	Retain for near surface collection
		Extraction Wells	High	Moderate	High	Moderate	Retain
Treatment	Biological	Aerobic Fixed Film	High	Low	Moderate	Moderate	Not Retained
		Anaerobic Fixed Film	Moderate	Low	Low	Low	Not retained
		Fluidized Bed Reactor	Moderate	Low	Low	Low	Not retained
		Rock Reed Filters	Low	Moderate	Low	Low	Not retained
		Trickling Filters	Low	Low	Moderate	Low	Not retained

TABLE 4.4-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

REMEDIAL ACTION PROCESS OPTIONS EVALUATION
GROUND WATER AND LEACHATE

Response Action	Remedial Technology	Process Option	Achieve Remedial Action Objectives[a]	Long-Term Effectiveness[a]	Short-Term Effectiveness[a]	Implementation[a]	Evaluation Result
	Physical/Chemical	Activated Carbon	High	High	High	High	Retain - for organics
		Air Stripping/Steam Stripping	Moderate	Moderate	Moderate	Moderate	Not retained
		Coagulation/Flocculation	High	Moderate	High	High	Retain - for inorganics
		Electrochemical	Moderate	Moderate	Moderate	Moderate	Not retained
		Filtration	Moderate	Moderate	Moderate	Moderate	Retain - for inorganics (use after coagulation/-flocculation)
		Ion Exchange	Moderate	Moderate	Moderate	Low	Retain - for inorganics
		Low Temperature Stripping	Moderate	Moderate	Moderate	Moderate	Not retained
		Precipitation	High	Moderate	Moderate	Moderate	Retain - for inorganics
		Reverse Osmosis	Moderate	Moderate	Moderate	Low	Not retained
		Sedimentation	Moderate	Moderate	Moderate	High	Retain - for inorganics
		UV/Hydrogen Peroxide/ Ozone Reactors	Moderate	Moderate	Moderate	Moderate	Retain - if polishing needed
		Ultra Filtration	Moderate	Moderate	Moderate	Low	Not retained
Disposal	On-Site	Ground Water Reinjection	Low	Low	Moderate	Moderate	Not retained
		Infiltration Trenches	Low	Moderate	Moderate	Moderate	Not retained
		Discharge to Surface Waters	Moderate	Moderate	Moderate	High	Retain
	Off-Site	Ground Water Reinjection	Low	Low	Moderate	Moderate	Not retained
		Infiltration Trenches	Low	Moderate	Moderate	Moderate	Not retained

TABLE 4.4-2 (cont.)
PFOHL BROTHERS LANDFILL FEASIBILITY STUDY

REMEDIAL ACTION PROCESS OPTIONS EVALUATION
GROUND WATER AND LEACHATE

Response Action	Remedial Technology	Process Option	Achieve Remedial Action Objectives[a]	Long-Term Effectiveness[a]	Short-Term Effectiveness[a]	Implementation[a]	Evaluation Result
		Discharge to Surface Waters	Moderate	Moderate	Moderate	High	Retain for uncontaminated and treated water
		Discharge to Sewers	High	High	High	High	Retain

[a] Process options were evaluated relative to only other process options within the same remedial technology according to the following:
Ability to achieve remedial action objectives.
Long Term Effectiveness:
1) Performance of the remediation
2) Magnitude of the remaining risk
3) Adequacy of controls
4) Reliability of controls
Short Term Effectiveness:
1) Protection of the community during remedial actions
2) Environmental impacts
3) Time until remedial objectives are achieved
4) Protection of workers during remedial actions
Implementability:
1) Technical feasibility
2) Administrative feasibility

[b] N/A = Evaluative ranking not applicable either because only one option exists for the technology or because the options were not compatable. See text for details.

Note that all of the above process options may be incorporated into alternatives during detailed design.

included as part of the remedial action at the site for those technology types which are part of the selected alternative.

4.4.1 TECHNOLOGY/PROCESS OPTIONS FOR LANDFILL SOLIDS/SOILS AND SEDIMENTS

General descriptions of the technologies, appropriate comments and their technical implementability are provided in Table 4.3-1. This section provides a brief summary of these options and provides justification for eliminating certain technologies.

4.4.1.1 No Action

The "no action" response allows for conditions to remain status quo, that is, no remedial actions are taken at the site. This option typically includes long-term monitoring and is maintained as a potential response action throughout the screening process.

4.4.1.2 Institutional Control Actions

Institutional controls represent general response actions that are intended to limit exposure to contaminated landfill solids, soils, and sediments. These actions include land use controls such as deed restrictions and removal of physical structures, and public education such as written warnings. Many of these actions have already been taken at the site and are also technically implementable.

Limited response actions, such as fencing, constitute a second category of remedial technologies and may be used alone for general site restrictions or as part of other remedial measures to reduce risks to public exposure. The Pfohl Brothers Landfill is currently fenced and this technology is technically implementable for future remediation also.

4.4.1.3 Containment Actions

Containment actions are intended to reduce dispersion and leaching of a hazardous substance to otherwise uncontaminated areas. Containment actions include placement of a constructed cap over the surface of the landfill, which minimizes exposure and reduces infiltration, and surface controls which alter surface runoff and evaporation at a site. As indicated in Table 4.3-1, all of the technologies under this category are technically implementable at the Pfohl Brothers landfill site.

The three capping technology process options present a large range in their ability to meet the criteria of achieving remedial action objectives, long-term effectiveness and short-term effectiveness. The native soil cap is the easiest to construct, so it ranks the highest in implementability and short-term effectiveness among the cap technologies in Table 4.4-1. The native soil cap, however, would also allow most of the water which currently infiltrates into the landfill to continue to do so. The production of contaminated landfill leachate and associated contamination of the alluvial aquifer would be expected to continue after this process option has been implemented. Although the amount of surface runoff is expected to be lower from the native soil cap than from the barrier caps, due to its higher infiltration characteristics, runoff from the native soil cap is likely to contain a large amount of sediment. The sediment would need to be removed before the surface runoff can be discharged to off-site streams, thus requiring construction of sediment detention basins.

The single and composite barrier caps would reduce infiltration through the landfill and sedimentation associated with surface runoff. Both barrier caps meet state capping regulations (6NYCRR, Part 360). The composite barrier cap is more difficult to construct and therefore receives a low rating for short-term effectiveness and implementation. The single barrier cap was selected as the preferred and representative process option for containment general response action capping technology.

The surface control technology process options are fairly easy to implement. Due to the large area the site covers and high annual rainfall, neither the revegetation nor grading process options would be effective in reducing infiltration. Neither process option would reduce exposure to contaminated landfill solids, so remedial action objectives would not be met. Revegetation is easier to implement than grading, so it has been retained as the representative and preferred process option for this technology type.

4.4.1.4 Removal Actions

The removal general response action consists of the technology type of excavation. Excavation is not implementable for the entire volume of landfill solids due to the thickness and depth of fill materials and shallow depth to water. Excavation has been retained, however, as an appropriate general response action for peripheral portions of the landfill where the fill materials are less thick. It is assumed that removal of localized landfill solids and soils containing high contaminant concentrations ("hot spots") is being undertaken separately, and therefore, will not be addressed in this evaluation.

4.4.1.5 Treatment Actions

This set of technology types consists of the collection, by excavation, of landfill solids and soils, as well as sediments, and subsequent treatment either at a facility located on-site or off-site. The remedial action categories of onsite and offsite treatment include biological (aerobic and anaerobic), stabilization/fixation, physical/chemical treatment and thermal treatment.

Due to the large quantity and heterogenous nature of the material in the Pfohl Brothers Landfill, source removal would require extensive excavation, handling and processing. Offsite treatment would also require handling and transport of the contaminated material, thereby creating a risk of exposure to the workers and general public. This technology type is, however, technically feasible. Therefore, the option of excavating the landfill and treating the soils and solids on or off site will be retained for further evaluation. Treatment of localized "hot spots" is being undertaken separately, and will therefore not be addressed in this evaluation.

Biological treatment, commonly referred to as bioremediation, is a process which uses soil microorganisms to chemically degrade organic constituents. Biodegradation can occur in the presence of oxygen (aerobic) or in the absence of oxygen (anaerobic). Available data suggest that halogenated aliphatic compounds, non-halogenated organic compounds, and nitrated compounds are treated successfully using this technology. However, this technology type has no record of demonstrated effectiveness in treating PCBs, dioxins or furans. In addition, bioremediation processes are not suitable for the treatment of wastes with high levels of metals, such as those found at the PBL site and were, therefore, not retained for further evaluation.

Stabilization/fixation is a physical/chemical process in which a stabilizing material is added to a liquid or semi-liquid waste to produce a solid. In general, this technology has been successful in immobilizing volatile metals and non-volatile metals in full-scale systems. Significant reductions in mobility of the leachate have not been demonstrated for many organic compounds. Stabilization has been most successfully demonstrated on PAHs, where 99% reduction in mobility has been achieved. This technology type is therefore considered technically implementable for metals and some organics at the site, and has been retained for further consideration.

Thermal treatment is a very effective technology type for treating organic and inorganic contaminants through the application of heat. With the exception of polar aromatic compounds (i.e., chlorinated phenols and methoxychlor) this process generally achieves a removal efficiency of greater than 98%. Thermal treatment does not destroy volatile metals, such as lead and mercury, or non-volatile metals, such as iron and chromium. Several process options such as rotary kiln, multiple hearth, circulating fluidized bed, pyrolysis, infrared thermal treatment, supercritical water oxidation, vitrification and low temperature thermal desorption options are included in this category. Among these, pyrolysis and super critical water oxidation technologies are considered to be technically unimplementable for this site.

Physical and chemical treatment technologies, such as air stripping, soil washing and dechlorination represent another technology type which is potentially applicable to contaminants at the site. Air stripping is a process used to transfer volatile contaminants in water or soil to the gaseous phase. It is less effective in removing the heavier, less volatile compounds, such as PAHs, in the soils and is, therefore, not technically implementable on this site.

Soil washing as described in Table 4.3-1 is considered to be technically implementable at this site. Dechlorination is a destruction process which uses a chemical reaction to remove chlorine atoms in chlorinated molecules, thus converting more toxic compounds to less toxic, more soluble products. Transformation of these chemicals in the soil facilitates their removal and subsequent treatment. This process option is not expected to treat volatile and non-volatile metals. To date, no full-scale soil treatment programs have been undertaken using dechlorination, especially for mixed debris encountered at landfills. Because of the clayey nature of the soils at the PBL site and the type of contaminants present, this technology would not be technically implementable and is eliminated from further evaluation.

Insitu treatment is a subset of the treatment general response action which contains a large number of technology type/process options, so has been presented separately for discussion purposes. This includes physical/chemical or biological treatment technologies that are used to treat contaminants in soils, solids and sediments without having to excavate these materials. The category of physical/chemical treatment includes physical and chemical vapor extraction, microwave heating, vitrification, soil flushing, and photolysis. These technologies are not appropriate for conditions at the Pfohl Brothers site primarily because of the heterogenous mixture of the waste material and lack of proven effectiveness in landfill media. Soil flushing technology would be impractical because the mixture of waste material would require the application of a variety of surfactants to remove all the contaminants. Effective removal could not be accomplished because the presence of trash and demolition debris would preclude an even distribution of the solution. For these reasons, all physical/chemical insitu treatment technologies are considered to be technically unimplementable at this site and are not considered further.

Insitu biological treatment includes aerobic and anaerobic treatment technologies. Because of the limited application and lack of demonstrated performance for these technologies for mixed debris at this landfill, biological processes are technically unimplementable and are also eliminated from further evaluation.

4.4.1.6 Disposal Actions

The disposal general response action includes transport offsite to either a RCRA subtitle C or RCRA subtitle D facility, or construction of an onsite containment facility. Onsite disposal may include excavation of portions of the landfilled material. The radioactive and/or dioxin-contaminated landfill solids and soils may have to be separated prior to offsite disposal and disposed of separately. Dioxin contaminated soils may not be able to be disposed of offsite due to EPA Land Ban restrictions. All are considered technically implementable and are retained for further evaluation.

4.4.2 TECHNOLOGY/PROCESS OPTIONS FOR GROUND WATER AND LEACHATE

Several general response actions were identified for ground water and leachate remediation, as discussed in Section 4.1. A set of technology types and process options was evaluated based on the general remedial actions. These actions ranged from "no action" to collection and treatment. General descriptions of technologies, types, and process options, appropriate comments, and initial screening based on their technical implementability are provided in Table 4.3-2. This section provides a brief summary of the technology types and process options for each general response action and provides justification for additional screening.

4.2.2.1 No Action

The "no action" general response action allows for current conditions to remain as no remedial actions are taken at the site. This response action typically includes the technology type/process option of long-term monitoring, and is maintained as a potential response action throughout the screening process to provide a baseline condition upon which all of the other response actions are compared.

4.4.2.2 Institutional Control Actions

Institutional controls are implemented to control the exposure to contaminated or potentially contaminated ground water for drinking and domestic uses. Included are well permit regulation for new wells, inspection and sealing of existing wells in areas at risk of ground water contamination, point of use treatment and public education in the form of written warnings. All four institutional control options have been retained since they are sufficiently different and because each of these should be undertaken as part of this general response action.

4.4.2.3 Containment Actions

Containment general response actions are intended to reduce off-site migration of contaminated ground water. Technology types for containment of horizontal migration of contaminated ground water include hydraulic and physical containment. Hydraulic containment consists of the reversal of ground water gradients via pumping or passive drainfields. In aquifers with low hydraulic conductivity, drainfields are more effective than wells in intercepting groundwater. However, installation of drainfields through waste materials may pose considerable difficulties and would require extreme health and safety precautions during installation. In addition, in order to completely intercept alluvial ground water leaving the site, the drainfields would need to be installed near the base of the alluvial aquifer. The shallow depth to water creates additional construction difficulties. Physical containment consists of barriers such as a slurry wall, grout curtain, or sheet piling. The physical containment technologies considered for use at the site each extend from the ground surface to the base of the alluvial aquifer. Their continuous nature provides physical containment of contaminants migrating laterally in both the aqueous and gaseous phases. Lateral containment of gaseous phase contaminants, if present at the site, provides an extra degree of protection to offsite uncontaminated areas that does not exist with the hydraulic containment technology process options. The grout curtain, sheet piling, bottom sealing and extraction well process options of containment are more difficult to implement and less effective than other options, and so these have not been carried forward.

4.4.2.4 Collection Actions

The collection general response action for ground water and leachate consists of two hydraulic collection technology process options. These process options, passive drainfields and extraction wells, are similar to the process options described for the ground water/leachate hydraulic containment technology. Unlike the hydraulic containment process options, the hydraulic collection technology process options do not need to completely intercept the water that flows in the vicinity of the collection system. Hydraulic collection technologies are most appropriate for maintaining water levels below a specified elevation, such as in dewatering systems, or for collecting separate-phase contaminants that may be present at the top or bottom of an aquifer.

The drainfields are most effective in collecting floating contaminants and in uniformly decreasing the water table surface at the location of the drainfield. The groundwater extraction wells would be easier to install through the landfill solids, and are more effective than the drainfields in decreasing the water table surface over a larger geographical area. Both options are retained, as the drainfields could be used for near surface collection.

4.4.2.5 Treatment Actions

This general response action includes technology types that collect the ground water and subsequently treat it at an on-site facility. Technology type categories include biological (aerobic and anaerobic) and physical/chemical. On-site treatment involves construction of an on-site facility or use of a mobile treatment unit.

Biological treatment has been discussed in Section 4.4.1.5 Compounds which can be treated by this technology type are the halogenated aliphatic compounds, the nonhalogenated organic compounds, and the nitrated compounds. PCBs, dioxins, and furans have proven recalcitrant to biotreatment. Thus, biological treatment technologies were not retained for further evaluation.

Physical/chemical treatment process options physically separate contaminants from the aqueous waste stream by precipitation, absorption, ion exchange, filtration, or vapor extraction. In general, different process options are required for removal of organics and inorganics. Treatment options for removal of inorganics include coagulation/flocculation followed by filtration, ion exchange, precipitation, and/or sedimentation. Physical/chemical process options for removal of organics include activated carbon followed by a polishing step using UV/Hydrogen Peroxide/Ozone reactors. These process options were retained for further analysis.

A variety of physical/chemical treatment process options were not retained. Air stripping and low temperature stripping do not effectively remove the less volatile compounds, such as PAHs. Electrochemical separation of metals from aqueous waste streams has not been tested on a full-scale basis. Reverse osmosis for removal of both organic and inorganic contaminants has potential problems with clogging of the membrane, large wastewater sidestreams and high maintenance requirements.

4.4.2.6 Disposal/Discharge Actions

Treated and untreated water that is collected at the site can be disposed of via reinjection or recharge to ground water, discharge to on- or off-site surface water bodies, or discharge to the municipal Publicly Owned Treatment Works (POTW) sewer system. Recharge and reinjection process options are usually more effective when the source of contamination has been removed or isolated, the depth to ground water is great and the aquifer media receiving the recharge water has a relatively high hydraulic conductivity. Since removal of source materials will not be undertaken, the depth to water is so shallow, and the alluvial materials contain many low permeability deposits, reinjection or recharge to ground water is not practical, either on or off site. Due to the proximity of surface water bodies (Ellicott Creek, Aero Creek, and Aero Lake) and POTW lines to the site, the option of discharging to surface water bodies and/or to the Buffalo POTW system has been retained.

4.5 SUMMARY OF SCREENING PROCESS

Table 4.5-1 summarizes the technologies and process options that are retained for remedial action alternative development. These technologies/process options were evaluated as technically implementable in Section 4.3 and in Section 4.4 were rated the highest, relative to other process options within each technology type, when evaluated against the four evaluation criteria: ability to meet remedial action objectives; short-term effectiveness; long-term effectiveness; and implementability.

Table 4.5-1

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY SUMMARY OF REPRESENTATIVE PROCESS OPTIONS RETAINED FOR ALTERNATIVES DEVELOPMENT

Landfill Solids/Soil and Sediment

- No Action
  - Monitoring
- Institutional Monitoring Controls
  - Deed and Land Use Zoning Restrictions
  - Fencing, Written Warnings
- Containment
  - Single Barrier Cap
  - Revegetation Surface Control, Grading
- Removal
  - Excavation
- Disposal
  - RCRA Subtitle D Off-Site Disposal
  - RCRA Subtitle C Off-Site Disposal
  - On-Site Disposal

Ground Water and Leachate

- No Action
  - Monitoring
- Institutional Control
  - Well Permit Regulation, Well Inspections/Sealing
  - Point of Use Treatment

Table 4.5-1 (continued)

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF REPRESENTATIVE PROCESS OPTIONS
RETAINED FOR ALTERNATIVES DEVELOPMENT

Containment

Drainfield Hydraulic Control
Slurry Wall, and Capping Physical Control

Collection

Passive Drainfield Hydraulic Collection
Extraction Well Hydraulic Collection

Treatment

Activated Carbon Physical/Chemical Treatment for Organics
Coagulation/Flocculation Physical/Chemical Treatment for Inorganics
Filtration Physical/Chemical Treatment for Inorganics
Ion Exchange Physical/Chemical Treatment for Inorganics
Precipitation Physical/Chemical Treatment for Inorganics
Sedimentation Physical/Chemical Treatment for Inorganics
UV/Hydrogen Peroxide/Ozone Reactors Physical/Chemical Treatment for Polishing

Disposal

On- and Off-Site Discharge to Surface Water
Off-Site Discharge to POTW

Section 5

5.0 DEVELOPMENT AND INITIAL SCREENING OF REMEDIAL ALTERNATIVES

In Section 4.3, remedial action technologies and process options were identified and evaluated for technical feasibility. Those that were determined to be technically feasible were further evaluated and screened in Sections 4.4 and 4.5 based on their ability to meet remedial action objectives, implementability, and short- and long-term effectiveness. Based upon the results of this screening, process options have been selected and formulated into remedial action alternatives which address the contamination of the various media at the site. Section 5.1 presents the method by which the alternatives were formulated from the retained process options. Section 5.2 contains descriptions of the alternatives. The criteria for and initial screening of these alternatives are presented in Sections 5.3 and 5.4, respectively. Remedial action alternatives which have been retained for detailed evaluation are presented further in Section 5.5.

5.1 DEVELOPMENT OF ALTERNATIVES

The federal and New York state guidelines on determining cleanup actions for a site both recommend that a range of alternatives first be developed. The alternatives should represent a range of general response actions and should meet the site remedial action objectives to varying degrees. The assembled alternatives are then screened against the criteria presented in Section 5.3. Those alternatives which can meet the remedial action objectives for the site, (along with the No Action alternative), are then further screened using the NYSDEC TAGM criteria to determine the alternatives which are retained for detailed evaluation.

The large number of general response actions, technology types and process options that were retained for the Pfohl Brothers Landfill site suggest that a large number of alternatives could potentially be assembled. In order to reduce the number of alternatives that are developed and yet assemble a comprehensive range of alternatives, the key general response actions were determined and became the basis for the alternatives. The key general response actions are those which best meet the remedial action objectives. They were determined by assembling the retained general response actions (Table 4.5-1) and by comparing how well each response action met the remedial action objectives for the landfill soils/solids, ground water and leachate seep media. These media are the basis for the evaluation because they are the media in which a significant risk exists (Section 3.0). A summary of this evaluation is contained in Table 5.1-1. The table ranks each of the general response actions retained from Section 4.0 (listed along the left side of the table) as high, medium or low in its ability to meet the RAOs. The RAOs include preventing continued exposure to human or environmental receptors and minimizing migration in each of the three medium. It should be noted that the sediment media is not represented in the table since risk from this media will be mitigated by remediation of other media (contaminated ditch sediments will be handled in the same way as landfill solids/soils during remediation and the risk due to contaminated Aero Creek sediments should be reduced to below significant levels by remediation of leachate seeps.)

General response actions were used in this evaluation rather than technology types or process options because the final selection of technology types and process options to be implemented at the site will not be made until the remedial design phase of the project. The rankings presented in Table 5.1-1, however, assume that the preferred process options discussed in Section 4.5 are representative of their respective general response actions.

As shown on Table 5.1-1, general response actions applied to the landfill solids and soils media have little effect in achieving remedial action objectives for leachate seeps or ground water. The general response actions applied to the ground water and leachate seeps similarly have little effect on attaining the solids/soils remedial action objectives. The table also shows that the No Action general response actions for both solids and aqueous media do not meet the remedial action objectives for any media. Institutional controls are shown in Table 5.1-1 to meet selected remedial action objectives to a moderate degree. The "medium" ranking was given in several categories because the selected institutional controls are designed to minimize exposure to human populations only; exposure to environmental receptors would continue. Landfill solids/soils containment has a beneficial effect on attaining the leachate seep remedial action objectives because the preferred containment process option (a single barrier cap) would reduce infiltration, lower the water table within the landfill and possibly eliminate the leachate seeps. The aqueous media collection/treatment/disposal group of general response actions do not merit a "high" ranking for minimizing migration of ground water and leachate seeps because, as discussed in Section 4.1 and 4.4, aqueous collection does not completely intercept the water and therefore some continued migration would occur.

TABLE 5.1-1
DEGREE TO WHICH RETAINED GENERAL RESPONSE ACTIONS SATISFY REMEDIAL ACTION OBJECTIVES DEVELOPED FOR THE PFOHL BROTHERS LANDFILL[a]

Retained General Reponse Actions By Media	Landfill Solids/Soils		Leachate Seeps		Ground Water	
	Prevent Exposure	Minimize Migration	Prevent Exposure	Minimize Migration	Prevent Exposure	Minimize Migration
<u>Solids/Soils Media</u>						
No Action	Low	Low	Low	Low	Low	Low
Institutional Controls	Medium	Low	Medium	Low	Low	Low
Containment	High	High	Medium	Medium	Low	Low
Removal/Disposal	Medium	Low	Low	Low	Low	Low
<u>Ground Water & Leachate</u>						
No Action	Low	Low	Low	Low	Low	Low
Institutional Controls	Low	Low	Medium	Low	Medium	Low
Containment	Low	Low	Medium	High	Medium	High
Collection/Treatment/ Disposal	Low	Low	Medium	Medium	Medium	Medium

(a) The remedial action objectives are summarized here for presentation purposes only and are intended to represent all of the remedial action objectives for each of the listed media, as discussed in Section 3.0.

Remedial alternatives were developed by assembling the key general response actions into different combinations. The evaluation of general response actions presented in Table 5.1-1 indicates that only three general response actions appear to individually attain the site remedial action objectives for one or more media. A medium or high ranking was needed for all of the remedial action objectives within a media for a general response action to be considered to meet the remedial action objectives for that media. The principle general response actions at the Pfohl Brothers Landfill site are:

- solids/soils media containment
- aqueous (ground water and leachate) media containment
- aqueous media collection/treatment/disposal

Using a yes/no matrix, presented in Table 5.1-2 it was found that a total of eight possible combinations exist for the three general response actions. The combinations represent a range of possible actions that can be taken to remediate the site. The eight combinations listed on Table 5.1-2 became the basis for ten remedial action alternatives. The number of the alternative(s) associated with each combination of general response actions are given in the last line of the table.

The first and seventh general response action combinations, (no solids containment but aqueous containment and collection/treatment/disposal) have been developed into two remedial alternatives. The two additional remedial alternatives (alternatives 2 and 8) include as key components two other general response actions - institutional controls and leachate seep collection/treatment/disposal, respectively. These additional alternatives were added because of the evaluation shown in Table 5.1-1 indicated these response actions have some benefit toward achieving remedial action objectives, even though they could not adequately by themselves satisfy the RAOs.

5.2 DESCRIPTION OF ALTERNATIVES

From the eight combinations of general response actions, ten remedial alternatives have been developed. The main components of the ten remedial alternatives are listed in tabular form on Table 5.2-1. More detailed descriptions of the technology types and process options which have been assembled for each alternative are given in Table 5.2-2 and discussed below.

TABLE 5.1-2
CONCEPTUAL DEVELOPMENT OF REMEDIAL ALTERNATIVES

Key General Response Action[b]	Possible Combinations of General Response Actions[a]							
Solids Media Containment	No	Yes	Yes	No	Yes	No	No	Yes
Ground water & leachate containment	No	No	No	No	Yes	Yes	Yes	Yes
Ground water & leachate Collection, Treatment and Disposal	No	Yes	No	Yes	No	No	Yes	Yes
Remedial Alternative Number[c]	1,2	3	4	5	6	7	8,9	10

NOTES:

(a) The yes/no designations indicate if the general response action is part of the alternative.
(b) The general response actions listed are those which can attain the remedial action objectives for one or more media, as presented on Table 5.1-1.
(c) The numbers assigned to the remedial alternatives are discussed in Section 5.2.

TABLE 5.2-1
SUMMARY OF REMEDIAL ALTERNATIVES

MEDIA	GENERAL RESPONSE ACTION	Alternatives									
		1	2	3	4	5	6	7	8	9	10
Landfill Solids/ Soils	No Action	✓									
	Institutional Controls		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Containment			✓	✓		✓				✓
Ground Water & Leachate[a]	No Action	✓									
	Institutional Controls		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Containment						✓	✓	✓	✓	✓
	Collection/Treatment/Disposal			✓		✓			✓[b]	✓[c]	✓

a) Institutional controls and containment general response actions for leachate are included in landfill solids/soils and/or groundwater response actions.
b) Collection/treatment/disposal only for leachate seeps which form inside containment system.
c) Colleciton/treatment/disposal for shallow ground water present inside containment system.

TABLE 5.2-2

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY DESCRIPTION OF REMEDIAL ACTION ALTERNATIVES

Alternative No. 1 - No Action

- Groundwater Monitoring
- Maintenance of existing fencing

Alternative No. 2 - Institutional Controls

- On-site well prohibition, off-site well monitoring
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 3 - Capping, Ground Water Collection, Treatment, and Disposal, and Institutional Controls

- On-site well prohibition, off-site well monitoring
- Single Barrier Cap with off-site wetland replacement
- Select Solids/Soils Excavation with On-Site Disposal (for shallow and peripheral contamination)
- Ground Water collection, on-site metals and organics treatment, and off-site disposal
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 4 - Capping with Institutional Controls

- On-site well prohibition, off-site well monitoring
- Single Barrier Cap with off-site wetland replacement
- Select solids/soils excavation with on-site disposal (for shallow and peripheral contamination)
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 5 - Ground Water Collection, Treatment, and Disposal, and Institutional Controls

- On-site well prohibition, off-site well monitoring
- Zoning and deed regulations, fencing and warning signs, and public education for landfill
- Ground water collection, on-site metals and organics treatment, and off-site disposal

Alternative No. 6 - Capping, Ground Water Containment, and Institutional Controls

- On-site well prohibition, off-site well monitoring
- Slurry wall containment
- Single Barrier Cap with off-site wetland replacement
- Select landfill solids/soils excavation and on-site disposal (for shallow and peripheral contamination)
- Zoning and deed regulations, fencing and warning signs, and public education for landfill
- Surface Runoff collection, channelization and off-site disposal

TABLE 5.2-2 (cont.)

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
DESCRIPTION OF REMEDIAL ACTION ALTERNATIVES

Alternative No. 7 - Ground Water Containment and Institutional Controls

- On-site well prohibition, off-site well monitoring
- Slurry wall containment
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 8 - Ground Water Containment, Leachate Seep Collection, Treatment and Disposal and Institutional Controls

- Slurry wall containment
- Leachate seep collection, treatment and off-site disposal
- On-site well prohibition, off-site well monitoring
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 9 - Ground Water Containment, Collection, Treatment and Disposal and Institutional Controls

- Slurry wall containment
- Ground Water collection, on-site metals and organics treatment and off-site disposal
- Off-site groundwater well monitoring
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

Alternative No. 10 - Capping, Ground Water Containment Collection, Treatment and Disposal and Institutional Controls

- Slurry wall containment
- Ground Water extraction, collection on-site metals and organics treatment, abd off-site disposal
- Single Barrier Cap with on-site wetland replacement
- Select landfill solids/soils excavation and on-site disposal (for shallow and peripheral contamination)
- Zoning and deed regulations, fencing and warning signs, and public education for landfill

In the descriptions of the ten remedial alternatives that follow, it has been assumed that drums visible on the surface of the landfill in areas B and C will have been excavated and adequately contained prior to undertaking the site-wide remedial activities. The drum removal is being implemented by the NYSDEC as an interim response measure and should be completed well in advance of the site-wide remedial activities described below. The NYSDEC has assumed responsibility for the extent of hot spot remediation and it will therefore not be addressed in this study.

5.2.1 ALTERNATIVE NO. 1 - NO ACTION

Under Alternative No. 1, no additional action will be taken to address the contamination present on the site or to reduce the risk posed by the contamination. The chainlink fences which surround portions of the site will be maintained under this alternative. On-site contamination of ground waters, surface waters and soils would continue as would off-site contamination of surface waters from leachate seeps. The potential for off-site contamination of both the bedrock and unconsolidated aquifers would remain. Potential exposure to landfill solids contamination would also continue since the existing fences do not completely encircle areas B and C. The No Action alternative is required under the CERCLA NCP, and is primarily used to assess the risks involved in not remediating the site. It also provides an evaluation of baseline conditions to which the effectiveness, implementability, and costs of other remedial alternatives can be compared.

Annual monitoring of ground water quality, periodic maintenance of the existing fence and public health evaluations conducted every five years are included under this alternative. Without institutional controls on well use, well drilling, and future land use, this alternative would not prevent exposure to potential receptors of media contaminated in excess of regulatory action levels.

5.2.2 ALTERNATIVE NO. 2 - INSTITUTIONAL CONTROLS FOR GROUND WATER AND LANDFILL SOLIDS/SOILS AND SEDIMENTS

Alternative No. 2 consists of institutional controls for both ground water use and access to the landfill. Institutional controls prevent or control the exposure to contaminants but do not reduce contaminant mobility or toxicity.

The institutional controls proposed for Alternative No. 2 are designed to prevent exposure to landfill solids/soils and sediments. These include zoning regulations that prohibit residential and industrial development of the landfill area, fencing and warning signs to prevent access to the site; and public education in the form of both public meetings and news media to inform local citizens and any on-site workers of the hazards presented at the landfill from soil ingestion exposures. Localized areas showing high levels of surface contamination ("hot spots") may require additional fencing to insure access restrictions.

Institutional controls that would be implemented to prevent exposure to ground water through the ingestion pathway include permit and use restrictions prohibiting development of new wells for potable water supplies and domestic use in both the unconsolidated and bedrock aquifers under and near the landfill. Sampling of off-site wells will be done on a yearly basis to monitor the potential for off-site plume migration. If contaminants are detected in off-site wells, water use restrictions may need to be implemented and may include provisions for point of use treatment or alternative water supply.

5.2.3 ALTERNATIVE NO. 3 - GROUND WATER AND LANDFILL SOLIDS INSTITUTIONAL CONTROLS, GROUND WATER COLLECTION, TREATMENT AND DISPOSAL, WITH LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 3 addresses the risks posed by the contamination on site through the use of institutional controls, passive collection and treatment for the ground water media, the containment remedial technology of capping and institutional controls for the solids/soils media. The capping remedial technology and ground water collection/treatment/disposal will address leachate seeps and surface water.

Institutional controls in the form of deed or permit restrictions would be required to prevent activities involving excavation within the landfill, such as industrial or residential development, which could result in breaching of the cap. Provisions for the off-site disposal of surface water runoff from the impermeable cap would also be included in this alternative.

The ground water institutional controls prevent exposures to ground water through the ingestion pathway by prohibiting development of wells for potable water supplies and domestic use in both the unconsolidated and bedrock aquifers under and near the landfill. Sampling of off-site wells will be done on a yearly basis to monitor the potential for off-site plume migration. If contaminants are detected in off-site wells, water use restrictions may need to be implemented and may include provisions for point of use treatment or alternate water supply.

The capping remedial technology addresses the risks posed by ingestion and dermal absorption of the contamination present at the site by providing a barrier between the contamination and human receptors.

A single barrier cap was selected as the preferred capping technology process option because it provided long-term effectiveness while minimizing short term effects and implementability problems. The cap proposed for installation at the site is a modified RCRA cap, designed in accordance with NYSDEC Part 360 regulations. This cap is a conservative design and will be re-evaluated during design. The cap would consist of, from bottom to top, a compacted protection layer, a gas venting layer covered by a low permeability layer (composed either of compacted clay or synthetic flexible membrane), a sand or gravel drainage layer, a geotextile and then a surface soil vegetation layer.

Areas B and C would be capped, with possible limited excavation and on-site disposal of peripheral areas where landfill solids are only a few feet thick. The result of selectively excavating portions of the landfill would be twofold: a decrease in the areal extent of landfill requiring a cap; and the consolidation of the contaminated landfill solid/soils. Excavation of peripheral areas may also need to be undertaken to achieve the required surface grade of the landfill while keeping the cap within the present landfill boundary. Based on historical records of landfill activities, sampling results from the RI and present land use, no cap will placed on Area A. Due to the lack of detected methane gas at the landfill, the need for a gas venting layer will be further evaluated during the remedial design phase.

Implementation of the cap will require that the site be cleared of all vegetation. The resulting large volume of vegetation will be mulched and disposed of on-site. Once the site is cleared, slope grading will be undertaken to control erosion, provide sufficient runoff from the site, and prevent ponding of surface water on the cap. Surface runoff and water collected in the landfill cap lateral drainage layer will be collected in surface ditches and discharged to nearby surface water bodies. Parts of the cap may lie within the 100-year floodplain. A berm or dike system would need to be constructed to effectively remove the cap from the 100-year floodplain area. The berm or dike may need to be constructed in the southeast portion of Area C.

The combination of reducing infiltration into the landfill through an impermeable cap and through regrading of the site is expected to reduce the ground water levels under the site enough to eliminate leachate seeps at the site. The risk posed by the dermal absorption of leachate would therefore be eliminated. Subsurface leachate derived from the landfill solids that migrates into the alluvial ground water system would be collected utilizing a gravel filled trench. The trench would be installed around areas B and C, to depths several feet below the potentiometric surface. The trench system would passively collect water through low-discharge pumping of water within the trench. Potentially contaminated water may bypass the trench through underflow.

Ground water collected through the shallow trench system would be treated through a treatment plant located on-site. Using analytical flow modeling techniques it has been conservatively estimated that the trench system will collect approximately 50 gallons per minute of shallow ground water, all of which would require treatment. Treatment would include a precipitation/settling/filtration process for metals removal followed by a physical/chemical process (Air Strip Granular Activated Carbon) for removal of organic constituents. Treated effluent from the on-site treatment plant would be discharged either to Buffalo Sewer Authority sewerage system (POTW) or surface waters. The water quality of the treated ground water may require a SPDES or equivalent permit and may exceed acceptable contaminant mass loadings to Ellicott Creek and/or to the Buffalo POTW.

Contaminated sediments will be remediated as a result of the landfill capping general response action. The drainage ditch sediments will be covered by the cap and therefore be part of the physical containment in a manner similar to that of the landfill solids. This will effectively eliminate the current drainage ditches. Once leachate discharges are controlled the presumed source of Aero Creek sediment contamination will be removed. It is therefore expected that contaminated Aero Creek sediments will be dispersed naturally, such as during high flow or storm periods, thereby reducing both the contaminant mass and the exposure risk within the Aero Creek sediments adjacent to the site.

A portion of the regulated wetlands present along Aero Creek and the 0.5 acre wetland in the southeast corner of Area C will be destroyed during remediation of the landfill. These wetlands will be compensated for by restoring and creating wetlands off site. Land acquisition would be required adjacent to the site. Both existing and newly created wetlands off site would replace those wetlands lost during remediation on a one-to-one basis.

5.2.4 ALTERNATIVE NO. 4 - LANDFILL SOLIDS/SOILS CAPPING AND GROUND WATER AND LANDFILL SOLIDS/SOILS INSTITUTIONAL CONTROLS

Alternative No. 4 consists of institutional controls for both ground water use and access restrictions to the landfill. The solids containment remedial technology of capping is also included under this alternative.

As proposed under Alternative No. 2, ground water institutional controls will be implemented to prevent exposures to ground water through the ingestion pathway. This would be accomplished by prohibiting development of wells for potable water supplies and domestic use in both the unconsolidated and bedrock aquifers. Sampling of off-site wells would be done on a yearly basis to monitor the potential for off-site plume migration, as proposed under the No Action Alternative.

Institutional controls proposed for the landfill would be identical to those described under Alternative No. 2.

The capping remedial technology for the landfill would be as described in Alternative No. 3. Contaminated sediments will be remediated as a result of landfill capping. The drainage ditch sediments will be covered by the cap and thus treated in a manner similar to that of the landfill solids. This will effectively eliminate the current drainage ditches. Once leachate discharges are controlled, the presumed source of Aero Creek sediment contamination will be removed. Regulated and non-regulated wetlands destroyed during remediation would be compensated for by restoring and creating wetlands off-site, as proposed under Alternative No. 3.

5.2.5 ALTERNATIVE NO. 5 - GROUND WATER COLLECTION, TREATMENT AND DISPOSAL, AND INSTITUTIONAL CONTROLS

Alternative No. 5 consists of institutional controls for landfill solids/soils combined with institutional controls and passive collection and treatment for the ground water media.

The institutional controls for landfill solids/soils and ground water would be as proposed under Alternative No. 2. Sampling of off-site wells would be done on a yearly basis to monitor the potential for off-site plume migration, as proposed under the No Action Alternative.

Subsurface leachate derived from the landfill solids that migrate into the alluvial aquifer ground water system would be collected around areas B and C utilizing a gravel-filled trench, as described in Alternative No. 3. The trench system would passively collect water through low discharge pumping of water within the trench.

Ground water collected through the shallow trench system would be treated through a treatment plant located on-site using the same physical/chemical processes as proposed under Alternative No. 3. Treated effluent from the treatment plant would be discharged either to Ellicott Creek or to the Buffalo POTW.

5.2.6 ALTERNATIVE NO. 6 - INSTITUTIONAL CONTROLS, GROUND WATER CONTAINMENT, AND LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 6 addresses the risks posed by the contamination on the site through the use of institutional controls and containment for the ground water media; collection and off-site disposal of surface water runoff and the institutional control and containment remedial technology of capping combined with the select excavation remedial technology with on-site disposal for the landfill solids/soils.

Ground water containment will be achieved by implementing a physical control remedial technology. As discussed in Section 4, the representative containment technology selected for incorporation into the alternatives is a slurry wall. The slurry wall would consist of a trench excavated through the native alluvial materials, and filled with a low permeability bentonite clay material. The trench would be excavated into the low permeability clay and till deposits which have been observed to exist near the base of the alluvial materials throughout much of the site.

To prevent off-site migration of contaminated ground water, the slurry wall physical containment system would encircle the landfill and connect to the low permeability surface cap. Special provisions for installing the slurry wall across underground pipelines and below the local water table will need to be incorporated into the design.

While Alternative 6 will achieve the ground water remedial action objective of minimizing off-site migration of contaminated water, a potential exists that contaminated alluvial ground water could migrate into the underlying bedrock aquifer system. This could potentially occur through areas where the basal alluvial clay and till deposits are thin or absent, allowing contaminants in the alluvial aquifer to slowly diffuse into the bedrock aquifer. However, institutional controls would be implemented to sample off-site monitoring wells on a yearly basis to assure that potential plume migration has not contaminated these wells. If contaminants are detected in off-site wells, water use restrictions may need to be implemented and may include provisions for point of use treatment or alternate water supply. Other restrictions implemented to prevent exposure to ground water through the ingestion pathway include prohibiting development of wells for potable water supplies and domestic use in both the unconsolidated bedrock aquifers under or near the landfill.

The combination of vertical barriers around the landfill, the reduction of infiltration into the landfill through an impermeable cap and the regrading of the site to promote drainage are expected to be sufficient to reduce the ground water levels under the site and eliminate leachate production on the site. The risk posed by the dermal absorption of leachate would be eliminated.

The same cap proposed for Alternative No. 3 would be installed under this alternative. In addition to the cap, excavation of peripheral portions of the landfill may be incorporated into the overall remediation of the site. The institutional controls for access to the landfill, the collection and off-site disposal of surface runoff, and wetlands replacement proposed for Alternative No. 3, are included under this alternative. As in alternatives 3 and 4, capping of the landfill will eliminate both the current drainage ditches and the leachate seeps that serve as a contaminant source to Aero Creek.

5.2.7 ALTERNATIVE NO. 7 - INSTITUTIONAL CONTROLS AND GROUND WATER CONTAINMENT

Alternative No. 7 addresses the risks posed by contamination on site through solids and aqueous media institutional controls and ground water containment.

The ground water institutional controls proposed under this alternative to prevent exposure to ground water through the ingestion pathway are the same as proposed for Alternative No. 3. Ground water containment would be achieved by implementing the slurry wall physical control remedial technology proposed in Alternative No. 6.

The institutional controls for access to the landfill in the form of deed or permits restrictions proposed for Alternative No. 3 are also included under this alternative.

5.2.8 ALTERNATIVE NO. 8. - GROUND WATER CONTAINMENT, INSTITUTIONAL CONTROLS, LEACHATE SEEP COLLECTION, TREATMENT AND DISPOSAL

Alternative No. 8 consists of institutional controls for ground water and landfill solids/soils combined with the physical containment remedial technology for leachate seeps. Off-site disposal of treated leachate seep water would also be included. Leachate seep collection, treatment and disposal warrants special attention because of the unique combination of general response actions assembled under this alternative. The alternatives which contain capping eliminated leachate seeps, and the alternatives which include ground water collection, treatment and disposal also, by default, eliminate leachate seeps.

The ground water institutional controls proposed under this alternative to prevent exposure to ground water through the ingestion pathway are the same as proposed for Alternative No. 2. Ground water containment would be achieved by implementing the slurry wall physical control remedial technology proposed in Alternative No. 6.

The institutional controls for the landfill solids would be identical to those incorporated into Alternative No. 2.

This alternative would include provisions for collection, treatment and off-site disposal of leachate seeps associated with the contained alluvial ground water system. It is anticipated that the leachate seep water to be collected would be several times greater than the current discharge from the leachate seeps, because infiltrating recharge water will no longer be able to migrate off-site through lateral flow in the alluvial ground water system, as it currently does. The collection system would consist of a gravel filled trench located within the bounds of the slurry wall and extending only a few feet below the top of the slurry wall. Since no cap is present and natural recharge would be contained, water levels would quickly rise to the level of the trench. It is possible near the middle of the contained area that water levels may rise above the ground surface. Water within the trench would be collected via a gravity drain system or, if needed, a low discharge pump. Collected water would then be conveyed to the on-site treatment system, as described previously in Alternative No. 3. Off-site disposal would involve a passive, gravity-driven system conveying the flow to a downgradient surface water body or to the Buffalo POTW. The water quality of the discharging ground water may require a SPDES or equivalent permit and may exceed acceptable contaminant mass loadings to Ellicott Creek and/or to the Buffalo POTW.

5.2.9 ALTERNATIVE NO. 9 - INSTITUTIONAL CONTROLS, WITH GROUND WATER CONTAINMENT, COLLECTION, TREATMENT AND DISPOSAL

Alternative No. 9 consists of institutional controls for landfill solids/soils combined with institutional controls and the physical containment, collection and the physical/chemical treatment remedial technology for ground water. The ground water collection general response action replaces the leachate seep collection general response action contained in Alternative 8. Ground water collection also effectively eliminates the leachate seeps.

The institutional controls would be identical to those incorporated into Alternative No. 2 and would be designed to minimize human exposure to contaminated media.

Ground water within the contained region would be collected through a series of extraction wells. Extraction wells would be located throughout areas B and C in order to uniformly collect ground water. Collected water would be treated through a treatment plant located on-site. Treatment would include a precipitation/settling/filtration process for metals removal followed by a physical/chemical process (Air Strip Granular Activated Carbon) for removal of organic constituents. Treated effluent from the on-site treatment plant would be discharged either to the Buffalo POTW or surface waters.

The water quality of the treated ground water may require a SPDES or equivalent permit and may exceed acceptable contaminant mass loadings to Ellicott Creek and/or to the Buffalo POTW. Due to the large amount of recharge, there is also a large potential for contaminated alluvial ground water to be induced into the underlying bedrock aquifer. Therefore, monitoring of off-site wells will be conducted on a yearly basis to assure that potential plume migration has not contaminated these wells. If contaminants are detected in off-site wells, water use restrictions may need to be implemented and may include provisions for point of use treatment or alternate water supply.

5.2.10 ALTERNATIVE NO. 10 - INSTITUTIONAL CONTROLS, GROUND WATER CONTAINMENT, COLLECTION, TREATMENT AND DISPOSAL WITH LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 10 addresses the risks posed by contamination on the site through the use of institutional controls with the containment and treatment technologies for the ground water media; institutional controls with the containment remedial technology of capping combined with the select excavation remedial technology with on-site disposal for the landfill solids/soils; ground water collection from within contained landfill areas and subsequent on-site treatment with off-site discharge; and the collection and off-site discharge for surface water runoff.

The ground water institutional controls and containment would be identical to that proposed for Alternative No. 6. Treatment and off-site disposal of the collected ground water would be the same as for Alternative No. 9.

The same cap and select excavation technologies proposed for Alternative No. 3 would be included in this alternative, as would the institutional controls for landfill access, wetland restoration, and surface water runoff collection and off-site disposal. Capping of the landfill will eliminate both the current drainage ditches and the leachate seeps that serve as a contaminant source to Aero Creek.

Ground water present within the landfill solids and underlying alluvial materials within the site areas contained by the slurry walls will be collected via a series of extraction wells. Due to the relatively low saturated thickness and lack of recharge available to the contained area, the extraction rates will be very low. Extracting ground water from within the contained landfill areas will quickly lower water levels and induce ground water flow towards the contained portion of the alluvial aquifer. This action will eliminate the migration of contaminants into the bedrock aquifer and into adjacent portions of the alluvial aquifer.

5.3 CRITERIA FOR SCREENING OF REMEDIAL ALTERNATIVES

The purpose of screening at this point in the Feasibility Study process is to narrow the field of alternatives to be considered in detail in the next step. Alternatives are evaluated based on their ability to meet remedial action objectives established for each media, on their short- and long-term effectiveness and on their implementability. It should be noted that at this time cost is not used for screening. The three evaluation criteria are discussed below.

5.3.1 REMEDIAL ACTION OBJECTIVES

The ability of a remedial alternative to meet remedial action objectives for the site is the most important of the screening criteria. The remedial action objectives established for the Pfohl Brothers Landfill site are presented in Section 3.0. These objectives are designed to meet the federal and state requirements that the remedy selected be protective of human health and the environment. Alternatives that meet the remedial action objectives for the site are further screened based on the effectiveness and implementability criteria described in the following sections. In addition, the No Action remedial alternative is retained for comparison against the other alternatives.

5.3.2 EFFECTIVENESS

1. The effectiveness of the alternative in eliminating significant threats to human health and the environment during the construction and implementation phase; and
2. The degree to which treatment is utilized in the remedy, and if it is utilized, what is the nature and quantity of residual;
3. How adequate and reliable are the controls required for the remedy; and
4. The expected lifetime or duration of effectiveness, as well as the time required for implementation.

5.3.3 IMPLEMENTABILITY

1. The technical feasibility with regard to ability to construct, reliability of technology and potential for additional action in the future.

2. The administrative feasibility regarding compliance with regulations and the ability to obtain required approvals.
3. The availability of services and materials required for the alternative. This includes commercial availability of technologies, equipment and specialists.

The NYSDEC Technical and Administrative Guidance Memorandum (TAGM) contains tables for each of the effectiveness and implementability criterion. These tables serve as a tool in evaluating the alternatives during this level of screening (see Appendix A). Each of the criterion is assigned a relative weight based on its importance. The tables are then used to compare the alternatives against established criteria. Total scores for each criterion can then be used for comparison of alternatives that may be similar in terms of how well they meet remedial action objectives.

5.4 INITIAL SCREENING OF REMEDIAL ALTERNATIVES

5.4.1 ALTERNATIVE NO.1 - NO ACTION

The no action alternative is not effective in protecting human health and the environment. Risks caused by exposure to landfill soils/sediments and ground water, as outlined in Section 3.0, remain at the site since the existing fencing may allow site access. No action does not prevent generation of leachate from the fill materials and subsequent contamination of ground water and surface water. No action is not effective in reducing off-site and vertical migration of contaminated ground waters.

The rating for implementation of the no action alternative is high since long term ground water monitoring and periodic maintenance of the existing fences are the only requirements under this alternative.

The no action alternative is retained for further evaluation per regulatory requirements to provide a baseline comparison for all other alternatives.

5.4.2 ALTERNATIVE NO.2 - INSTITUTIONAL CONTROLS FOR GROUND WATER AND LANDFILL SOLIDS/SOILS AND SEDIMENTS

Institutional controls restricting on- and off-site use of ground water are not totally effective in preventing use of contaminated ground water for domestic purposes. In particular, the extent of the off-site contaminant plume, if any, will need to be monitored closely. Institutional controls, by themselves, also do not prevent the generation and transport of leachate from the landfill solids and the subsequent contamination of ground water and surface water. In addition, institutional controls are not effective in reducing off-site migration of contaminated ground waters.

Institutional controls which limit access to the landfill solids/soils and sediments, if enforced adequately, are moderately effective in reducing risk to human health by exposure to landfill soils. Fences, currently in place at the landfill, are designed to limit access but may not be completely effective in restricting access. Institutional controls for soils/sediments do not prevent infiltration of precipitation and generation of leachate.

The rating for implementation of institutional controls for ground water and landfill solids/soils and sediment are high as the required administrative approvals are expected to be obtained with little difficulty.

While Alternative No. 2 is fairly effective and implementable, it meets remedial action objectives for human health for only some of the media and does not meet remedial action objectives for the environment. Alternative No.2 is therefore not retained for further evaluation.

5.4.3 ALTERNATIVE NO. 3 - INSTITUTIONAL CONTROLS, GROUND WATER COLLECTION, TREATMENT, AND DISPOSAL, WITH LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 3 is moderately effective in protecting human health and only slightly effective in protecting the environment. Installation of the cap will be effective in providing a barrier between the contamination and potential receptors and in eliminating leachate production. This will reduce contamination in Aero Creek and eliminate the existing drainage ditches. If undertaken, the additional remedial action of select excavation and on-site disposal of peripheral areas of shallow fill materials provides slightly more effectiveness in protecting human health and the environment since the areal extent of contamination has been decreased. The construction of the cap may pose some short-term risks due to the potential for dust generation and erosion of contaminated fill. The cap provides long term effectiveness, because the design life of the cap is approximately 30 years. The landfill access institutional controls for preventing breaching of the cap should be moderately to highly effective.

Institutional controls restricting use of ground water are moderately effective in preventing exposure to the unconsolidated and bedrock aquifers under the landfill. However, the extent of the off-site contaminant plume, if any, will need to be monitored closely to prevent use of off-site ground water for domestic purposes. In addition, institutional controls are not effective in reducing off-site migration of contaminated ground waters.

Implementability rating of the shallow ground water collection system is high since materials and labor for construction are available. Difficulties may be encountered with underground piping and if leachate seeps change their discharge point over time. Implementation rating of institutional controls for ground water is high as the required administrative approvals are expected to be obtained with little difficulty. The cap should be installed relatively easily as the materials and labor necessary for its construction are readily available. Therefore its implementability rating is high. Clearing and regrading the site may be difficult to implement given the low stability of the fill materials. Select excavation, if undertaken, is moderately implementable as labor and equipment are readily available. The administrative implementability of the cap is high as the required approvals are expected to be obtained relatively easily.

Although it is implementable, the ability for contaminated ground water to migrate of-site renders this alternative unable to meet remedial action objectives for the aqueous media and is therefore eliminated from further evaluation.

5.4.4 ALTERNATIVE NO. 4 - GROUND WATER AND LANDFILL SOLIDS/SOILS INSTITUTIONAL CONTROLS WITH LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 4 is effective in protecting human health and the environment only for the solids media; it is moderately effective in protecting human health in the aqueous media due to the ground water institutional controls. As with Alternative No. 3, the cap is moderately effective and will eliminate drainage ditches and leachate seeps which are a source of contamination for Aero Creek. The landfill access institutional controls are moderate to highly effective for this alternative in protecting human health and the environment.

Institutional controls restricting use of ground water are moderately effective in preventing exposure to the unconsolidated and bedrock aquifers under the landfill. However, the extent of the off-site contaminant plume, if any, will need to be monitored closely to prevent use of off-site ground water for domestic purposes. In addition, institutional controls are not effective in reducing off-site migration of contaminated ground waters.

As described in Alternative No. 3, the cap and both the ground water and the landfill access institutional controls are highly implementable.

Alternative No. 4, does not meet the remedial action objectives for ground water, so it is eliminated from further evaluation.

5.4.5 ALTERNATIVE NO. 5 - GROUND WATER COLLECTION, TREATMENT AND DISPOSAL, AND INSTITUTIONAL CONTROLS

Alternative No. 5 is moderately effective in protecting human health from exposure to contaminated landfill solids and ground water, but is not effective in protecting human health or the environment from the other possible exposure pathways.

The moderate evaluation for the effectiveness of the institutional controls restricting use of ground water for this alternative are the same as evaluated for Alternative No. 3. Additionally, the high effectiveness of the shallow ground water collection system is the same as for Alternative No. 3.

As described in Alternatives No. 2 and 3, the ground water use restrictions, institutional controls and leachate collection system, respectively, are highly implementable.

Alternative No. 5 is less effective than Alternative No. 3 since there is no provision for solids containment, but is considerably more implementable. Continued environmental exposure to contaminated landfill solids and soils, and the ability for contaminated ground water to migrate off-site under this alternative causes it to not meet remedial action objectives for the site and is therefore eliminated from further evaluation.

5.4.6 ALTERNATIVE NO. 6 - INSTITUTIONAL CONTROLS, GROUND WATER CONTAINMENT, AND LANDFILL SOLIDS/SOILS CAPPING

Alternative No. 6 is effective in protecting human health and the environment. Installation of the cap will be effective in providing a barrier between the contamination and potential receptors and in eliminating leachate production which is a source of contamination for Aero Creek. If undertaken, the additional remedial action of select excavation and on-site disposal of peripheral areas of shallow fill materials provides slightly more effectiveness in protecting human health and the environment since the areal extent of contamination has been decreased. The construction of the cap and excavation of fill material may pose some short-term risks due to the potential for dust generation and erosion of contaminated fill. The cap provides long term effectiveness, because the design life of the cap is approximately 30 years. The institutional controls for preventing breaching of the cap should be effective.

The implementation of the cap is moderate as the materials and labor necessary for its construction are readily available. Clearing and regrading the site may be difficult to implement given the low stability of the fill materials. Select excavation, if undertaken, is moderately implementable as labor and equipment are readily available. The administrative implementability of the cap is high as the require approvals are expected to be obtained with little difficulty.

Containment of the unconsolidated aquifer by implementing a slurry wall at the perimeter of the landfill will be highly effective in reducing off-site migration of contaminated ground water and preventing leachate contamination of surface water. However, the potential exists for contamination of the bedrock aquifer by downward migration of ground water from the unconsolidated aquifer. Institutional controls will be highly effective in eliminating human health risks due to exposure to ground water located under the landfill. Careful monitoring is required to assure that off-site ground water has not been contaminated and to implement institutional controls for these wells in a timely fashion.

Construction of the slurry wall may pose some short-term risk due to the potential for dust generation and erosion of contaminated fill. The slurry wall provides long-term effectiveness because the design life is approximately 30 years.

Implementability of the slurry wall is classified as moderate because of potential difficulties with underground piping and high water table. Materials and labor required for construction of the slurry wall are available. The administrative implementability of the slurry wall and ground water institutional controls is high as the required approvals are expected to be obtained with little difficulty.

As described in Alternative No. 2, the ground water use and the landfill access restrictions institutional controls are both highly implementable.

With the addition of the ground water containment general response action, Alternative No. 6 is more effective than all of the previous alternatives in meeting the remedial action objectives for contaminated media at the site. Therefore this alternative is carried forward for further evaluation.

5.4.7 ALTERNATIVE NO. 7 - INSTITUTIONAL CONTROLS AND GROUND WATER CONTAINMENT

Alternative No. 7 is moderately effective in protecting of human health and the environment from contaminated ground water, but is not protective of risks to the environment from contaminated soils and sediments.

The moderate effectiveness of the institutional controls restricting the use of ground water and the effectiveness of the slurry wall in containing ground water would be the same as for Alternative No. 6.

Alternative 7 does not meet the remedial action objectives for landfill soils and solids, and is therefore eliminated from further evaluation.

5.4.8 ALTERNATIVE NO. 8 - GROUND WATER CONTAINMENT, INSTITUTIONAL CONTROLS, LEACHATE SEEP COLLECTION, TREATMENT AND DISPOSAL

Alternative No. 8 moderately protective of human health and the environment for the aqueous media, but is not protective of continued risk to the environment from contaminated landfill solids. The moderate effectiveness of the landfill access institutional controls for this alternative is the same as for Alternative No. 2. The moderate effectiveness of the institutional controls restricting the use of ground water and of the slurry wall containment of ground water would be the same as for Alternative No. 2 and 6, respectively. The collection, treatment and off-site disposal of leachate would be similar to that described for shallow ground water collection and treatment in Alternative No. 3, and should be highly effective in reducing contamination of surface waters by leachate. The leachate collection system may, however, allow for ground water within the middle of the contained area to rise to the ground surface. The construction of the leachate collection systems may pose some short term risk due to the potential for erosion of contaminated landfill materials.

The implementability rating of the leachate collection system is high since materials and labor for construction are available. Difficulties may be encountered with underground piping and if leachate seeps change their discharge point over time. As described in Alternatives No. 2 and 6, respectively, the ground water use restrictions institutional controls and the slurry wall containment are moderately implementable.

Alternative No. 8 does not provide protection from exposure to landfill solids and soils that Alternatives 3, 4, and 6 provide, therefore this alternative is eliminated from further evaluation.

5.4.9 ALTERNATIVE NO. 9 - INSTITUTIONAL CONTROLS, GROUND WATER CONTAINMENT, COLLECTION, TREATMENT AND DISPOSAL

The moderate effectiveness of the landfill access institutional controls for this alternative is the same as for Alternative No. 2. The moderate effectiveness of the slurry wall containment of ground water would be the same as for Alternative No. 6. The additional remedial actions of on-site ground water extraction and treatment combined with ground water containment are collectively more effective in protecting human health and the environment, and thus more fully attain remedial action objectives for the aqueous media alone than do Alternatives 1 through 7, because the volume of contaminated ground water is reduced. The ground water extraction and treatment remedial actions may also reduce the vertical migration of contaminants from the alluvial to the bedrock aquifer, depending on the pumping rates employed. Construction of the slurry wall and extraction wells may pose some short-term risk due to the potential for dust generation and erosion of contaminated fill. The slurry wall and pump/treat system provide long term effectiveness, because the design life is approximately 30 years.

Moderately effective institutional controls may be implemented for use of off-site wells. Careful monitoring is required to assure that off-site ground water has not been contaminated and to implement institutional controls for these wells in a timely fashion if necessary.

The implementability rate of the slurry wall and ground water extraction and treatment system is classified as moderate because of potential difficulties for the slurry wall, with underground piping and the high water table, and for the ground water extraction and treatment system, with heterogeneous nature of the material would require close monitoring and supervision. Materials and labor required for construction of the slurry wall and ground water extraction and treatment system are available. The administrative implementability of the slurry wall and ground water institutional controls is high as the required approvals are expected to be obtained relatively easily.

Like Alternative No. 8, Alternative No. 9 does not provide the protectiveness from exposure to landfill solids and soils that Alternatives 3, 4, and 6 provide, therefore this alternative is also eliminated from further evaluation.

5.4.10 ALTERNATIVE NO. 10 - INSTITUTIONAL CONTROLS, GROUND WATER CONTAINMENT, COLLECTION, TREATMENT AND DISPOSAL WITH LANDFILL SOLIDS/SOILS CAPPING

As described in Alternative No. 3, the cap for Alternative No. 10 is moderately effective in protecting human health and the environment. Like Alternative No. 9, the additional remedial actions of on-site ground water extraction and treatment combined with ground water containment are collectively more effective in protecting human health and the environment, and thus more fully attain remedial action objectives than do Alternatives 1 through 8 because the volume of contaminated ground water is reduced. The ground water extraction and treatment remedial actions are also effective in eliminating vertical migration of contaminants from the alluvial to the bedrock aquifer. The construction of the cap and excavation of fill material may pose some short-term risks due to the potential for dust generation and erosion of contaminated fill. The cap provides long term effectiveness because the design life of the cap is approximately 30 years. Capping of the landfill will eliminate both the current drainage ditches and the leachate seeps that serve as a contaminant source to Aero Creek. The institutional controls for preventing breaching of the cap should be effective.

The moderate effectiveness of the institutional controls restricting the use of ground water and of the slurry wall containment of ground water would be the same as evaluated for Alternative No. 6. The high effectiveness of the pump/treat system and moderate effectiveness of the ground water institutional controls, as described in Alternative No. 5, is the same for this alternative.

Similar to Alternative No. 6, the implementability of the cap is high as the materials and labor necessary for its construction are readily available. Clearing and regrading the site may be difficult to implement given the low stability of the fill materials. Select excavation is moderately implementable as labor and equipment are readily available. The administrative implementability of the cap is high as the required approvals are expected to be obtained.

Implementability of the slurry wall and pump and treat system is classified as moderate because of potential difficulties for the slurry wall, with underground piping and the high water table, and for the pump and treat system, with the heterogeneous nature of the fill materials and the required close monitoring and supervision. Materials and labor required for construction of the slurry wall and pump/treat system are available. The administrative implementability of the slurry wall and ground water institutional controls is high as the required approvals are expected to be obtained relatively easily.

Alternative No. 10 is the most effective of the ten alternatives and is implementable. Therefore this alternative is carried forward for further evaluation.

5.5 SUMMARY OF REMEDIAL ACTION ALTERNATIVES

Based on the evaluation of alternatives using the criteria of ability to meet remedial action objectives, effectiveness and implementability presented in the previous section, the following alternatives are retained for detailed analysis in Section 6.0:

Alternative No. 1 - No Action

Alternative No. 6 - Ground Water Containment, Landfill Solids/Soils Capping, and Institutional Controls.

Alternative No. 10 - Ground Water Containment, Collection, Treatment and Off-Site Disposal, Landfill Solids/Soils Capping, and Institutional Controls.

Section 6

6.0 REMEDIAL ALTERNATIVES EVALUATION PROCESS AND CRITERIA

6.1 EVALUATION PROCESS AND CRITERIA

A total of three alternatives for remediation were carried through the screening process presented in Section 5.0. These are:

Alternative 1 -	No Action
Alternative 6 -	Capping, Select Solids/Soils Excavation with On-Site Disposal, and Ground Water Containment
Alternative 10 -	Capping, Select Solids/Soils Excavation with On-Site Disposal, and Ground Water Containment and Collection with On-Site Treatment and Off-Site Disposal

The purpose of this section is to analyze these alternatives in enough detail so that they may be objectively compared and the most viable alternative selected by decision-makers.

The Technical and Administrative Guidance Memorandum (TAGM) identifies seven evaluation criteria to address technical and policy considerations that have proven to be important for selecting remedial alternatives. These criteria are listed and briefly described below.

6.1.1 COMPLIANCE WITH APPLICABLE NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGs)

Alternatives are evaluated to determine whether they comply with all applicable or relevant and appropriate requirements or, if a waiver is required, how it is justified. The alternatives are evaluated against three categories of SCGs, chemical-, location-, and action-specific. In addition, any federal standard which is more stringent than the state standard should be used. This item is given a relative weight of 10 in the TAGM evaluation.

6.1.2 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternatives are evaluated to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks present at the site by eliminating, reducing, or controlling exposure to levels established during development of remediation goals. This factor is given a relative weight of 20 by the TAGM evaluation criteria.

6.1.3 SHORT-TERM EFFECTIVENESS

The short-term impacts of alternatives shall be evaluated and will consider the short-term risks that might be posed to the community during implementation, time until protection is achieved, the potential impacts on workers during remedial action, the effectiveness and reliability of protective measures, and the potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. Short-term effectiveness carries a relative evaluation weight of 10.

6.1.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered include the magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. Also, the adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and/or untreated waste will be evaluated. This criterion should include assessment of the potential need to replace components of the alternative and associated risks. This item is given a relative evaluation weight of 15.

6.1.5 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT

The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered include the amount of hazardous contaminants that will be destroyed, treated, or recycled; the degree to which treatment reduces the inherent hazards posed by principal threats at the site; the degree to which the treatment is irreversible; and the type and quantity of residuals that will remain following treatment. This item carries a relative evaluation weight of 15.

6.1.6 IMPLEMENTABILITY

The ease or difficulty of implementing the alternatives shall be assessed by considering the technical and administrative feasibility of a technology and the availability of services and materials. The technical feasibility includes difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. The administration factors include coordination with other offices and agencies. The assessment of availability of services and materials includes the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment, specialists and skilled operators, and provisions to ensure any necessary additional resources; and the availability of services and materials with competitive bidding.

Of the total evaluation weight of 15 assigned to implementability in the TAGM, technical feasibility receives a maximum of 10, while administrative feasibility and availability of services and materials combine to make up the remaining five.

6.1.7 COSTS

The types of costs that shall be evaluated include capital costs, including both direct and indirect costs; annual operation and maintenance costs; and future capital costs as described below.

- <u>Capital Costs</u> - Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs.
    - Equipment Costs - Equipment necessary for the remedial action; (these materials remain until the site remedy is complete).
    - Land and Site-Development Costs - Purchase of land and site preparation of existing property.
    - Building and Services Costs - Buildings, utilities, and purchased services.

  - Disposal Costs - Transporting and disposing of waste material.

  - Engineering Expenses - Administration, design, construction supervision, drafting, and treatability testing.

  - Legal Fees and License or Permit Costs

  - Start Up and Shakedown Costs

  - Contingency Allowances - To cover unforeseen circumstances.

- Operation and Maintenance Costs - Annual post-construction costs necessary to ensure the continued effectiveness of a remedial action. The following annual cost components should be considered:

  - Operating Labor Costs - Wages, salaries, training, overhead, and fringe benefits associated with post-construction operation

  - Maintenance Material and Labor Costs

  - Auxiliary Materials and Energy - Chemicals, electricity, water, and sewer, etc.

  - Disposal of Residues - To treat or dispose of residuals such as sludges from treatment processes or spent activated carbon.

  - Purchased Services - Sampling costs, laboratory fees, and professional fees which can be predicted.

  - Administrative Costs

  - Insurance, Taxes and Licensing Costs

  - Replacement Costs

  - Costs of Periodic Site Reviews - Reviews to be conducted every five years if a remedial action leaves any hazardous substances, pollutants, or contaminants at the site.

- Future Capital Costs - For any future remedial action

A present worth analysis is performed to bring all future costs to the current year (1991) for easy comparison. A cost sensitivity analysis may then be used to evaluate any uncertainties concerning specific assumptions made for individual costs. At this stage of the Feasibility Study, costs are expected to be within -30 to +50 percent.

The alternative with the lowest present worth analysis will be assigned the highest score of 15; other alternatives will be assigned the score inversely proportional to their present worth.

6.2 ALTERNATIVE 1 - NO ACTION

6.2.1 DESCRIPTION

The No Action alternative provides a baseline for comparing other remedial action alternatives for the site. Because no remedial activities would be implemented to mitigate contamination present at the site, long-term human health and environmental risks for the site would be essentially the same as those identified in the Baseline Human Health Risk Assessment. The No Action Alternative does not remedy or control the risk from any of the contaminated media at the site.

Under this alternative, continued ground water monitoring and public health evaluations would be conducted periodically. Ground water monitoring would be accomplished utilizing 10 existing wells installed on and adjacent to the site. These wells would be sampled on an annual basis for contaminants of concern and would be frequently monitored for static water level to assess the hydraulic gradient.

Public health evaluations would be conducted every five years and would allow the State of New York (NYS) to assess the potential risks to human health and the environment posed by the site.

It should be noted that there is an existing fence around the perimeter of the site, so physical access is limited in this alternative.

6.2.2 EVALUATION

6.2.2.1 Compliance with Applicable New York State Standards, Regulations and Guidelines

Alternative 1 does not meet the chemical-specific ARARs related to legally applicable and "to be considered" (TBC) state and stream standards, and drinking water standards for ground water under this alternative.

Chemical-specific ARARs are not satisfied by this alternative due to seepage loading to surface water, health risks from ingestion of soils and sediments, the exposure to carcinogens via soils, seeps, and sediments, and potential exposure if both the unconsolidated and bedrock aquifers are used as a water supply in the future.

Action-specific ARARs are pertinent only concerning remedial actions and are not applicable to the No Action alternative.

Location-specific ARARs are satisfied by the No Action alternative because there is no action taken that affects the floodplains or wetlands.

6.2.2.2 Overall Protection of Human Health and the Environment

The No Action alternative provides no treatment, engineering, or institutional measures to control the exposure of receptors to contaminated fill, and ground water. The migration of contaminants to ground water, sediments and soils would continue. Therefore, no reduction in risks to human health and the environment (as indicated in the Baseline Human Health Risk Assessment) would occur under the No Action alternative.

6.2.2.3 Short-Term Impacts and Effectiveness

The implementation of the No Action alternative consists of the sampling of existing ground water monitoring wells. Minimal risk to workers may occur during well sampling due to incidental inhalation of borehole vapors or the dermal contact/ingestion of potentially contaminated ground water. Risk to the community and the environment as a result of ground water monitoring is minimal. Remedial action objectives would not be achieved by this alternative, so there is no time frame for completion.

6.2.2.4 Long-Term Effectiveness and Permanence

Because the No Action alternative does not manage or reduce the hazards associated with the site, the magnitude of residual risk remaining after its implementation would be high. The use of ground water monitoring in this alternative may be regarded as a risk control. It is reliable in indicating ground water contamination which has already occurred, however, it would not allow time for action to prevent contaminant migration. This method of risk control is therefore minimal.

6.2.2.5 Reduction in Toxicity, Mobility, and Volume

There is no treatment process utilized in the No Action alternative. As a result, this alternative does not provide any reduction in toxicity, mobility, or volume of the contaminated media.

6.2.2.6 Implementability

The equipment, specialists, and services required for implementing the ground water monitoring program are readily available in the Buffalo region. Coordination and approval from other regulatory agencies for the implementation of inspections and ground water monitoring would not be difficult to obtain.

6.2.2.7 Cost

The cost for implementation of the No Action alternative would be incurred by the monitoring of ground water. The capital, annual operation and maintenance, and present costs for operation of the site inspection and ground water monitoring program are detailed in Appendix B and summarized below.

• Capital	$ 0
• Present Worth of Annual/Periodic Costs	$ 560,000
• Total Present Worth (at 9% over 30 years)	$ 560,000

6.3 ALTERNATIVE 6 - CAPPING WITH SELECT EXCAVATION, GROUND WATER CONTAINMENT WITH RUNOFF COLLECTION AND OFF-SITE DISPOSAL

6.3.1 DESCRIPTION

Alternative No. 6 addresses the risks posed by the contamination present on the site with the following elements;

- Select excavation with on-site disposal
- Single barrier capping of the landfill with wetlands replacement
- Slurry wall containment of ground water
- Surface runoff collection with off-site disposal to surface water body
- Institutional controls for landfill access and ground water well use

6.3.1.1 Excavation

Under this alternative, areas along the periphery of the landfill with less than four feet of contaminated fill would be excavated and disposed of on the unexcavated portion of the landfill as a cost reduction measure. This would include excavation of yards for houses located in the southeast corner of the site. Selective excavation would minimize the size of the cap required and the excavated material could be used as fill in grading the entire site thus potentially decreasing overall costs. This will be further evaluated in the design stage of the project. It is assumed that approximately 52,800 cubic yards (CY) of fill along the east side of Area B and in the southwest corner of Area C will be affected, however confirmatory sampling should be conducted during the remedial design phase of the project to fully characterize the thickness of fill material along the perimeter of the site. The need for odor control during excavation will be addressed during design. Upon completion of excavation activities the areas would be backfilled with clean soil and revegetated with native vegetation. The remaining portions of areas B and C that contain landfill solids would then be encircled by slurry walls and capped.

Prior to placement of the excavated materials described above and the installation of the cap, the site would be cleared and grubbed of all vegetation and regraded. The vegetation would be cut and mulched utilizing a Hydro-ax, and spread over the site. Because there is no record of excessive methane gas generation on the site, it is believed that the additional organics will not overload the gas venting system. Prior to use of the Hydro-ax the area must be cleared of all exposed drums. It is assumed that the drums will be overpacked and disposed of either on or off-site. However, no cost is included for the drums due to the uncertainty of the number of drums involved. By regrading the site, surface water runoff would be controlled and erosion and infiltration through the cap would be minimized.

6.3.1.2 Wetlands

It is possible that the site clearing and grading activities will destroy a portion of the regulated wetlands along Aero Creek. These wetlands communities will be reestablished off-site.

Approximately one acre of off-site property will be modified to reestablish wetland communities similar to that which existed historically on the property. The most promising location is a parcel located west of Area B (Section 92.02, Block 1, Lot 24). This property is currently undeveloped. Aerial photographs indicate that this property was a former wetland area that was subsequently drained. Presently, stormwater is routed to a drainage ditch that runs parallel along Scott Place. Restoration and creation of a new wetland in this area would require clearing and grubbing, with limited grading to reestablish the appropriate hydrology for the site. Surface water from both Aero Creek and runoff from the landfill could be used as sources of water for the newly created wetland system.

Portions of the off-site property may still contain wetland communities. This portion of the area will be restored. The newly created and restored wetland will be similar in type, nature and function to existing state regulated wetlands in the Ellicott Creek basin. The existing site hydrology will be modified to incorporate flow from the wetland to Ellicott Creek.

Three types of communities will be created or restored: herbaceous marsh, shrub swamp, and deciduous hardwood tree swamp. Various herbaceous vegetation will be planted at a density of 400 plants per acre. One-quarter of the area will be planted with a variety of herbaceous species at an increased density of 800 plants per acre. Trees and shrubs will be planted over three-quarters of the area at a density of 400 per acre (Table 6.3-1). The exact species to be planted will be dependent on availability at the time of planting.

A vegetation monitoring plan will be developed in order to evaluate the success of the creation and restoration project. The growth and survival of both herbaceous and woody species planted in the created and restored wetlands will be monitored, as well as the growth and proliferation of herbaceous and woody species invading these areas. The invading species will become a significant vegetation component as volunteer colonization of native plants adapted to different water depths will provide great success in wetland community establishment.

6.3.1.3 Capping

In order to minimize earthwork and required fill, the existing site topography and drainage will be maintained as much as possible by providing two high points running east-west along the center of each area B and C with drainage via a series of parallel peaks and gullies oriented north-south. This slope, the minimum allowed per NYCRR part 360 regulations, would result in peaks approximately 20 ft above the existing grade. A vegetative buffer along the edge of the site would be provided to improve aesthetics. Drainage would be collected along the periphery of the site, and discharged along existing drainage routes (see Figure 6.3-1 or RI Figure 2-3). Berms will be provided as necessary so the cap is constructed outside the 100 year flood plain (RI Figure 2.7).

Once the landfill is properly graded, the site would be capped. The cap would cover all of areas B and C that are not excavated. The primary purpose of a landfill cap would be to eliminate direct contact of receptors with site contamination, minimize infiltration of precipitation into the landfill solids and reduce uncontrolled landfill gas emissions through the surface of the landfill into the ambient air. Potential air emission would instead be exhausted through new passive vents which could be retrofitted to treat gaseous emissions, if necessary.

The NYSDEC part 360 regulations require several components/layers in a cap design, each necessary for a specific purpose: (1) a gas venting layer which overlies the landfill solids and contains a piping system that allows methane gases produced by decomposition of wastes to be conveyed to vent pipes passing through the low-permeability layer of the cap overlying it: (2) a low-permeability layer (typically clay or a synthetic material) that minimizes infiltration of precipitation into the landfill, thus

TABLE 6.3-1

CREATED WETLAND PLANT LIST

Species Code	Botanical Name	Common Name
Tree and Shrubs		
ACE RUB	Acer rubrum L	Red maple
ALN RUG	Alnus rugosa	Speckled alder
CEP OCC	Cephalanthus occidentalis L.	Common buttonbush
ILE LAE	Ilex laevigata	Smooth holly
FRA PEN	Fraxinus pennsylvanica Marsh.	Green ash
FRA NIG	Fraxinus nigra	Black ash
GLE AQU	Gleditsia aquatica Marshall	Water-locust
QUE BIC	Quercus bicolor	Swamp white oak
MAG VIR	Magnolia virginiana L.	Sweetbay
NYS SYL	Nyssa sylvatica Marsh.	Swamp tupelo
PER BOR	Persea borbonia (L.) Spreng.	Red bay
SAL SP.	Salix species	Willow
ULM AME	Ulmus americana L.	American elm
Herbs and Ground Cover		
CAR SP.	Carex species	Sedge
CYP SP.	Cyperus species	Flatsedge
DUL ARU	Dulichium arundinaceum (L.) Britton	Three-way sedge
ELE SP.	Eleocharis species	Spike rush
HYD UMB	Hydrocotyle umbellata L:	Marsh pennywort
LEE ORY	Leersia oryzoides	Rice cutgrass
JUN EFF	Juncus effusus L.	Soft rush
JUN SCI	Juncus scirpoides Lam.	Needle-pod rush
NYM ODO	Nymphaea odorata Ait.	Fragrant white water-lily
PAN SP.	Panicum species	Panic grass
PER VIR	Peltandra virginica (L.) Kunth	Green arum
POL PUN	Polygonum punctatum Ell.	Dotted smartweed
PON COR	Pontederia cordata L.	Pickerelweed
RHY INU	Rhynchospora inundata (Oakes) Fern.	Inundated beakrush
SCI SP.	Scirpus species	Bulrush
SAG SP.	Sagittaria species	Arrowhead

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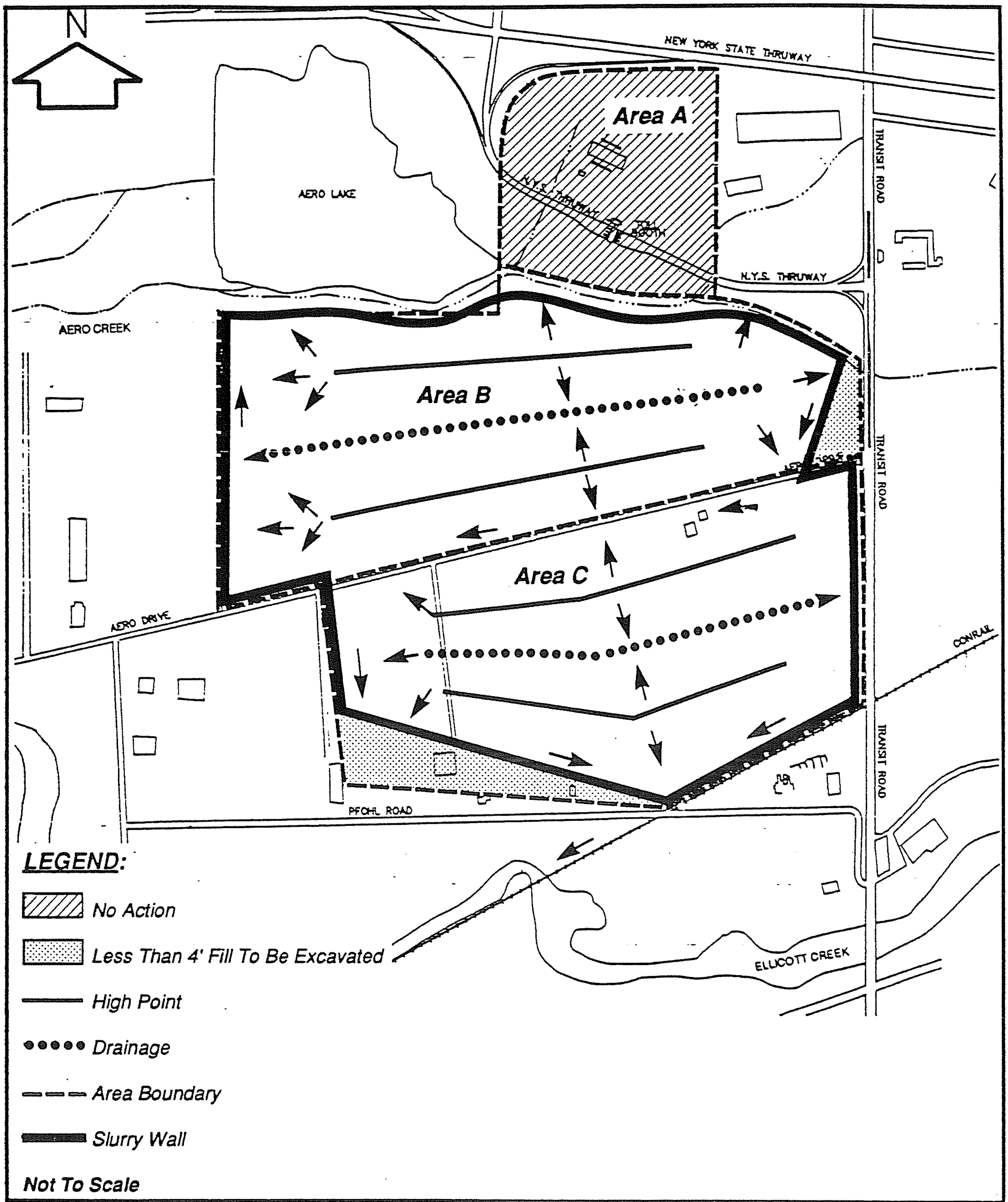

CDM

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planners & management consultants

Figure 6.3-1

Cap Grading Schematic

Draft Feasibility Study
Pfohl Brothers Landfill, Cheektowaga, New York

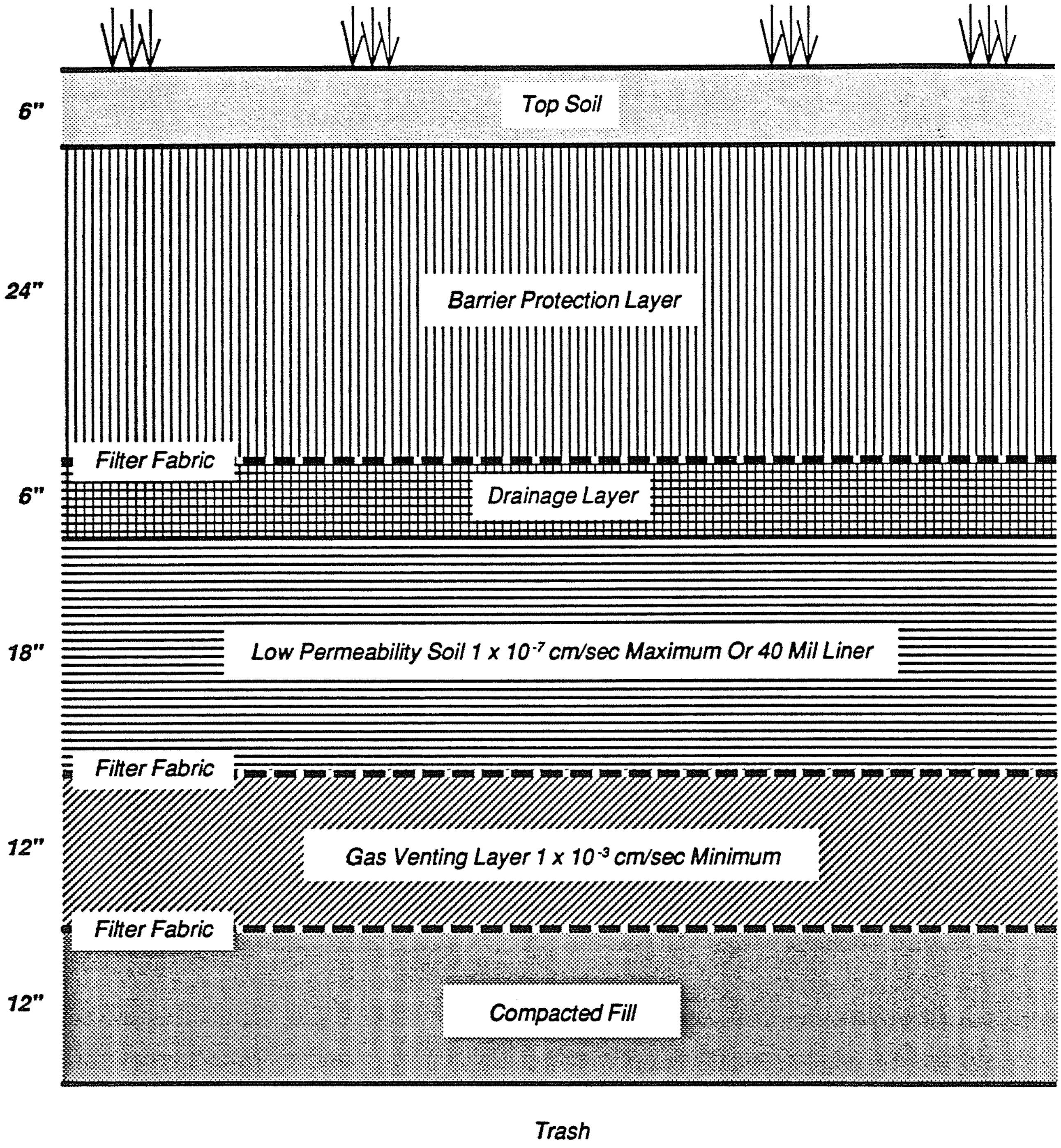
reducing the production of leachate within the landfill; (3) a barrier layer that acts as a buffer to protect the integrity of the low-permeability layer and acts as a supporting layer for the topsoil layer; and (4) a final layer of topsoil that is used to promote the growth of a vegetative cover.

In addition to the standard NYS cap design, two additional layers were added. First, 12" of compacted cover is placed on top of the landfill trash to protect the overlying filter fabric. A drainage layer would also be placed to enhance the drainage capacity of the cap. The drainage layer of permeable sand would be installed between the low permeability layer and the barrier layer. The addition of the drainage layer is based on the HELP modelling which indicated infiltration might cause water to build up and pond on the impermeable layer.

The first layer on top of the compacted layer (see Figure 6.3-2) is the gas venting layer (typically a sand material) that is required to have a minimum coefficient of permeability of 1×10^{-3} cm/sec and a maximum of five percent by weight passing the No. 200 sieve. The minimum thickness of the gas venting layer is 12 inches. Gas venting risers (see Figure 6.3-3) must be spaced at a maximum separation of one vent per acre of final cover and be installed at a depth of at least three feet into the refuse unless otherwise approved by NYSDEC. Risers must be backfilled with crushed stone, or some other porous media acceptable to NYSDEC. The venting risers must be exposed at least three feet above final elevation of the cover system and be fitted with a goose neck cap or equivalent to allow effective venting. A horizontal venting network of perforated pipes may also be used to better facilitate the relief of gas from under the low permeability layer of the cap.

Landfill gas venting systems must be designed to prevent the migration of concentrated amounts of landfill gases off site. Gas venting systems are necessary for all landfills in New York state upon closure and must be designed and constructed in accordance with the requirements of subdivision 360-2.13(p) of 6 NYCRR Part 360. These systems must prevent the accumulation of landfill gas at concentrations greater than 25 percent of the lower explosive limit in structures on site and off site, prevent concentrations greater than the lower explosive limit for the gases at or beyond the property boundary, and control objectionable odors caused by any gas emissions.

The gas venting layer is required to be bounded above and below by a geotextile filter layer. This will allow gas to migrate into the gas venting layer but prevent the coarser grained materials of the gas venting layer from mixing with the finer particles of the soils above or below the gas venting



<u>NOTE</u>:
Thickness of layers shown reflects the minimum thickness allowed by NYSDEC.

Not To Scale

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Figure 6.3-2

Design Schematic For Single Barrier Cap

Draft Feasibility Study
Pfohl Brothers Landfill, Cheektowaga, New York

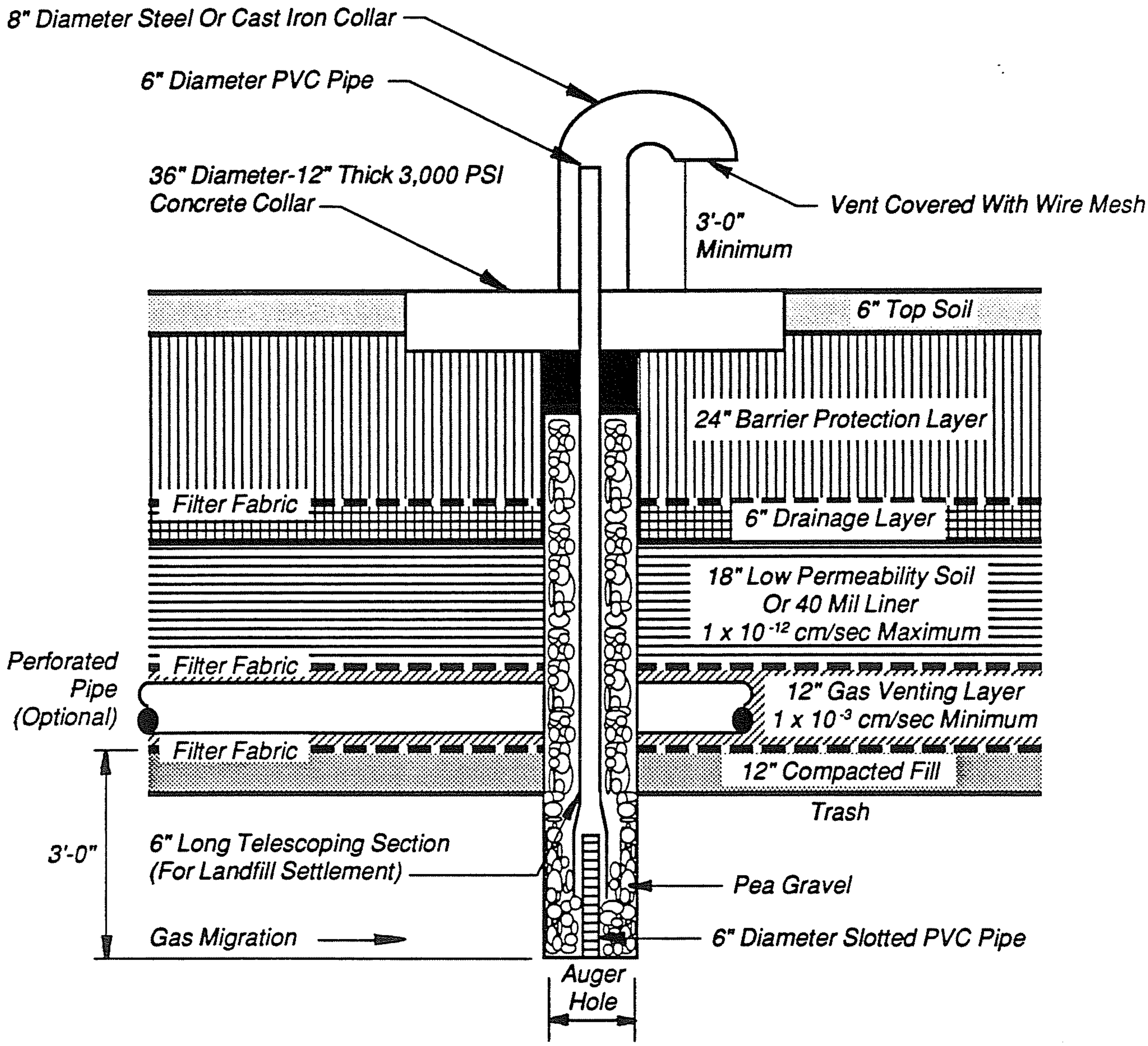

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Figure 6.3-3

Passive Gas Vent Detail

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Pfohl Brothers Landfill, Cheektowaga, New York

through the landfill and into the alluvial aquifer on an average annual basis. For an estimated landfill area of 6.1 million square feet, approximately 40 million gallons infiltrate annually. The large amount of infiltrating water under the No Action scenario could easily account for the mounded water table surface depicted in Sheets 4 through 6 of the RI report.

The HELP model results for the landfill cap indicate that approximately 2.5 inches of water infiltrates on an average annual basis. Climatologic, surface soil, vegetative cover and landfill area values used in the No Action simulations and the cap design comparable to that described previously, but containing a clay rather than a geotextile barrier, yielded an estimated 1500 gallons of water that infiltrate into the landfill on an average annual basis. Thus, there is a decrease in recharge to the alluvial aquifer in the vicinity of the landfill due to the cap, as water which formerly infiltrated now runs off. This is expected to cause a decrease in the potentiometric surface by at least 2 to 4 feet in the first year. A comparison of the decreased potentiometric surface elevations with existing surface topography indicates that the water table surface will remain several feet below any surface feature. It is therefore assumed that the cap and slurry wall system will effectively eliminate the leachate seeps, and that no leachate collection system would be needed.

6.3.1.5 Institutional Controls

The ground water institutional controls proposed for implementation under this alternative would ensure that contaminated ground water is not unknowingly ingested. These controls include off-site well monitoring and on site well permit regulation. These measures can be effective in protecting the public from exposure to contaminants through ground water ingestion.

Off-site well monitoring would be conducted on a yearly basis to assure that contamination of the wells has not occurred. Should contaminants be detected in off-site wells, well permit restrictions would be instituted. These restrictions could include instituting abandonment of the well with provisions for an alternate water supply or point of use (POU) treatment technologies.

Well abandonment would ensure that no future exposure is possible. If a well owner is unwilling to have a well abandoned, then judicial decree could be pursued. Well abandonment can be moderately expensive, including time and materials for well inspection and grouting. This control is desirable in that no future consumption of ground water from these wells is guaranteed.

The soil-bentonite slurry wall composition offers several advantages at the Pfohl Brothers Landfill site over other types of slurry walls. This type of slurry wall exhibits the widest range of chemical compatibilities, has the lowest permeability, and is installed at the lowest unit cost compared to cement-bentonite slurry walls. In addition, the soil-bentonite slurry wall requires no operation and maintenance, other than continued sampling of offsite monitoring wells to verify that contaminants have not leaked through the wall. Prior to construction, design studies should be undertaken that include depth to the subsurface low permeability deposits and waste/wall compatibility studies should also be performed. Design phase results will then be used in determining optimum configuration and to incorporate additional measures needed to enhance the performance of the slurry wall. It is assumed that no compatibility problems exist between the landfill solids, landfill alluvial ground water and the slurry wall due to the relatively neutral pH and low contaminant concentrations of the landfill alluvial ground water. Thus for costing purposes it is assumed that the lifetime of the slurry wall will extend 30 years.

The effect of the slurry wall and cap on water levels within the alluvial aquifer was evaluated to determine the need for a leachate collection system. The evaluation consisted of examining existing potentiometric surface maps of the alluvial aquifer and conducting infiltration modeling simulations.

Sheets 4 through 6 of the Phase 1 RI report (CDM, 1991) depict the alluvial aquifer potentiometric surface over several measurement periods. All of the maps show ground water mounding under the landfill on the order of 2 to 4 feet, compared to potentiometric surface elevations at the western edge of the site. The mounding is likely caused by the relatively high recharge which occurs through the landfill solids. The high recharge is due to the relatively high porosity and permeability of the landfill solids and to the lack of surface runoff present in the hummucky landfill areas.

Infiltration modeling simulations were undertaken using the Hydrologic Evaluation of Landfill Performance (HELP) model (EPA, 1984). The HELP model is a quasi-two dimensional water balance model that simulates water movement across, into, through and out of landfills. The model requires climatologic, soil and landfill design data, and utilizes a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage and lateral drainage. HELP was used to estimate the average annual water balance values for the existing landfill configuration (the No Action alternative) and for the landfill cap as included under this alternative. For the No Action scenario, approximately 10 inches of water infiltrate

The slurry wall would consist of a vertical wall which would completely encircle portions of areas B and C that would contain landfill solids after excavation activities take place. The wall would be tied into low permeability materials present within the unconsolidated deposits on the bottom, and the surface cap on the top. Figure 6.3.1 shows the projected locations of the slurry walls. The combined length of the slurry walls would be approximately 9,700 feet.

The slurry wall would be constructed in a vertical trench that is excavated under a slurry via a special backhoe. The slurry is introduced just after the trench is opened and before the water table is reached. In locations where the water table is at or near ground surface, localized dewatering prior to excavation may need to be undertaken. It was assumed for costing purposes that special dewatering would not be necessary. The slurry would consist of a bentonite clay and water mixture that would hydraulically shore up the trench to prevent collapse and would minimize flow of water through the trench walls. The slurry trench is backfilled with an engineered soil mixture that would consist of clean fill material with at least 20 percent of the volume of fine grained material less than 200 mesh sieve size. The soil mixture would be blended with the bentonite slurry on the surface and placed into the trench to form a soil-bentonite slurry wall. This backfill material would be pushed into the trench with a bulldozer or poured from trucks. Special procedures would be required to construct the slurry wall across Aero Drive on both the east and west sides of the site, due to considerations of roadway traffic and of buried pipelines that parallel the road. Aero Drive may have to be temporarily closed during slurry wall construction activities. The slurry wall emplacement would require a large work and preparation area adjacent to the open trench and a level trench surface. Since the landfill site would already be cleared and graded, these do not represent implementability constraints.

The slurry trench would be excavated or keyed approximately 3 feet into the low permeability clays and till materials which are present below most of the site. Based on soil boring and trench excavation data obtained from the remedial investigation, it appears that the low permeability deposits (assumed to have permeabilities less than about 10^{-5} cm/sec) are present, on the average, ten to twelve feet below ground surface in the proposed trench areas. For costing purposes it is assumed that the trench would be excavated to a uniform depth of fifteen feet for slurry walls and that at least three feet of clay or till are present at the slurry wall location. The slurry walls will also be keyed into the surface caps that will be constructed over the site. A special cap consisting of aggregate and/or geotextiles may be constructed as a traffic cap over the slurry wall in the sections where it crosses under Aero Drive.

and erosion. The lower six inches in contact with the low permeability layer must be relatively free of stones, debris, etc.

The final layer of the cap consists of at least six inches of topsoil capable of supporting vegetative growth so as to minimize erosion. Geosynthetics may also be required to inhibit erosion on top of the final layer in certain locations where steep slopes are encountered. NYSDEC may require a thicker top soil layer if: (1) sufficient moisture retention to promote vegetative growth cannot be sustained; or (2) the proposed barrier cap use requires a thicker topsoil layer.

Each layer of the landfill cap is subject to strict quality assurance/quality control (QA/QC) testing to ensure the materials used during construction are in conformance with requirements of 6 NYCRR Part 360. Settlement and stability analysis by a qualified geotechnical engineer must be performed to ensure the appropriateness of the cap design. NYDEC has final approval on all engineering design drawings and specifications.

It should be noted that, after the selection of a capping material and a grading plan, a soil erosion and sediment control plan will need to be developed and approved by NYSDEC.

Institutional controls would be implemented to prevent any activities that could create a breach in the cap, such as industrial or residential development of the site. These controls would be in the form of deed or permit restrictions imposed on the site.

Area A historically did not receive fill materials during the operation of the landfill, and no samples taken in this area indicate hazardous wastes are present. Therefore, no action is proposed for Area A. Further sampling will be conducted in the Phase II Remedial Investigation to fully characterize this area, but it is not expected that the additional data will alter the proposed remedial action.

6.3.1.4 Slurry Wall

The ground water containment would be in the form of a slurry wall. The slurry wall would serve as a physical control to prevent offsite migration of contaminated alluvial aquifer ground water as well as landfill gas. When combined with the surface cap, the slurry wall would also minimize the production and offsite migration of leachate.

layers adjacent to it. This will, in turn, prevent clogging of the perforated pipes within the gas venting layer. The geotextile filter material used is to be compatible with leachate produced in the landfill and must not be adversely affected by any overlying materials. Geotextile filter openings must be sized in accordance with NYSDEC regulations.

The gas venting layer is overlain by a low-permeability barrier layer. This layer can be either a low permeability soil layer (usually clay) or a 40 mil geosynthetic liner material. If the soil component is used, it must be a minimum of 18 inches in compacted thickness, have a maximum permeability of 1 x 10^{-7} centimeters per second (cm/sec), and meet all of the requirements set forth in 6 NYCRR Part 360 subsection 360-2.13 (q). The soil component must be placed on a slope of no less than four percent to promote drainage. The low-permeability soil layer is to be installed in three successive lifts with the maximum final compacted thickness of each lift being six inches. Conformance testing is required throughout installation of each lift and is typically comprised of particle size analysis, Atterberg Limits tests, and laboratory permeability tests. Use of the clay layer often presents constructability and source location problems.

If a geosynthetic liner is employed for the low-permeability layer, the material used will need to have a minimum thickness of 40 mils and a permeability of 1 x 10^{-12} cm/sec or less. The geosynthetic must be chemically compatible with materials it may come in contact with and be able to accommodate the expected physical stresses caused by settling. The geomembrane must be placed on a minimum four percent slope to promote surface water runoff. Installation of geomembranes is generally precluded due to field seaming considerations when the ambient air temperature is below 41° F or above 104° F or when wind speeds exceed 20 miles per hour. For costing purposes, it was assumed the geosynthetic liner is used for this site.

The low permeability layer is to be covered by a drainage layer having a minimum thickness of six inches and consisting of a coarse grained material. This layer is overlain by a geotextile filter layer which prevents the coarse grained materials of the drainage layer from mixing with the finer grained particles of the barrier layer. The drainage layer will reduce buildup of hydraulic head on the liner by providing an outlet for water which has infiltrated to this level.

The geotextile filter layer is to be covered by a barrier layer having a minimum thickness of 24 inches of soil to prevent damage to the low-permeability layer resulting from frost action, root penetration, An alternative to the voluntary abandonment of downgradient wells is instituting point-of-use (POU) treatment technologies. In many cases, it may be more economical and practical to treat only ground waters that are required for potable or other use then to treat vast quantities of slightly contaminated ground water. POU technologies include dispersed treatment systems such as home or business water treatment systems. For ground water used only for watering lawns and gardens or washing cars, treatment of low-level contamination may be unnecessary.

In accordance with the National Contingency Plan (March 8, 1990: 55 Federal Register 8666), since contamination is left on site, a review of the remedial action conducted on the site must be performed no less than every five years. Therefore an update of the risk assessment and a qualitative evaluation of the condition of the containment elements is proposed to be conducted every five years.

6.3.2 EVALUATION

6.3.2.1 Compliance with Applicable New York State Standards, Regulations and Guidelines

Alternative No. 6 does not meet chemical-specific ARARs for potable water quality because this alternative allows for the possibility of contaminants to migrate via diffusion into the bedrock aquifer, which is a water supply aquifer. Chemical-specific ARARs for surface water and leachate seeps are met due to containment of leachate discharges and groundwater and health based risks of landfill soil are met by capping. Exposure risk from contaminated sediments remaining in Aero Creek will be reduced to acceptable levels through capping, and natural flushing processes.

Location-specific ARARs concerning wetlands preservation are met by restoration or replacement of wetlands offsite. ARARs concerning wetlands and floodplains would be considered and met during design of the remedial action.

The remedial action taken under this alternative involves excavation and on-site disposal of portions of the landfill, regrading, and installation of a slurry wall and a soil cap. Action-specific ARARs would be addressed during remedial design. These include federal and state air quality standards for air emissions, New York state stream standards as they relate to sediment control, OSHA standards for workers during implementation of the remediation, and RCRA standards for design of the cap, land disposal (if necessary) and closure.

6.3.2.2 Overall Protection of Human Health and the Environment

Alternative No. 6 is protective of human health. The ingestion and dermal absorption pathway for the landfill solids/soils media is addressed by providing a barrier between the contamination and the receptors. The slurry wall and cap greatly reduce contaminated groundwater from migrating into the bedrock aquifer and off-site. The ground water institutional controls provide an institutional barrier preventing ingestion of contaminated ground water. The resulting exposure to contaminants once the alternative is implemented is acceptable.

The technologies implemented at the site will not allow unrestricted use of the site. On-site ground water wells would not be permitted due to the presence of ground water contamination. Any activity, such as most industrial or residential development, would not be possible due to the detrimental effect it would have on the integrity of the cap.

The magnitude of residual risk at the site is moderate since the contamination is still present. The containment technologies are reliable and the control of these technologies is adequate, but should the cap or slurry wall fail, exposure to contamination could potentially occur.

6.3.2.3 Short-Term Impact and Effectiveness

During implementation of Alternative No. 6, dust will be generated during the excavations for the slurry wall and the consolidation of fill materials, as well as when the site is regraded and the cap installed. Potential risks to the community and to workers could occur from the airborne migration of contaminants and the volatilization of volatile organic compounds (VOC). The implementation of dust suppression measures, such as water or chemical dust suppressants, would help to mitigate the generation of dust, but it is not expected that complete removal of risk from airborne contaminants is possible.

Air quality monitoring would be conducted during the implementation of the alternative, and if results show that the emissions exceed action levels, the workers would be required to wear Level B protection to prevent exposure. Level B protection would be an effective and reliable measure to protect the workers.

The potential environmental impacts resulting from the implementation of the alternative would be contaminated sediment entering the surface waters adjacent to the site, temporary loss of wetland habitat and possible contamination of the aquifer during construction of the slurry wall. With excavation activities and the installation of the slurry wall in such close proximity to Aero Creek and, to a lesser degree, Ellicott Creek, the potential for contaminated sediment transport to surface waters is high. Mitigation measures implemented on the site would be the placement of berms and hay bales around excavated areas, stockpiles, and non-vegetated slopes to intercept surface water run-off, preventing the off-site transport of sediments. These measures are effective and would mitigate a majority of the sediment transport.

The implementation of this alternative, including the design of the various components of the alternative, would take approximately 2.5 years. The design of the alternative would be completed within six months.

6.3.2.4 Long-term Effectiveness and Permanence

As a result of the implementation of this alternative, no reduction in volume or concentration of the contaminants would occur. However, since the cap and slurry wall contain the contamination, only moderate risk remains on the site.

The remaining risk for the landfill solid/soils media is adequately controlled because the cap is designed to prevent breaching from settling of the fill material, erosional forces from surface water run-off, and freeze and thaw cycles. The management controls for the cap are adequate. Maintenance of the cap is not difficult nor labor intensive but must be conducted on a periodic basis and if portions of the cap are damaged, must be repaired immediately to prevent release of or exposure to contaminants. The design life of a cap is assumed to be 30 years for costing purposes.

Control of the remaining risk for the migration of groundwater would be marginally adequate as the integrity of the slurry wall and bottom barrier is difficult to test directly. It is assumed that annual sampling of off-site wells will provide adequate monitoring of the effectiveness of the aquifer containment actions.

6.3.2.5 Reduction in Toxicity, Mobility and Volume

Alternative No. 6 does not reduce the toxicity of the contamination present on the site as no treatment technologies are employed under this alternative although some natural degradation may occur. Contaminant mobility on the site is minimized by the cap and the slurry wall. It is not known to what extent the dissolved phase contamination will spread to the bedrock aquifer. The volume of solids contamination would not change as a result of the implementation of this alternative, but the areal extent of the landfill will decrease due to the consolidation of fill from the peripheral areas of the site.

6.3.2.6 Implementability

The construction of the cap and slurry wall proposed for Alternative No. 6 are relatively easy to implement. Once the site is cleared and regraded, the placement of the slurry wall and cap requires readily available equipment, materials and workers. However, the slurry wall's reliability is dependent on its ability to key into clays or tills which may be thin or absent. Most of the other technical difficulties or unknowns that exist for this technology relate to regrading the site. Portions of the site are unstable due to the presence of marshes and wetlands, and due to the unstable nature of the fill material. These areas could require specialized equipment and construction procedures to allow work in unstable environments.

Once the cap and slurry wall are in place, they are reliable in meeting the containment goals of the technologies. Visual inspection of the integrity of the cap is the only monitoring required to evaluate the performance of the cap. If the cap is found to be damaged from erosion, fill settlement, or unauthorized excavations into the cap, repair of the breach is easy, relatively inexpensive, and requires readily available equipment, materials and workers. Continued ground water monitoring of off-site wells could be used to verify the integrity of the slurry walls.

6.3.2.7 Cost

The costs associated with implementing this alternative are detailed in Appendix B and summarized below. It should be noted that costs for drum handling are not included and may be substantial.

• Capital Costs	$44,000,000
• Present Worth of Annual/Periodic Costs	$1,194,000
• Total Present Worth Costs	$45,194,000

Indirect capital expenditures included under this alternative include direct capital costs for:

- Excavation and consolidation of fill
- Replacement of wetlands
- Site grading and recontouring
- Installation of single barrier cap
- Slurry wall construction
- Establishment of ground water monitoring program

Indirect capital costs include: costs for engineering and design (15 percent of direct capital costs); legal fees (three percent of direct capital costs); regulatory permit fees, such as the cost to institute ground water well restrictions (three percent of direct capital costs); construction contractor mobilization and demobilization costs (one percent of direct capital costs); and contingencies (20 percent of direct capital costs).

Annual costs associated with this alternative include:

- Cap maintenance, including mowing
- Off-site ground water well monitoring
- Permit administration

The periodic costs associated with this alternative include the five year review of the site.

The total present worth costs of the alternative includes the direct and indirect capital costs in combination with the present worth of the annual and periodic costs over 30 years at an annual rate of nine percent.

6.4 ALTERNATIVE 10 - CAPPING WITH SELECT EXCAVATION, GROUND WATER CONTAINMENT AND COLLECTION WITH ON-SITE TREATMENT AND OFF-SITE DISPOSAL

6.4.1 DESCRIPTION

Alternative No. 10 addresses the risks posed by the contamination present on the site with the following elements;

- Select excavation of peripheral areas with on-site disposal
- Single barrier capping of the landfill with wetlands replacement
- Slurry wall containment of ground water
- Surface runoff collection with offsite disposal to surface water body
- Ground Water collection with on-site treatment and off-site disposal to POTW or to surface water
- Institutional controls for preservation of the cap

Under this alternative, the contamination in the landfill solids and soils would be addressed in the same manner as in Alternative No. 6, as described in Section 6.3.1. The site would be cleared and grubbed of all vegetation and regraded. Selected areas along the periphery of the landfill, delineated by additional sampling, would be excavated and deposited on the unexcavated portion of the landfill. The contaminated portions of the landfill would then be capped. Ground water in saturated portions of the landfill solids within the slurry wall would be collected via extraction wells. The extracted water would be treated on site and disposed of off site. Institutional controls for the cap, as described under Alternative No. 6, would also be undertaken.

Institutional controls would be implemented to prevent any activities that could create a breach in the cap. No action would be taken in Area A which historically did not receive hazardous wastes during the operation of the landfill.

As with Alternative No. 6, ground water containment would be in the form of a soil-bentonite slurry wall surrounding the contaminated portion of the landfill. Ground water institutional controls would also be implemented to provide annual off-site well monitoring.

6.4.1.1 Groundwater Extraction

To eliminate the potential for contaminated alluvial ground water to migrate into the underlying bedrock aquifer through areas where the basal alluvial clays and tills are thin or absent, extraction wells would be installed. Preliminary calculations indicate that ground water within the landfill solids would have to be extracted under very low pumping rates to avoid localized dewatering and pump malfunction. Low pumping rates are needed due to the lack of recharge and decrease in existing potentiometric surface, as discussed in Section 6.3-1. A semi-analytical two dimensional model (THEIS2; Koch & Assoc., 1987) was utilized to estimate the number of monitoring wells and approximate pumping rates needed for the contained alluvial aquifer. Aquifer properties were obtained from information available in the site RI report (CDM, 1991) and from waste characteristics included in the HELP model (EPA, 1984).

The simulations indicated that the optimum pumping configuration would be four clusters of wells with each cluster oriented in a "five-spot" pattern such that corner wells in this pattern would be located approximately 600 feet apart and covering approximately one fourth of the combined area of landfill areas B and C. The modeling simulations also indicated that a total sustainable drawdown of each well is approximately 0.2 gallon per minute (gpm) and for each cluster approximately 1 gpm, indicating that the entire system pumping rate would be approximately 4 gpm. This low yield is primarily due to the low saturated thickness of the landfill solids (approximately 6 feet) and lack of recharge due to the cap and slurry walls. It was also assumed in these simulations that recharge from the underlying bedrock aquifer was negligible. The extraction rates decreased water levels within the contained region sufficiently to cause a reversal of existing vertical hydraulic gradients between the alluvial and bedrock aquifers. To account for possible increases in saturated thickness beyond what was simulated, simplifying assumptions incorporated into the simulations and for recharge from the bedrock aquifer, the extraction system was designed to pump at 20 gpm after the cap and slurry wall were installed.

The extraction system would consist of 20, two-inch diameter stainless steel well points driven to 20 feet into the capped landfill areas. Water would be extracted under a vacuum pump system, with the well points connected to one of two vacuums via piping and manifolds. Extracted water would be routed to the on-site treatment system. Adjustments to suction pressure and extraction rates for each wellpoint would have to be undertaken after the system is installed to obtain optimum performance.

6.4.1.2 Treatment

Ground water collected through the containment and extraction processes would be treated through an on-site treatment plant. The conceptual design of the ground water treatment process is based on flows and loadings that are expected to occur in two phases at the Pfohl Brothers Landfill as described below. Tables 6.4-1 and 6.4-2 list these expected loadings in pounds per day (#/day), and includes both average values and maximum values for various parameters of concern during the two phases. Table 6.4-3 identifies the surface water discharge limits that the treatment process effluent will have to meet. It must be noted that these limits represent conservative criteria in the event that discharge to the POTW is not available as an option. If the combined ground water/leachate can be discharged directly to the POTW, pretreatment may not be required.

The implementation of the groundwater extraction and treatment was assumed to occur in two phases. The construction, or short-term phase, would be required to handle estimated flows of 50-100 gpm. The second, operational phase, will begin after completion of the cap and slurry wall construction. Flow during this phase is expected to decrease to approximately 20 gpm due to significant decrease in infiltration and groundwater migration. Ground water quality during this phase will be monitored on a regular basis to identify changes in flows and characteristics. Loading information presented in tables 6.4-2 and 6.4-3 are conservative estimates based on existing data. Loadings are expected to decrease with time during operation. The design life for this phase is expected to be 30 years.

The treatment plant requires the capability of initially handling a hydraulic loading of 100 gpm and then eventually handling a reduced hydraulic loading of 20 gpm. The treatment process would involve metals removal, solids removal by filtration, and removal of organic constituents by granular activated carbon (GAC). Due to the small volume of water to be treated, a package plant approach for providing required treatment objectives was used since this approach is the most cost-effective approach from a design, installation and operational point of view. Two vendors have been contacted

TABLE 6.4-1

PFOHL BROTHERS
EXPECTED MASS LOADINGS TO ON-SITE TREATMENT PLANT

Parameter	Avg. Conc. (μg/L)	Average Loading (#/day)		Max. Conc. (μg/L)	Max. Loading (#/day)	
		Phase I	Phase II		Phase I	Phase II
Benzene	146	0.175	0.035	290	0.348	0.070
Chlorobenzene	11000	13.211	2.642	11000	13.211	2.642
Chloroethane	900	1.081	0.216	900	1.081	0.216
1,2-Dichlorobenzene	4	0.005	0.001	57	0.068	0.014
1,4-Dichlorobenzene	121	0.145	0.029	240	0.288	0.058
1,3-Dichlorobenzene	82	0.098	0.020	89	0.107	0.021
1,1-Dichloroethane	2453	2.946	0.589	4900	5.885	1.177
1,1-Dichloroethylene	240	0.288	0.058	240	0.288	0.058
trans-1,2-Dichloroethylene	9.2	0.011	0.002	85	0.102	0.020
Ethylbenzene	6	0.007	0.001	6	0.007	0.001
1,1,1-Trichloroethane	7513	9.023	1.805	15000	18.014	3.603
Trichloroethylene	2.2	0.003	0.001	2.2	0.003	0.001
Toluene	23	0.028	0.006	43	0.052	0.010
Xylenes	400	0.480	0.096	400	0.480	0.096
2-Chlorophenol	13	0.016	0.003	13	0.016	0.003
2,4-Dimethylphenol	785	0.943	0.189	940	1.129	0.226
2-Methylphenol	72	0.086	0.017	72	0.086	0.017
4-Methylphenol	75	0.090	0.018	75	0.090	0.018
Phenol	2003	2.406	0.481	4000	4.804	0.961
Dibenzofuran	41.5	0.050	0.010	63	0.076	0.015
Diethylhexylphthalate (DEHP)	422	0.507	0.101	840	1.009	0.202
N-Nitrosodiphenylamine	7	0.008	0.002	9	0.011	0.002
PAHs	20.5	0.025	0.005	39	0.047	0.009
Aldrin	0.0075	0.000	0.000	0.008	0.000	0.000
Dieldrin	0.018	0.000	0.000	0.028	0.000	0.000
DDD	0.011	0.000	0.000	0.011	0.000	0.000
Endrin	0.028	0.000	0.000	0.028	0.000	0.000
Endosulfan II	0.69	0.001	0.000	0.69	0.001	0.000
PCBs	110	0.132	0.026	110	0.132	0.026

TABLE 6.4-1 (Cont.)

PFOHL BROTHERS
EXPECTED MASS LOADINGS TO ON-SITE TREATMENT PLANT

Parameter	Avg. Conc. (µg/L)	Average Loading (#/day)		Max. Conc. (µg/L)	Max. Loading (#/day)	
		Phase I	Phase II		Phase I	Phase II
Aluminum	37112	44.570	8.914	303000	363.891	72.778
Arsenic	12.2	0.015	0.003	22.3	0.027	0.005
Barium	1530	1.837	0.367	10000	12.010	2.402
Beryllium	7.63	0.009	0.002	14.8	0.018	0.004
Cadmium	12	0.014	0.003	122	0.147	0.029
Chromium	148	0.178	0.036	426	0.512	0.102
Cobalt	25.5	0.031	0.006	157	0.189	0.038
Copper	3060	3.675	0.735	3060	3.675	0.735
Lead	204	0.245	0.049	1640	1.970	0.394
Manganese	1883	2.261	0.452	16100	19.335	3.867
Mercury	1.9	0.002	0.000	4.7	0.006	0.001
Nickel	97	0.116	0.023	521	0.626	0.125
Selenium	12.4	0.015	0.003	12.8	0.015	0.003
Silver	5.9	0.007	0.001	16.6	0.020	0.004
Vanadium	63.4	0.076	0.015	471	0.566	0.113
Zinc	394	0.473	0.095	8270	9.932	1.986
Cyanide	30	0.036	0.007	31	0.037	0.007

NOTES:

PHASE I: FLOW = 100 gpm

PHASE II: FLOW = 20 gpm

LOADINGS = "0.000" ARE LESS THAN 0.001 #/day

TABLE 6.4-2

PFOHL BROTHERS
EXPECTED MASS LOADINGS TO ON-SITE TREATMENT PLANT

CONVENTIONAL PARAMETERS

Parameter	Avg. Conc. (μg/L)	Average Loading (#/day)		Max. Conc. (μg/L)	Max. Loading (#/day)	
		Phase I	Phase II		Phase I	Phase II
Acidity	1.0	1.20	0.24	1.0	1.20	0.24
Alkalinity	598	718.17	143.63	1040	1249.00	249.80
Ammonia	14.7	17.65	3.53	30.5	36.63	7.33
BOD-5	9.2	11.05	2.21	20	24.02	4.80
Ca as CaCO3	530	636.51	127.30	1249	1500.00	300.00
Chloride	165	198.16	39.63	877	1053.24	210.65
COD	81.6	98.00	19.60	193	231.79	46.36
Hardness	788	946.36	189.27	1740	2089.67	417.93
MBAS	10.5	12.61	2.52	15	18.01	3.60
Nitrate-Nitrite	9.0	10.81	2.16	4.4	5.28	1.06
NTA	1.12	1.35	0.27	1.0	1.20	0.24
Oil and Grease	3.1	3.72	0.74	5.7	6.85	1.37
Phenol	0.092	0.11	0.02	0.35	0.42	0.08
Phosphate	0.258	0.31	0.06	0.64	0.77	0.15
Sulfate	205	246.20	49.24	700	840.67	168.13
Suspended Solids:						
Total	583	700.16	140.03	4010	4815.85	963.17
Fixed	474	569.26	113.85	3060	3674.94	734.99
Volatile	142	170.54	34.11	950	1140.91	228.18
Sulfide	1.31	1.57	0.31	1.31	1.57	0.31
TKN	14.5	17.41	3.48	32.9	39.51	7.90
TOC	20.7	24.86	4.97	52.4	62.93	12.59
Total Solids	1763	2117.29	423.46	3930	4719.77	943.95
Total Petroleum Hydrocarbons	0.68	0.82	0.16	0.76	0.91	0.18

NOTES:

PHASE I: FLOW = 100 gpm

PHASE II: FLOW = 20 gpm

TABLE 6.4-3

PFOHL BROTHERS
SURFACE WATER DISCHARGE LIMITS

Parameter	Effluent Limit ($\mu g/L$)
Benzene	5
Chlorobenzene	5
Chloroethane	5
1,2-Dichlorobenzene	1.67
1,4-Dichlorobenzene	1.67
1,3-Dichlorobenzene	1.67
1,1-Dichloroethane	5
1,1-Dichloroethylene	5
trans-1,2-Dichloroethylene	5
Ethylbenzene	5
1,1,1-Trichloroethane	5
Trichloroethylene	11
Toluene	5
Xylenes	5
2-Chlorophenol	50
2,4-Dimethylphenol	50
2-Methylphenol	50
4-Methylphenol	50
Phenol	5
Dibenzofuran	50
Diethylhexylphthalate (DEHP)	50
N-Nitrosodiphenylamine	50
PAHs	50
Aldrin	0.005
Dieldrin	0.001
DDD	0.001

TABLE 6.4-3
(continued)

PFOHL BROTHERS
SURFACE WATER DISCHARGE LIMITS

Parameter	Effluent Limit (μg/L)
Endrin	0.002
Endosulfan II	0.009
PCBs	0.001
Aluminum	100
Arsenic	190
Barium	1000
Beryllium	11
Cadmium	1.7
Chromium	318
Cobalt	5
Copper	18.5
Lead	6.3
Manganese	50
Mercury	0.2
Nickel	142
Selenium	1
Silver	0.1
Vanadium	14
Zinc	30
Cyanide	5.2

to establish a package plant that would be suitable for treating ground water/leachate. Their systems are described briefly in the following text. Treatability studies conducted during the remedial design phase of the project would determine which system would be implemented for the site. System A, the more expensive of the two systems, was used in the cost analysis.

System A

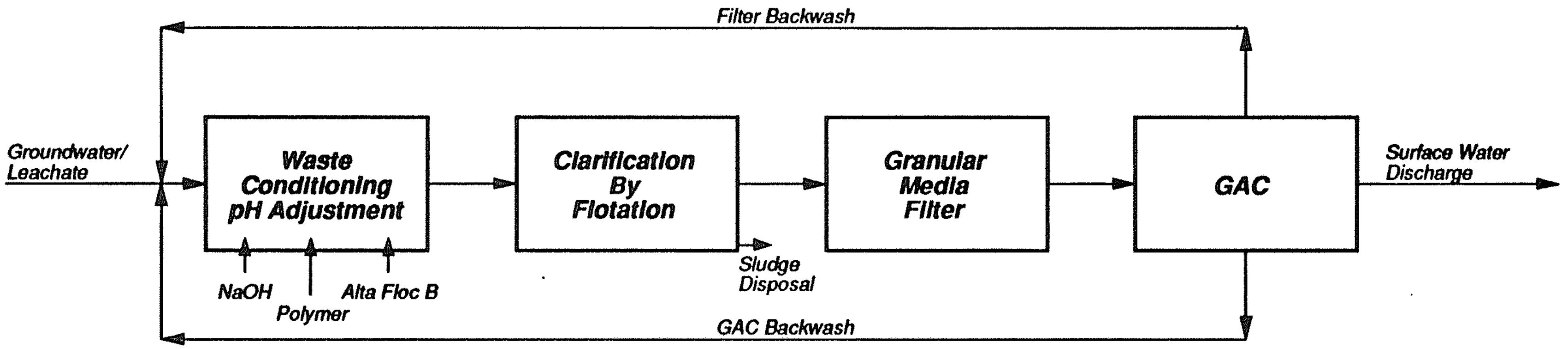
Metals of concern would be precipitated out using sodium hydroxide and subsequent solids generated would be removed by a dissolved air flotation (DAF) system. Included in the DAF system is a waste conditioning tank where the ground water/leachate would be chemically treated with sodium hydroxide, a polymer, and Altafloc B solutions for conditioning and pH adjustment. After conditioning, the ground water/leachate would pass through a flotation tank where extremely fine air bubbles are injected at high pressure into the waste stream. The air bubbles become attached to solids suspended in the liquid stream causing the solids to float forming a blanket. The blanket is then removed by surface skimmers.

The clarified water from the DAF system would discharge into a granular-media filter for additional solids removal prior to granular activated carbon filtration. A two-stage GAC filtration system would be the primary treatment process used to remove the organics prior to discharging to surface water.

Backwash from the polishing filters and carbon filters would be recirculated to the head of the plant. A process flow diagram for this package treatment plant is shown in Figure 6.4-1.

System B

In this package plant, metals would be removed by precipitation/flocculation followed by sedimentation. The precipitation/flocculation process would occur in a chemical waste treatment tank with chemical and polymer addition. The chemical waste treatment tank would be constructed as a three compartmented mixing, contact and reaction tank. The first compartment would be for feeding sulfuric acid and a coagulant such as alum. The next compartment would be for acid neutralization with a caustic feed. The third compartment would be for the feed of sulfite and a polymer.



Not To Scale

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Figure 6.4-1

System A Process Flow Diagram

Draft Feasibility Study
Pfohl Brothers Landfill, Cheektowaga, New York

Flow from the third compartment of the chemical waste treatment tank would be by gravity into the inlet of an inclined plate clarifier to allow settling of the precipitated metal hydroxides. The inclined plate packs direct the solids to a sludge compartment where they are pumped to an auxiliary sludge holding tank and then dewatered with a small filter press.

The clarified water would flow into a clearwell tank and be pumped through a mixed media polishing filter for solids removal prior to granular activated carbon filtration. Granular activated carbon would be the primary treatment process used to remove the organics prior to discharging to surface water.

Backwash from the polishing filters and granular activated carbon would be recirculated to the head of the plant. A process flow diagram for this package treatment plant is shown in Figure 6.4-2.

6.4.2 EVALUATION

6.4.2.1 Compliance with Applicable New York State Standards, Regulations and Guidelines

Alternative No. 10 meets chemical-specific ARARs related to potable (Class GA) ground water due to collection, treatment and off-site disposal. Chemical-specific ARARs for surface water and leachate seeps are met due to elimination of leachate discharges and groundwater treatment. Health-based risks from the landfill soil and solids are reduced to acceptable levels by capping.

Location-specific ARARs concerning wetlands preservation are met by replacement of wetlands off site. ARARs concerning wetlands and floodplains would be considered and met during design of the remedial action.

Action-specific ARARs would be addressed during remedial design. These include federal and state air quality standards for air emissions, NYS stream standards as they relate to sediment control, OSHA standards for workers during implementation of the remediation, RCRA standards for design of the cap and land disposal and closure, and either pretreatment effluent limitations if discharged to a POTW or SPDES effluent limitations if discharged to surface waters.

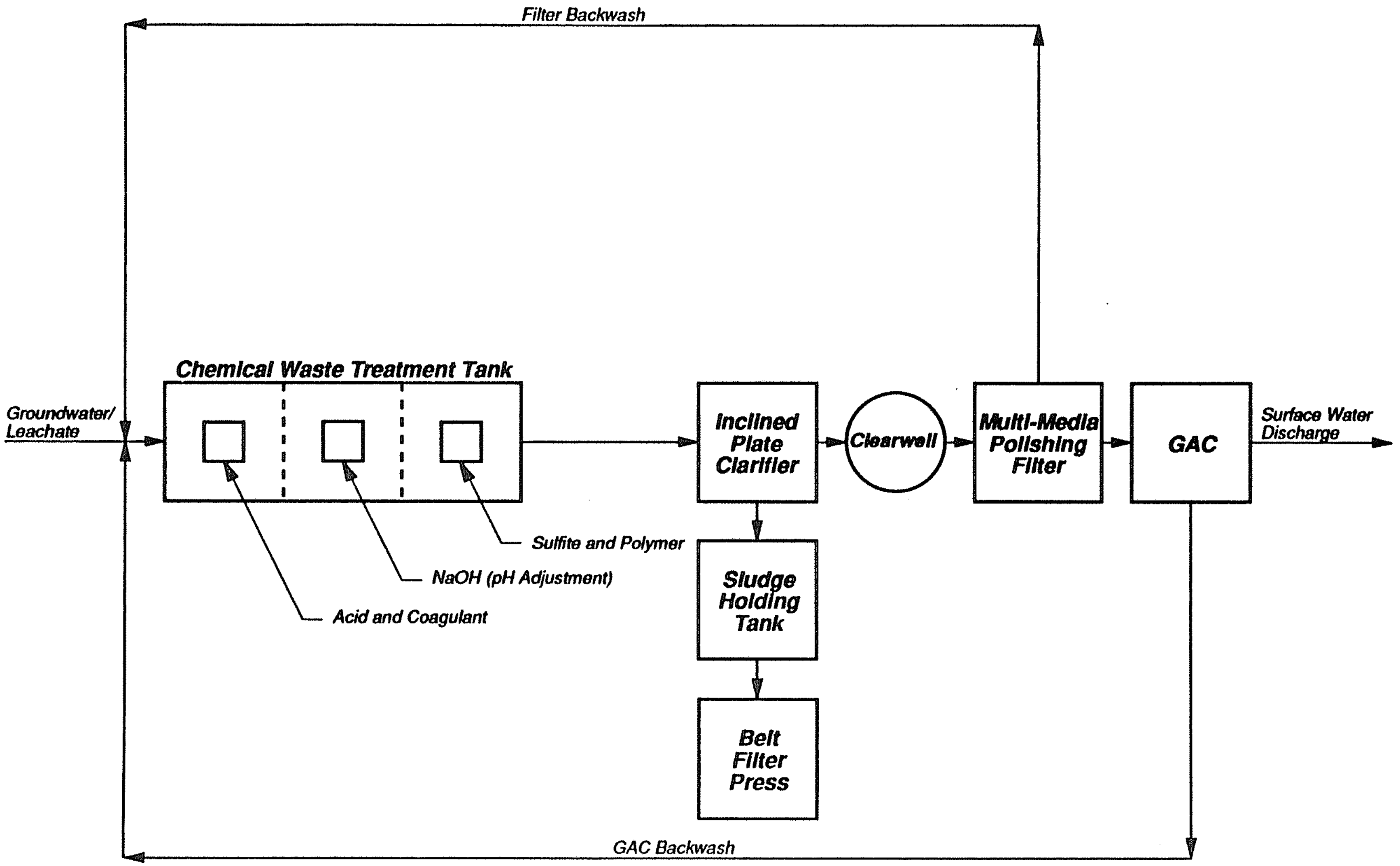

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Figure 6.4-2

System B Process Flow Diagram

Draft Feasibility Study
Pfohl Brothers Landfill, Cheektowaga, New York

6.4.2.2 Overall Protection of Human Health and the Environment

Alternative No. 10 is protective of human health. The ingestion and dermal absorption pathway for the landfill solids/soils media is addressed by providing a barrier between the contamination and the receptors. The slurry wall and ground water extraction prevent contamination of groundwater from migrating off site. The ground water institutional controls provide an institutional barrier preventing ingestion of contaminated ground water. The resulting exposure to contaminants once the alternative is implemented is acceptable.

The technologies implemented at the site will required restricted use of the site. On-site ground water consumptive use wells would not be permitted due to the presence of alluvial aquifer ground water contamination and because heavy pumping in the bedrock aquifer may induce contaminated ground water from the alluvial aquifer. Any activity, such as most industrial or residential development, would not be possible due to the detrimental effect it would have on the integrity of the cap.

The magnitude of residual risk at the site is moderate since the contamination is still present. The containment technologies are reliable and the control of these technologies is adequate, but should the cap, slurry wall or ground water extraction system fail, exposure to contamination could potentially occur.

6.4.2.3 Short-term Impact and Effectiveness

During implementation of Alternative No. 10, dust will be generated during the excavations for the slurry wall and the consolidation of fill materials, as well as when the site is regraded and the cap installed. Potential risks to the community and to workers could occur from airborne contaminants and the volatilization of organic compounds (VOC). The implementation of dust suppression measures, such as water or chemical dust suppressants, would help to mitigate the generation of dust, but it is not expected that complete removal of risk from airborne contaminants is possible.

Air quality monitoring would be conducted during the implementation of the alternative, and if results show that the emissions exceed action levels, the workers would be required to wear Level B protection to prevent exposure. Level B protection would be an effective and reliable measure to protect the workers.

The potential environmental impacts resulting from the implementation of the alternative would be contaminated sediment entering the surface waters adjacent to the site, temporary loss of wetland habitat, and possible contamination of the aquifer during construction of the slurry wall. With excavation activities and the installation of the slurry wall in such close proximity to Aero Creek and, to a lesser degree, Ellicott Creek, the potential for contaminated sediment transport to surface waters is high. Mitigation measures implemented on the site would be the placement of berms and hay bales around excavated areas, stockpiles, and non-vegetated slopes to intercept surface water run-off, preventing the off-site transport of sediments. These measures are effective and would mitigate a majority of the sediment transport.

The implementation of this alternative, including the design of the various components of the alternative, would take approximately 3.5 years. The design of the alternative would be completed within six months. Protection against off-site migration of contaminants in ground water would be achieved after the first year when the slurry wall is completed, and after three years the cap would be installed and site-wide protection achieved.

6.4.2.4 Long-term Effectiveness and Permanence

As a result of the implementation of this alternative, a reduction in volume and concentration of the contaminants would occur via the ground water extraction and treatment. Since the cap and slurry wall contain the solids contamination, only moderate risk remains on the site.

The remaining risk for the landfill solid/soils media is adequately controlled as the cap is designed to prevent breaching from settling of the fill material, erosional forces from surface water run-off, and freeze and thaw cycles. The management controls for the cap are adequate. Maintenance of the cap is not difficult nor labor intensive but must be conducted on a periodic basis and if portions of the cap are damaged, must be repaired immediately to prevent release of or exposure to contaminants. The design life of a cap is approximately 30 years.

Control of the remaining risk for the migration of groundwater would be adequate due to the implementation of ground water extraction. If the cap and/or slurry wall failed, pumping rates could be increased,to account for additional recharge.

6.4.2.5 Reduction in Toxicity, Mobility and Volume

Alternative No. 10 reduces the toxicity of the contamination present on the site as treatment technologies for contaminated ground water are employed under this alternative. The mobility of all of the contamination on the site is prevented by the cap, slurry wall, and ground water extraction system. It is assumed that contamination will not spread to the bedrock aquifer because pumping within the alluvial aquifer will be sufficient to locally induce ground water flow towards the contained materials. The volume of soil/solids contamination would not change as a result of the implementation of this alternative, but the areal extent of the landfill will decrease due to the consolidation of fill from the peripheral areas of the site.

6.4.2.6 Implementability

The construction of the cap and slurry wall proposed for Alternative No. 10 is relatively easy to implement. Once the site is cleared and regraded, the placement of these containment devices utilizes readily available equipment, materials and workers. The only technical difficulties or unknowns that exist for this technology relate to regrading the site. Portions of the site are unstable due to the presence of marshes and wetlands, and due to the unstable nature of the fill material. These areas could require specialized equipment and construction procedures to allow work in unstable environments.

Once the cap and slurry wall are in place, they are reliable in meeting the containment goals of the technologies. Visual inspection of the integrity of the cap is the only monitoring required to evaluate the performance of the cap. If the cap is found to be damaged from erosion, fill settlement, or unauthorized excavations into the cap, repair of the breach is easy, relatively inexpensive, and requires readily available equipment, materials and workers.

Installing well points into the landfill solids should also be relatively easy to implement due to the shallow well completion depths. Well installation methods could be modified if difficulties are encountered in the field. Implementing the wellpoint extraction piping, collection, and treatment systems would also be reasonably easy due to easy access and proven technologies. The installation of the ground water extraction system will need to be coordinated with installation and vegetation of the surface cap layers.

6.4.2.7 Cost

The costs associated with implementing this alternative are detailed in Appendix B and summarized below. Note that these costs do not address drum removal although the associated cost may be substantial.

• Capital Costs	$44,990,000
• Present Worth of Annual/Periodic Costs	$ 8,799,000
• Total Present Worth Costs	$53,789,000

Capital expenditures included under this alternative include direct capital costs for:

- Excavation and consolidation of fill
- Replacement of wetlands
- Site grading and recontouring
- Installation of single barrier cap
- Slurry wall construction
- Installation of ground water extraction system
- Purchase and installation of on-site treatment plant
- Establishment of ground water monitoring program

The costs for the packaged treatment system is based on the higher of the two estimates supplied by the vendors. The installation of the system was assumed to be 50% of the equipment cost.

Indirect capital costs include: costs for engineering and design (15 percent of direct capital costs); legal fees (three percent of direct capital costs); regulatory permit fees, such as the cost to institute ground water well restrictions (three percent of direct capital costs); construction contractor mobilization and demobilization costs (one percent of direct capital costs); and contingencies (20 percent of direct capital costs).

Annual costs associated with this alternative include:

- Cap maintenance, including mowing
- Off-site ground water well monitoring
- Permit administration
- Treatment plant O&M, including sludge disposal costs

Treatment plant O&M costs were assumed to be 10% of the total capital costs of the equipment.

The periodic costs associated with this alternative include the five year review of the site.

The total present worth costs of the alternative includes the direct and indirect capital costs in combination with the present worth of the annual and periodic costs over 30 years at an annual rate of nine percent.

6.5 COMPARATIVE ANALYSIS

In previous sections, each of the three alternatives were evaluated individually against the seven criteria described in Section 6.1. This section provides a relative comparison of their performance on the same criteria. The purpose of this comparative analysis is to identify the strengths and weaknesses of each alternative relative to the other alternatives. Table 6.5-1 summarizes the comparative analysis of the three alternatives. Each alternative is rated - 1 (low), 2 (moderate) or 3 (high) on its ability to meet each evaluation criteria. The ranking is then multiplied by the weight given to the evaluation criteria in the TAGM in order to get a weighted score. Weighted scores are summed for each alternative. A discussion of this evaluation is given below.

6.5.1 COMPLIANCE WITH ARARs

Alternative 1 - No Action does not meet the chemical-specific ARARs. Alternative 10 meets the chemical-specific ARARs for all media. Alternative 6 meets the chemical-specific ARARs for all media except ground water because the ground water is only contained and not treated as in Alternative 10. Also in Alternative 6, the possibility exists that contaminants may migrate off-site by diffusion into the bedrock aquifer.

Table 6.5-1

COMPARATIVE ANALYSIS OF FINAL ALTERNATIVES

Evaluation Criteria	Weighting Factor (TAGM)	Alternative 1		Alternative 6		Alternative 10	
		Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Compliance with ARARs	10	1	10	2	20	3	30
Overall Protection	20	1	20	2	40	3	60
Short-term Impacts and Effectiveness	10	3	30	2	20	1	10
Long-term Effectiveness and Permanence	15	1	15	2	30	3	45
Reduction in Toxicity, Mobility, and Volume	15	1	15	2	30	3	45
Implementability	15	3	45	2	30	1	15
Cost	15	3	45	2	30	1	15
	100	**13**	**180**	**14**	**200**	**15**	**220**

WHERE: 1=LOW
2=MODERATE
3=HIGH

Location-specific ARARs are met by Alternative 1 because no action is taken which would affect floodplains or wetlands. Alternatives 6 and 10 will meet location-specific ARARs by replacing wetlands off-site, but portions of the 100-year floodplain present in areas B and C would be eliminated by a dike or berm that would be constructed to protect the cap from flood damage.

The action-specific ARARs are not applicable for Alternative 1 because no action is being taken. Action-specific ARARs would be addressed during remedial design for Alternatives 6 and 10.

6.5.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The No Action Alternative provides no reduction in risk to human health and the environment. Alternatives 6 and 10 provide overall protection from exposure with landfill soils/solids, and contaminated ground water. Alternative 10 provides an extra degree of protection to the environment through the on-site ground water collection and treatment system. This system is expected to alter the hydraulic gradient and cause ground water to flow toward the landfill solids, thereby providing an extra level of protection to the bedrock aquifer.

6.5.3 SHORT TERM IMPACTS AND EFFECTIVENESS

Each of the alternatives includes ground water monitoring, which involves minor risk to workers and the community during sampling. In addition, Alternatives 6 and 10 have an increased risks for airborne, surface water and ground water contamination during construction, which is estimated to last for 2.5 years for Alternative 6 and 3.5 years for Alternative 10. Both alternatives 6 and 10 will have a negative impact on wildlife habitat during construction. In all cases, mitigation measures will be taken to minimize potential impacts during construction. Due to the increased duration of construction, Alternative 10 has slightly higher short-term impacts and slightly lower short-term effectiveness than Alternative 6.

6.5.4 LONG TERM EFFECTIVENESS AND PERMANENCE

The No Action alternative monitors, but does not contain or reduce the hazards associated with the site, thus the long-term risk is considered high. Alternative 6 is designed to contain the contamination by use of a cap and slurry wall. However, there is no treatment so some risk remains. Alternative 10 includes ground water extraction which decreases the risk associated with contaminated ground water present in the landfill solids, and so is more effective. The life expectancy of the cap and slurry wall in alternatives 6 and 10 is approximately 30 years, so longevity is high for both when compared to the No-Action alternative. However, none of these alternatives offer a permanent remedy.

6.5.5 REDUCTION IN TOXICITY, MOBILITY, AND VOLUME

The No Action alternative provides no containment or treatment and thus no decrease in toxicity, mobility or volume. Alternative 6 reduces contaminant mobility via the cap and slurry wall. Alternative 10 incorporates a ground water extraction system in addition to the cap and slurry wall, thus reducing contaminant mobility. In addition, Alternative 10 provides a reduction in volume and contaminants via on-site ground water treatment.

6.5.6 IMPLEMENTABILITY

All alternatives include ground water monitoring, which is considered easily implementable. The other technologies (cap, slurry wall, ground water extraction and treatment) are also considered reliable and relatively easy to construct. The materials and services required for implementation are readily available. Required coordination with regulatory agencies will be greater for alternatives 6 and 10. The ground water extraction and treatment systems cause Alternative 10 to be more difficult to implement than Alternative 6.

6.5.7 COST

The total present worth cost for Alternative 1 is $480,000; Alternative 6 is $45,194,000; and Alternative 10 is $53,789,000.

Section 7

7.0 REFERENCES

Camp Dresser & McKee. 1991. Draft Baseline Human Health Risk Assessment, Pfohl Brothers Landfill. Prepared for the state of New York Department of Environmental Conservation.

Camp Dresser & McKee. 1991. Draft Remedial Investigation Report, Pfohl Brothers Landfill, Cheektowaga, New York. Prepared for the state of New York Department of Environmental Conservation.

Kock & Associates. 1987. THEIS 2.

New York State Department of Environmental Conservation. 1990. 6NYCRR Part 360 Solid Waste Management Facilities, NYSDEC, New York, New York.

New York State Department of Environmental Conservation. Technical and Administrative Guidance Memorandum for the Selection of Remedial Actions at Inactive Hazardous Waste Sites (TAGM). Division of Hazardous Waste Remediation. Albany, New York.

New York State Department of Environmental Conservation and New York State Department of Health. 1990a. Radiochemical Analysis, Addendum No. 1: Groundwater, Pfohl Brothers Landfill. Cheektowaga, New York. March 1990.

New York State Department of Environmental Conservation and New York State Department of Health. 1990b. Radiochemical Analysis, Addendum No. 2: Soil/Waste Sampling, Pfohl Brothers Landfill. Cheektowaga, New York.

U.S. Airforce. 1985. The Installation Restoration Program Toxicology Guide. Prepared by Arthur D. Little. Prepared for Aerospace Medical Research Laboratory. Wright - Patterson Air Force Base. Ohio. October 1985.

U.S. Environmental Protection Agency. 1990c. National Contingency Plan. (FR SS: 8666-8865).

U.S. Environmental Protection Agency. 1988. The Hydrologic Evaluation of Landfill Performance (HELP) Model.

U.S. Environmental Protection Agency. 1988c. Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA. Office of Emergency and Remedial Response. Washington D.C.

Appendices

APPENDIX A

TECHNICAL AND ADMINISTRATIVE GUIDANCE MANUAL (TAGM) ALTERNATIVE EVALUATION TABLES

TABLE A-1

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVE SCREENING FACTORS[a]

	Alt. No. 1	Alt No. 2	Alt. No. 3	Alt. No. 4	Alt. No. 5	Alt. No. 6	Alt. No. 7	Alt. No. 8	Alt. No. 9	Alt. No. 10
Short/Long Term Effectiveness										
1. - Significant short term risk to community	No (4)	No (4)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
- Can short term risks be controlled?	NA	NA	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
- Does mitigation of short term risks impact community?	NA	NA	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
2. - Significant short term risk to environment?	No (4)	No (4)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
- Are reliable mitigative measures available?	NA	NA	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Yes (3)
3. - Time required to implement	≤2 yr. (1)	≤2 yr. (1)	>2 yr. (0)	>2 yr. (0)	>2 yr. (0)	>2 yr. (0)	<2 yr. (1)	<2 yr (0)	>2 yr. (0)	>2 yr. (0)
- Required duration of mitigation for short term risk	NA	NA	>2 yr. (0)	>2 yr. (0)	>2 yr. (0)	>2 yr. (0)	<2 yr.(1)	>2 yr. (0)	>2yr. (0)	>2yr. (0)
4. - On-site treatment	NA	NA	✓ H_2O (0.5)	NA	✓ H_2O (0.5)	NA	NA	✓ H_2O (0.5)	✓ H_2O (0.5)	✓ H_2O (1.0)
- Off-site treatment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
- Land disposal	NA	NA	✓ (0)	✓ (0)	✓ (0)	✓ (0)	✓ (0)	✓ (0)	✓ (0)	✓ (0)
5. - Is remedy permanent?	No (0)	No (0)	Partially (1)	No (0)	Partially (1)	No (0)	No (0)	Partially (0.5)	Partially (1)	Partially(1.5)
6. - Expected lifetime of remedy	25-30 yr. (3)	25-30 yr. (3)	25-30 yr. (3)	25-30 yr. (3)	25-30 yr (3)	25-30 yr (3)	25-30 yr (3)	25-30 yr (3)	25-30 yr (3)	25-30 yr (3)

TABLE A-1 (Cont.)

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVE SCREENING FACTORS[a]

	Alt. No. 1	Alt No. 2	Alt. No. 3	Alt. No. 4	Alt. No. 5	Alt. No. 6	Alt. No. 7	Alt. No. 8	Alt. No. 9	Alt. No. 10
7. - Quantity of untreated waste after remediation	≥50% (0)	≥50% (0)	≥50% (0)	≥50% (0)	≥50% (0)	≥50% (0)	≥50%(0)	≥50% (0)	≥50% (0)	≥50% (0)
- Treated residual left at site?	NA	NA	Some (1)	NA	Some (1)	NA	NA	Some (1)	Some (1)	Some (1)
- Is treated residual toxic?	--	--	No (0.5)	--	No (0.5)	--	--	No (0.5)	No (0.5)	No (0.5)
- Is treated residual mobile?	--	--	No (0.5)	--	No (0.5)	--	--	No (0.5)	No (0.5)	No (0.5)
8. - Duration of O&M	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)
- Env. controls required as part of remedy?	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
- Degree of confidence in controls	Somewhat (0)	Somewhat (0)	Very (1)	Very (1)	Very (1)	Very (1)	Very (1)	Somewhat (1)	Very (1)	Very (1)
- Degree of long term monitoring required	Minimum (2)	Minimum (2)	Ext (0)	Mod (1)	Ext (01)	Mod (1)	Mod (1)	Ext (0)	Ext (0)	Ext (0)
Short/Long Term Effectiveness Subtotal	14	14	11.5	9	11.5	9	11	11	11.5	11.5
Implementability										
1. - Technical Feasibility										
- Difficulty of Construction	i (3)	i (3)	iii (1)	iii (1)	ii (2)	iii (1)	ii (2)	iii (1)	iii (1)	iii (1)
- Reliability of technology	i (3)	i (3)	i (3)	i (3)	i (3)	i (3)	i (3)	i (3)	i (3)	i (3)

TABLE A-1 (Cont.)

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVE SCREENING FACTORS[a]

	Alt. No. 1	Alt No. 2	Alt. No. 3	Alt. No. 4	Alt. No. 5	Alt. No. 6	Alt. No. 7	Alt. No. 8	Alt. No. 9	Alt. No. 10
- Delays?	i (2)	i (2)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)
- Additional remedial action needed?	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)	ii (1)
2. - Administrative Feasibility										
- Coordination with other agencies	i (2)	i (2)	iii (0)	ii (1)	iii (0)	ii (1)	ii (1)	iii (0)	iii (0)	iii (0)
3. - Availability of Services and Materials										
- Availability of technologies?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
- More than one vendor?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
- Equipment available?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
Implementability Subtotal	14	14	9	10	10	10	9	9	9	9
TOTAL SCORE	28	28	20.5	19	21.5	19	22	20	20.5	20.5

[a] Source: New York State Department of Environmental Conservation Division of Hazardous Remediation, Albany, NY Technical and Administrative Guidance Memorandum (TAGM) for Selection of Remedial Actions at Inactive Hazardous Waste Sites.

NA = Not Applicable
- = Answer skipped due to previous answer
✓ = This option included in alternative
(3) = Score suggested in TAGM.
i,ii or iii = Corresponding answer listed in TAGM.

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVES DETAILED ANALYSIS SCREENING FACTORS[a]

	Alternative No. 1	Alternative No. 6	Alternative No. 10
Compliance with SCG's			
1. Chemical - specific	No (0)	Yes (2.5)	Yes (4)
2. Action - specific	No (0)	Yes (3)	Yes (3)
3. Location - specific	No (0)	Yes (3)	Yes (3)
Compliance subtotal	0	8.5	10
Protection of Human Health and the Environment			
1. - Unrestricted land use after remediation?	No (0)	No (0)	No (0)
2. - Is exposure to contaminants after remediation acceptable:			
- via air pathway?	Yes (3)	Yes (3)	Yes (3)
- via surface/ground water pathway?	SW only (1)	Mostly (3)	Yes (4)
- via soils/sediments pathway?	No (0)	Yes (3)	Yes (3)
3. - Magnitude of health risk after remediation	High (2)	Moderate (3)	Low (5)
4. - Magnitude of residual risks after remediation	High (0)	Moderate (3)	Low (4)
Protectiveness Subtotal	6	15	19
Short Term Effectiveness			
1. - Significant short term risk to community	No (4)	Yes (0)	Yes (0)
- Can short term risks be controlled?	N/A	Yes (1)	Yes (1)
- Does mitigation of short term risks impact community?	N/A	Yes (0)	Yes (0)
2. - Significant short term risk to environment?	No (4)	Yes (0)	Yes (0)
- Are reliable mitigative measures available?	N/A	Partially (2)	Partially (2)
3. - Time required to implement	≤2 yr. (1)	>2 yr. (0)	>2 yr. (0)
- Required duration of mitigation for short term risk	≤2 yr. (1)	>2 yr. (0)	>2 yr. (0)
Short-term effectiveness subtotal	10	3	3

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVES DETAILED ANALYSIS SCREENING FACTORS[a]

	Alternative No. 1	Alternative No. 6	Alternative No. 10
Long Term Effectiveness and Permanence			
1. - Type of treatment or land disposal	N/A	Land Disposal (0)	Onsite Treatment (3)
2. - Is remedy permanent?	No (0)	No (0)	Yes, For GW (2)
3. - Expected lifetime of remedy	25-30 yr. (3)	25-30 yr. (3)	25-30 yr. (3)
4. - Quantity of untreated waste after remediation	≥50% (0)	≥50% (0)	25-50% (1) - GW
- Is treated residual left at site?	No (2)	No (2)	No (2)
- Is treated residual toxic?	N/A	N/A	N/A
- Is treated residual mobile?	N/A	N/A	N/A
5. - Duration of O&M	>5 yr. (0)	>5 yr. (0)	>5 yr. (0)
- Env. controls required as part of remedy?	Yes (0)	Yes (0)	Yes (0)
- Degree of confidence in controls	Moderate (1)	Moderate (1)	Moderate (1)
- Degree of long term monitoring required	Minimum (2)	Moderate (1)	Extensive (0)
Long Term Effectiveness Subtotal	8	7	12
Reduction of Toxicity, Mobility or Volume			
1. Volume of hazardous waste reduced			
- Quantity destroyed or treated	None (0)	None (0)	20-40% - GW (1)
- Are untreated or conc. wastes produced?	No (2)	No (2)	Yes (0)
- Disposal method for residual wastes	N/A	N/A	Offsite disposal (0)
2. Reduction in mobility			
- Quantity of waste immobilized	< 60% (0)	< 60% (0)	<60% (0)
- Method of Immobilization	N/A	N/A	Containment (1)

PFOHL BROTHERS LANDFILL FEASIBILITY STUDY
SUMMARY OF NEW YORK STATE REMEDIAL ALTERNATIVES DETAILED ANALYSIS SCREENING FACTORS[a]

	Alternative No. 1	Alternative No. 6	Alternative No. 10
3. Irreversibility of the destruction, treatment or immobilization	N/A (0)	N/A (0)	Partially (2)
Reduction of Toxicity, Mobility or Volume Subtotal	2	2	4
Implementability			
1. Technical Feasibility			
- Difficulty of Construction	Easy (3)	Moderate (2)	Difficult (1)
- Reliability of technology	Very (3)	Somewhat (2)	Very (3)
- Likelihood of delays	Unlikely (2)	Likely (1)	Likely (1)
- Need for additional remedial action	Yes (1)	Yes (1)	No (2)
2. Administrative Feasibility			
- Degree of coordination with other agencies	Minimum (2)	Normal (1)	Normal (1)
3. Availability of Services and Materials			
- Availability of technologies?	Yes (1)	Yes (1)	Yes (1)
- More than one vendor?	Yes (1)	Yes (1)	Yes (1)
- Equipment available?	Yes (1)	Yes (1)	Yes (1)
Implementability Subtotal	14	10	11
TOTAL SCORE	40	45.5	59

[a] Source: New York State Department of Environmental Conservation Division of Hazardous Waste Remediation, Albany, NY Technical and Administrative Guidance Memorandum (TAGM) for Selection of Remedial Actions at Inactive Hazardous Waste Sites, Tables 5.2 through 5.7.

N/A = Not Applicable
(3) = Score relative to maximum TAGM value.

APPENDIX B

DETAILED COST ESTIMATES

B.1 DESCRIPTION OF COST ESTIMATING PROCEDURE

Costs for each alternative were developed as follows. Direct capital costs include materials, labor and equipment costs for the remedial action items in each alternative. Indirect capital costs were established as percentages of direct capital costs, and include Engineering and Design costs, contingency allowances to cover costs related to unforeseen circumstances, health and safety requirements, other direct costs such as legal and regulatory fees, and mobilization/demobilization costs incurred by the construction crews.

Annual O&M costs are post-construction costs which include the yearly costs for site upkeep and the off-site groundwater monitoring program. Periodic O&M costs are post-construction costs which do not occur on a yearly basis such as the five-year Public Health Evaluation.

Costs were evaluated over a 30-year period (unless noted otherwise) presented as a Present Worth Total Cost. The present worth factor of the annual costs was calculated as follows:

$$A = \frac{(1+t)^N - 1}{t(1+t)^N}$$

Where N - Design Life = 30 years
t - Discount Rate = 9%

The present worth factor (A) for periodic costs was calculated using the following formula:

$$A = \frac{\overset{B}{\Sigma}}{t-1} \left[\frac{1}{(1+t)^N} \right] t$$

Where B = $\frac{\text{Design Life}}{\text{N}}$
t - Discount Rate = 9%
N - Period Frequency

Filename: ALT1A.WK1

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 28-Aug-91 02:48 PM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 1: NO ACTION

DESCRIPTION: Ground water quality monitoring.

DIRECT CAPITAL COSTS
(Includes Labor, Equipment & Materials, Unless Otherwise Noted)

COST COMPONENT	UNIT	QUANTITY	UNIT COST	TOTAL CAPITAL COST
1. Additional Groundwater Monitoring Wells	EA	0	$0	$0
TOTAL DIRECT CAPITAL COSTS				$0
INDIRECT CAPITAL COSTS (% of Direct Capital Costs)				
1. Engineering & Design (15%)				$0
2. Contingency Allowance (20%)				$0
3. Other Indirect Costs				
A. Legal (3%)				$0
B. Regulatory (3%)				$0
C. Mobilization/Demobilization (5%)				$0
TOTAL INDIRECT CAPITAL COSTS				$0
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)				$0

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 28-Aug-91 02:48 PM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL
FEASIBILITY STUDY

ALTERNATIVE 1: NO ACTION

DIRECT ANNUAL/PERIODIC COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT ANNUAL COST	LIFE OF ITEM (YEARS)	PRESENT WORTH (to nearest 1000's) ANNUAL COSTS	PRESENT WORTH (to nearest 1000's) PERIODIC COSTS
1. Groundwater monitoring								
a. Groundwater sampling	EA	ANNUAL	10	$500	$5,000	30	$51,000	n/a
b. Sample analysis	EA	ANNUAL	10	$1,000	$10,000	30	$103,000	n/a
c. Well O&M	EA	ANNUAL	1	$20,000	$20,000	30	$205,000	n/a
2. Public Health Evaluation	EA	EVERY 5 YRS	1	$40,000	n/a	5	n/a	$66,000
3. Fence Upkeep	EA	ANNUAL	1	$500	$500	30	$5,000	n/a
TOTAL DIRECT ANNUAL COSTS:					$35,500			
TOTAL PRESENT WORTH ANNUAL COSTS:							$364,000	
TOTAL PRESENT WORTH PERIODIC COSTS:								$66,000
TOTAL PRESENT WORTH OF DIRECT ANNUAL/PERIODIC COSTS:								$430,000

INDIRECT ANNUAL/PERIODIC COSTS (PERCENTAGE OF DIRECT ANNUAL COSTS):

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT ANNUAL COST	LIFE OF ITEM (YEARS)	ANNUAL COSTS	PERIODIC COSTS
1. Administration (10%)	EA	ANNUAL	1		$3,600	30	$37,000	n/a
2. Maintenance Reserve & Contingency Costs (25%)	EA	ANNUAL	1		$8,900	30	$91,000	n/a
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS:								$128,000

TOTAL PRESENT WORTH (Capital & Annual/Periodic) COSTS:	$560,000

Filename: ALT6A.WQ1

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 12-Sep-91 11:45 AM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 6

DESCRIPTION: Construction of a NYS single barrier cap, off-site wetland replacement
select landfill solids/soils excavation and on-site disposal,
slurry wall containment, and off-site groundwater monitoring.

DIRECT CAPITAL COSTS
(Includes Labor, Equipment & Materials, Unless Otherwise Noted)

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST (to nearest 1000's)
1.Site Preparation				
a. Clear w/ Hydro-ax	AC	115	$1,300.00	$150,000
b. Mulch	AC	115	$700.00	$81,000
2. Excavation, Spreading & Grading				
a. Areas < 4 ft fill	CY	54900	$10.60	$582,000
b. Dust control	LS		$199,800.00	$200,000
c. Backfill and Reveg.	CY	54900	$13.20	$725,000
3. Capping				
a. Seeding	LS	1	$112,800.00	$113,000
b. 6" Topsoil	CY	88700	$19.20	$1,703,000
c. 24" Barrier protection layer	CY	354800	$13.62	$4,832,000
d. 6" Drainage layer	CY	88700	$26.67	$2,366,000
e. 40 mil liner	SY	532400	$7.27	$3,871,000
f. Filter fabric	SY	1597200	$3.34	$5,335,000
g. 12" Gas venting layer	CY	177467	$26.67	$4,733,000
h. Passive gas vents	LS	115	$3,000.00	$345,000
i. Contouring fill	CY	317500	$13.62	$4,324,000
j. Erosion control	CY	1000	$35.67	$36,000
k. Compaction	CY	204100	$3.50	$714,000
4. Wetlands				
a. Land	AC	1	$10,000.00	$10,000
b. Clear & Grub	AC	1	$1,000.00	$1,000
c. Grading	CY	4840	$2.00	$10,000
d. Planting	LS	1	$1,800.00	$2,000
e. Permit	LS	1	$5,100.00	$5,000
f. Coordination/management	LS	1	$32,600.00	$33,000
5. Slurry wall	LS	1	$664,900.00	$665,000
TOTAL DIRECT CAPITAL COSTS				$30,840,000

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET
(+50% to -30% Level)

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 6

INDIRECT CAPITAL COSTS (% of Direct Capital Costs)

1. Engineering & Design (15%)	$4,626,000
2. Contingency Allowance (20%)	$6,168,000
3. Health and Safety Requirements/Facilities	$200,000
4. Other Indirect Costs	
A. Legal (3%)	$930,000
B. Regulatory (3%)	$930,000
C. Mobilization/Demobilization (1%)	$308,000
TOTAL INDIRECT CAPITAL COSTS	$13,160,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)	$44,000,000

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 12-Sep-91 11:45 AM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 6

DIRECT ANNUAL/PERIODIC COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YEAR)	UNIT COST	DIRECT ANNUAL COST	LIFE OF ITEM (YEARS)	PRESENT WORTH (to nearest 1000s)	
							ANNUAL COSTS	PERIODIC COSTS
DIRECT ANNUAL/PERIODIC COSTS								
1.Cap								
a. Inspection	EA	ANNUAL	1	$2,000	$2,000	30	$21,000	n/a
b. Mowing	EA	ANNUAL	1	$35,400	$35,400	30	$364,000	n/a
c. Cap Repair & Maintenance	EA	ANNUAL	1	$11,500	$11,500	30	$118,000	n/a
2. Fence Upkeep	EA	ANNUAL	1	$500	$500	30	$5,000	n/a
3.. Off-site Groundwater Monitoring								
a. Groundwater well sampling	EA	ANNUAL	8	$500	$4,000	30	$41,000	n/a
b. Sample analysis	EA	ANNUAL	8	$1,000	$8,000	30	$82,000	n/a
c. Well O&M	LS	ANNUAL	1	$20,000	$20,000	30	$205,000	n/a
4. Public Health Evaluation	EA	EVERY 5 YRS	1	$40,000	n/a	5	n/a	$66,000
TOTAL DIRECT ANNUAL COSTS:					$81,000			
TOTAL PRESENT WORTH OF DIRECT COSTS:							$836,000	
TOTAL PRESENT WORTH OF DIRECT PERIODIC COSTS:								$66,000
TOTAL PRESENT WORTH OF DIRECT ANNUAL/PERIODIC COSTS:								$902,000
INDIRECT ANNUAL/PERIODIC COSTS (Percentage of Total Direct Annual Costs):								
Administration (10%)	LS	ANNUAL	1		$8,100	30	$83,000	n/a
Maintenance Reserve & Contingency Costs (25%)	LS	ANNUAL	1		$20,300	30	$209,000	n/a
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS:								$292,000
TOTAL PRESENT WORTH (Capital & Annual/Periodic) COSTS:								$45,194,000

Filename: ALT10A.WQ1

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 12-Sep-91 11:36 AM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 10

DESCRIPTION: Construction of a NYS single barrier cap, off-site wetland replacement
select landfill solids/soils excavation and on-site disposal,
slurry wall containment, and off-site groundwater monitoring.

DIRECT CAPITAL COSTS
(Includes Labor, Equipment & Materials, Unless Otherwise Noted)

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST (to nearest 1000s)
1.Site Preparation				
a. Clear w/ Hydro-ax	AC	115	$1,300.00	$150,000
b. Mulch	AC	115	$700.00	$81,000
2. Excavation, Spreading & Grading				
a. Areas < 4 ft fill	CY	54900	$10.60	$582,000
b. Dust control	LS		$199,800.00	$200,000
c. Backfill and Reveg.	CY	54900	$13.20	$725,000
3. Capping				
a. Seeding	LS	1	$112,800.00	$113,000
b. 6" Topsoil	CY	88700	$19.20	$1,703,000
c. 24" Barrier protection layer	CY	354800	$13.62	$4,832,000
d. 6" Drainage layer	CY	88700	$26.67	$2,366,000
e. 40 mil liner	SY	532400	$7.27	$3,871,000
f. Filter fabric	SY	1597200	$3.34	$5,335,000
g. 12" Gas venting layer	CY	177467	$26.67	$4,733,000
h. Passive gas vents	LS	115	$3,000.00	$345,000
i. Contouring fill	CY	317500	$13.62	$4,324,000
j. Erosion control	CY	1000	$35.67	$36,000
k. Compaction	CY	204100	$3.50	$714,000
4. Wetlands				
a. Land	AC	1	$10,000.00	$10,000
b. Clear & Grub	AC	1	$1,000.00	$1,000
c. Grading	CY	4840	$2.00	$10,000
d. Planting	LS	1	$1,800.00	$2,000
e. Permit	LS	1	$5,100.00	$5,000
f. Coordination/management	LS	1	$32,600.00	$33,000
5. Slurry wall	LS	1	$664,900.00	$665,000
6. Groundwater extraction system	LS	1	$240,000.00	$240,000
7. Onsite groundwater treatment				
a. Equipment	LS	1	$289,000.00	$289,000
b. Installation	LS	1	$144,500.00	$145,000
c. Piping	LS	1	$28,900.00	$29,000
TOTAL DIRECT CAPITAL COSTS				$31,540,000

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET
(+50% to -30% Level)

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 10

INDIRECT CAPITAL COSTS (% of Direct Capital Costs)	
1. Engineering & Design (15%)	$4,731,000
2. Contingency Allowance (20%)	$6,308,000
3. Health and Safety Requirements/Facilities	$200,000
4. Other Indirect Costs	
A. Legal (3%)	$950,000
B. Regulatory (3%)	$950,000
C. Mobilization/Demobilization (1%)	$315,000
TOTAL INDIRECT CAPITAL COSTS	$13,450,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)	$44,990,000

SCREENING OF REMEDIAL ACTION ALTERNATIVES
COST ESTIMATING WORKSHEET DATE: 12-Sep-91 11:36 AM
(+50% to -30% Level) BY: MED

PROJECT: PFOHL BROTHERS LANDFILL SITE
FEASIBILITY STUDY

ALTERNATIVE 10

DIRECT ANNUAL/PERIODIC COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YEAR)	UNIT COST	DIRECT ANNUAL COST	LIFE OF ITEM (YEARS)	PRESENT WORTH (to nearest 1000s) ANNUAL COSTS	PERIODIC COSTS
DIRECT ANNUAL/PERIODIC COSTS								
1.Cap								
a. Inspection	EA	ANNUAL	1	$2,000	$2,000	30	$21,000	n/a
b. Mowing	EA	ANNUAL	1	$35,400	$35,400	30	$364,000	n/a
c. Cap Repair & Maintenance	EA	ANNUAL	1	$11,500	$11,500	30	$118,000	n/a
2. Fence Upkeep	EA	ANNUAL	1	$500	$500	30	$5,000	n/a
3.. Off-site Groundwater Monitoring								
a. Groundwater well sampling	EA	ANNUAL	8	$500	$4,000	30	$41,000	n/a
b. Sample analysis	EA	ANNUAL	8	$1,000	$8,000	30	$82,000	n/a
c. Well O&M	LS	ANNUAL	1	$20,000	$20,000	30	$205,000	n/a
4. Public Health Evaluation	EA	EVERY 5 YRS	1	$40,000	n/a	5	n/a	$66,000
3. Groundwater extraction	LS	ANNUAL	1	$9,200	$9,200	30	$95,000	n/a
4. Treatment plant O&M (incl sludge disposal)								
a. Plant O&M	LS	ANNUAL	1	$46,200	$46,200	30	$475,000	n/a
b. Sludge disposal	LS	ANNUAL	1	$68,700	$68,700	30	$706,000	n/a
c. GAC O&M	LS	ANNUAL	1	$424,000	$424,000	30	$4,356,000	n/a
TOTAL DIRECT ANNUAL COSTS:					$630,000			
TOTAL PRESENT WORTH OF DIRECT COSTS:							$6,468,000	
TOTAL PRESENT WORTH OF DIRECT PERIODIC COSTS:								$66,000
TOTAL PRESENT WORTH OF DIRECT ANNUAL/PERIODIC COSTS:								$6,534,000
NDIRECT ANNUAL/PERIODIC COSTS (Percentage of Total Direct Annual Costs):								
Administration (10%)	LS	ANNUAL	1		$63,000	30	$647,000	n/a
Maintenance Reserve & Contingency Costs (25%)	LS	ANNUAL	1		$157,500	30	$1,618,000	n/a
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS:								$2,265,000
TOTAL PRESENT WORTH (Capital & Annual/Periodic) COSTS:								$53,789,000