# FEASIBILITY STUDY REPORT

# TRIMMER ROAD LANDFILL SITE

Town of Parma, Monroe County , New York
(Site Registry No. 8-28-012)

WORK ASSIGNMENT NO. D003600-12

Prepared For

## New York State Department of Environmental Conservation

FEBRUARY 2001

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

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**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

*By*

**DVIRKA AND BARTILUCCI CONSULTING ENGINEERS**
**WOODBURY, NEW YORK**

**FEBRUARY 2001**

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approximate 10-acre manmade pond and an approximate 7-acre parcel of land containing the landfill access road. The landfill portion of the site consists of a nearly square parcel of land that is elevated approximately 10 to 25 feet relative to the surrounding land surface (see Figure 1-2). Waste appears to have been buried up to the site boundaries in the area of the landfill. The manmade pond, which is about 10 acres in size, is located adjacent to the landfill area on the northeastern side of the site. A perimeter drainage ditch flows along a portion of the southern boundary of the site, turns north and flows along the eastern boundary and drains into the pond. A second perimeter ditch flows eastward along a portion of the northern boundary of the site and also discharges into the pond. The pond discharges to a tributary of Buttonwood Creek, which is a Class C stream that drains into Lake Ontario.

The site is bordered by undeveloped land on all sides. Access to the site is via a 1/4-mile long private road with a locked gate adjacent to Trimmer Road. Access can also be gained to the site by walking through forested land and following recreational vehicle trails. The site is not fenced, and is presently unused and overgrown with emergent trees and scrub growth.

The Trimmer Road Landfill was a private disposal facility that accepted municipal waste from surrounding towns of Monroe County and industrial waste from local industries. There are reports that drums were disposed at the site. Efforts to confirm these reports have not produced evidence to confirm them. There are also reports that wastes from several local industrial facilities were collected and disposed at the site. Some of these industries are known to have produced hazardous waste. While there is no direct evidence of disposal of hazardous waste at the Trimmer Road Landfill, chemical analyses of groundwater samples indicate the presence of chlorinated volatile organic compounds, such as vinyl chloride, dichloroethene and chlorobenzene.

The Trimmer Road Landfill was in violation of NYSDEC regulations for sanitary landfills for much of the time it operated. Violations cited by the Monroe County Health Department included refuse burned on-site; refuse not spread, compacted and covered; refuse protruding through cover; vermin and insect infestation; insufficient grading; uncontrolled release of leachate; and blowing paper.

## 1.0 INTRODUCTION

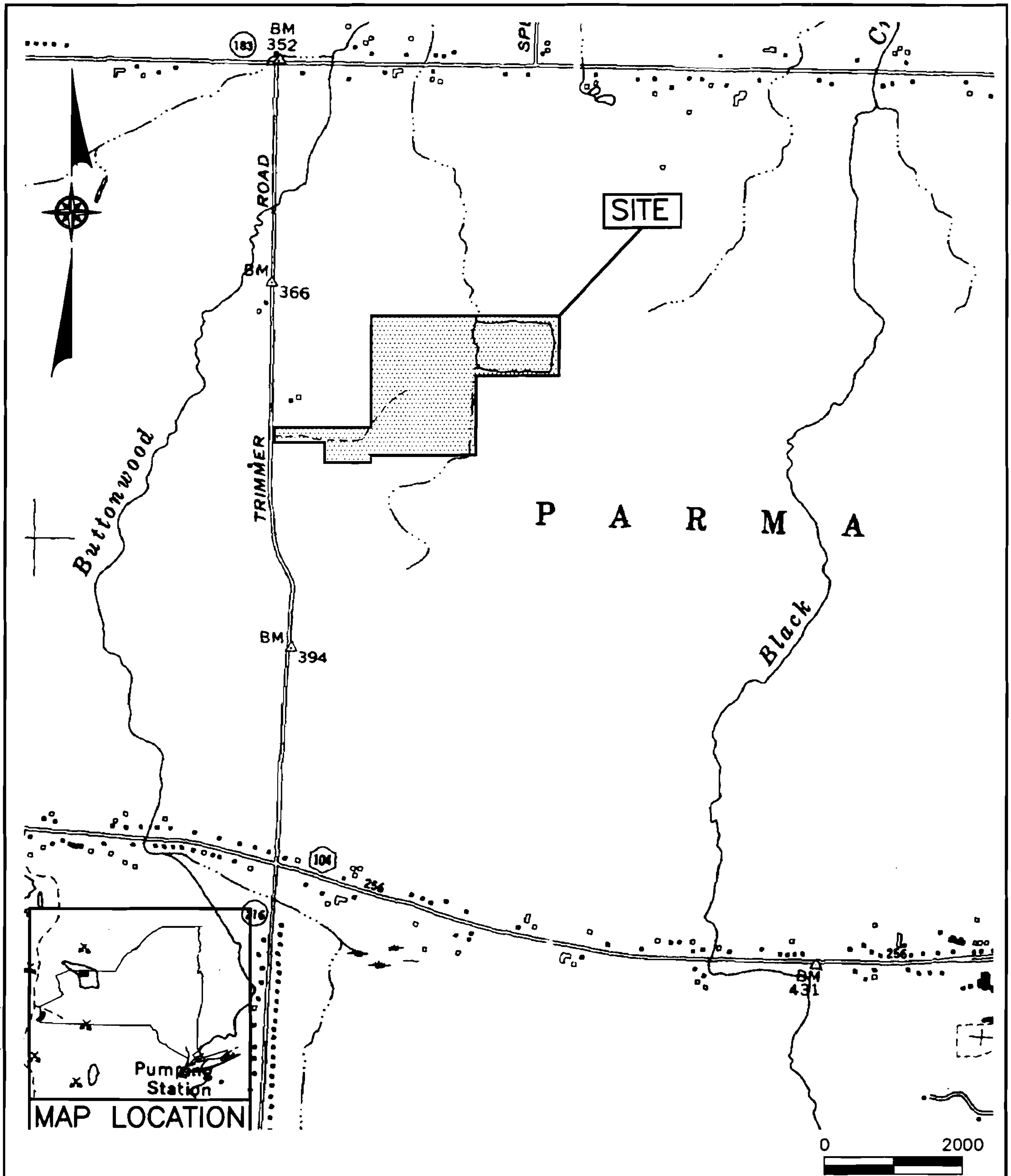
This section describes the purpose of the feasibility study for the Trimmer Road Landfill Site, and provides a description of the site and site background, summary of the remedial investigation results and risk assessment, definition of the remedial action objectives, and description and approach to the feasibility study.

### 1.1 Purpose and Site Background

As part of New York State's program to investigate and remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) issued a Work Assignment to Dvirka and Bartilucci Consulting Engineers (D&B) under the State Superfund Standby Contract between D&B and NYSDEC, to conduct a remedial investigation and feasibility study (RI/FS) for the Trimmer Road Landfill Site located in the Town of Parma, Monroe County, New York (see Figure 1-1). The Trimmer Road Landfill is listed as a Class 2 site on the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites (Site No. 8-28-012). A Class 2 site is one that represents a "significant threat to public health or environment and some action is required."

The objectives of the RI/FS are to determine the nature, extent and source of contamination resulting from hazardous waste disposal; ascertain the threat to human health and the environment; and develop a long-term cost effective remedial action that will be protective of human health and the environment.

The Trimmer Road Landfill Site is located in a rural agricultural area of Monroe County on Trimmer Road in the Town of Parma. The site is approximately 2 miles northwest of Parma Corners and 10 miles northwest of the City of Rochester (see Figure 1-1). The site is the location of a former, privately-owned landfilling operation that reportedly accepted municipal and industrial waste from suburban townships in the Rochester area. A reported 40-acre section of the 60-acre site was used for landfilling, which occurred between 1952 and 1974. The property on which the Trimmer Road Landfill is located contains a 40-acre landfill, an




SOURCE: N.Y.S. DOT SPENCER PORT QUADRANGLE, N.Y.

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TRIMMER ROAD LANDFILL
TOWN OF PARMA, NEW YORK

SITE LOCATION MAP

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FIGURE 1-1

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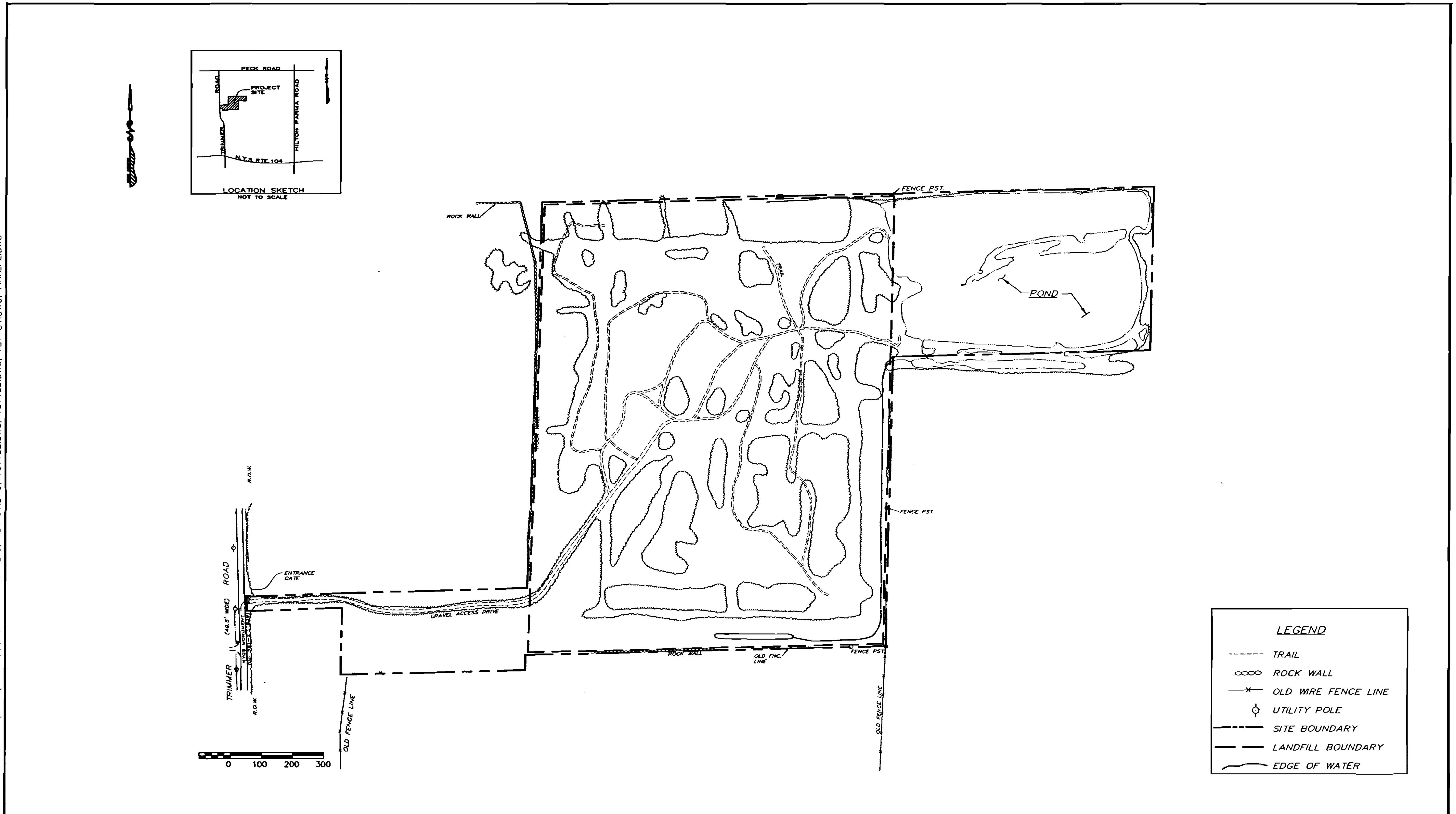


TRIMMER ROAD LANDFILL
TOWN OF PARMA, NEW YORK

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SITE MAP

FIGURE 1–2

A Phase I Investigation conducted in 1983 for NYSDEC identified sparse vegetation on the landfilled area with debris protruding through the ground cover. At that time, numerous leachate seeps were noted discharging from the toe of the fill.

A Phase II Investigation conducted in 1986 for NYSDEC found organic compounds and metals contamination in groundwater, and established that the groundwater flow direction in the overburden is to the northwest. Leachate from landfill seeps was noted entering the perimeter drainage ditch and discharging to the pond in the northeast portion of the site.

This feasibility study has been prepared based on the results of the remedial investigation and in accordance with the federal Comprehensive Emergency Response, Compensation and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act (SARA) and the New York State Superfund Program, including the NYSDEC Technical and Administrative Guidance Memorandum (TAGM HWR-90-4030) for "Selection of Remedial Actions at Inactive Hazardous Waste Sites."

## 1.2 Remedial Investigation Results

The following is a summary of the findings and conclusions resulting from the remedial investigation, and exposure and habitat-based assessments conducted for the Trimmer Road Landfill Site as a function of the media investigated. These findings and conclusions are based on comparison of the investigation results to standards, criteria and guidelines (SCGs) selected for the site. The results of the investigation are described in detail in the Remedial Investigation Report, dated October 2000.

<u>Topography</u>

The Trimmer Road Landfill Site is located in a poorly drained, relatively flat lying portion of the lake plain of Lake Ontario. Regional ground surface slopes gently (1%) to the north toward Lake Ontario. The natural ground surface at the perimeter of the site ranges from 387 feet above mean sea level (amsl) at the southeast corner to approximately 370 feet amsl at the northeast corner. The landfill surface is 10 to 25 feet above the original ground surface with maximum elevation of approximately 396 feet in the north central portion. Landfill side slopes, located adjacent to the site boundaries range from 12% to 18% on all sides with the exception of the access road. The access road slopes downward to the southwest at 1%. The surface of the landfill is generally flat-lying with localized depressions and hummocks, and is poorly drained.

Site Drainage

Surface water drainage over the landfill site is controlled by topography resulting from the landfill operation. Differential settling of waste and poorly compacted cover material have resulted in a hummocky surface over much of the site. Ponding of surface water is common between topographic highs. In other areas of the site, the ground surface slopes to the property lines and surface water flows offsite or to the perimeter ditch.

Regional drainage is generally to the northeast toward Lake Ontario. The area around the site is generally poorly drained and exhibits standing water following heavy rains or snow melt. Several distributary channels have been observed during heavy rains or snowmelt due to the poorly developed drainage patterns caused by low relief and low permeability soils.

Two intermittent streams convey surface water flow toward and away from the site. The first stream flows into the perimeter ditch south of the site. The perimeter ditch directs surface water flow east to the southeast corner of the landfill, and then northward along the east perimeter ditch until it discharges into the pond. The pond is the headwater for the second intermittent stream. The outlet stream of the pond flows northward and ultimately to a tributary of Buttonwood Creek.

Landfill Characteristics and Site Geology

Aerial photography and subsurface soil investigation of the site suggest that the ground surface was stripped of topsoil and subsurface soils down to bedrock, or very dense weathered bedrock or soil, before waste was deposited. Many of the backhoe test pits excavated during the remedial investigation encountered waste at elevations below the existing off-site ground surface, indicating that this surface was removed prior to waste deposition. The manmade pond was likely excavated and the material from it used as cover material for the landfill or it was mined for off-site use.

Soil cover over the landfill site is spotty and thin. Large trees and bushes are common across the site. Waste can be observed protruding through the thin soil cover and in the roots of fallen trees in many locations. The thickness of soil covering waste is generally between 0.5 foot and 2 feet as observed in 17 of the 20 test pits that encountered waste. The occurrence of buried waste is confined within the site property boundaries. The absence of off-site buried waste was confirmed by several backhoe test pits on, or adjacent to, the property lines, and observations of natural ground surface and soil conditions. Waste has been observed on properties adjacent to the site, however this waste appears randomly located and consists of surface debris covered with leaves that probably blew or rolled off-site during the operation of the landfill.

The thickness of waste at the site ranges from 0 feet near the site boundaries to about 25 feet near the center of the site. Based on aerial photographs and test pit data, the bottom of the landfill is flat lying and was probably excavated to a depth of 1 to 3 feet below the surrounding land surface, exposing bedrock. It appears that overburden soils were stripped and may have been mined for topsoil or stockpiled for landfill cover material. Backhoe test pit excavations and soil boring results indicate that waste in the landfill was placed directly on the bedrock surface.

Off-site overburden consists of a single surficial deposit of reddish brown poorly sorted silt and fine sand ranging from 2 feet to 7 feet thick. The transition from the overburden to bedrock is gradational. In some off-site locations, the separation between overburden and bedrock is marked by a courser lag deposit of fairly well sorted sand or gravel overlying the bedrock. In many other places, the soft weathered bedrock appears as a massive red silt.

Bedrock beneath the site is mapped as the Queenston shale (Rickard, 1970). Bedrock is generally shallow (less than 7 feet below ground surface). Shallow bedrock is evident by the frequency of tabular cobbles and boulders found at or near ground surface. The shallow bedrock is also reflected by the poorly developed, shallow root structures of many trees in the forested area around the site. Many trees have blown over due to poor root systems. The wide and shallow root masses that they reveal, along with the lack of well developed tap roots, suggests impenetrable subsurface (i.e., bedrock) at shallow depths.

The upper bedrock is predominantly siltstone which is relatively soft. Bedrock wells were often drilled to depths of 10 to 15 feet using hollow stem augers before rock coring was performed. Rock cores at each of the deep monitoring well locations indicated the presence of relatively low water yielding fractures in the bedrock. Rock quality designations (RQDs) indicated generally massive bedrock and averaged 81%.

Site Hydrogeology

Shallow groundwater flow occurs in the thin overburden deposits that overlie bedrock. Off-site shallow groundwater flow is local and influenced by the hummocky topography surrounding the site. On-site it is radial within the landfill. The landfill is the most significant topographic feature in the area. Precipitation falling on the landfill either runs off to the perimeter ditch or infiltrates downward through the cover material and fill, then flows away from the center of the landfill. With the exception of leachate seeps, no channeled surface water drainage has been observed off the landfill. Where no ditches exist, shallow groundwater discharges create wetland areas adjacent to the landfill. The geometric mean of shallow well hydraulic conductivity values is $5.5 \times 10^{-5}$ cm/s. Using two different methods, the values range between $1.1 \times 10^{-6}$ cm/sec and $9.6 \times 10^{-4}$. Beyond the landfill site, shallow groundwater flow follows the regional groundwater flow, which is to the north.

Groundwater flow in bedrock at the site is generally toward the northwest. Bedrock is the Queenston shale formation which is comprised of sandstone and siltstone beds. These beds are generally massive, and primary porosity and permeability are very low. The beds contain fractures and secondary porosity and permeability through the fracture network is significantly higher than through the rock matrix itself. Hydraulic conductivity testing of the deep monitoring wells indicates a geometric mean hydraulic conductivity of $8.9 \times 10^{-5}$ cm/s. Using two different methods, the values range between $2.0 \times 10^{-6}$ and $2.1 \times 10^{-3}$ cm/sec. The results can be found in Appendix D of the Remedial Investigation report.

Landfill Gas

Results of landfill gas monitoring conducted during the remedial investigation indicate that volatile organic compounds (VOCs) were not detectable (that is, they were less than 1 ppm) and methane occurs in low concentrations (less than 50 ppm, except for one location where an 86 ppm level was found). As a result, landfill gas is not a concern at the site.

Leachate

The concentrations of contaminants in leachate are relatively low. The highest concentration of total VOCs detected was 123 ug/l. Semivolatile organic compounds (SVOCs) concentrations are very low, with the maximum total SVOC concentration being 38 ug/l. A number of metals exceeded standards, criteria and guidelines, in particular iron, manganese and sodium, which significantly exceeded SCGs. There were no pesticides or PCBs detected in any leachate samples. Most leachate is flowing into the perimeter ditch along the east side of the landfill, where it causes a contravention of surface water SCGs, and into the pond east of the landfill. Based on these results, leachate is a concern.

Waste

Waste is exposed at ground surface in areas of the site and the thickness of soil cover over waste is less than 6 inches to 1 foot over other portions of the site. The exposed and thin cover over waste is a source of contamination which could result in surface migration of contaminants off the site and direct exposure to wildlife and humans. The waste throughout the landfill is also a continuing source of groundwater contamination. Therefore, waste is a concern at the site.

Subsurface Soil

Based on visual and PID screening of subsurface soils conducted during drilling of off-site monitoring wells, excavation of test pits and analysis of a subsurface soil sample collected from a test pit, no buried waste and no landfill-related contaminants occur in off-site subsurface soil. In the area of the landfill, waste appears to have been placed on bedrock and, in general, soil is not present beneath the waste. On-site subsurface soils that lie above or adjacent to waste do not appear to contain contaminants based on field observations. As a result, subsurface soil contamination is not a concern.

Groundwater

Shallow groundwater in the overburden at the northwest corner of the site is slightly contaminated with VOCs and metals. SVOCs (except for bis[2-ethylhexyl]phthalate) and pesticides, PCBs and cyanide were not detected above SCGs. Maximum total VOCs in the three water table monitoring wells along the northwest boundary of the landfill range from 204 ug/l to 428 ug/l, and generally comprise chlorinated hydrocarbons. Groundwater contaminant flow appears to be to the northwest (but has not impacted monitoring wells as close as 400 feet northwest of the landfill or downgradient private water supply wells).

Bedrock groundwater is not contaminated with VOCs, SVOCs, pesticides, PCBs or cyanide. Metals concentrations in bedrock groundwater exceed SCGs for some metals, but it is unclear whether the concentrations are background or landfill related. There are no apparent concentration differences between upgradient and downgradient monitoring wells. Although contaminant concentrations are not high, the migration of VOC and metals contaminated groundwater off-site is a concern.

Surface Water

Surface water samples indicate that landfill-related VOCs are present in surface water on or near the site; however, the concentrations do not exceed SCGs. In the one sample analyzed for the full suite of contaminants, SVOCs, pesticides and PCBs were not detected. Aluminum, iron and selenium exceed SCGs for the surface water sampled near the site. The metals are conveyed to the surface water through leachate seeps causing exceedances of surface water SCGs. The elevated concentrations of metals in surface water appear to only occur adjacent to the site. Based on these results, metals contamination of surface water is a concern.

Surface Water Sediment

Surface water sediment samples contained no exceedances of SCGs for VOCs, pesticides, PCBs or cyanide. Phenols were the only SVOC detected and had a concentration slightly above SCGs. Phenols were not detected in leachate or groundwater samples, and may be naturally occurring. Several metals were detected in exceedance of SCGs and, at one location, metals occur in concentrations above the severe effects level for benthic communities. These metals include iron and manganese, as well as arsenic, cadmium, nickel, silver and zinc. As a result, surface water sediment contamination is a concern.

Private Water Supply

Private water supply wells do not contain VOCs in exceedance of SCGs. Iron, was detected above water supply SCGs in one of the wells, but the concentration is comparable to groundwater sampled from upgradient monitoring wells near the site and is considered background. Since the private water supply wells are located downgradient of the site, VOC-contaminated groundwater is a concern.

## 1.3 Risk Assessment Results

Risks at and in the vicinity of the Trimmer Road Landfill Site were evaluated on the basis of the site environmental setting, and information on the nature and extent of contamination. The exposure assessment addresses the current and potential human contact with contaminants of concern at potential locations where human exposure could occur, and potential impacts to ecological receptors. The exposure assessment and wildlife habitat survey are included in the Remedial Investigation Report, dated October 2000. The following provides a summary of the findings and conclusions of the exposure and wildlife habitat assessments.

### 1.3.1 Exposure Assessment

The results of the remedial investigation indicate that waste is the contaminant source at the Trimmer Road Landfill Site. Contaminants have been detected above standards, criteria and guidelines established for the site in leachate, groundwater, surface water and surface water sediment. The contaminants of concern are volatile organic compounds and metals. VOCs above SCGs have been identified in leachate and groundwater, while metals above SCGs have been found in leachate, groundwater, surface water and surface water sediment. In general, based on existing data, contaminant concentrations are fairly low and confined to areas on or near the site.

Due to the remote location of the site, possible receptors are limited to trespassers, including hikers, horseback riders, ATV riders and hunters. These individuals are likely to be adults or teenage children. The only other potential human receptors are groundwater users downgradient from the site.

Exposure to contaminants originating from the site can come from any one of five media, which includes waste, leachate, groundwater, surface water and surface water sediment. Table 1-1 lists the status of exposure pathways identified at the site. Based on the remedial investigation results and exposure assessment, none of the pathways are currently complete and there is no immediate acute health hazard. However, source control is recommended to mitigate

Table 1-1

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**EXPOSURE PATHWAY STATUS FOR HUMAN RECEPTORS**

| Media | Exposure Point | Route of Exposure | Pathway Status |
|---|---|---|---|
| Waste | Landfill surface | Ingestion | Potentially complete, but unlikely |
| | Landfill surface | Inhalation | Potentially complete, but very unlikely |
| | Landfill surface | Dermal Contact | Potentially complete |
| Leachate | Seeps along southern, northern and eastern site boundary | Ingestion | Potentially complete, but unlikely |
| | Seeps along southern, northern and eastern site boundary | Inhalation | Potentially complete, but very unlikely |
| | Seeps along southern, northern and eastern site boundary | Dermal Contact | Potentially complete |
| | Monitoring and water supply wells | Ingestion | Potentially complete |
| Groundwater | Monitoring and water supply wells | Inhalation | Potentially complete |
| | Monitoring and water supply wells | Dermal Contact | Potentially complete |
| Surface Water | Perimeter ditch and pond | Ingestion | Potentially complete, but unlikely |
| | Perimeter ditch and pond | Inhalation | Potentially complete, but very unlikely |
| | Perimeter ditch and pond | Dermal Contact | Potentially complete |
| Surface Water Sediment | Perimeter ditch and pond | Ingestion | Potentially complete, but unlikely |
| | Perimeter ditch and pond | Inhalation | Potentially complete, but very unlikely |
| | Perimeter ditch and pond | Dermal Contact | Potentially complete |

groundwater contamination and leachate seeps to prevent contaminant migration away from the site, and the completion of potential exposure pathways and possible chronic exposures.

### 1.3.2 Wildlife Habitat Assessment

During the remedial investigation, signs of atypical biotic conditions were evaluated at the Trimmer Road Landfill Site. A few isolated instances of wildlife mortality were observed. A dead snapping turtle, great blue heron and deer were found on the site. Each showed evidence of attack by a predator. The area is utilized as a private hunting reserve, which could explain the remains of the deer.

A few dead trees are present adjacent to the landfill. Based on the review of historical aerial photographs, the surface water drainage patterns have shifted. It appears that the change in hydrology from the pond construction and shift in surface raised the water table just north of the pond. This could explain why the present community is a healthy silver maple, willow dominated wetland with remnant beeches.

The existing wetland communities appear to be very healthy and robust, indicating no evidence of effects of contamination from the landfill.

The intermittent nature of the stream which flows through the Trimmer Road Landfill Site results in a macroinvertebrate fauna that is low in richness and diversity both within the site and immediately upstream of the site, and likely excludes any resident fish populations. The presence of mayflies just upstream of the site and absence of these generally sensitive organisms within the landfill indicates that at least some level of impact is likely occurring. However, this impact may be more related to observed sedimentation in the stream from heavy erosion of the stream banks than to on-site contaminants. The abundance of mayflies within the pond indicates little if any stress is occurring to the benthic macroinvertebrate community in the pond.

The macroinvertebrates that were collected in both the stream and pond did not have any observable abnormalities and appeared healthy. Aquatic vegetation (mostly coontail) was observed along the entire shore of the pond and appeared healthy. Overall no evidence of contaminant-related stress was observed in either the stream or pond, although impacts from sedimentation in the stream is likely influencing the macroinvertebrate community.

Site-related chemicals could enter surface water through leachate discharge or runoff from the landfill surface. Soil particles eroded from the face of the landfill also become deposited within the surface water network. Organic compounds and metals tend to sorb to particulates that eventually end up as bottom sediment deposits. Once in the sediment, the chemicals may become unavailable, transform into other chemical forms or be incorporated into the food web.

Macroinvertebrate and fish sampling conducted near the site boundaries provides strong evidence that the aquatic community, both benthic and pelagic, has not been adversely impacted by the landfill. Metals contamination of some site sediments is likely to limit the community structure and abundance of the macroinvertebrate community at points of direct leachate discharge. However, these impacts appear to be localized.

Migration of any bioaccumulative compounds from the site would represent a potential threat to fish and wildlife receptors. Recent federal Water Quality Guidance for the Great Lakes lists 22 chemicals of special concern due to their toxicity, persistence, and potential for bioaccumulation. These chemicals include PCBs, mercury, DDT and metabolites, certain other pesticides, chlorinated benzene compounds and dioxin. None of these compounds were detected during the remedial investigation.

### 1.4 Remedial Action Objectives

Remedial action objectives are goals developed for the protection of human health and the environment. Definition of these objectives requires an assessment of the contaminants and media of concern, migration pathways, exposure routes and potential receptors. Typically, remediation goals are established based on standards, criteria and guidelines (SCGs) to protect human health and the environment. SCGs for the Trimmer Road Landfill Site, which were developed as part of the remedial investigation, include 6 NYCRR Part 360, NYSDEC Technical and Administration Guidance Memorandum (TAGM) No. 4046, *Determination of Soil Cleanup Objective and Cleanup Levels (1994)*, NYSDEC Technical and Operational Guidance Series (TOGS) (1.1.1), *Ambient Water Quality Standards And Guidance Values and Groundwater Effluent Limitations (1998) and NYSDEC Division of Fish and Wildlife/Division of Marine Resources Technical Guidance for Screening Contaminated Sediment (January 1999).* Based on these SCGs, the results of the remedial investigation and the human health risk and wildlife habitat assessments, the remedial action objectives developed for the site are the following:

1. Protection of human health through prevention of migration of contaminated groundwater to potable water supply wells;
2. Prevention of direct contact (dermal absorption, inhalation and incidental ingestion) with leachate and waste;
3. Reduction of infiltration of precipitation through waste, generation of leachate and adverse impacts to groundwater; and
4. Protection of ecological resources through prevention of migration of leachate to surface water and sediment.

In addition to consideration of SCGs to meet the remedial action objectives, Applicable or Relevant and Appropriate Requirements (ARARs) are considered when formulating, screening and evaluating remedial alternatives, and selecting a remedial action. ARARs may be categorized as contaminant-specific, location-specific or action-specific. Federal statutes, regulations and programs may apply to the site where state or local standards do not exist. Potentially applicable contaminant-specific, location-specific and action-specific ARARs for the Trimmer Road Landfill Site, along with guidance, advisories, criteria, memoranda and other information issued by regulatory agencies to be considered (TBC), are presented in Tables 1-2, 1-3 and 1-4. As a note, many of the NYSDEC ARARs include federal requirements which have been delegated to New York State. Generally, federal ARARs are referenced when state requirements do not exist.

## Table 1-2

### TRIMMER ROAD LANDFILL SITE
### FEASIBILITY STUDY REPORT
### POTENTIALLY APPLICABLE CHEMICAL-SPECIFIC ARARs/TBCs

| Citation/ Reference | Title | Applicable Media | Potential ARAR/TBC | Regulatory Agency |
|---|---|---|---|---|
| 6 NYCRR 360 | Solid Waste Management Facilities | Solid Waste | ARAR | NYSDEC |
| 6 NYCRR 371 | Identification and Listing of Hazardous Waste | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 376 | Land Disposal Restrictions | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 700-705 | Surface Water and Groundwater Classifications and Standards | Surface Water/ Groundwater | ARAR | NYSDEC |
| 6 NYCRR 750-758 | State Pollutant Discharge Elimination System | Wastewater Discharge | ARAR | NYSDEC |
| State Sanitary Code - Part 5 | Drinking Water Supply | Water Supply | ARAR | NYSDOH |
| TOGS 1.1.1 | Ambient Water Quality Standards and Guidance Values | Surface Water/ Groundwater | TBC | NYSDEC |
| TOGS 1.3.1 | Waste Assimilative Capacity Analysis & Allocation for Setting Water Quality Based Effluent Limits | Wastewater Discharge | TBC | NYSDEC |
| TOGS 1.3.1C | Development of Water Quality Based Effluent Limits for Metals Amendment | Wastewater Discharge | TBC | NYSDEC |
| TOGS 1.3.2 | Toxicity Testing in the SPDES Program | Wastewater Discharge | TBC | NYSDEC |
| Air Guide No. 1 | Guideline for the Control of Toxic Ambient Air Contaminants | Air | TBC | NYSDEC |
| TAGM HWR-4046 | Determination of Soil Cleanup Objectives and Cleanup Levels | Soil | TBC | NYSDEC |

## Table 1-3

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**POTENTIALLY APPLICABLE LOCATION SPECIFIC ARARs/TBCs**

| Citation/ Reference | Title | Applicable Media | Potential ARAR/TBC | Regulatory Agency |
|---|---|---|---|---|
| 6 NYCRR 608 | Use and Protection of Waters | Surface Water | ARAR | NYSDEC |
| 6 NYCRR 256 | Air Quality Classification System | Air | ARAR | NYSDEC |
| 6 NYCRR 360 | Solid Waste Management Facilities | Solid Waste | ARAR | NYSDEC |
| N/A | Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites | Hazardous Waste Sites | TBC | NYSDEC |

Table 1-4

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**POTENTIALLY APPLICABLE ACTION SPECIFIC ARARs/TBCs**

| Citation/Reference | Title | Applicable Media | Potential ARAR/TBC | Regulatory Agency |
|---|---|---|---|---|
| 6 NYCRR 200 | General Provision | Air | ARAR | NYSDEC |
| 6 NYCRR 201 | Permits and Registrations | Air | ARAR | NYSDEC |
| 6 NYCRR 211 | General Prohibitions | Air | ARAR | NYSDEC |
| 6 NYCRR 212 | General Process Emission Sources | Air | ARAR | NYSDEC |
| 6 NYCRR 364 | Waste Transporter Permits | Solid/Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 370 | Hazardous Waste Management System – General | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 372 | Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 373 | Hazardous Waste Management Facilities | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 375 | Inactive Hazardous Waste Disposal Site Remedial Program | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 376 | Land Disposal Restrictions | Hazardous Waste | ARAR | NYSDEC |
| 6 NYCRR 617 and 618 | State Environmental Quality Review | All Media | ARAR | NYSDEC |
| 6 NYCRR 621 | Uniform Procedures | All Media | ARAR | NYSDEC |
| 6 NYCRR 624 | Permit Hearing Procedures | All Media | ARAR | NYSDEC |
| 6 NYCRR 650 | Qualifications of Operators of Wastewater Treatment Plants | NA | ARAR | NYSDEC |
| 6 NYCRR 700-705 | Classifications and Standards of Quality and Purity | Surface Water/ Groundwater | ARAR | NYSDEC |
| 6 NYCRR 750-758 | State Pollutant Discharge Elimination System | Surface Water/ Groundwater | ARAR | NYSDEC |
| Air Guide No. 1 | Guideline for the Control of Toxic Ambient Air Contaminants | Air | TBC | NYSDEC |
| Air Guide No. 29 | Technical Guidance for Regulating and Permitting Air Emissions from Air Strippers, Soil Vapor Extraction Systems and Cold-Mix Asphalt Units | Air | TBC | NYSDEC |

**Table 1-4** (continued)

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**POTENTIALLY APPLICABLE ACTION SPECIFIC ARARs/TBCs**

| Citation/Reference | Title | Applicable Media | Potential ARAR/TBC | Regulatory Agency |
|---|---|---|---|---|
| Air Guide No. 41 | Permitting for Landfill Gas Energy Recovery | Air | TBC | NYSDEC |
| TAGM HWR-4030 | Selection of Remedial Actions at Inactive Hazardous Waste Disposal Sites | Hazardous Waste | TBC | NYSDEC |
| TAGM HWR-4031 | Fugitive Dust Suppression and Particulate Monitoring Programs at Inactive Hazardous Waste Sites | Air | TBC | NYSDEC |
| TAGM HWR-4046 | Determination of Soil Cleanup Objectives and Cleanup Levels | Soil | TBC | NYSDEC |
| N/A | Analytical Services Protocol | All Media | TBC | NYSDEC |
| TOGS 1.3.1 | Waste Assimilative Capacity Analysis & Allocation for Setting Water Quality Based Effluent Limits | Wastewater Discharge | TBC | NYSDEC |
| TOGS 1.3.1C | Development of Water Quality Based Effluent Limits for Metals Amendment | Wastewater Discharge | TBC | NYSDEC |
| TOGS 1.3.4 | BPJ Methodologies | Wastewater Discharge | TBC | NYSDEC |
| TOGS 2.1.2 | UIR at Groundwater Remediation Sites | Groundwater | TBC | NYSDEC |
| TOGS 2.1.3 | Primary & Principal Aquifer Determinations | Groundwater | TBC | NYSDEC |
| 29 CFR 1910.120 | Hazardous Waste Operations and Emergency Response | NA | ARAR | USDOL |
| 40 CFR 122 | EPA Administered Permit Programs: The National Pollutant Discharge Elimination System | Wastewater Discharge | ARAR | USEPA |

## 1.5 Feasibility Study Description

The Technical and Administrative Guidance Memorandum (TAGM) prepared by NYSDEC entitled, "Selection of Remedial Actions at Inactive Hazardous Waste Sites," describes the feasibility study as a process to identify and screen potentially applicable remedial technologies, combine technologies into alternatives and evaluate appropriate alternatives in detail, and select an appropriate remedial action plan. The objective of this feasibility study is to meet the goal of this guidance document, as well as USEPA guidance in a focused, concise manner.

In general, as discussed above, the Trimmer Road Landfill Site is not highly contaminated. Under current conditions and use, the site does not pose an imminent or significant threat to human health or the environment. Although waste disposed at the site does cause a contravention of groundwater standards, it does not appear to be significantly impacting off-site groundwater and causing impairment of water supply. Surface soil is not contaminated and exceedances of the SCGs in leachate, surface water and surface water sediment do not appear to be significantly impacting human health or the environment. However, due to reported industrial waste disposed at the site, including drums, it is possible that contaminant releases could be more significant in the future, and that contaminated groundwater could migrate farther off-site and impact water supplies. Because of these potential impacts, the focus of this feasibility study will be an evaluation of cover options to minimize contact with exposed waste and leachate, and to minimize infiltration of precipitation through the waste and continued generation of leachate and impacts to groundwater, surface water and sediment.

The approach of a feasibility study is to initially develop remedial action objectives for medium-specific or operable unit-specific goals to protect human health and the environment. The goals consider the contaminants and contaminant concentrations as determined by the remedial investigation, the exposure routes and potential receptors as determined by the exposure assessment, and the acceptable contaminant or risk levels or range of levels.

In the initial phase of the feasibility study, identified remedial technologies which are not technically applicable to contamination found, or are unproven and/or are not commercially available, will be eliminated from further consideration. The technologies remaining after initial screening will be assembled into remedial alternatives for evaluation. Preliminary evaluation of alternatives will consider effectiveness, implementability and relative costs.

Effectiveness evaluation includes consideration of the following:

- The potential effectiveness of process options in handling the estimated areas or volumes of contaminated media, and meeting the remediation goals identified by the remedial action objectives;
- The potential impacts to human health and the environment during the construction and implementation phase; and
- The proven effectiveness and reliability of the process with respect to the contaminants and conditions at the site.

Implementability includes both the technical and administrative feasibility of utilizing the technology or alternative. Administrative feasibility considers institutional factors, such as the ability to obtain necessary permits for on-site or off-site actions, and the ability to restrict land use based on specific remediation measures. Technical feasibility considers such aspects as the ability to comply with SCGs, availability and capacity of treatment, storage and disposal facilities, the availability of equipment and skilled labor to implement the technology, the ability to design, construct and operate the alternative, and acceptability to the regulatory agencies and the public.

Preliminary costs are considered at this stage of the feasibility study process for the purpose of relative cost comparison among the alternatives.

The results of the preliminary evaluation include potentially viable technologies or combinations of technologies/alternatives for the site which will be carried forward for detailed evaluation.

The guidance requires that a feasibility study provide a detailed analysis of the potential remedial alternatives based on consideration of the following evaluation criteria for each alternative.

- Threshold Criteria
  - Compliance with standards, criteria and guidelines/ARARs
  - Protection of human health and the environment
- Balancing Criteria
  - Short-term impacts and effectiveness
  - Long-term effectiveness and permanence
  - Reduction in toxicity, mobility and/or volume of contamination
  - Implementability
  - Cost

In addition to the above-listed Threshold and Balancing Criteria, the guidance also provides the following modifying criteria:

- Modifying criteria
  - Community acceptance

Provided below is a description of each of the feasibility study criteria.

Compliance with applicable regulatory standards, criteria and guidelines applies the federal and New York State ARARs/SCGs identified for the Trimmer Road Landfill Site to provide both action-specific guidelines for remedial work at the site and contaminant-specific cleanup standards for the alternatives under evaluation. In addition to action-specific and contaminant-specific guidelines, there are also location-specific guidelines that pertain to such issues as restrictions on actions at historic sites. These guidelines and standards are referenced in

Section 1.4 of this document, and are considered a minimum performance specification for each remedial action alternative under consideration.

Protection of human health and the environment is evaluated on the basis of estimated reductions in both human and environmental exposure to contaminants for each remedial action alternative. The evaluation focuses on whether a specific alternative achieves adequate protection, and how site risks are eliminated, reduced or controlled through treatment, engineering or institutional controls. An integral part of this evaluation is an assessment of long-term residual risks to be expected after remediation has been completed. Evaluation of the human health and environmental protection factor is generally based, in part, on the findings of a exposure assessment. The exposure assessment performed for this site incorporates the qualitative estimation of the risk posed by carcinogenic and noncarcinogenic contaminants detected during the remedial investigation.

Evaluation of short-term impacts and effectiveness of each alternative examines health and environmental risks likely to exist during the implementation of a particular remedial action. Principal factors for consideration include the expediency with which a particular alternative can be completed, potential impacts on the nearby community and on-site workers, and mitigation measures for short-term risks required by a given alternative during the necessary implementation period.

Examination of long-term impacts and effectiveness for each alternative requires an estimation of the degree of permanence afforded by each alternative. To this end, the anticipated service life of each alternative must be estimated, together with the estimated quantity and characterization of residual contamination remaining on-site at the end of this service life. The magnitude of residual risks must also be considered in terms of the amount and concentrations of contaminants remaining following implementation of a remedial action, considering the persistence, toxicity and mobility of these contaminants, and their propensity to bioaccumulate.

Reduction in toxicity, mobility and volume of contaminants is evaluated on the basis of the estimated quantity of contamination treated or destroyed, together with the estimated quantity of waste materials produced by the treatment process itself. Furthermore, this evaluation considers whether a particular alternative will achieve the irreversible destruction of contaminants, treatment of the contaminants or merely removal of contaminants for disposal elsewhere.

Evaluation of implementability examines the difficulty associated with the installation and/or operation of each alternative on-site and the proven or perceived reliability with which an alternative can achieve system performance goals (primarily the SCGs discussed above). The evaluation examines the potential need for future remedial action, the level of oversight required by regulatory agencies, the availability of certain technology resources required by each alternative and community acceptance of the alternative.

Cost evaluations presented in this document estimate the capital, and operation and maintenance (O&M) costs, including monitoring, associated with each remedial action alternative. From these estimates, a total present worth for each option is determined.

Community acceptance evaluates the technical and administrative issues and concerns which the community may have regarding each of the alternatives.

## 1.6 Approach to Feasibility Study

The approach to this feasibility study will be to evaluate technologies that will meet the remedial action objectives (RAOs) developed for the site. Since these RAOs, listed in Section 1.4, focus on elimination of contact with waste and leachate, and reduction of infiltration of precipitation through the landfill and generation of leachate, the only technologies that would meet these objectives would be removal and capping/cover technologies. However, because waste removal would involve the excavation and off-site disposal of over 1 million cubic yards of waste and is prohibitively costly, perhaps over $50 million, only capping/cover technologies will be evaluated in this feasibility study.

As discussed previously, the low levels of groundwater contamination detected just off-site are not currently impacting human health or the environment and may be naturally attenuating. Therefore, active groundwater remediation will not be evaluated. Only groundwater monitoring as part of each of the alternatives will be evaluated. Reduction of infiltration of precipitation through the waste will mitigate impacts to groundwater.

# Section 2

## 2.0 DESCRIPTION OF FOCUSED REMEDIAL TECHNOLOGIES

### 2.1 Introduction

In general, response actions which satisfy remedial objectives for a site include institutional, containment, isolation, removal or treatment actions. As previously discussed, for the Trimmer Road Landfill Site, waste removal and treatment actions will not be evaluated due to the large volume, as well as the composition of waste in the landfill. Consistent with New York State Department of Environmental Conservation guidance, focusing on institutional, containment and isolation technologies as presumptive remedies for municipal landfills will aid in accelerating remediation of this site. In addition to evaluating appropriate institutional, containment and isolation technologies, United States Environmental Protection Agency guidance under the Comprehensive Emergency Response, Compensation and Liability Act requires the evaluation and comparison of a no-action alternative to the action alternatives. Each response action for each medium of interest must satisfy the remedial action objectives for the site.

The screening of technologies is performed by evaluating the ability of each technology to meet specific remedial action objectives, technical implementability, and short-term and long-term effectiveness. A discussion of selected response actions and their applicability to the Trimmer Road Landfill Site is provided below.

### 2.2 No Action

The no-action alternative will be considered, and as described above, will serve as a baseline to compare and evaluate the effectiveness of other alternatives. Under the no-action scenario, only monitoring will be considered as a limited remedial response action. Monitoring would consist of periodic groundwater sampling to evaluate changes over time in conditions at the site and to ascertain the level of any natural attenuation which may occur or any increase in contamination which may necessitate remedial action. Natural attenuation (under the no-action alternative), as opposed to active remediation, relies entirely on naturally occurring physical, chemical and biological processes (e.g., dilution, dispersion and degradation) to reduce contaminant concentrations. As mentioned above, some natural attenuation currently appears to be occurring in groundwater downgradient of the site.

## 2.3 Institutional Controls

Institutional controls may include access restrictions and deed restrictions. Access restrictions, such as eliminating access to the landfill by fencing and posting of signs warning of the presence of contamination/hazardous waste, are considered potentially applicable to the site. Deed restrictions could be imposed to limit uses of and activities at site, and possibly around the site. Restrictions could be developed by the Town of Parma and implemented through the building permit approval process and changes in zoning. The implementation and enforcement of the restrictions essentially would be the responsibility of the Town. Deed restrictions, in addition to zoning which prohibit/restrict future use and development of the site, would be a potentially applicable institutional control.

## 2.4 Isolation/Containment

Potentially applicable isolation and containment technologies include surface barriers, such as permeable covers, semi-permeable covers, evapotranspiration covers and low permeability caps. These technologies are designed to prevent direct contact with waste, and in some cases, to significantly reduce the infiltration of precipitation into waste and mitigate leachate generation, and groundwater and surface water contamination. The following provides a discussion of each of these covers/caps.

### 2.4.1 Part 360 Cap

Technology Description: This technology, which is defined in the New York State Part 360 regulations for landfill closure, is a low permeability cap. This cap consists of a four-layered system comprised of a 6-inch vegetated topsoil upper layer, underlain by a 12- to 24-inch drainage/barrier protection layer, followed by a low permeability layer ($10^{-7}$ cm/sec) comprised of clay (18 inches) or a flexible membrane liner (FML), followed by a 12-inch gas venting layer. The gas venting layer can be substituted for with additional gas vents. The thickness of the Part 360 cap ranges from 2 to 5 feet depending on whether a FML or clay is used for the low permeability layer, if a gas venting layer is used and, if the drainage/barrier protection layer is 1 or 2 feet in thickness. This cap mitigates direct contact with waste and infiltration of precipitation into waste. For the Trimmer Road Landfill, this cap will require significant site regrading to achieve required minimum 4% slopes to promote surface drainage off the cap.

Initial Screening Results: A Part 360 Cap will provide protection from direct contact with waste material and infiltration of precipitation into the waste and generation of leachate. It will provide significant additional protection over the semi-permeable and permeable caps presented below regarding generation of leachate and, therefore, will be retained for further consideration.

### 2.4.2 Semi-permeable Cover

Technology Description: This technology provides for the placement of an 18-inch semi-permeable soil cover ($10^{-5}$ cm/sec hydraulic conductivity) over waste. This type of cover would mitigate direct contact with waste but, even with significant site grading to promote surface runoff (4%), which would be required for the Trimmer Road Landfill, would not preclude infiltration of precipitation through the waste, generation of leachate, and groundwater and surface water contamination.

Initial Screening Results: Since a semi-permeable cover provides little additional benefit over a permeable cover and will be significantly more costly, this technology will not be considered further.

### 2.4.3 Evapotranspiration Cover

Technology Description: This technology involves placement of a soil cover and planting of special vegetation to minimize infiltration of precipitation into waste. Through the storage, and evaporation and transpiration of precipitation by the trees prior to percolation into and through the waste material, leachate generation and groundwater contamination is reduced or eliminated. The thickness of this cap can vary depending on the type of soil available on-site or in the vicinity of the site, to create an appropriate root zone for the plants, as well as an appropriate storage zone for water. A minimum thickness for this type of cover is typically 2 to 4 feet.

At least one vendor offers an engineered biological technology that utilizes poplar trees with deep root systems planted into specially prepared soils, which allows the root system to dehydrate the soils during the growing season and create water storage capacity for the dormant winter months. Such caps have been installed and approved as an alternative cover for closed, unlined landfills in Pennsylvania and Tennessee.

Existing data on the effectiveness of this cover versus a $10^{-7}$ cm/sec cover is limited. The effectiveness of caps with soil and vegetative cover are currently being evaluated by the United States Environmental Protection Agency in the Alternative Cover Assessment Program (ACAP). The results of this program will be made available over the next 5 years.

Poplar trees have also been utilized along boundaries of landfills to mitigate leachate migration. Moisture and chemicals in the leachate are used by the trees for growth and development. Contaminants that cannot be taken up by the trees may be degraded in the soil surrounding the trees through enhancement of the naturally occurring aerobic degradation process. They may also be contained in the organic rich soil beneath the trees and prevented from migrating to deeper groundwater or off-site.

<u>Initial Screening Results</u>: This technology will be considered further for application at the Trimmer Road Landfill Site since it likely will be more effective in reducing infiltration of precipitation as compared to a semi-permeable cover, it can be used to control leachate migration, and it will likely require little site grading.

### 2.4.4 Soil Cover

Technology Description: This technology provides for the placement of 1 to 2 feet of permeable soil (typically $10^{-3}$ cm/sec hydraulic conductivity) over waste. This type of cover would mitigate direct contact with waste. With site grading to promote surface runoff, this technology would somewhat reduce infiltration of precipitation, but would not be as effective at reducing leachate generation, leachate seeps and groundwater contamination as the three cap/cover technologies discussed above.

Initial Screening Results: Although the permeable cover will not significantly reduce infiltration of precipitation, it will provide for protection against direct contact with waste and, with significant site grading to promote drainage off the landfill surface, which would be required for the Trimmer Road Landfill, would reduce leachate generation. In addition, it likely would be a low-cost remediation alternative. Therefore, this technology will be considered further.

## 2.5 Summary Evaluation of Remedial Technologies

Based on the above screening of remedial technologies, the following isolation/ containment methods will be retained for further evaluation:

- Part 360 Cap
- Evapotranspiration Cover
- Soil Cover

In addition to the above technologies, no action with groundwater monitoring and institutional controls will also be evaluated further.

## Table 2-1

### TRIMMER ROAD LANDFILL SITE
### FEASIBILITY STUDY
### SUMMARY SCREENING OF REMEDIATION TECHNOLOGIES

| General Response Action | Remedial Technology | Description | Summary of Initial Screening Results |
|---|---|---|---|
| Waste Remediation Technologies | Part 360 Cap | A four layered system consisting of a vegetated topsoil upper layer, underlain by a drainage/barrier layer followed by a low permeability clay layer or geosynthetic membrane followed by a gas venting layer/system. This cap will eliminate direct contact with waste and generation of leachate. | Retained for further consideration. |
| | Semi-permeable Cover | An 18-inch ($10^{-5}$ cm/s) soil cover to mitigate direct contact with waste and reduce generation of leachate. | Not retained for further consideration since this cover does not provide significant benefit over a permeable soil cover and is more costly. |
| | Evapotranspiration Cover | A vegetative cover consisting of a 2 to 3 foot soil cover and vegetation, such as poplar trees, that will provide for a cover to mitigate direct contact with waste, and with sufficient water holding capacity and evapotranspiration will have the capability to reduce infiltration of precipitation and generation of leachate. | Retained for further consideration. |
| | Soil Cover | A 2-foot ($>10^{-5}$ cm/s) soil to mitigate direct contact with waste. | Retained for further consideration. |

# Section 3

To achieve the minimum 4 percent grade and to properly manage storm water runoff and direct the majority of runoff to the existing pond and the east side of the landfill, approximately 150,000 cubic yards (cy) of waste would need to be cut and relandfilled to obtain the grades shown in the conceptual grading plan. Daily cover would need to be placed over excavated exposed waste to control odors and erosion of waste during regrading. The elevations shown on the conceptual grading plan (Figure 3-1) are for the subgrade and do not include the 12-inch soil cover to be placed over the waste mass after regrading.

Long-term groundwater monitoring and institutional controls, as described for the no-action alternative, is also included as part of this alternative to evaluate the effectiveness of the soil cover and site regrading, and control use of the site. Maintenance of this alternative would include site inspections, cutting of the vegetated cover and maintenance of the on-site swales and retention basins, as well as the stream channel.

### 3.1.3 Alternative 3 – Evapotranspiration Cover with Long-term Groundwater Monitoring

Under this alternative, an enhanced soil and vegetative cover would be placed on the upper, flat portion of the landfill, to reduce percolation of precipitation through the waste material.[1] The existing side slopes would not be disturbed. The engineered soil and vegetative cover would comprise a phytoremediation system that uses hybrid, fast-growing, deep-rooting trees (e.g., poplar, cottonwood, willow) to limit infiltration and percolation through the waste zone, and thereby limit leachate generation. Excerpts from the results of an evaluation and preliminary design are provided in Appendix A and are summarized below.

For the purpose of this feasibility study, the effectiveness of the evapotranspiration cover was evaluated using a proprietary hydrologic performance model designed to predict water percolation below the root zone for porous vegetative caps. Based on the modeling results for the Trimmer Road Landfill, the cover for this feasibility study alternative would provide a

[1] Information for the development of this alternative was obtained from Ecolotree, Inc., which developed has the Ecolotree® Cap, or ECap. The ECap is currently being evaluated in the Alternative Cover Assessment Program (ACAP) through the US Environmental Protection Agency' Remedial Technologies Development Forum. The NYSDEC does not endorse any particular branded product or system.

minimum of 4 inches of available water holding capacity in the cover soils and amendments. Surface application of organic amendments, such as composted yard waste or wastewater treatment biosolids, would also be performed.

Cost figures for this alternative are based on the following design which includes a three year pilot study. The evapotranspiration cover would be planted on the flat upland portion of the landfill, estimated to be 27 acres in size. It is assumed at this time that, for the most part, the existing trees and shrubs on this upland portion would be removed. Portions of the successional northern hardwoods areas may be left in place and planted around. This decision would be made after evaluating tree density, depth of existing soil, and the logistics of placing and grading borrow soil in these areas. Trees would only be planted on the sloping edges of the landfill to fill gaps in the existing hardwood trees. The tree rows would curve gradually in a south to east orientation across the landfill (see Figure 3-2) to provide a forest-like appearance. The site would be seeded with native grasses.

Hybrid poplars grow quickly, typically between 3-10 feet per year. The trees that would be planted would be yearlings and would reach maturity and would provide an effective cover within approximately 3 years of planting. Poplar roots have been observed at 7 feet below ground at a leachate irrigation site in Oregon and at 9.5 feet below ground at a RCRA site in Wisconsin. Appropriately selected hybrid poplar trees can grow vigorously for 20+ years and can have life spans of 50+ years.

Since no significant additional run off from the landfill is anticipated with this alternative, it likely that neither the stream channel nor the existing drainage channel, which receives overflow from the pond, would require significant improvement.

The evapotranspiration cover typically would require little maintenance after the first three growing seasons. However, proper monitoring and maintenance is important during the first 3 years to ensure a healthy evapotranspiration cover. These activities are as follows:

# 3.0 DEVELOPMENT AND PRELIMINARY EVALUATION OF ALTERNATIVES

Based on the review of the technologies discussed in Section 2.0, the next phase of the feasibility process is to develop remedial alternatives for preliminary evaluation based on effectiveness, implementability and relative cost. Remedial alternatives can comprise individual technologies or a combination of technologies.

## 3.1 Description of Remedial Alternatives

### 3.1.1 Alternative 1 – No Action with Long-term Groundwater Monitoring

This alternative provides no active remediation and relies solely on natural attenuation for remediation of waste, leachate and groundwater contamination. However, the "no action" alternative would provide for long-term monitoring of the groundwater to monitor the effectiveness of natural attenuation. This alternative would also include placement of institutional/land use controls on the site, such as deed restrictions and covenants, to ensure appropriate future use/control of the site that would protect human health and the environment.

Long-term groundwater monitoring would consist of monitoring private water supply wells, and existing and proposed groundwater monitoring wells for a period of at least 30 years. Nine wells, comprising five existing groundwater monitoring wells (MW-4S, MW-5S, MW-8S, MW-8D, MW-10S), two proposed groundwater monitoring wells (MW-11D and MW-12D) and two private water supply wells, would be sampled for full Target Compound List +30 (TCL +30) organic compounds, Target Analyte List (TAL) metals (total) and cyanide at the initiation of the groundwater monitoring program. Subsequent sampling and the analyses to be performed over the 30-year monitoring period is provided in Table 3-1.

**Table 3-1**

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**LONG-TERM GROUNDWATER MONITORING PROGRAM**

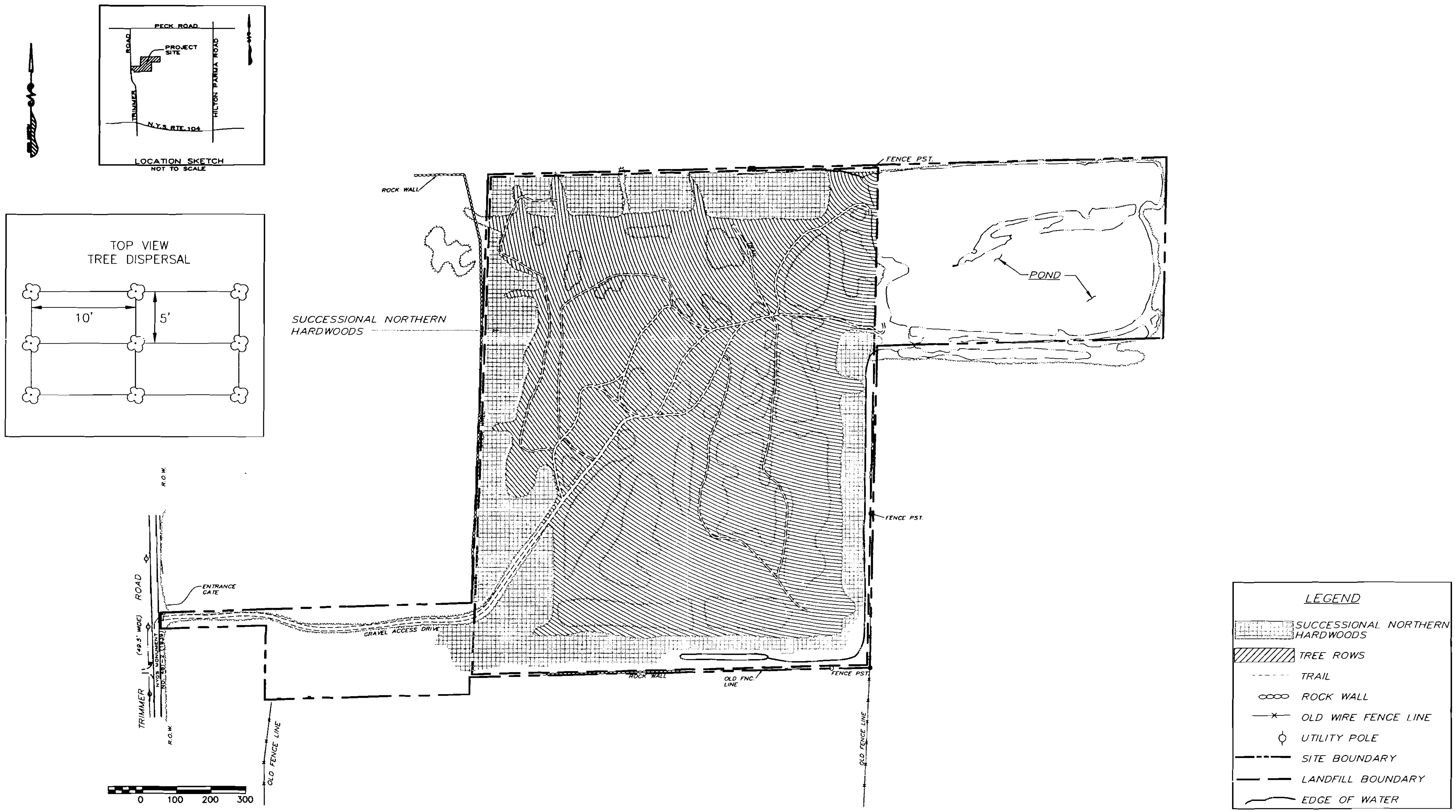
| Round | Sample Interval (years) | Sample Date | Analyses | Wells To Be Sampled |
|---|---|---|---|---|
| 1 | 0 | Spring Year 0 | TCL +30, TAL metals (total), cyanide | 9 wells* |
| 2 | 0.5 | Fall Year 0 | VOCs, TAL metals (total) | 7 wells** |
| 3 | 0.5 | Spring Year 1 | VOCs, TAL metals (total) | 7 wells |
| 4 | 1 | Spring Year 2 | VOCs, TAL metals (total) | 9 wells |
| 5 | 2 | Spring Year 4 | VOCs, TAL metals (total) | 7 wells |
| 6 | 5 | Spring Year 9 | TCL +30, TAL metals (total), cyanide | 7 wells |
| 7 | 5 | Spring Year 14 | VOCs, TAL metals (total) | 7 wells |
| 8 | 5 | Spring Year 19 | VOCs, TAL metals (total) | 7 wells |
| 9 | 5 | Spring Year 24 | VOCs, TAL metals (total) | 7 wells |
| 10 | 5 | Spring Year 29 | VOCs, TAL metals (total) | 7 wells |

*The group of 9 wells includes MW-4S, MW-5S, MW-8S, MW-8D, MW-10S, MW-11D, MW-12D and water supply wells.
**The group of 7 wells excludes MW-4S (redundant contaminated well) and MW-10S (background well) from the group of 9 wells.

### 3.1.2 Alternative 2 – Soil Cover with Long-term Groundwater Monitoring

This alternative includes regrading of the site to achieve a minimum 4 percent slope and placement of a 12-inch permeable soil cover over the 36 acre waste mass. The purpose of the regrading is to promote storm water drainage off the landfill surface. This alternative also includes construction of two storm water retention basins on the south side of the landfill and regrading of the landfill perimeter to direct surface runoff to the pond on the east side of the site and the retention basins. The soil cover would consist of 6 inches of general fill and 6 inches of a vegetative medium consisting of topsoil and grass over the surface of the waste to mitigate contact with waste and leachate. As discussed in Section 1.0, the existing topography of the elevated surface of the landfill is generally flat with localized depressions and hummocks, and is poorly drained, while the side slopes are steep and vegetated. In order to enhance the effectiveness of this alternative, significant regrading of the site would be required to direct runoff of storm water off the waste mass and reduce infiltration of precipitation. An evaluation of the existing site grading and drainage was performed to determine the most efficient and cost-effective means of obtaining the necessary grades and to properly manage storm water runoff. An illustration of the conceptual grading plan is provided in Figure 3-1 contained in the map pocket at the end of this document.

Due to the potential for storm water drainage to discharge onto surrounding properties after regrading, particularly along the western and northern boundaries of the landfill, swales will be required along these boundaries to channel flow to the on-site pond. These swales would have a minimum 1 percent grade. To control storm water runoff along the southern boundary of the landfill, two on-site retention basins would be required. One basin would be located in the southwest corner of the landfill and the second basin would be located in the southeast corner of the landfill. Five drainage swales would be constructed on the top and eastern portions of the landfill to direct storm water to the stream which borders the eastern boundary of the site. These swales would have a minimum of 2 percent grade to direct water to the east and the existing pond. It is anticipated that the existing drainage channel north of the pond would not require improvement as part of this alternative.




TRIMMER ROAD LANDFILL
TOWN OF PARMA, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

CONCEPTUAL PLAN FOR EVAPOTRANSPIRATION COVER

FIGURE 3-2

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Site inspections would be completed at the site every 2 weeks during the first growing season, every 3-4 weeks during the second and third growing season, and quarterly for the next 12 years. Inspections would be for conditions such as insect damage, surface disturbances or rutting caused by vehicles traversing the site, gullies, soil erosion and other stresses to the vegetation. Replanting of observed mortality would be performed in the spring of the second growing season.

- Mowing and weeding of the site would be performed four times annually for the first 3 years and two times per year for the next 12 years.
- Pruning of the trees would be performed annually for the first 2 years.
- Fertilization would be performed annually for the first 3 years and once every 3 years for the next 12 years. Insect and animal control would be performed for the first 3 years.

In order to evaluate the effectiveness of the evapotranspiration cover at the Site, a pilot study is recommended. The pilot study would be a modified version of the USEPA Alternative Cover Assessment Program (ACAP) currently being conducted to evaluate different types of landfill covers. The conceptual scope for the pilot study would involve the evaluation of the effectiveness of four different covers. Two covers would consist of soil planted with hybrid poplar trees and two covers would consist of a soil cover planted with grass. The two covers planted with poplar trees would be designed with water holding capacities of 4 inches and 8 inches. The two soil covers vegetated with grass would be designed with water holding capacities of 2.2 and 4 inches. The soil cover with 2.2 inches of water holding capacity would simulate the cover described in Alternative 2.

The test cells would be lined with a 60-mil linear low-density polyethylene geomembrane. The geomembrane would be overlain with a geocomposite. The geocomposite would be overlain by an interim cover to separate moisture trapped above the membrane from root activity. The interim cover will be overlain with a root barrier. Above the root barrier would be the prescribed cover. Collected water would be conveyed to a water collection basin. In addition to measuring infiltration, climate conditions would also be monitored using a weather station. The pilot study would be a minimum of three years.

Long-term groundwater monitoring and institutional controls, as discussed for Alternative 2, are also included as part of this alternative to evaluate the effectiveness of the evapotranspiration cover and control use of the site.

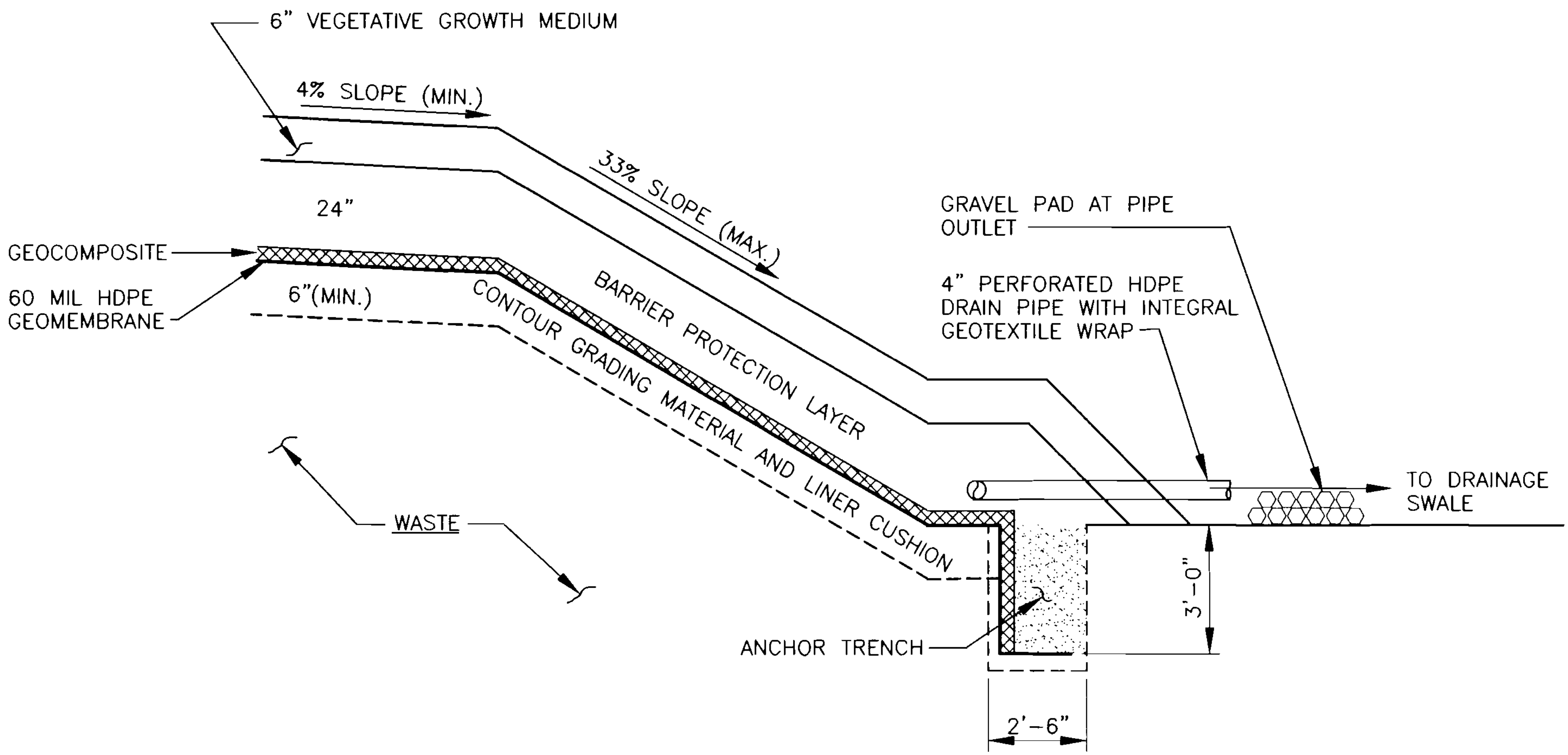
### 3.1.4 Alternative 4 - Part 360 Cap with Long-term Groundwater Monitoring

This alternative provides for the placement of a low permeability geomembrane cap over the entire landfill. Prior to placement of the cap, the landfill would be regraded similar to Alternative 2 as shown in Figure 3-1 to achieve required slopes for drainage, as well as to divert storm water runoff to the existing pond and new retention basins. Once the site has been regraded, the cap would be constructed consistent with Part 360 regulations and would consist of, from bottom to top:

- 12-inch soil cover/geomembrane cushion which assumes adding 6 inches of select contour grading material to the existing 6-inch cover;
- 60-mil high density polyethylene (HDPE) liner;
- geocomposite drainage layer;
- 24-inch barrier protection/drainage layer; and
- 6-inch topsoil/vegetative growth medium

An illustration of this cap is provided in Figure 3-3. Based on Hydrologic Evaluation of Landfill Performance (HELP) modeling completed for similar landfills, this cap, assuming 2 to 3 defects per acre, would likely be over 95 percent effective at reducing precipitation from migrating through underlying waste.

The Trimmer Road Landfill has been closed for over 25 years and methane gas generation is low, as verified during the remedial investigation. Because of the low amounts of gas currently being generated, costs can be reduced by altering design parameters. For example,




NOT TO SCALE

TRIMMER ROAD LANDFILL SITE
TOWN OF PARMA, NEW YORK

# PART 360 CAP CROSS-SECTION

FIGURE 3-3

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in lieu of a gas venting layer and one gas vent per acre, four gas vents per acre may be installed without a gas venting layer.

The existing pond is typically at capacity during most of the year. Significant additional flow to the pond, which is expected with a Part 360 cap, would require improvement to the intermittent stream which presently receives overflow from the pond. This stream is located on the northeast corner of the landfill and flows northward to a tributary of Buttonwood Creek. The stream channel extends approximately 3,000 feet to the north through wooded areas prior to intersecting and flowing under Peck Road. The stream flows under Peck Road through a 48-inch corrugated metal pipe.

Evaluation of the extent that the stream channel would need to be improved would require a drainage basin analysis to evaluate the flow the stream currently receives and the additional flow it would receive if this alternative were implemented. Preliminary drainage calculations to determine the increase in volume to the stream from runoff from the Part 360 cap during a 25 year, 24-hour storm event, indicates over 100 cubic feet per second of additional flow would be introduced to the stream channel. Therefore, improvements to this off-site stream channel to handle the additional flow (dredging and placement of rip-rap) would be necessary as part of this alternative.

Monitoring of groundwater and placement of institutional controls would be conducted utilizing the same long-term monitoring plan described for Alternatives 1, 2 and 3 to evaluate the effectiveness of the Part 360 cap and control use of the site. Maintenance of the cap would include site inspections, cutting of the vegetated cover, and maintenance of the swales and retention basins, as well as the on-site and off-site stream channels for the 15 year remediation period.

Provided below is a preliminary evaluation of these alternatives for effectiveness, implementability and relative costs. A description of these criteria is provided in Section 1.4.

## 3.2 Evaluation of Remedial Alternatives

### 3.2.1 Alternative 1

*Effectiveness*

Alternative 1, No Action, would not meet any of the remedial action objectives which have been established for the Trimmer Road Landfill Site, as discussed in Section 1.4 of this document, since no physical remedial action would be performed. Although, based on the results of the exposure assessment, the landfill currently does not pose a significant threat to human health and the environment, and there is no immediate acute health hazard, without mitigation of infiltration of precipitation through the waste material, there would be continued generation of leachate and impacts on groundwater, surface water and sediment. In addition, because of reported disposal of industrial waste, including drums, at the landfill, environmental conditions could worsen in the future. This alternative relies solely on natural attenuation, which would likely take many decades to be effective. As a result, this alternative is not effective.

*Implementability*

This alternative is readily implementable. However, since the no action alternative does not alter the potential for contact with waste and does not mitigate infiltration of precipitation, leachate generation and contamination of groundwater, it does not meet the minimum remediation criteria from a regulatory perspective.

*Cost*

The cost associated with this alternative includes only the cost for installation of two new deep monitoring wells, and the cost for long-term groundwater monitoring. Therefore, the cost for this alternative would be significantly lower than the "action" alternatives discussed below.

### 3.2.2 Alternative 2

*Effectiveness*

Alternative 2, regrading the landfill and placement of a soil cover, would meet two of the remedial action objectives for the site. It would be effective at mitigating contact with waste, and although this alternative would not be as effective as Alternatives 3 and 4 in reducing infiltration of precipitation through the waste mass, generation of leachate and contamination of groundwater, regrading of the site and planting grasses would promote storm water runoff and evapotranspiration, and reduce infiltration through waste to some extent. Therefore, Alternative 2 would partially meet the remedial action objectives for the site by reducing infiltration of precipitation, generation of leachate, and impacts to groundwater, surface water and sediment.

*Implementability*

All the necessary labor, equipment, materials and supplies for regrading the landfill and placement of a soil cover are readily available and it would be easy to construct. It is estimated that approximately 150,000 cy of material would need to be cut and refilled on the landfill in order to modify the site grade and direct storm water runoff to the existing pond and new retention basins. Excavating waste likely would cause generation of odors and require the placement of daily cover on exposed waste during regrading. In addition, approximately 70,000 cy of material would need to be brought to the site for construction of the soil cover, which would result in increased truck traffic in the vicinity of the site.

*Cost*

The cost for Alternative 2 would be moderate. The soil needed for construction of the cover ($10^{-3}$ cm/sec permeability) is readily available locally. The cost of this alternative is comparable to Alternative 3, but significantly lower than Alternative 4.

### 3.2.3 Alternative 3

*Effectiveness*

Alternative 3, placement of an evapotranspiration cover, would meet two of the remedial action objectives for the site by effectively mitigating contact with waste and significantly reducing infiltration of precipitation through the landfill. Generation of leachate, and contamination of groundwater, surface water and sediment would be reduced, by this alternative; however, it would not be as effective as Alternative 4. Since the evapotranspiration cover would be planted as part of this alternative is comprised of yearling trees, this alternative would not be fully effective until the trees mature in 3 years. In addition, as described in Section 3.1.3, the use of evapotranspiration cover for remediation of landfills is considered a developing technology, and information on the effectiveness of the cover on a full-scale level is limited. Data currently is being generated through the USEPA ACAP program to demonstrate the cover's effectiveness versus geomembrane and clay caps.

*Implementability*

All the necessary equipment, labor and materials are readily available for placement of soil cover and planting of trees. The required soil for a 4-inch AWHC cover can be obtained from local suppliers and the hybrid trees can be obtained from existing tree plantations. Minimal site regrading would need to be performed, and therefore, minimal waste would be disturbed reducing the potential for the creation of odors and need for daily cover material. Planting of the trees can be performed by a local landscaping firm with appropriate oversight from the design firm. Approximately 65,000 cy of material would need to be brought to the site for construction of the soil cover which would produce increased truck traffic in the vicinity of the site.

*Cost*

The cost of this alternative would also be moderate. Placement of a 1.5 foot soil cover and purchasing of 23,000 trees would be the most significant cost. The total cost for this alternative would be greater than Alternative 1 and comparable to Alternative 2, but would be substantially less than Alternative 4.

### 3.2.4 Alternative 4

*Effectiveness*

Alternative 4, Part 360 cap, would meet all of the remedial action objectives for the site. The low permeability cap would prevent direct contact with waste and leachate, and would significantly reduce infiltration of precipitation through the waste and adverse impacts to groundwater, surface water and sediment. A Part 360 cap is a proven, effective technology for closure of landfills.

*Implementability*

Construction, operation and maintenance of a Part 360 cap are readily implementable. The necessary labor, equipment, materials and supplies are commercially available. Potential difficulties associated with regrading the landfill to obtain required slopes include the extensive cut and fill required (approximately 150,000 cy) and the potential for odors created by exposed waste. As discussed with Alternative 2, during site regrading, all exposed waste must be covered at the end of each day to minimize odors and prevent erosion of waste.

A significant amount of material (approximately 190,000 cy) would need to be transported to the site for construction of the cap, resulting in increased truck traffic in the vicinity of the site. Installation of the low permeability geomembrane would result in significant storm water runoff which would need to be managed. Based on the conceptual grading plan shown in Figure 3-1, two retention basins would be constructed in addition to use of the existing pond to manage storm water runoff from the landfill. Because a significant amount of runoff would be generated, it is unlikely that the existing pond would be able to retain this runoff. Therefore, it would be necessary to improve the stream channel to which the pond discharges. This would necessitate significant improvement to approximately 3,000 feet of the existing drainage channel to Buttonwood Creek, as well as the stream channel on the east side of the landfill.

*Cost*

The cost of Alternative 4 is high. Construction of a low permeability cap is significantly more costly than the no action (Alternative 1), soil cover (Alternative 2) and evapotranspiration cover (Alternative 3) alternatives.

## 3.3 Summary Evaluation of Alternatives

Provided in Table 3-2 is a summary of the preliminary evaluation of the remedial alternatives developed for the Trimmer Road Landfill Site.

With regard to the selection of alternatives to be evaluated further in detail in order to select a remedial plan for the site, all of the alternatives discussed above (Alternatives 2 through 4) are considered viable and would be evaluated further in Section 4.0, together with the no action alternative (Alternative 1) as required by CERCLA and the New York Superfund Program.

Table 3-2

**TRIMMER ROAD LANDFILL SITE**
**FEASIBILITY STUDY REPORT**
**SUMMARY OF PRELIMINARY COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES**

| Remedial Alternative | | Effectiveness | Ease of Implementation | Cost | Retained |
|---|---|---|---|---|---|
| Alternative 1 | No Action and Long-term Groundwater Monitoring | Low | High (however, likely will not be acceptable to regulatory agencies or the public) | Low | Yes (required by feasibility study guidance) |
| Alternative 2 | Soil Cover and Long-term Groundwater Monitoring | Moderate | Moderate (requires significant site regrading and cutting of waste) | Moderate | Yes |
| Alternative 3 | Evapotranspiration Cover and Long-term Groundwater Monitoring | Moderate to High | Moderate to High | Moderate | Yes |
| Alternative 4 | Part 360 Cap and Long-term Groundwater Monitoring | High | Moderate to Low (requires significant site regrading and cutting of waste, and creates difficulties with management of storm water runoff) | High | Yes |

# Section 4

## 4.0 DETAILED ANALYSIS OF ALTERNATIVES

Based on the preliminary evaluation of the remedial alternatives developed for the Trimmer Road Landfill Site in Section 3.0, all of the alternatives for the site have been retained for detailed analysis. The following are the alternatives to be evaluated in detail in this section:

Alternative 1 – No Action with Long-term Groundwater Monitoring

Alternative 2 – Soil Cover with Long-term Groundwater Monitoring

Alternative 3 – Evapotranspiration Cover with Long-term Groundwater Monitoring

Alternative 4 – Part 360 Cap with Long-term Groundwater Monitoring

Placement of a Part 360 Cap is a demonstrated, proven technology for the remediation of municipal solid waste landfills. It has been shown to be effective in significantly reducing infiltration of precipitation through waste material and, therefore, reducing generation of leachate and contamination of underlying groundwater. An evapotranspiration cover is a developing technology, but appears to be effective and is under continuing evaluation in limiting infiltration of precipitation through waste. Selection of the evapotranspiration cover will require performance of a pilot study at the Trimmer Road Landfill to evaluate its site-specific effectiveness. Potential effectiveness is based on information provided by a firm which is experienced in phytoremediation, and has developed and implemented evapotranspiration covers. A soil cover with 4% slopes and permeable cover material is a minimal action for remediation of landfills. No Action provides no remedial action and depends completely on natural processes for effectiveness.

Provided below is a detailed evaluation of each of the alternatives. Based on this detailed evaluation, a remedial plan for the site will be selected for public comment. In accordance with federal (USEPA) and New York State guidance, the following feasibility study evaluation criteria will be addressed in the detailed evaluation of alternatives.

- Threshold Criteria

  - Protection of human health and the environment
  - Compliance with applicable regulatory standards, criteria and guidelines (SCGs)/Applicable or Relevant Regulations and Requirements (ARARs)

- Balancing Criteria

  - Short-term impacts and effectiveness
  - Long-term effectiveness and permanence
  - Reduction in toxicity, mobility and/or volume of contamination
  - Implementability
  - Cost

- Modifying Criteria

  - Community acceptance

A detailed description of each of these criteria is provided in Section 1.4 of this document.

Provided below is a comparative analysis of the remedial alternatives to each of the evaluation criteria presented above.

## 4.1 Overall Protection of Human Health and the Environment

Alternative 1, no action with long-term groundwater monitoring, is currently protective of human health and the environment since, based on the results of the remedial investigation and exposure assessment, currently there is no immediate acute health hazard. However, unless infiltration of precipitation through the waste is mitigated, there will continue to be generation of leachate and impacts on groundwater, surface water and surface water sediment. Long-term impacts may include contamination of downgradient water supply wells. Although the site is in a remote location, trespassers are able to access the site and come into contact with waste and contaminated leachate. In addition, although land use and activity restrictions can be put in place, long-term implementation and effectiveness of these restrictions cannot be guaranteed. Also, because of reported disposal of industrial waste at the site, including drums, releases of more significant contamination may occur in the future. Therefore, although this alternative is currently protective of human health and the environment, it may not be protective in the future.

Alternative 2 would provide some additional protection of human health and the environment through placement of additional soil cover to mitigate contact with exposed waste. By modifying the on-site grade to promote surface runoff, and by planting a vegetative cover to promote evapotranspiration and control erosion, infiltration of precipitation through waste will be reduced. Reduction of infiltrating precipitation will reduce leachate generation and the number and volume of leachate seeps, as well as reduce resulting impacts to groundwater, surface water and surface water sediment.

Alternative 3, placement of an evapotranspiration cover, would also provide protection of human health and the environment. It would consist of placing of a soil cover to mitigate contact with the waste and planting an enhanced evapotranspiration medium to reduce infiltration of precipitation through the waste. As a result, generation of leachate, and contamination of groundwater, surface water and sediment will also be reduced. Planting of poplar trees would be more effective at reducing infiltration of precipitation through waste than a permeable soil cover vegetated with grass. However, it would not be as effective as Alternative 4, placement of a Part 360 cap, as discussed below.

Alternative 4, placement of a Part 360 cap, would be the most effective alternative with respect to protection of human health and the environment. A low permeability cap will be more effective than a soil/evapotranspiration cover in reducing the infiltration of precipitation through the waste, and the generation of leachate and impacts to groundwater, surface water and sediment. The low permeability cap will also be more effective than a soil/evapotranspiration cover in preventing contact with waste or contaminated leachate.

Based on this comparative analysis, Alternative 4 would be the most protective of human health and the environment followed in order by Alternatives 3, 2 and 1, respectively. Although current impacts to human health and the environment at the Trimmer Road Landfill Site are not significant, future impacts to the water supply wells downgradient of the site and future releases of contamination due to reported disposal of industrial waste, including drums, are a concern. Placement of a Part 360 cap would significantly reduce infiltration of precipitation and thereby significantly reduce impacts to groundwater. Alternatives 2 and 3 would also reduce infiltration of precipitation, however, the placement of the evapotranspiration cover would be more effective at reducing the infiltration of precipitation than Alternative 2, soil cover, due to the high evapotranspiration rate of the trees and moisture retention capacity of the soils.

## 4.2 Compliance with Standards, Criteria and Guidelines

Alternative 1, no action, will not be compliant with any of the standards, criteria and guidelines (SCGs), applicable or relevant and appropriate requirements (ARARs) or remedial action objectives (RAOs) established for the site as described in Section 1.4. In particular, it will not mitigate leachate generation and impacts to groundwater, surface water or sediment, nor will it provide any additional protection with regard to contact with waste or leachate.

Alternative 2, soil cover, will be compliant with some of the SCGs, ARARs and RAOs for the site. This alternative will mitigate contact with waste, but will not significantly reduce infiltration of precipitation, and therefore, the generation of leachate and impacts to groundwater, surface water and sediment, although reduced, will likely continue.

Alternative 3, evapotranspiration cover, will also be compliant with some SCGs, ARARs and RAOs for the site. This alternative will mitigate contact with the waste and has the potential to significantly reduce the generation of leachate, if demonstrated effective at the site. Through a significant reduction in leachate generation, the evapotranspiration cover will be effective in mitigating impacts to groundwater, surface water and sediment.

Alternative 4 will be compliant with the SCGs, ARARs and RAOs established for the site. The waste will be capped in accordance with New York State Part 360 requirements, eliminating the potential for contact with waste and leachate, and significantly reducing infiltration of precipitation through the waste, thereby significantly reducing impacts on groundwater, surface water and sediment.

In summary, Alternative 4, through placement of the Part 360 cap, would be the most compliant with the SCGs, ARARs and RAOs for the site, followed by Alternatives 3, 2 and respectively.

### 4.3 Short-term Impacts and Effectiveness

Alternative 1 will have only short-term construction-related impacts related to monitoring well installation and can be fully implemented immediately. However, this alternative will not be effective in the short term in preventing potential direct contact with waste and leachate. It will also not be effective at mitigating the generation of leachate and impacts on groundwater, surface water and sediment.

Alternative 2, soil cover, can be implemented within 9 to 12 months after selection of this alternative and issuance of a Record of Decision, and will be effective immediately in the short term in reducing the potential for direct contact with waste. As discussed previously, placement of soil cover will not achieve a high degree of mitigation of leachate generation and impacts on groundwater, surface water and sediment. This alternative includes significant site regrading to enhance storm water runoff. Over 150,000 cy of waste will need to be cut and relandfilled. Daily cover also will need to be placed during implementation of this alternative to minimize generation of odors, however, odors may still occur during regrading. With proper implementation of a construction health and safety plan, and construction quality assurance plan, there will be no adverse impacts on human health and the environment during construction of the cover. Approximately 70,000 cy of material will need to be brought on-site for use in construction of the soil cover. Other than an increase in truck traffic, no other significant disruption to the surrounding community is expected with implementation of this alternative. Any waste generated during construction of the cover will be properly and safely handled, and replaced on-site under the cover.

Alternative 3, evapotranspiration cover, can be implemented within 12 to 15 months after selection of this alternative and issuance of the Record of Decision. Through placement of the soil on-site for planting of the trees, this cover will be immediately effective in reducing the potential for direct contact with waste. Although in the long-term this is expected to be effective in reducing infiltration of precipitation and mitigation of impacts on groundwater, it will take approximately 3 years before the trees are mature and for the cover to be fully effective. Minimal site grading will be required to implement this alternative, therefore, there will be minimal short-term impacts, such as odors, associated with exposure of waste material. Approximately 70,000 cy of material will need to be brought on-site for use in construction of the soil cover. Other than an increase in truck traffic, no other significant disruption to the surrounding community is expected with implementation of this alternative.

Once a Record of Decision has been issued, Alternative 4, installation of a Part 360 cap, will take approximately 18 to 24 months to be implemented. This alternative will be effective in the short term in eliminating the potential for direct contact with waste and leachate, and reducing infiltration of precipitation through waste. All work associated with construction of the cap can be performed without adverse impacts to human health, including the surrounding residents, as well as the environment, with proper engineering, and health and safety controls. As stated above for Alternative 2, over 150,000 cy of waste will need to be cut and filled on the site. Daily cover will be placed over the waste to minimize odors, however, odors likely will still occur. Due to the volumes of material that will be needed to be brought on-site for construction of the cap (approximately 190,000 cy), significant truck traffic will occur during implementation of this alternative. Any waste that may be generated during construction will be properly and safely handled, and placed on-site under the cap.

Based on the above discussion, short-term impacts would rank as described below. Alternative 1 would have the least adverse short-term impacts followed by Alternative 3, which can be implemented without significant site grading or cutting of the waste material. Alternatives 2 and 4 will require significant regrading of the landfill. Alternative 2 would have fewer short-term impacts than Alternative 4 due to the large volumes of soil requiring transportation to the site for Alternative 4, and the associated increase in truck traffic in the vicinity of the site. Based on short-term effectiveness, Alternative 4 would rank the highest, followed by Alternatives 2, 3 and 1. When considering combined short-term impacts and short-term effectiveness, all of the alternatives would rank about equal.

## 4.4 Long-term Effectiveness and Permanence

Alternative 1 will not provide for long-term effectiveness and permanence, since remediation of the waste will not occur. Under this alternative, waste and leachate will continue to be accessible, and leachate will continue to be generated and will continue to impact groundwater, surface water and sediment.

Alternative 2 will provide less long-term effectiveness and permanence than Alternative 3, since placement of a soil cover likely will not be as effective in long-term reduction of leachate generation. Impacts to groundwater will be greater compared to an evapotranspiration cover. As discussed in Section 3.0, modeling performed for both covers indicates that the evapotranspiration cover will be approximately 35 percent more effective at reducing infiltration of precipitation as compared to Alternative 2, soil cover. Alternatives 2 and 3 can be considered permanent if properly maintained.

Alternative 4 will provide long-term effectiveness and permanence in protecting human health and the environment by controlling exposure to and release of contaminants from the waste. Placement of a low permeability cap is considered an effective long-term and permanent remedial action. The risk posed by the contaminants that remain on-site would be minimal, since the waste will be isolated from direct exposure if the cap is properly maintained. As stated in Section 3.0, this alternative will likely be greater than 95% effective at reducing infiltration of precipitation through the waste. This alternative will require inspection and maintenance for the 15-year remediation period. The extended long-term effectiveness and permanence of a Part 360 cap geomembrane beyond the 15-year period is unknown.

Based on this comparative analysis, Alternative 4, Part 360 cap, is the most effective in the long term for remediation of the landfill by providing the greatest degree of long-term effectiveness and permanence. Of the remaining alternatives, Alternative 3 provides greater reduction of infiltration of precipitation than Alternative 2. Therefore, it is likely that Alternative 3 will be more effective in the long term. Alternative 1 will be the least effective in the long term.

### 4.5 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 1 will not be effective in reducing the toxicity, mobility or volume of waste, and as a result, contaminants will continue to be released to and migrate in the environment.

Alternative 2 also will not reduce the toxicity or volume of the waste, but placement of the soil cover and site regrading would reduce the mobility of contaminants in the waste and migration to groundwater, surface water and sediment through the enhancement of storm water runoff and reduction of infiltration of precipitation.

Alternative 3, evapotranspiration cover, will not reduce the toxicity or volume of the waste, but will reduce to a greater extent infiltration of precipitation and generation of leachate. This will result in reduced mobility of contaminants to the groundwater, surface water and sediment, compared to Alternative 2.

As with Alternatives 2 and 3, Alternative 4 will not reduce the toxicity or volume of waste. However, it will significantly reduce the mobility of contaminants in the waste material through isolation and mitigation of infiltration of precipitation through the waste. Reduction of infiltration of precipitation and migration through waste will reduce impacts to groundwater, surface water and sediment, and therefore, will reduce the toxicity and volume of contaminants in these media. Since this alternative will not treat or destroy the waste, and the effectiveness of a Part 360 cap beyond 15 year maintenance period is not known, it is considered potentially reversible.

Based on the above comparative analysis, Alternative 4 will be the most effective at reducing the mobility of contaminants to the environment, followed by Alternatives 3, 2 and 1 respectively. As discussed above, since Alternative 3 will be more effective at reducing infiltration of precipitation and generation of leachate, it will be more effective than Alternatives 2 and 1 at reducing the toxicity and volume of contaminants in groundwater, surface water and sediment.

### 4.6 Implementability

As discussed in Section 3.2, although Alternative 1 is readily implementable physically, it is not implementable from a regulatory perspective, since it does not provide for any mitigation of infiltration of precipitation and leachate generation. Therefore, the Trimmer Road Landfill Site would continue to impact groundwater, surface water and sediment, and threaten downgradient water supply wells.

All of the necessary labor, equipment, materials and supplies for implementation of Alternative 2, placement of a soil cover, are readily available. Site regrading to enhance storm water runoff will require cutting and filling over 150,000 cy of waste. The length of time required to excavate this volume of material may result in problems with odors. Approximately 70,000 cy of material will need to be transported to the site thereby increasing truck traffic in the surrounding community. Once the 12-inch soil cover is installed, future use of the site will need to be restricted in order to ensure the integrity of the soil cover.

Alternative 3, installation of the evapotranspiration cover, is easily implementable. Although it employs a developing technology, the technology is commercially available and all of the necessary labor, equipment, materials and supplies are readily available. Minimal site regrading is required although over 65,000 cy of material will need to be brought to the site as part of the cover, thereby increasing truck traffic in the surrounding community. Trees can be planted by local landscapers with oversight by the design firm. Once completed, the site will resemble a forest, which could be utilized for passive recreational purposes, such as hiking or hunting. This land use is consistent with present land use.

Alternative 4, placement of the Part 360 cap, will significantly increase surface runoff, and therefore, increase flow to the existing pond and downgradient stream channels. Significant upgrading of the stream channel between the on-site pond and Buttonwood Creek likely would be required if this alternative is implemented. This would require obtaining easements from property owners to improve and maintain the stream channel. Although the materials and supplies needed for installation of the Part 360 cap are readily available, these materials, as well as the construction techniques for installation, are more specialized than those required for the soil cover or evapotranspiration cover. Placement of the Part 360 cap could limit future site use because maintenance of the integrity of the geomembrane would require maintaining the ground surface as a grassy open field.

No delays regarding implementation of any of the alternatives is expected, except for improving the off-site drainage system associated with Alternative 4 and the need to obtain easements. Coordination with the appropriate regulatory agencies and governmental utilities would be necessary for all of the alternatives, but is not expected to impact implementation.

Alternative 1, no action, is the easiest alternative to implement followed by Alternatives 3, 2 and 4, respectively. Due to the complexity of the materials and supplies, and construction techniques, in addition to the need for storm water drainage improvements and long-term maintenance requirements, Alternative 4, Part 360 cap, will be more difficult to implement compared to Alternative 2, soil cover and Alternative 3, evapotranspiration cover.

## 4.7 Cost

The estimated capital costs, and long-term (30-year) operation and maintenance (O&M) and monitoring present worth costs associated with each of the remedial alternatives are presented in Table 4-1. A detailed breakdown of each cost estimate is provided in Appendix B.

The following assumptions were utilized in the preparation of the cost estimates:

- Costs are rounded to the nearest thousand dollars.

Table 4-1

**TRIMMER ROAD LANDFILL**
**FEASIBILITY STUDY REPORT**
**REMEDIAL ALTERNATIVES COST SUMMARY**

| Alternative | Estimated Capital Cost | Estimated Contingency and Engineering Fees | Present Worth of Annual Operating Maintenance and Monitoring Costs (30 years) | Total Estimated Costs Based on Present Worth |
|---|---|---|---|---|
| 1 | $10,000 | $5,000 | $44,000 | $59,000 |
| 2 | $3,308,000 | $764,000 | $162,000 | $3,470,000 |
| 3 | $1,830,000 | $550,000 | $145,000 | $2,525,000 |
| 4 | $6,072,000 | $1,518,000 | $297,000 | $7,887,000 |

- All site work costs (e.g., excavation, relandfilling, etc.) were estimated using costs obtained from recent bids for landfills in the vicinity of the site (i.e., Village of Brockport), Means Site Work Cost Data for 1999, experience in construction adjusted for hazardous site remediation, and discussion with remedial contractors, material suppliers, trucking companies and disposal facilities.

As can be seen in Table 4-1, Alternative 1 is the least costly, followed by Alternatives 3, 2 and 4, respectively.

## 4.8 Community Acceptance

It is expected that Alternative 1 will not be acceptable to the local community because it does not provide for protection from the potential for exposure to waste and leachate, and will not reduce the impacts to groundwater, surface water and sediment.

Since Alternative 2 provides protection against direct contact with waste and reduces impacts to the environment, this alternative may be acceptable to the community.

Alternative 3 will likely be more acceptable to the community than Alternative 2, since it provides greater protection against direct contact with waste and greater reduction of impacts to the environment.

Placement of a Part 360 Cap, Alternative 4, will likely be the most acceptable alternative to the community, since it will provide for the greatest protection against exposure to waste and leachate, and will be the most effective alternative at reducing impacts to the environment. However, the increased truck traffic on local roads associated with this alternative may not be acceptable to the community. For these reasons, it is not clear whether Alternative 4 would be the most acceptable to the community. In terms of permanence, the Alternatives rank 4, 3, 2 and 1, respectively.

A summary of the comparative analysis of the alternatives is provided in Table 4-2.

## Table 4-2

## TRIMMER ROAD LANDFILL SITE
## FEASIBILITY STUDY REPORT
## SUMMARY OF REMEDIAL ALTERNATIVES COMPARATIVE ANALYSIS

| Evaluation Criteria | Alternative 1 – No Action with Long-term Groundwater Monitoring | Alternative 2 – Soil Cover with Long-term Groundwater Monitoring | Alternative 3 – Evapotranspiration Cover with Long-term Groundwater Monitoring | Alternative 4 – Part 360 Cap with Long-term Groundwater Monitoring |
|---|---|---|---|---|
| Protection of Human Health and the Environment | 4 | 3 | 2 | 1 |
| Compliance with SCGs/ARARs | 4 | 3 | 2 | 1 |
| Short-term Impacts and Effectiveness* | – | – | – | – |
| Long-term Effectiveness and Permanence | 4 | 3 | 2 | 1 |
| Reduction of Toxicity, Mobility or Volume through Treatment | 4 | 3 | 2 | 1 |
| Implementability | 1 | 3 | 2 | 4 |
| Cost | 1<br>($59,000) | 2<br>($3,470,000) | 2<br>($2,525,000) | 4<br>($7,887,000) |
| Community Acceptance | 4 | 3 | 2 | 1 |
| Total | 22 | 20 | 14 | 13 |

Note: Lowest numerical score is highest ranking.

* Based on combined consideration of short-term impacts and effectiveness, all of the alternatives would rank about equal for this evaluation criteria.

# Section 5

# Appendix A

## APPENDIX A

## EXCERPTS FROM EVAPOTRANSPIRATION COVER EVALUATION REPORT

The following discussion is a summary from an evapotranspiration cover report prepared by Ecolotree, Inc. The report was prepared in order to develop a conceptual design and cost associated with construction and maintenance of an evapotranpiration cover for the Trimmer Road Landfill Site. Copies of the complete report are available upon request from the New York State Department of Environmental Conservation. The listing of any technology, corporation, company, person, or facility in this report does not constitute endorsement, approval, or recommendation by the New York State Department of Environmental Conservation.

Phytoremediation is the use of plants for removing contaminants or preventing contaminant migration. Over the last 10 years there has been a growing interest in the use of closely planted trees on top of landfills in place of current prescriptive covers, (such as the Part 360 cap). In contrast to compacted clay and geomembrane barrier caps, vegetative covers are expected to improve over time due to deeper root growth and increased water holding capacity created by leaf drop, root sloughing, and root exudation.

Hybrid poplar trees are often utilized for phytoremediation applications because they exhibit high water uptake and growth rates, develop deep root systems , are easily propagated, and cna be planted economically. The Ecolotree Cap (Ecap) is a patented phytoremediation system that uses fast growing, deep rooting Salicacea trees (e.g., poplar, cottonwood, willow) to cover landfills and contaminated soils. Hybrid poplars grow quickly, typically between 3 - 10 feet per year; their roots have been observed at 9.5 feet below the ground at a RCRA site in Wisconsin. Appropriately selected trees can grow vigorously for 20+ years and can have lifespans of 50+ years.

**Evaluation by ACAP**

Ecolotree's Ecap is being evaluated by the U.S. Environmental Protection Agency's Alternative Cover Assessment Program (ACAP). ACAP was created by the US Environmental Protection Agency to evaluate landfill covers that are conceptually different but functionally equivalent to the geomembrane or clay covers now permitted under existing solid waste regulations. ACAP conducts the performance evaluation at a site for a period of five years. One or more prescriptive cover test cells (similar to a mini Part 360 cap) are built adjacent to an 'alternative' cover such as a phytoremediation system. The cells are lined so that all percolating water can be accurately measured. The yearly drainage through the side-by-side covers is evaluated with respect to the performance objective. The ECap cover is presently being evaluated at two of the 11 ACAP sites. The data obtained from the 11 ACAP studies constructed across the nation are intended for use by site owners and state/federal decision-makers to evaluate landfill cover options and the products promoted by technology vendors.

**Case Histories**

Bluestem Landfill #2 – Marion, IA

Bluestem Landfill #2 is an operational municipal solid waste landfill with a future capped area of over 90 acres (beginning in 2002). For ecological, economic, and aesthetic reasons, Bluestem staff hope to install a vegetative cover in place of current prescriptive cover designs for future closure activities. In order to permit an alternative cover for final closure, the Iowa Department of Natural Resources (IDNR) has requested that further demonstration data be obtained. To obtain this definitive data, Bluestem has agreed to participate in ACAP. Based on water modeling results, an ECap cover was chosen that consists of 2 ft of interim cover and 3 ft of borrow soil blended with compost at a 5:1 ratio (by volume). RCRA Subtitle D (geomembrane) cap, IDNR-approved compacted clay cap, and ECap test cells were constructed and instrumented in September 2000. A full-scale ECap installation at the site is expected to cost 25% less than a clay cap and 60% less than a geomembrane cap.

Marine Corps Logistics Base – Albany, Georgia

The Marine Corps Logistics Base (MCLB) has a chlorinated solvent groundwater plume resulting from a historic landfill area. The base needs to cap this area within several years, and would like to use a vegetative cap in place of the prescribed compacted clay cap. To document ECap equivalence to the prescribed cover, the base is evaluating the two covers via ACAP. The HELP and Ecolotree hydrologic models were run to design an ECap cover equivalent to the prescribed cover for percolation under average year and extreme year conditions. The test pads were constructed and trees were planted in March 2000, with meaningful results expected beginning in 2001. Feasibility study estimates for capping 17 acres and performing 30 years of O&M are $10.5 million for the prescriptive RCRA cap and $5.4 million for the ECap (Lunardini and Daniel, 2000).

## ECap Design and Layout

### Hydrologic Water Modeling

#### Overview

In collaboration with various academic faculty and consulting engineers since 1995, Ecolotree staff have created a hydrologic performance model to determine appropriate site-specific ECap designs. The model is designed to predict water percolation below the root zone for porous vegetative caps, in contrast to the Hydrologic Evaluation of Landfill Performance (HELP) model, which was designed to predict percolation through low permeability covers. The vegetative water model takes into account the water inputs (precipitation and irrigation) and outputs (runoff, evapotranspiration, and percolation below the root zone) to predict soil moisture fluctuations on a weekly basis (**Figure 4**). Review of climate records, soil hydrologic properties, landfill slope, cover soil thickness, and projected water uptake rates is required to set up the model parameters. The model assumes that a mature tree stand has been established and that significant percolation occurs only when the soil moisture content exceeds its field capacity. Monthly percolation is calculated from the following equation:

$$\begin{aligned}\text{Percolation} = {} & \text{initial soil moisture} + \text{precipitation} + \text{irrigation} \\ & - \text{runoff} - \text{effective ET} - \text{final soil moisture}\end{aligned}$$

The model can be run to predict percolation below a grass-only cap or a tree/grass cap root zone for established cover soil conditions, or it can be run to evaluate percolation for varying available water holding capacity (AWHC) values. The AWHC is defined as the soil water fraction that can be taken up by plants. The appropriate cover soil depth and amendment blend is chosen to obtain the desired AWHC (and subsequently achieve the regulatory percolation goal). The objective is to keep soil moisture in the root zone 'sponge' between the field capacity and the wilt point of the soil.

The following notes and assumptions, as cited in Tables 1-4, are important for understanding the model results:

1. Values are the average (1961-1990) precipitation results for Rochester, New York (data provided by the Midwestern Regional Climate Center).

2. To convert inches to gallons/acre, multiply times 27,158.

3. Although the degree of water percolation into frozen soils is dependent on factors such as grain size distribution and soil moisture at the time of initial freezing, frozen soils typically allow for only minimal water infiltration (Kane, 2000). It was conservatively assumed for December – March that 50% of the precipitation infiltrates into the soil and 50% melts and becomes runoff. It was conservatively assumed that no runoff occurs between April and November.

4. For an ECap cover, canopy interception is assumed to be 15% of monthly precipitation for May through October, 5% for April and November, and zero for December - March. For a grass-only cover, canopy interception is assumed to be zero for all months.

5. Values are the average (1990-1999) grass potential evapotranspiration rates for Rochester, New York (provided by the Northeast Regional Climate Center).

6. Conversion factors for converting grass PET to grass and poplar PET: 1.0 for November - March; 1.1 for April and October; 1.2 for May and September; and 1.3 for June - August.

7. Field capacity for the ECap cover is assumed to be twice the AWHC value; field capacity for the 1 ft grass-only cover assumed to be 2.16 inches (Carrow et. al., 1990).

8. AWHC for the ECap cover has been arbitrarily set for cover selection purposes; AWHC for the 1 ft grass-only cover is assumed to be 4.38 inches (Carrow et al., 1990).

9. Wilt point = field capacity - AWHC

10. Soil Water Depletion Fraction, f, is a function of PET and crop type (Doorenbos, J., and Kassam, A.H., 1979). It is assumed that the grass/poplar crop is analogous to alfalfa.

11. BML = field capacity - (f*AWHC).

12. For moisture contents above the BML, effective ET = PET. Below the BML, effective ET < PET (decreases linearly to ET = 0 at the wilt point). From <u>Yield Response To Water</u>.
13. January beginning soil moisture is arbitrarily set to correspond with end of December soil moisture values.

14. Calculated ending soil moisture = beginning soil moisture + precipitation + irrigation - surface runoff - effective ET - percolation.

15. Percolation past the soil/root zone occurs when soil moisture content exceeds field capacity.

## Hydrologic Modeling for the Trimmer Road Landfill

### Climatic Conditions

The Trimmer Road Landfill is located in a freeze-thaw climate with moderate summers, frozen conditions in the winter, and mild spring and fall weather. This climate is very hospitable to hardwood deciduous trees, and poplar species such as eastern cottonwood can be found growing on and surrounding the landfill.

Historic precipitation values (1961-1990) for were obtained from the Midwestern Regional Climate Center. The average annual precipitation for Rochester, New York between during this time period was 31.97 inches. Rochester typically receives fairly uniform precipitation, with monthly averages ranging from 2.08 – 3.40 inches. Snow constitutes the majority of the precipitation between December and February. Average monthly potential evapotranspiration (PET) estimates (1990-1999) for grass were provided for Rochester by the Northeast Regional Climate Center. Average annual grass PET for this time period was 21.31 inches.

### Hydrologic Modeling Results

Leakage through vegetative caps is determined to a great extent by the soil available water holding capacity (AWHC). Sand has a very low AWHC of 0.4-1.0 inch/ft, while silt loam has a high AWHC of 2.0-2.3 inch/ft (Carrow et al., 1990). Thus, the Ecolotree hydrologic model was evaluated for the following conditions:

- ECap, 4 inches of AWHC (**Table 1, Figure 5**)
- ECap, 6 inches of AWHC (**Table 2, Figure 6**)
- ECap, 8 inches of AWHC (**Table 3, Figure 7**)
- Grass-only cap, 1 foot of silt-loam soil, AWHC = 2.16 inches (**Table 4, Figure 8**)

The predicted annual percolation rates and cover efficiency values ((precipitation – percolation)/precipitation) were obtained for the ECap covers and grass-only cover. The results are as follows:

- ECap, 4 inches of AWHC: percolation = 4.0 inches, efficiency = 87%
- ECap, 6 inches of AWHC: percolation = 2.6 inches, efficiency = 92%
- ECap, 8 inches of AWHC: percolation = 1.7 inches, efficiency = 95%
- Grass-only cap, 1 foot of silt-loam soil: percolation = 6.2 inches, efficiency = 81%

The model assumes that a mature ECap has been established at the site, characterized by full canopy and maximum water uptake rates. Typically maturity is achieved by the end of the third growing season. Although the understory grasses will help to reduce percolation during the two or three establishment years following planting, more percolation is expected to take place than for a mature ECap. By inference from the existing hydrologic models, predicted percolation for a 6 inch AWHC ECap is expected to be approximately 4 inches for year 1 and year 2, and 3 inches for year 3.

**Cover Recommendations**

The model predicts that a 1 ft thick soil cover planted with grass will leak substantially under average climatic conditions. This leakage is due to an insufficient amount of AWHC in 1 ft of soil, lower evapotranspiration rates than with a tree-grass cover, and the shallow rooting nature of grasses (typically 12-18 inches deep, not expected to root into waste). Abnormal climatic conditions, such as higher precipitation rates, cooler summers, and warmer winters than average, would result in even higher leakage rates. The ECap cover is expected to leak significantly less water than the grass-only cover because it has greater AWHC, increased evapotranspiration rates, and deeper rooting potential.

Based on these results, an ECap cover is recommended to minimize the long-term percolation of water into waste, and thus minimize the long-term liability of the state and the landfill owner. The ECap also has numerous auxiliary benefits, as outlined in section 1.2, *Objectives and Benefits*. To ensure a successful ECap, two criteria must be met:

1. Provide a minimum of 4 inches of AWHC in the cover soils and amendments (necessary for water storage and tree health).

2. Provide a minimum of 3 feet of rootable material to reduce the potential of 'windthrow' (blowing over of trees caused by severe winds). If site investigations indicate that the near-surface waste is rootable, then the waste can be used for a portion of the 3 foot requirement.

Although the ECap cover materials would ideally be constructed to contain 8+ inches of AWHC, this solution is probably not economically feasible. Approximately 4 ft of silt-loam soil would be required to provide an AWHC of 8 inches. Thus, an ECap cover containing 4 inches of AWHC is more realistic. Since the site currently has an average of approximately 6 inches of silt topsoil (1.1 inches of AWHC), an additional 2.9 inches of AWHC is needed. This additional AWHC can be obtained with a variety of materials, contingent on availability and cost. Although laboratory testing for AWHC is necessary to confirm a final cover design, three examples of potential covers are as follows:

1. 6 inches of existing soil and 1.5 ft of borrow topsoil (assuming a silt material)
2. 6 inches of existing soil and 2.5 ft of sandy loam fill dirt
3. 6 inches of existing soil and a 1.5 – 2.0 ft blend (estimated) of sandy loam fill dirt and organic amendments (e.g. compost, wastewater treatment biosolids)

If the near-surface waste is deemed rootable, it can also contribute to the AWHC of the ECap cover. A 1 ft layer of rootable municipal waste has an AWHC of approximately 2.6 inches (Oweis and Khera, 1998). Thus, the total AWHC of an ECap with a 4 inch AWHC soil cover would actually be on the order of 7.6 inches.

Surface application of organic amendments, such as composted yard waste or wastewater treatment biosolids, is also strongly recommended. These amendments could be applied in a 3 inch thick, 1 ft wide swath along the tree rows to provide nutrients, increase AWHC, reduce weed competition, and discourage burrowing animals from damaging the trees. The amendments could be applied on a one-time basis at the time of planting, or could be applied on a 3-6 year rotation, contingent on amendment availability, cost, and soil fertility.

**Tree Selection and Layout**

The ECap will be planted on the flat upland portion of the landfill, estimated to be 27 acres in size. It is assumed at this time that the existing trees and shrubs on this upland portion will be removed. This vegetation can be ground or chipped and incorporated into the cover soils on-site. Portions of the successional northern hardwoods areas may be left in place and planted around. This decision will be made after evaluating tree density, depth of existing soil, and the logistics of placing and grading borrow soil in these areas. Trees will only be planted on the sloping edges of the landfill to fill gaps in the existing hardwood trees. The planting will consist of approximately 85% hybrid poplar trees, 10% willow, and 5% 'other' (e.g. ash, maple). The hybrid poplar and willow will be planted with a between-tree spacing of 5 feet, and a between-row spacing of 10 feet. The 5% ash, maple, and other chosen species will be intermixed with these trees and spaced 10 feet from the other trees. Approximately 850 trees will be planted per acre (50 $ft^2$/tree), for a total of 23,000 trees. This spacing will provide maximum water uptake capacity and stabilization of surface soils, while allowing for vehicle and equipment access across the site (for mechanized mowing, organic amendment application, and recreational activities). The tree rows will curve gradually in a south to east orientation across the landfill, and will start and stop to accommodate the existing recreational trails (Figure 8). The site will be seeded with native grasses and forbes to provide a lush understory.

**Instrumentation Options**

If soil moisture monitoring is desired for the landfill cover, the site can be instrumented with datalogged or modemed nests of soil moisture sensors. The soil moisture results, in conjunction with rain gauge results, can provide valuable information for estimating water leakage into waste. The type and quantity of sensors are dependent upon the desired degree of automation, cost, and the availability of local labor for instrument monitoring.

**ECap Construction Activities**

**Site Characterization**

The following site characterization tasks are necessary before site preparation can begin:

1. Mow the upland portion of the landfill.
2. Survey the upland portion of the landfill into a 20-40 block grid pattern. Dig a test pit in the center of each block to determine existing cover thickness.
3. Evaluate the rootability of the near-surface waste by removing approximately 10 trees from

across the site and evaluating their root development.

4. Document the location of on-site trees marked for salvage.
5. Analyze the existing cover soils, borrow soils, and amendment sources for nutrient and water-holding properties.
6. Finalize the cover design by selecting borrow soil and amendment sources and determining cover thickness.
7. Layout the tree planting plan.
8. Evaluate the proposed planting technique (vibrating ripper tooth) by testing the equipment at several locations on the landfill.

**Site Preparation**

The expected site preparation tasks are as follows:

1. Clearing and grubbing: Mow the site to a 3 inch height, remove and chip the existing trees and brush and spread this material across the site.

2. Grading: Place and grade soils and amendments to achieve the specified cover thickness and slope; fill in areas of surface cavitation.

3. Fertilization: Broadcast spread granular fertilizer across the site.

4. Tree row layout: Layout the location of the tree planting rows.

**ECap Construction**

The expected construction tasks are as follows:

1. Tree planting: Trees will be planted into 3 inch wide, 3 ft deep trenches created by a vibrating ripper tooth (pulled by a Ditchwitch track trencher or equivalent equipment). Planting should be completed May 15 to maximize survival.

2. Biosolid or compost addition: Apply a 3 inch thick, 1 ft wide layer of biosolids or compost along the tree rows following planting.

3. Understory seeding: Rototill the site to prepare an appropriate seed bed, broadcast spread grass seed across the site, and perform follow-up harrowing.

**EBuffer Installation**

Numerous laboratory studies and field applications have demonstrated the effectiveness of hybrid poplar trees in treating a variety of organic pollutants, including trichloroethylene, benzene, toluene, dioxane, and atrazine (Wichman, 1990, Paterson and Schnoor, 1992, Burken, 1993, Nair et al., 1993, Burken, 1996, Newman et al., 1997, Aitchison et al., 2000). Remediation of these compounds is achieved by a combination of plant uptake and enhanced biodegradation by root-associated microorganisms. EBuffers have been installed for interception of landfill leachate, organic contaminant plumes, and fertilizer-impacted groundwater at 16 sites in eight states.

Installation of an EBuffer at the Trimmer Road Landfill is constrained by property boundaries, drainage channels, wetland areas, and existing vegetation. Installation would require purchase of off-site property or a large-scale clearing of existing trees on the side slopes and immediately surrounding the landfill. In addition, it is expected that the existing trees on-site currently provide some phytoremediation treatment of groundwater and leachate seeps. Due to these factors, a full-scale EBuffer installation is not recommended. A small scale strategic planting of trees is recommended, however, in plume or leachate seep areas with insufficient natural vegetation.

**Monitoring and Maintenance Activities**

The ECap typically requires little maintenance after the first three growing seasons. However, proper monitoring and maintenance is important during the first three years to ensure a healthy ECap. These activities are as follows:

1. Site inspections: A trained inspector will observe the site every two weeks during the first growing season, and every 3-4 weeks during the second and third growing season. The inspector will look for such conditions as insect damage, surface disturbances or rutting caused by vehicles traversing the site, gullies, soil erosion, and other stresses to the vegetation.

2. Replanting: With proper site preparation, installation, and maintenance, tree survival at the site is expected to be 90+%. However, as with all large-scale vegetative plantings, some mortality is likely. Replanting of observed mortality should be performed in the spring of the second growing season.

3. Mowing and weeding: The site should be mowed to a 3 inch height when the grass or weed height exceeds 8 inches (expected to be 3-5 times annually). Selective removal of noxious weeds, such as morning glory, may be required.

4. Pruning: The trees should be pruned annually to remove double leaders, dead branches, insect damage, and canker.

5. Insect and animal control: Insect and animal damage require quick response times. Cottonwood beetle, gypsy moths, tent caterpillars, and wood borers can damage the trees. Insect reatment is usually achieved by spraying of commercially-available insecticide.

6. Apply fertilizer and other soil amendments: Soil and foliar (leaf) samples will be taken annually and analyzed for macro and micro-nutrients. Based on these results, addition of soil amendments may be required. These amendments could include fertilizer, organic materials, and lime or gypsum (for soil pH adjustment).

Long-term maintenance tasks (after year 3) are expected to consist of quarterly site inspections, mowing 2-3 times annually, and fertilization on an as-needed basis only.

# Appendix B

# APPENDIX B

# DETAILED COST ESTIMATE

## TRIMMER ROAD LANDFILL
## ALTERNATIVE 1
## NO ACTION WITH LONG-TERM GROUNDWATER MONITORING
## COST ESTIMATE

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| <u>Capital Costs</u> | | | | |
| Installation of 2 deep groundwater monitoring wells | -- | Lump Sum | $10,000.00 | $10,000 |
| **Estimated Capital Cost** | | | | **$10,000** |
| **Contingency and Engineering Fees** | | | | |
| Contingency allowance (20%) | | | | $2,000 |
| Engineering fees (30%)* | | | | $3,000 |
| **Estimated Contingency and Engineering Fees** | | | | **$5,000** |
| **TOTAL ESTIMATED CAPITAL COST** | | | | **$15,000** |
| <u>Annual Operating and Maintenance Costs</u> | | | | |
| **Groundwater Monitoring Costs Year 1A*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis** | 11 | Samples | $700 | $7,700 |
| Estimated per event monitoring costs | | | | $10,700 |
| **Groundwater Monitoring Costs Years 1B, 2, 5,15, 20, 25 and 30*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis** | 9 | Samples | $300 | $2,700 |
| Estimated per event monitoring costs | | | | $5,700 |

TRIMMER ROAD LANDFILL
ALTERNATIVE 1
NO ACTION WITH LONG-TERM GROUNDWATER MONITORING
COST ESTIMATE (CONTINUED)

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Groundwater Monitoring Costs Year 3*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis** | 11 | Samples | $300 | $3,300 |
| | Estimated per event monitoring costs | | | $6,300 |
| **Groundwater Monitoring Costs Year 10*** | | | | |
| Groundwater sampling | 1 | Mandays | $600 | $600 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis** | 9 | Samples | $700 | $6,300 |
| | Estimated per event monitoring costs | | | $8,700 |
| | Present worth of groundwater monitoring (30 yrs, i=5%)** | | | **$44,000** |
| | **Remedial Alternative 1 Total Estimated Costs** | | | **$59,000** |

* Includes design and construction inspection.
**Sample analysis and frequency of sampling is provided on Table 3-1 of the report

**TRIMMER ROAD LANDFILL**
**ALTERNATIVE 2**
**SOIL COVER WITH LONG-TERM GROUNDWATER MONITORING**
**COST ESTIMATE**

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Capital Costs** | | | | |
| **Mobilization/demobilization*** | - | Lump Sum | $100,000 | $100,000 |
| | | | | |
| **Site Preparation** | | | | |
| Clearing and grubbing | 36 | Acres | $7,000 | $249,000 |
| | | | | |
| **Soil Cover** | | | | |
| Unclassified excavation and landfilling | 150,000 | CY | $9.00 | $1,350,000 |
| Buy/haul/place 6" daily soil cover | 10,000 | CY | $6.00 | $60,000 |
| Buy/haul/place 6" soil cover | 30,000 | CY | $6.00 | $180,000 |
| Buy/haul/place 6" vegetative growth medium | 30,000 | CY | $14.00 | $420,000 |
| Seed, fertilize and mulch | 175,000 | SQ YD | $1.00 | $175,000 |
| | | | | |
| **Long-term Monitoring** | | | | |
| Installation of 2 deep groundwater monitoring wells | -- | Lump Sum | $10,000 | $10,000 |
| | | | | |
| | **Estimated Capital Cost** | | | **$2,544,000** |
| **Contingency and Engineering Fees** | | | | |
| Contingency allowance (15%) | | | | $382,000 |
| Engineering fees (15%)** | | | | $382,000 |
| **Estimated Contingency and Engineering Fees** | | | | $764,000 |
| **TOTAL ESTIMATED CAPITAL COST** | | | | **$3,308,000** |
| **Annual Operating and Maintenance Costs** | | | | |
| **Cover** | | | | |
| Site inspection | 4 | Mandays | $600 | $2,400 |
| Vegetation maintenance and site materials | - | Lump Sum | $3,000 | $3,000 |
| Miscellaneous site work (including swale maintenance) | 10 | Mandays | $600 | $6,000 |
| | Annual cost | | | $11,400 |
| | Present worth of annual operation & maintenance cost for 15 yrs (i=5%) | | | **$118,000** |

# TRIMMER ROAD LANDFILL
# ALTERNATIVE 2
# SOIL COVER WITH LONG-TERM GROUNDWATER MONITORING
# COST ESTIMATE (CONTINUED)

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Groundwater Monitoring Costs Year 1A*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 11 | Samples | $700 | $7,700 |
| | Estimated per event monitoring costs | | | $10,700 |
| **Groundwater Monitoring Costs Years 1B, 2, 5,15, 20, 25 and 30*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 9 | Samples | $300 | $2,700 |
| | Estimated per event monitoring costs | | | $5,700 |
| **Groundwater Monitoring Costs Year 3*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 11 | Samples | $300 | $3,300 |
| | Estimated per event monitoring costs | | | $6,300 |
| **Groundwater Monitoring Costs Year 10*** | | | | |
| Groundwater sampling | 1 | Mandays | $600 | $600 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 9 | Samples | $700 | $6,300 |
| | Estimated per event monitoring costs | | | $8,700 |
| | Present worth of groundwater monitoring (30 yrs, i=5%)*** | | | **$44,000** |
| | **Remedial Alternative 2 Total Estimated Costs** | | | **$3,470,000** |

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings

** Includes design and construction inspection.

***Sample analysis and frequency of sampling is provided on Table 3-1 of the report

# TRIMMER ROAD LANDFILL
## ALTERNATIVE 3
## EVAPOTRANSPIRATION COVER WITH LONG-TERM GROUNDWATER MONITORING
## COST ESTIMATE

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| <u>**Capital Costs**</u> | | | | |
| **Mobilization/demobilization*** | - | Lump Sum | $100,000 | $100,000 |
| | | | | |
| **Site Preparation** | | | | |
| Clearing and grubbing | 27 | Acres | $7,000 | $189,000 |
| Buy/haul/place planting material | 65,000 | CY | $14.00 | $910,000 |
| Seed, fertilize and mulch | 131,000 | SQ YD | $1.00 | $131,000 |
| | | | | |
| **Evapotranspiration Cover** | | | | |
| Pilot Study | -- | Lump Sum | $250,000 | $250,000 |
| Design, procurement and preparation* | -- | Lump Sum | $20,000 | $20,000 |
| Cover installation*** | -- | Lump Sum | $320,000 | $320,000 |
| | | | | |
| **Long-term Monitoring** | | | | |
| Installation of 2 deep groundwater monitoring wells | -- | Lump Sum | $10,000 | $10,000 |
| | | **Estimated Capital Cost** | | **$1,830,000** |
| **Contingency and Engineering Fees** | | | | |
| Contingency allowance (15%) | | | | $275,000 |
| Engineering fees (15%)*** | | | | $275,000 |
| | **Estimated Contingency and Engineering Fees** | | | $550,000 |
| | **TOTAL ESTIMATED CAPITAL COST** | | | **$2,380,000** |
| | | | | |
| <u>**Annual Operating and Maintenance Costs**</u> | | | | |
| **Cover Year 1** | | | | |
| Site inspection | 5 | Mandays | $600 | $3,000 |
| Replanting | -- | Lump Sum | $15,000 | $15,000 |
| Mowing | 4 | Mandays | $600 | $2,400 |
| Miscellaneous site work (including insect control, fertilization, weeding and pruning) | -- | Lump Sum | $15,000 | $15,000 |
| | Annual cost | | | $35,400 |

# TRIMMER ROAD LANDFILL
## ALTERNATIVE 3
## EVAPOTRANSPIRATION COVER WITH LONG-TERM GROUNDWATER MONITORING
## COST ESTIMATE (CONTINUED)

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Cover Years 2 and 3** | | | | |
| Site inspection | 3 | Mandays | $600 | $1,800 |
| Mowing | 4 | Mandays | $600 | $2,400 |
| Miscellaneous site work (including insect control, fertilization, weeding and pruning) | -- | Lump Sum | $15,000 | $15,000 |
| | Annual cost | | | $19,200 |
| **Cover Years 4 and 15** | | | | |
| Site inspection | 1 | Mandays | $600 | $600 |
| Mowing | 2 | Mandays | $600 | $1,200 |
| Miscellaneous site work (including fertilization) | -- | Lump Sum | $2,500 | $2,500 |
| | Annual cost | | | $4,300 |
| | Present worth of annual operation & maintenance cost 15 yrs (i=5%) | | | **$101,000** |
| **Groundwater Monitoring Costs Year 1A*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis***** | 11 | Samples | $700 | $7,700 |
| | Estimated per event monitoring costs | | | $10,700 |
| **Groundwater Monitoring Costs Years 1B, 2, 5,15, 20, 25 and 30*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis***** | 9 | Samples | $300 | $2,700 |
| | Estimated per event monitoring costs | | | $5,700 |
| **Groundwater Monitoring Costs Year 3*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis***** | 11 | Samples | $700 | $7,700 |
| | Estimated per event monitoring costs | | | $10,700 |

## TRIMMER ROAD LANDFILL
## ALTERNATIVE 3
## EVAPOTRANSPIRATION COVER WITH LONG-TERM GROUNDWATER MONITORING
## COST ESTIMATE (CONTINUED)

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Groundwater Monitoring Costs Year 10*** | | | | |
| Groundwater sampling | 1 | Mandays | $600 | $600 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis***** | 9 | Samples | $700 | $6,300 |
| | Estimated per event monitoring costs | | | $8,700 |
| | Present worth of groundwater monitoring (30 yrs, i=5%)***** | | | **$44,000** |
| | **Remedial Alternative 3 Total Estimated Costs** | | | **$2,525,000** |

*Includes bonds, insurance and temporary facilities
** Includes predesign submittals
**Includes mobilization/demobilization and temporary facilities
*** Includes design and construction inspection.
****Sample analysis and frequency of sampling is provided on Table 3-1 of the report

TRIMMER ROAD LANDFILL
ALTERNATIVE 4
PART 360 CAP WITH LONG-TERM GROUNDWATER MONITORING
COST ESTIMATE

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| <u>Capital Costs</u> | | | | |
| **Mobilization/demobilization*** | - | Lump Sum | $300,000 | $300,000 |
| | | | | |
| **Site Preparation** | | | | |
| Clearing and grubbing | 36 | Acres | $7,000 | $252,000 |
| | | | | |
| **Geomembrane Cap** | | | | |
| Unclassified excavation and landfilling | 150,000 | CY | $9.00 | $1,350,000 |
| Buy/haul/place 6" daily soil cover | 10,000 | CY | $6.00 | $60,000 |
| Buy/haul/place contour grading material | 30,000 | CY | $6.00 | $180,000 |
| Buy/haul/place 60 mil HDPE geomembrane | 175,000 | SQ YD | $6.00 | $1,050,000 |
| Buy/haul/place geocomposite | 175,000 | SQ YD | $5.00 | $875,000 |
| Buy/haul/place 24 inch barrier protection layer | 120,000 | CY | $6.00 | $720,000 |
| Buy/haul/place 6" vegetative growth medium | 30,000 | CY | $14.00 | $420,000 |
| Seed, fertilize and mulch | 175,000 | SQ YD | $1.00 | $175,000 |
| Passive vents | 144 | Vents | $2,500 | $360,000 |
| | | | | |
| **Long-term Monitoring** | | | | |
| Installation of 2 deep groundwater monitoring wells | -- | Lump Sum | $10,000 | $10,000 |
| | | | | |
| **Storm Water Drainage System** | | | | |
| On-site conveyance swale construction | -- | Lump Sum | $120,000 | $120,000 |
| Off-site conveyance swale | -- | Lump Sum | $200,000 | $200,000 |
| | | | | |
| | **Estimated Capital Cost** | | | **$6,072,000** |
| **Contingency and Engineering Fees** | | | | |
| Contingency allowance (15%) | | | | $911,000 |
| Engineering fees (10%)** | | | | $607,000 |
| **Estimated Contingency and Engineering Fees** | | | | $1,518,000 |
| **TOTAL ESTIMATED CAPITAL COST** | | | | **$7,590,000** |
| | | | | |
| <u>**Annual Operating and Maintenance Costs**</u> | | | | |
| **Part 360 Cap** | | | | |
| Site inspection | 4 | Mandays | $600 | $2,400 |
| Miscellaneous site work (including swale maintenance) | 20 | Mandays | $600 | $12,000 |
| Vegetation maintenance and site materials | - | Lump Sum | $10,000 | $10,000 |
| | Annual cost | | | $24,400 |
| | Present worth of annual operation & maintenance cost for 15 yrs (i=5%) | | | **$253,000** |

**Alternative 4**
**Trimmer Road Landfill**
**Part 360 Cap with Long-term Groundwater Monitoring**
**Cost Estimate (continued)**

| Item | Quantity | Units | Unit Cost | Total |
|---|---|---|---|---|
| **Groundwater Monitoring Costs Year 1A*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 11 | Samples | $700 | $7,700 |
| | Estimated per event monitoring costs | | | $10,700 |
| **Groundwater Monitoring Costs Years 1B, 2, 5,15, 20, 25 and 30*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 9 | Samples | $300 | $2,700 |
| | Estimated per event monitoring costs | | | $5,700 |
| **Groundwater Monitoring Costs Year 3*** | | | | |
| Groundwater sampling | 2 | Mandays | $600 | $1,200 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipment, materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 11 | Samples | $300 | $3,300 |
| | Estimated per event monitoring costs | | | $6,300 |
| **Groundwater Monitoring Costs Year 10*** | | | | |
| Groundwater sampling | 1 | Mandays | $600 | $600 |
| Purge water disposal | 4 | Drums | $200 | $800 |
| Equipmer  materials and supplies | - | Lump Sum | $1,000 | $1,000 |
| Sample analysis*** | 9 | Samples | $700 | $6,300 |
| | Estimated per event monitoring costs | | | $8,700 |
| | Present worth of groundwater monitoring (30 yrs, i=5%)*** | | | **$44,000** |
| | **Remedial Alternative 4 Total Estimated Costs** | | | **$7,887,000** |

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings
** Includes design and construction inspection.
***Sample analysis and frequency of sampling is provided on Table 3-1 of the report

## 5.0 RECOMMENDED ALTERNATIVE

Based on the preliminary evaluation of the remedial alternatives described in Section 3.0, and the detailed evaluation of these alternatives in Section 4.0, Alternative 3 – Evapotranspiration Cover with Long-term Groundwater Monitoring – is the recommended alternative for remediation of the Trimmer Road Landfill Site. This alternative meets all of the remedial action objectives identified for the site and all of the feasibility study evaluation criteria, in particular, protection of human health and the environment, and attainment of the standards, criteria and guidelines established for the site.

Although Alternative 4 – Part 360 Cap with Long-term Groundwater Monitoring – ranks slightly higher than Alternative 3, Alternative 4 is approximately $5.3 million more costly than Alternative 3, would be more difficult to implement than Alternative 3 and likely would have significant short term impacts due to substantial cutting of waste and regrading of the landfill. In addition, Alternative 4 likely would require substantial drainage improvements in the vicinity of the site and easements to provide for the drainage improvements. Alternative 3 will require minimal site regrading and cutting of waste, and can be implemented without significant short term impacts. Also, Alternative 3 would not require significant drainage improvements. Planting of the trees as part of evapotranspiration cover will not be difficult to implement and can be performed by a local contractor with oversight of the design firm.

Placement of the evapotranspiration cover and continued long-term groundwater monitoring would provide significant protection of human health and the environment through elimination of exposure to waste and contaminated leachate. The cover would reduce infiltration of precipitation through the landfill, thereby reducing the generation of leachate and impacts to groundwater and the stream adjacent to the landfill. In order to improve the effectiveness of the evapotranspiration cover with regard to migration of contaminated groundwater off-site, it is recommended that trees also be planted along the northern and western boundaries of the landfill. These additional trees will provide for phytoremediation of shallow contaminated groundwater that may migrate off-site and impact downgradient water supply wells.

Once the evapotranspiration cover is installed, the site will require maintenance for the first 5 years and little to essentially no maintenance for the remainder of the 30-year remediation period. The site will be able to be utilized for passive recreational purposes, such as hiking, however, deed restrictions or covenants would need to be put in place to ensure that the site is not utilized for residential, commercial or industrial purposes in the future, and that the vegetation and soil cover not be disturbed.

Use of an evapotranspiration cover for capping landfills is an emerging technology. Although this cover is a promising method of landfill remediation, since only limited data are currently available demonstrating its effectiveness, it is recommended that a pilot study be performed to evaluate the site-specific effectiveness of this technology at the Trimmer Road Landfill Site. An evapotranspiration cover is not expected to be as effective as a Part 360 cap in reducing the infiltration of precipitation and generation of leachate, particularly in the dormant winter months. However, it is anticipated to provide for sufficient reduction of infiltration and leachate generation, and resulting groundwater and surface water contamination to justify selection as the recommended alternative. If the effectiveness of the cover is not determined to be acceptable based on the results of the pilot study and the Alternative Cover Assessment Program (ACAP) presently being conducted by the United States Environmental Protection Agency, Alternative 4 – Part 360 Cap with long-term groundwater monitoring – would become the recommended alternative.