2.2.2

DRAFT

DRAFT
ENGINEERING EVALUATION / COST ANALYSIS
BENNINGTON ~~MUNICIPAL~~LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

Submitted To:

U.S. Environmental Protection Agency
Region I

Prepared By:

McLaren/Hart Environmental Engineering Corporation
Penn Center West III, Suite 106
Pittsburgh, Pennsylvania 15276

APRIL 15, 1994
REV 1 JUNE 25, 1994

TABLE OF CONTENTS
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON ~~MUNICIPAL~~LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TABLE OF CONTENTS (cont'd)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON ~~MUNICIPAL~~LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

SECTION **PAGE NO.**

TABLE OF CONTENTS (cont'd)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON ~~MUNICIPAL~~LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

SECTION **PAGE NO.**

TABLE OF CONTENTS (cont'd)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

FIGURES

FIGURE NO.

TABLES

TABLE NO.

TABLE OF CONTENTS (cont'd)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

APPENDICES

appendix E removed;

ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPE	Chlorinated Polyethylene
CLP	Contract Laboratory Program
cm/sec	centimeters per second
COD	Chemical Oxygen Demand
CRQL	Contract Required Detection Limit
cy	cubic yard
DAF	Dissolved Air Flotation
E&S	Erosion and Sedimentation
EE/CA	Engineering Evaluation/Cost Analysis
FML	flexible membrane liner
gpm	gallons per minute
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
ISCR	Initial Site Characterization Report
LFI	Limited Field Investigation
MCLs	Maximum Contaminant Levels
McLaren/Hart	McLaren/Hart Environmental Engineering Corporation
mg/l	milligram per liter
MW	Monitoring Well
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
O&M	Operation and Maintenance
Order	Administrative Order by Consent (Docket No. I-91-1093)
OSWER	Office of Solid Waste and Emergency Response
OVA	Organic Vapor Analyzer
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
POTW	Publicly Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PRSC	Post-Removal Site Control
PSA	Preliminary Site Assessment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RACT	Reasonably Available Control Technology

ABBREVIATIONS (cont'd)

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RIWP	Remedial Investigation Work Plan
SACM	Superfund Accelerated Cleanup Model
Settling Parties	Bennington ~~Municipal~~-Landfill Superfund Site Settling Parties
Site	Bennington ~~Municipal~~-Landfill Superfund Site
SI	Site Inspection
SVOC	Semivolatile Organic Compounds
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TDS	Total Dissolved Solids
Town	Town of Bennington
TOC	Total Organic Carbon
TOX	Total Organic Halogens
TSD	Treatment, Storage and Disposal
USEPA	United States Environmental Protection Agency
VLDPE	Very Low Density Polyethylene
VOC	Volatile Organic Compound
VSA	Vermont Statutes Annotated
VTAEC	Vermont Agency of Environmental Conservation
VTANR	Vermont Agency of Natural Resources

EXECUTIVE SUMMARY

In voluntary response to a directive by the United States Environmental Protection Agency (USEPA) dated February 18, 1994, requiring that the Bennington ~~Municipal~~-Landfill Superfund Site Settling Parties (Settling Parties) undertake efforts to expedite response actions at the Bennington ~~Municipal~~-Landfill Superfund Site (Site) within the USEPA Superfund Accelerated Cleanup Model (SACM) program, the Settling Parties have prepared an Engineering Evaluation/Cost Analysis (EE/CA) for this Site. An EE/CA is intended to evaluate source control measures consistent with the document titled "Guidance On Conducting Non-Time Critical Removal Actions" (EPA/540-R-93-057, August 1993) (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and address response action objectives specified by USEPA. ~~The purpose of an EE/CA is to determine if the SACM approach is relevant to the Site. This EE/CA meets its intended purpose.~~ Ultimately, EPA will use the EE/CA to select its preferred alternative for source control measures at this Site. As detailed in the "Presumptive Remedy for CERCLA Municipal Landfill Sites" (Dir. No. 9355.0-49FS, September 1993), EPA believes that the most appropriate way to address the source contamination at a municipal landfill site is the containment of landfill contents and collection and/or treatment of landfill gases and leachate (if present). The objective of the presumptive remedy initiative is to use the program's past experience to streamline site investigations and expedite selection of cleanup actions. At this point in the project, USEPA presumes the remedy for CERCLA municipal landfill sites, that is, the containment of landfill contents and collection and/or treatment of landfill gases and leachate (if present) might apply to the Site. If appropriate, other source control measures related to the containment remedy are also evaluated. These additional source control measures can include control of surface and ground water to prevent future saturation of the landfill contents. The presumptive remedy does not address the cleanup of contaminated ground water, if present, beyond the facility boundaries.

The ~~remedial~~ response technologies related to non-time-critical removal actions at landfills evaluated in this EE/CA are as follows:

- capping of the landfill;
- landfill gas management;
- leachate collection and treatment;
- upgradient shallow groundwater control measures; and,
- soils/sediments response measures ~~remediation~~ (at potentially impacted locations).

These response action objectives are intended to minimize future potential impacts from the landfill Site to the environment, and to prevent future exposure to the public health from the landfill where that potential exists.

USEPA has stated ~~contends~~ that the Site may present future potential impacts to health and the environment. More specifically, USEPA has indicated that the landfill represents a potential for impact to the environment due to the discharge of landfill leachate and landfill gas to the environment and potential dermal exposure to the landfill contents through direct contact. USEPA considers the potential future environmental threat from the landfill to include the discharge of volatile organic compounds (VOCs) to groundwater and the air and the discharge of Polychlorinated Biphenyls (PCBs) to soils and possibly groundwater.

The response actions evaluated in this EE/CA are designed to minimize, to the extent practicable, the migration of potentially contaminated sediments, soils and water downgradient of the landfill. The following response action objectives evaluated in the EE CA are designed to address the potential threats outlined by USEPA:

Landfill (Source Area) Response Action Objectives

- Prevent, to the extent practicable, direct contact with and ingestion of soil/debris within the landfill and beneath the landfill;

- Prevent, to the extent practicable, the potential for water to infiltrate through the landfill debris mass in order to ~~and~~ reduce the resultant leachate generation;

- Control, to the extent practicable, surface water runoff in order to minimize erosion;

- Control landfill gas so that methane gas does not present a fire or explosion hazard. Prevent, to the extent practicable, the inhalation of landfill gas containing hazardous substances, pollutants or contaminants to the extent necessary to meet state and federal standards;

- Prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater; and,

- Prevent, to the extent practicable, the migration of contaminated groundwater and leachate beyond the boundary of compliance.

Drainage Pond and Culvert Area Response Action Objectives

- Prevent, to the extent practicable, the migration of contaminants from the soils and sediments in the Drainage Pond and culvert area to the groundwater;

- Prevent, to the extent practicable, direct contact with and ingestion of soil and sediments in the Drainage Pond and culvert area; and,

- Prevent, to the extent practicable, ecological impacts from contaminants in the Drainage Pond and culvert area.

This EE/CA will present removal action technology alternatives designed to meet the response action objectives identified above. The EE/CA will evaluate potential alternative removal action technologies in regard to effectiveness, implementability and cost. Where applicable, some removal action technologies have only been preliminarily evaluated based upon the expectation of incorporating additional engineering information gathered as part of the proposed Phase 1B RI.

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared by McLaren/Hart Environmental Engineering Corporation (McLaren/Hart) on behalf of the Bennington ~~Municipal~~ Landfill Superfund Site Settling Parties (Settling Parties) pursuant to Paragraph 17 of the Remedial Investigation/Feasibility Study (RI/FS) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - Administrative Order by Consent (Docket number I-91-1093) (Order), or as subsequently modified and approved by United States Environmental Protection Agency (USEPA). This document presents engineering evaluations and cost analyses of response action technology alternatives related to the minimization of future potential impacts from the landfill to human health and the environment.

This EE/CA evaluates removal action technologies for a Non-Time-Critical Removal Action (NTCRA) and is intended to address contamination at the Bennington ~~Municipal~~ Landfill Superfund Site (Site). The USEPA considers the undertaking of a removal action for this Site as appropriate within the guidance of NTCRAs and is consistent with the National Contingency Plan (NCP). For the Site, USEPA anticipates that based upon the presumptive remedy for municipal landfills, the NTCRA should not involve ~~will not result in~~ the removal and treatment of the landfill contents ~~contaminants~~ off-site but rather should ~~will~~ involve the containment and treatment of contaminants on-site. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions (OSWER Directive 9355.0-48FS). USEPA's letter regarding response action objectives for the removal action is attached as Appendix A. This letter summarizes the response action objectives for the NTCRA for the Site.

This EE/CA presents site characterization information in Section 2.0 which includes site history, previous response ~~remedial~~ actions undertaken at the Site, a description of the source, nature and extent of contamination and description of previous analytical data obtained for the Site; Section 3.0 presents response action objectives and regulatory requirements including statutory limits of removal action, ~~response action objectives,~~ a tentative schedule for any removal actions, and a description of potentially Applicable or Relevant and Appropriate Requirements (ARARs); Section 4.0 contains an identification of removal action technologies and selection of potential removal action alternatives; Section 5.0 contains an analysis of removal action alternatives for effectiveness, implementability and cost; and Section 6.0 presents a comparative analysis of removal action alternatives.

2.0 SITE CHARACTERIZATION

2.1 SITE HISTORY

Prior to its use as a refuse disposal site, the Site was an active sand and gravel pit. The Site began operations as a municipal landfill in June 1969, receiving residential, commercial and industrial wastes. The Town of Bennington (Town) leased the property for use as a landfill until 1985, at which time the Town purchased the Site from Mr. Alden Harbour. Throughout the operational period of 1969 to 1987 municipal, commercial and industrial wastes, including but not limited to scrap capacitors containing polychlorinated biphenyls (PCBs), paint thinner, waste inks, waste oils, paint wastes, glues, and solvents were disposed of in the landfill. From 1969 until 1975 liquid industrial wastes from Bennington area industries were disposed of in an excavated area within the landfill approximately 70 feet long, 35 feet wide and 2 to 4 feet deep. This area has been previously referred to as the "buried lagoon" although it is not considered a lagoon in a regulatory context. The disposal of liquids into this area ceased in mid-1975. This excavated area was not utilized after 1975 and, after attempts to solidify its contents failed, was filled in with landfill material. Photogrammetric mapping conducted during the Phase 1A Remedial Investigation (RI) indicates that approximately 5 to 20 feet of municipal refuse was subsequently placed over this area. For the purposes of historical consistency only, this backfilled area will be referred to in this document as the "buried lagoon".

A buried drainage system constructed by the Town in 1976 was designed to divert surface water and shallow groundwater away from the landfill. This drainage system discharges into a Drainage Pond on the eastern side of the Site.

A surface water diversion channel was constructed by the Town in 1976 to drain surface water runoff from the western portion of the landfill. Water in this diversion channel flows south along the west side of the landfill, eventually draining into a wooded, locally swampy area south of the landfill. A direct connection has not been observed between the diversion channel and any continuous surface water drainage features at the Site. Surface drainage from the area south of the landfill has been observed to flow through the culvert under the Site access road and toward the area where well B-1 is located. USEPA has also observed sheet flow across this location toward the wetlands east of well B-1. This wetland forms the headwaters of Hewitt Brook.

A formal closure of the landfill pursuant to state solid waste regulations was conducted in accordance with design specifications in the Vermont Agency of Natural Resources (VTANR) approved Bennington Landfill Closure Plan dated March 25, 1989 prepared by Dufresne-Henry, Inc. for the Town. Actual closure of the landfill commenced on September 1, 1989 and was completed October 16, 1990. The Town received approval of the closure of the landfill on October 16, 1990 by the VTANR in accordance with Vermont Solid Waste Management Regulations and the requirements of the Vermont Solid Waste Division.

2.1.1 Site Description and Background

The Bennington Landfill occupies approximately 15 acres of ~~the~~ a 28 acre parcel of land. The Site is located on the north side of Houghton Lane, approximately three miles north of the center of the Town in southwestern Vermont (See Figure I of Appendix D). At its maximum height, the landfill thickness is approximately ~~between 30 and~~ 50 feet (See Figure IV of Appendix D). The landfill is ~~covered~~ closed with a ~~low permeability~~ VTANR approved soil cover which has ~~cover and~~ thick grassy vegetation.

Current oOperations taking place at the Site include the temporary staging of brush and white goods, and the transfer and recycling of municipal solid waste. Abutting ~~West of~~ the Site, dewatered municipal sewage sludge is temporarily stored. This temporary stockpile area was built according to State regulations including creation of four foot U-shaped berms of existing natural soils surrounding each stockpile. Tarps are currently placed over the sludge to prevent rainwater infiltration.

The Site is bounded to the north by an inactive sand and gravel pit, to the west by Vermont Route 7, to the east by a wetland area and Hewitt Brook, and by low density residential housing to the south of Houghton Lane.

Three surface water bodies flow within one mile of the landfill: Furnace Brook, Stratton Brook, and Hewitt Brook. Furnace Brook and Stratton Brook are located one mile east of the landfill and Hewitt Brook is located 1/4 mile east of the landfill.

Hewitt Brook flows south/southwest and enters the Wallomsac River 2.5 miles from the landfill. The surface water flow direction is predominantly east to southeast. There are no known surface water usage intakes within 3 miles downstream from the landfill (USEPA, 1987). In 1991, VTDEC sampled a well along Willow Brook which may intake surface water. No contamination was detected in that sample nor subsequent sampling by USEPA in 1992.

The nearest residential area to the landfill is located approximately 875 feet south along Houghton Lane. The population within a 2-mile radius of the Site is 1,974 people (USEPA, 1987).

2.1.2 Previous Investigations

Several environmentally related investigations have previously taken place at the Site.

In August 1974, the Town conducted a study of the leachate at the landfill, utilizing Environmental Associates of Burlington, Vermont. The Vermont Agency of Environmental Conservation (VTAEC) also conducted a study of the landfill leachate as part of a research project in September 1974. A second evaluation by Environmental Associates was conducted in July 1975.

In the winter of 1976, the USEPA National Enforcement Investigation Center analyzed samples of leachate and soil from the area of the buried lagoon. These sampling results indicate that PCBs were detected in both the solid and liquid phase. The actual sampling locations, however, are not in the information database of the project.

In August 1986, VTAEC's Waste Management Division, Department of Water Resources and Environmental Engineering, conducted a Site Inspection (SI) of the landfill, in response to a Preliminary Site Assessment (PSA) completed by the VTAEC in January 1986. Groundwater samples were collected from private and on-site wells, in addition to on-site surface water and sediment samples. This data is presented in Appendix A of the Phase 1A Remedial Investigation Work Plan (RIWP). Benzene, ethylbenzene, toluene, xylene, naphthalene, di-n-butyl phthalate, ethyl phthalate, 2-methylnaphthalene, p-chloro-m-cresol, 4-methylphenol, and PCBs were detected in samples collected from the outflow of the landfill underdrain (culvert). Nickel, lead, and arsenic were also detected in the underdrain water samples and in sediment samples in this area. No VOCs were detected at the three surface water sampling locations, and semivolatiles and metals detected were not considered attributable to the landfill.

The VTAEC prepared a report entitled, "Bennington Landfill, Houghton Lane, Bennington Vermont, 05201, USEPA ID #: VTD 981064223, Potential Hazardous Waste Site, SI, February, 1987" which recommended that a Remedial Investigation/Feasibility Study (RI/FS) be conducted at the Site.

On July 1, 1987 the Town ceased the disposal of solid waste in the landfill and began operation of a transfer station under contract with VICON Recovery System. The Town received final closure approval of the landfill from the VTANR on October 16, 1990 in accordance with

Vermont Solid Waste Management Regulations and the requirements of the Vermont Solid Waste Division.

The Town installed five groundwater monitoring wells (one of which cannot be located) at the landfill and as part of State closure requirements for the Site, performs semi-annual monitoring of groundwater in the wells, and surface water in the Drainage Pond and Hewitt Brook. Surface water samples designated "SS-HL" are collected from Hewitt Brook at the intersection with Houghton Lane, whereas samples identified as "swamp" are taken from surface water in the wetland area located east-southeast of the landfill. Samples are collected by the Town in the spring and fall of each year from the monitoring wells, Drainage Pond and Hewitt Brook and are analyzed for the following parameters: pH~~Ph,~~ conductivity, Total Organic Carbon (TOC), Total Organic Halogens (TOX), nitrate, Total Dissolved Solids (TDS), temperature, Chemical Oxygen Demand (COD), chloride, sodium, sulfate and heavy metals. In addition, two monitoring wells have been installed to monitor groundwater quality at the temporary sludge stockpiling area (for municipal waste water treatment sludge) which is on a property owned by the Town adjacent to and west of the Site. These wells are monitored for the same parameters as the other four wells.

Pursuant to Section 105(8)(b) of CERCLA, 42 U.S.C. §9605(8)(b), the Site was proposed for inclusion on the National Priorities List (NPL) published by the Administrator of EPA in the Federal Register on June 24, 1988 (53 Fed. Reg. 23,978). The Site was finally listed on the NPL on March 31, 1989 (NPL final rule update #5, 54 Fed. Reg. 13,295).

In May 1989, USEPA personnel conducted an assessment of the Site, during which they collected soil and water samples. Analysis of those samples revealed many of the same contaminants at similar concentrations as those detected by the VTAEC-SI.

In August and December 1990, Aquatec, Inc. on behalf of VTAEC pursuant to a landfill assessment study, collected five groundwater monitoring well samples and one domestic well

(Boulger) sample. In addition, two surface water samples were collected during the August sampling event, and two leachate samples were collected during the December 1990 sampling event. The August sampling results indicate detections of volatile organic and semivolatile compounds in MW-1, MW-3 and in the landfill underdrain. The December results are consistent with the August results, except that MW-1 was not analyzed. In addition, PCBs were included in the December sampling analysis parameters, and were detected in MW-3 and in the landfill underdrain. The analysis of the domestic well sample from the Boulger well did not detect any VOCs.

Analysis of samples collected from domestic wells adjacent to the Site in 1976, 1986, and 1990 indicate that domestic wells adjacent to the Site have ~~off-site groundwater has~~ not been impacted by the landfill. Additional sampling conducted by USEPA during the Phase 1A RI in 1993 confirm these earlier findings. Results of all analyses for VOCs, semivolatile organic compounds (SVOCs) and PCBs were non-detect. Metals concentrations in domestic well samples do not reflect any impact from the landfill.

In June 1991, pursuant to the Order, the Respondents retained McLaren/Hart to provide engineering services required by the Order.

During a limited inspection of the Site in July 1991, USEPA field-screened exposed areas of the landfill slopes with a photoionization detector (PID). In addition, limited sampling was conducted.

Limited Field Investigation

A Limited Field Investigation (LFI) was conducted by McLaren Hart in December 1991 in order to streamline the RI/FS scoping process. The LFI aided in the development of a conceptual Site model and served to further define the scope of work presented in the Phase 1A RIWP

The objectives of the LFI were to

- increase the understanding of the Site in order to enhance the RI/FS scoping effort; and,

- improve the focus of the RI/FS to reduce time and cost.

During November and December of 1991, the tasks of the USEPA-approved LFI Work Plan for the Site were implemented by McLaren/Hart and its subcontractors. LFI field activities included geophysical surveys of the landfill perimeter and surrounding areas, field reconnaissance of surficial geological features, assessment of the existing groundwater monitoring system, and field screening. Field screening for VOCs and PCBs was conducted on-site using the McLaren/Hart Mobile Laboratory. Screening was conducted on samples of surface water, sediment, leachate, soil gas and the air phase in landfill gas vents and monitoring well headspace.

The results of the LFI were as follows:

- The landfill edge was delineated during the geophysical survey. In addition two areas of anomalously high subsurface conductivity were identified south and east of the landfill.

- The geological reconnaissance located one bedrock outcrop in the northwest portion of the Site (OC-1) and a large exposure (OC-6) in the roadcut for Exit 2 of Vermont Route 7 North. Bedrock at both locations was determined to be of the Cheshire Quartzite Formation. Bedding was determined to dip at approximately 20° toward the southeast. The predominant fracture trend was N30°E, with a near vertical dip.

- Available information regarding the existing monitoring network was obtained. However, due to USEPA concerns regarding the utility of the wells, the existing network was not included in the proposed network for Phase 1A RI activities.

- Field screening detected PCBs at several of the surface water and sediment sampling locations, and in the leachate collected from the landfill underdrain. VOCs were detected in these media and in samples collected from landfill leachate seeps. Organic Vapor Analyzer (OVA) screenings of landfill gas vents and monitoring well headspace did not detect the presence of non-methane VOCs. Subsequent Mobile Laboratory analysis of one vent sample indicated low non-methane VOC concentrations, while analysis of one well headspace sample indicated no detectable non-methane VOCs.

Phase 1A RI - Based upon the findings of the LFI, and in consideration of the requirements of the Order and the Statement of Work, McLaren/Hart prepared and submitted to USEPA a Phase 1A RI/FS Work Plan for the Site, on February 3, 1992. After two revisions of the document to address USEPA comments, the August 10, 1992 submittal was conditionally approved by USEPA. Field activities commenced in September, 1993. The findings of each task are described below.

Seismic Refraction Survey - A seismic refraction survey of the Site was conducted to determine bedrock depths. The survey indicated relatively shallow bedrock in the northwest portion of the Site (<25 feet). Bedrock depths at other areas on-site were much greater (up to 550 feet) and beyond the resolution of the technique. Seismic determinations of the top of the glacial till are in general agreement with depths at boring locations. The top of the saprolite unit could not be distinguished from the overlying till by the seismic survey.

Mobile Laboratory PCB Delineation - During Phase 1A, a total of 37 samples were collected and analyzed by the Mobile Laboratory to delineate PCBs in soils and sediment at the Site.

The extent of PCBs in sediment was delineated in the area east of the Drainage Pond and the area south of the landfill. In the area east of the Drainage Pond, Aroclor 1242 were restricted to a small drainage outlet between Pond B and Pond C. In the area south of the landfill PCBs were generally detected at concentrations less than 1 part per million (ppm) throughout the area. Surface water samples proposed for these areas were not collected, as dry conditions prevailed and sampling was not possible at the time of this activity.

The Mobile Laboratory was also used to delineate the extent of Aroclor 1242 in surface and saturated subsurface soils in the Drainage Pond area. Concentrations of Aroclor 1242 were restricted to surface soils immediately adjacent to and east of the Drainage Pond. Concentrations of Aroclor 1242 were restricted to surface soils immediately adjacent to and east of the Drainage Pond. Aroclor 122 in saturated subsurface soils were restricted to two samples, also collected in close proximity to the Drainage Pond.

Sampling for Contract Laboratory Program (CLP) Analysis - The Phase 1A sampling effort involved collection of 95 samples of soil, sediment, leachte, surface water and groundwater fo analysis of Target Compound List (TCL) and TargetAnalyte List (TAL) parameters. Th sampling was conducted to provide further site characerization, confirm Mobile Laborato findings and support USEPA's baseline risk assessment of the Site.

Twenty soil samples were collected from the Drainage d Area, the area south of the land the area east-northeast of the landfill and from backgrd areas. Analytical results confir the findings of the LFI field screening and Phase 1A deation efforts for PCBs. Data ind that other TCL/TAL parameters were detected in sat concentrations below the Co Required Detection Limit (CRQL)~~, and therefore w~~ ~~no further investigation.~~

(BENN 0000657 R001A)

Seventeen sediment samples were collected from the area south of landfill, area east of Drainage Pond, Hewitt Brook, Drainage Pond, northern gravel pit and at background locations. The results confirmed previous Mobile Laboratory findings and provided data for the baseline risk assessment. No TCL/TAL compounds were detected in significant ~~sufficient~~ concentrations or extent. ~~to warrant further investigation.~~

Eight samples of leachate and underlying soils were collected from landfill leachate seeps and from the landfill underdrain. In addition, one sample location initially proposed for sampling of surface water and sediment (SWAT-10/SED-10) was sampled as leachate, based upon field observations of soil staining and field parameters of the aqueous sample. Analytical results confirmed previous findings (i.e.: no PCBs and only low concentrations of VOCs in leachate seeps, Aroclor 1242 and VOCs detected in underdrain leachate). TCL semivolatiles and TAL metals were detected in leachate samples only at low concentrations. For these samples the Mobile Lab identified the detected PCB as Aroclor 1242. CLP analysis identified the PCB Compound at Aroclor 1248. Aroclor 1248 is 6% more chlorinated by weight than Aroclor 1242 (48% to 42%). Because of this slight difference in chlorination levels, the chromatographic pattern of the two Aroclors is similar and therefore, it can be difficult to differentiate the two species.

Thirteen surface water samples were collected from the area south of landfill, northern gravel pit, area east of Drainage Pond, Hewitt Brook and from background areas. TCL VOCs were detected at or slightly above the CRQL in one sample (SWAT-14) in the northern gravel pit and in one sample (SWAT-07) from Hewitt Brook. TCL semivolatiles, pesticides and PCBs were not detected at concentrations above the CRQL in any of the surface water samples. TAL metal were not detected in surface water samples at concentrations or extent to warrant further investigation.

Thirty three groundwater samples were collected from Site monitoring wells during two rounds of sampling conducted during Phase 1A. Results from both rounds indicate that detectable concentrations of several TCL VOCs are present in shallow groundwater immediately downgradient and adjacent to the landfill. Highest concentrations during each round were encountered in water table well B-6-1. Several TCL VOCs were detected in both rounds of bedrock groundwater samples analysis at concentrations below a quantifiable level.

The two rounds of TCL semivolatile data indicate that quantifiable levels of phthalates and phenolic compounds, detected in the first sampling round in B-8, B-5-1, B-2-3 and B-7-3 were not detected in the second round, with the exception of 4-methyl phenol. During the second round, TCL semivolatiles (4-methyl phenol and hexachloroethane) were detected only in sample B-6-1, at low parts per billion (ppb) concentrations.

Analytical results for the two rounds of groundwater samples indicate that with the exception of PCB Aroclor 1221 detected only in the first round of sampling in two downgradient wells (B-5-1 and B-5-2), no PCBs were detected. The results for pesticide analysis indicate tentatively identified compounds at concentrations below quantifiable levels, however, Quality Assurance/Quality Control (QA/QC) review of the data indicates the probability of false positive results.

Of the TAL metal analyzed, only barium was detected at a quantifiable concentration above the Maximum Contaminant Level (MCL). Barium was detected above the MCL in samples from wells B-5-1 and B-5-2, both completed within the shallow water bearing unit. No quantifiable concentrations of any other TAL metal was detected above an Applicable or Relevant and Appropriate Requirement (ARAR) in the round water sampling results.

Air Quality Assessment - Collection and analysis of upwind and downwind air samples during Phase 1A indicated that low concentrations of PCBs and benzene are present at the Site. A preliminary assessment of the air quality indicates that the detected concentrations of PCBs do not present an unacceptable risk and that benzene concentrations are within Vermont background concentrations (USEPA - 1988 Nonmethane Organic Compound Sampling Program, Final Report, Volume II, Urban Air Toxics Sampling Program, Burlington Vermont) and therefore not a concern. A review of surface soil data indicates that no toxic metals are present at sufficient concentrations to require additional air sampling for determination of impacts to air quality by metals entrained in airborne particulates.

Geotechnical Assessment of Landfill ~~Cap~~ Soil Cover - An evaluation of the existing landfill ~~cap~~ soil cover was conducted which included both a visual inspection of the ~~cap~~ soil cover and geotechnical sampling of ~~cap~~ cover soils. A total of 17 borings were drilled for classification of ~~cap~~ cover soils, and geotechnical analysis were performed on seven soil samples. Results of the visual inspection indicate that the ~~cap~~ soil cover is generally intact, however, several areas of erosion/settling of ~~cap~~ soil cover materials were noted. Borings and geotechnical sampling indicate that ~~cap~~ soil cover thickness is locally less than 24 inches and that the permeability in places is greater than 1×10^{-4} cm/sec.

Ecological Assessment - A qualitative ecological assessment conducted during Phase 1A concluded the following:

- The Site is surrounded by a complex vegetative community typical of southwestern Vermont, and includes 13 identified wetlands.
- The vegetative community affords excellent habitat for a variety of mammal, bird, reptile, and amphibian species.
- No ecotoxicological impacts were observed in the terrestrial ecological communities is the vicinity of the Site

- Ecological analysis of the on-site aquatic ecosystems did not identify any indications of impacts to those systems from possible environmental contamination.

- The macrobenthic invertebrates found in Ponds A, B, and C were typical of nonpolluted waters.

- Substantial populations of amphibians, normally sensitive to environmental contaminants, were observed in all three ponds.

The results of the qualitative ecological assessment indicate that the potential for ecological impacts from the release of hazardous substances from the Site is small. The area of ecological concern is the Drainage Pond receiving effluent from the landfill, where PCB concentrations are sufficient to potentially impact ecological receptors.

Hydrogeological Investigation - A hydrogeological investigation was conducted during Phase 1A which consisted of a boring program, well/piezometer/staff gage installation, hydraulic monitoring and slug testing of monitoring wells. The findings of the investigation are as follows:

- A surficial, unconfined sand and gravel water-bearing unit is present across the Site, perched on top of low-permeability till materials.

- The water table within this unit pinches out to the west and south and is oriented in a bowl-like shape which mimics the top of the underlying till deposits.

- Flow within the surficial water-bearing unit is horizontally from west to east at velocities ranging from 4.03 x 10^{-3} feet/day to 12.80 feet/day, eventually discharging into the headwaters of Hewitt Brook (See Figure 5 of Appendix D).

- A confined bedrock aquifer is present immediately west, south and east of the landfill, separated from the surficial water-bearing unit by 100 to 530 feet of low permeability till and weathered bedrock. Northeast of the landfill this low permeability unit is absent and groundwater in the bedrock exists under unconfined conditions.

- A potential west-to-east component of flow potential exists within the bedrock aquifer, as well as a potential groundwater divide to the west of the landfill.

- Surface water in Pond B and the intermittent stream draining Pond B is a result of groundwater discharge from the surficial water-bearing unit.

2.2 PREVIOUS REMEDIAL ACTIONS

Several actions have been taken by the Town to reduce the potential for the generation of leachate. These include measures intended to divert surface water and groundwater away from the landfill and the installation of a ~~low permeability~~ VTANR-approved soil ~~cap~~ cover to minimize leachate generation by reducing infiltration of precipitation through the landfill.

2.2.1 Surface Water Diversion

In the spring of 1976, the Town constructed a shallow diversion channel along the western edge of the landfill. Prior to installation of the diversion channel, surface water flowing from the west had created wet conditions in some areas of the western portion of the landfill. The surface water diversion channel, installed in accordance with a request of the VTAEC, was intended to divert surface water away from the landfill. This diversion channel runs south along the west side of the landfill, eventually draining into a wooded, locally swampy area south of the landfill. A direct connection has not been observed between the diversion channel and any continuous surface water drainage features at the Site.

2.2.2 Groundwater Diversion

The existing landfill underdrain system is the result of measures implemented by the Town to minimize the potential for groundwater to come in contact with landfill refuse The first segment of the underdrain was constructed in the spring of 1976, contemporaneous with construction of the surface water diversion channel. This segment of the underdrain was intended to drain a wet area in the western portion of the landfill. A conversation with the excavation contractor for the project indicated the following regarding construction of the first segment of the underdrain:

- The underdrain excavation ran approximately east-west through landfill materials.
- The western-most portion of the drain was oriented slightly south of west, to intercept the wet area described above.
- Six-inch diameter perforated drain pipe was placed approximately two feet below the base of the fill and backfilled with gravel, followed by the native materials excavated to create the trench. The average depth of the trench was approximately 12 feet below the top of fill material at the time of excavation.
- Moist or saturated soil was encountered at most locations of the trench, including the western end of the trench.
- The trench did not extend into the area of the former buried lagoon. The excavation contractor was not aware of a lagoon on-site

The northern extension of the underdrain system was constructed in natural soils in approximately 1979/1980 to collect shallow groundwater from an area east of the landfill. According to the former landfill operator, the northern extension of the landfill underdrain was constructed in a 4 to 5 foot deep trench with corrugated, perforated pipe backfilled with stone. Landfill materials were not encountered during trenching. The northern extension of the landfill underdrain system was subsequently covered as landfilling progressed eastward.

The former landfill operator also indicated that several stone-filled lateral drains were also constructed. These laterals trended north-south and were connected to the eastern-most segment of the underdrain system between the end of the underdrain culvert and the first standpipe.

According to a knowledgeable Town employee, the eastward extension of the underdrain was constructed at the time of the northern extension, diverting flow to the current location of the end of the culvert, approximately 25 feet west of the Drainage Pond.

The approximate layout of the landfill underdrain system was presented in the Phase 1A Work Plan. The eastern portion of the underdrain was field located by Town employees using a metallic pipe locator. The western and northern portions of the underdrains are drawn in dashed lines to indicate that the locations are approximate and based on interviews with Town employees familiar with the installation of the underdrain system. Standpipe locations, noted as "upright drain pipes" on the Marshfield Engineering Project Layout drawing dated December 20, 1982, are standpipes associated with the underdrain system. The excavation contractor and the former landfill operator indicated that standpipes were installed in at least two locations along the western (first segment) and northern portions of the underdrain.

2.2.3 Landfill Closure

A formal closure of the landfill was conducted in accordance to design specifications in the approved Bennington Landfill Closure Plan, dated March 25, 1989, and prepared by Dufresne-Henry, Inc. for the Town. Actual closure of the landfill commenced on September 1, 1989 and was completed October 16, 1990. Design components included:

- grading of the landfill to provide drainage and reduce infiltration;
- placement and compaction of a two-foot thick VTANR-approved soil cover to achieve a permeability of 5×10^{-6} cm/sec or less;
- landfill gas control via installation of passive gas vents;
- seeding and mulching to prevent erosion of the VTANR-approved soil cover and to protect the effectiveness of the VTANR-approved soil cover material;
- post-closure water quality monitoring including both groundwater and surface water; and,
- post-closure maintenance through routine inspection by the Town.

The Town received approval of the closure from VTANR on October 16, 1990 were implemented in accordance with Vermont Solid Waste Management Regulations and the requirements of the Vermont Solid Waste Division were satisfied.

2.3 SOURCE, NATURE AND EXTENT OF CONTAMINATION

2.3.1 Contaminant Sources/Potential Release Mechanisms

2.3.1.1 Contaminant Sources

Contaminant sources at the Site include

1. The landfill, which includes the buried lagoon area and the underdrain system within the landfill.

2. The Drainage Pond.

From 1969 until 1975, liquid industrial wastes from Bennington area industries were disposed of in an excavated area within the landfill approximately 70 feet long, 35 feet wide and 2 to 4 feet deep. This area has been previously referred to as the "buried lagoon" although it is not considered a lagoon in a regulatory context. This area served more as a point-of-entry for liquids received from local industries. The disposal of liquids into this area ceased in mid-1975. This excavated area was not utilized after 1975 and it was filled in with landfill material after attempts to solidify its contents failed. This area was subsequently covered by municipal refuse. Photogrammetric work conducted during Phase 1A indicates that the refuse thickness ranges between 5 and 20 feet directly overlying the lagoon.

Based on the current understanding regarding landfill operations including disposal in the area of the buried lagoon and the results of the LFI, it appears to be more appropriate to consider the landfill itself, including the buried lagoon area and the underdrain system as a source area rather than focusing on each individual area within the landfill.

The Drainage Pond located east of the landfill receives the effluent from the aforementioned drain system. Water and soil samples collected from this area during the LFI and during Phase 1A contained PCBs and VOCs.

Additional groundwater sampling will be conducted during Phase 1B to determine whether the Drainage Pond represents a separate source of downgradient detections observed at monitoring well B-5 (which is distinct from potential upgradient sources within the landfill).

2.3.1.2 Potential Release Mechanisms

Potential release mechanisms for the landfill include downward leaching to groundwater, leachate seepage and runoff from the landfill surface and, leachate seepage and release to atmosphere during dry periods. Contaminants reaching the water table would be transported away from the source area in the direction of groundwater flow.

Potential release mechanisms for the Drainage Pond include leaching to groundwater, evaporation to the atmosphere and wind transport of particulates from the Drainage Pond during dry periods. Overland flow and/or groundwater discharge are potential release mechanisms to surface water.

2.3.2 Nature and Extent of Contamination

2.3.2.1 Groundwater

As discussed in Section 2.1.2, the Phase 1A characterization of Site groundwater quality identified quantifiable detections of constituents of concern in two areas within the shallow sand and gravel aquifer at the Site. Samples from monitoring well B-6-1, in the western portion of the site, contained several VOCs above MCLs. Samples from monitoring wells B-5-1 and B-5-2, located in the eastern portion of the site, downgradient of the Drainage Pond and the landfill, contained concentrations of VOCs below MCLs and PCBs above MCLs.

Existing data suggests that these detections are localized. Further sampling during Phase 1B will be conducted to confirm or modify this initial assessment. The effort will involve collection of screening samples from the shallow sand and gravel aquifer downgradient of the landfill, upgradient and downgradient to the Drainage Pond and from the existing piezometers in the Hewitt Brook Area.

2.3.3 Surface Water

The LFI and Phase 1A characterization indicate that no significant affects to surface water have occurred. Above background concentration of TCL/TAL analytes were restricted to isolated occurrences. No exceedances of Clean Water Act Water Quality Criteria for chronic or acute exposures were encountered at concentrations or distributions sufficient to warrant concern.

While it is anticipated that this initial characterization will be confirmed, USEPA has requested further evaluation of surface water quality and drainage patterns, to be conducted during Phase 1B. The work will include further evaluation of drainage features and sampling at subsequently determined location(s) agreed upon by USEPA.

2.3.4 Soils/Sediment

Based upon LFI and Phase 1A results, affected soils/sediments are restricted to the Area South of Landfill and the Drainage Pond Area.

2.3.4.1 Area South of Landfill

PCBs in the Area South of Landfill have been detected in the surficial soil/sediment east and west of the culvert passing beneath the Transfer Station access road (1.77 ppm and 1.94 ppm, respectively).

USEPA has requested that additional surface and subsurface soil/sediment samples be collected in the Area South of Landfill to confirm the surficial delineation and to provide data for the (12" to 24") subsurface soil interval. This sampling will be conducted during Phase 1B.

2.3.4.2 Drainage Pond Area

As indicated in Section 2.1.2, sampling during the LFI and Phase 1A identified PCBs in surface soil/sediment samples collected in the vicinity of the landfill underdrain culvert, as well as within and east of the Drainage Pond. In addition, LFI sampling indicated the presence of PCBs in saturated subsurface soils immediately east of the Drainage Pond. Further sampling will be conducted during Phase 1B to assess the distribution of PCB concentrations surrounding and below the Drainage Pond.

2.3.5 Ambient Air

The collection and analysis of upwind and downwind air samples has generated data that indicates that low level concentration of PCBs and benzene are present in the air at the Site. As described in Appendix C of the Initial Site Characterization Report (ISCR), a preliminary assessment of the air quality indicates that the presence of PCBs in air at the Site do not present and unacceptable risk and that the benzene concentrations detected are within Vermont background levels and therefore not a concern.

A review of the surface soil data indicates that no toxic metals are present at a sufficient concentration to require the sampling and analysis of additional air samples for the determination of whether or not the Site air quality has been adversely impacted by metals entrained in airborne particulates.

No additional data requirements are identified for the Phase 1B RI.

2.3.6 Leachate

During LFI and Phase 1A, leachate was sampled from three intermittently flowing seeps and from the landfill underdrain. Analysis of the seep samples indicated only low concentrations of VOCs and no detected PCBs. Quantified detections of PCBs and VOCs were detected in underdrain leachate samples. TCL semivolatiles and TAL metals were detected in the underdrain leachate samples only at low concentrations.

2.4 ANALYTICAL DATA

Analytical results for sampling at the Site prior to CERCLA activities have been provided to USEPA as Appendix A of RI/FS Work Plan, Revised August 10, 1992. Appendix G of the same document summarizes results of PCB and VOC screening samples analyzed by the McLaren/Hart Mobile Laboratory during the LFI in December 1991. Analytical results collected during the Phase 1A RI were presented in the ISCR submitted to USEPA on October 18, 1993. Data for additional PCB screening samples analyzed by the McLaren/Hart Mobile Laboratory during Phase 1A are presented in Appendix B of the ISCR, while Appendix F of the ISCR contains analytical results of Phase 1A CLP sampling. In addition, all data from Phase 1A CLP sampling and from subsequent sampling efforts requested by USEPA (which include groundwater sampling during November, 1993 and January, 1994 and additional sampling of Drainage Pond sediments) have been provided to USEPA in an electronic database format.

2.5 STREAMLINED RISK EVALUATION

The findings of the Streamlined Risk Evaluation presented below were derived from USEPA's EE/CA Approval Memorandum for this Site. ~~draft Approval Memorandum to perform an EE/CA for this Site.~~

The Site conditions discussed in Section 2.3 demonstrate that there is a continuing release and migration of hazardous substances from the source area at the landfill to groundwater and to the sediments in the Drainage Pond. The release of hazardous substances to the groundwater has resulted in exceedances of Federal and State drinking water standards, and thereby poses a potential threat to future on-Site residential users of the overburden groundwater.

A draft baseline risk assessment for this Site was performed by USEPA using groundwater and sediment data derived from Phase IA of the Remedial Investigation. The risk evaluation indicates that the estimateds cancer risk posed by contamination at the Site is 2 x 10^{-3}, based upon the reasonable maximum exposure to ingestion of shallow groundwater by a future residential user. The risk is primarily due to the presence of vinyl chloride, PCBs, arsenic and beryllium. The risk evaluation further indicates that the release of hazardous substances to the sediments in the underdrainage area adjacent to the landfill (which is dry part of the year) presents a threat to youth trespassers. The estimated cancer risk is 2 x 10^{-3}, based on the reasonable maximum exposure (dermal contact and ingestion) with sediments by a current trespasser. The risk is due to the presence of PCBs.

Consequently, based upon the NCP factors listed in the EE/CA ~~Draft~~ Approval Memorandum (listed below), USEPA has determined that a potential threat exists to public health or welfare or the environment. The NCP factors referenced in the Approval Memorandum are:

- (i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;

- (ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

- (iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;

- (v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

A removal action is therefore appropriate to abate, prevent, minimize, stabilize, mitigate, or eliminate such threat(s). In particular, a removal action is necessary to control and contain the release of hazardous substances from the landfill at the Site through source control measures.

3.0 SCOPE OF REMOVAL ACTION, REMOVAL RESPONSE OBJECTIVES AND REGULATORY REQUIREMENTS

This EE/CA describes the scope of the EE/CA and the non-time-critical removal actions which are source control and actions to prevent, to the extent practical, impact to ground water and sediments. The EE/CA differs from the scope of the Remedial Investigation/Feasibility Study in that the RI/FS addresses the long-term action of ground water remediation and any other remaining risks.

3.1 STATUTORY LIMITS OF REMOVAL ACTIONS

CERCLA may provide in excess of $2 million for response actions which are compensable under the Hazardous Substance Superfund established by Section 9507 of the Internal Revenue Code of 1986. However, CERCLA §104(c) and 40 Code of Federal Regulations (CFR) §300.415(b)(5) ~~specifically states~~ provide that "Fund-financed removal actions, other than those authorized under Section 104(b) of CERCLA, shall be terminated after $2 million has been obligated for the action or 12 months have elapsed from the date that removal activities begin on-site," unless the lead agency determines that ~~an exemption~~ one of the enumerated is applicable to the response action.

Response actions exempt from the aforementioned statutory limitations can be classified as either "emergency" or "consistency" exemptions, and waivers may be sought in such cases. As stated in Section 104~~(b)(5)(i)~~(c)(1)(A) emergency exemptions may be granted when "There is an immediate risk to public health or welfare or the environment; continued response actions are immediately required to prevent, limit, or mitigate an emergency; and such assistance will not otherwise be provided on a timely basis". As stated in Section 104~~(b)(5)(ii)~~(c)(1)(C), consistency exemptions are appropriate when "continued response action is otherwise appropriate and consistent with the remedial action to be taken"

The anticipated duration for removal actions (from on-site initiation to completion) for the Site is not expected to exceed 12 months. Estimated costs for some of the removal action alternatives presented in Section 5.0 would exceed $2 million, if implemented. Therefore, in the event that the statutory limitation for a fund-financed removal action is exceeded, an exemption waiver would be required to implement the removal action.

3.2 ~~RESPONSE~~ ACTION REMOVAL RESPONSE ~~ACTION~~ OBJECTIVES

~~Response~~ Action Removal Response ~~action~~ objectives have been developed by USEPA for the Site to minimize future potential impacts to human health and the environment through source control measures. These objectives were provided to the Settling Parties in a letter from USEPA dated March 7, 1994. The ~~response~~ action removal response ~~action~~ objectives identified for the landfill, Drainage Pond and culvert area (the immediate area adjacent to the culvert beneath the access road to the landfill) of the Site are described below:

<u>Landfill (Source Area) ~~Response~~ Action Removal Response ~~Action~~ Objectives</u>

- Prevent, to the extent practicable, direct contact with and ingestion of soil/debris within the landfill and beneath the landfill;

- Prevent, to the extent practicable, the potential for water to infiltrate through the landfill debris mass and reduce the resultant leachate generation;

- Control, to the extent practicable, surface water runoff to minimize erosion;

- Control landfill gas so that methane gas does not present a fire or explosion hazard. Prevent, to the extent practicable, the inhalation of landfill gas containing hazardous substances, pollutants or contaminants to the extent necessary to meet state and federal standards;

- Prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater; and,

- Prevent, to the extent practicable, the migration of contaminated groundwater and leachate beyond the boundary of compliance.

Drainage Pond and Culvert Area Response Action Objectives

- Prevent, to the extent practicable, the migration of contaminants from the soils and sediments in the Drainage Pond and culvert area to the groundwater;

- Prevent, to the extent practicable, direct contact with and ingestion of soil and sediments in the Drainage Pond and culvert area; and,

- Prevent, to the extent practicable, ecological impacts from contaminants in the Drainage Pond and culvert area.

3.3 SCHEDULE OF REMOVAL ACTION

~~The components of removal action schedule consists of:~~

- ~~preparation and submittal of the EE/CA;~~

- ~~selection of the removal action alternative by USEPA; and,~~

- ~~a public comment period.~~

The components of the removal action schedule consist of :

- preparation of the EE/CA Report;
- EPA issuance of Proposed Plan;
- public comment period;
- EPA issuance of Action Memorandum;
- NTCRA negotiations;
- NTCRA design period;
- NTCRA construction.

In accordance with Section 300.820(a) of the NCP, a public notice which describes the EE/CA, describes the USEPA's preferred removal action alternative, and announces a public comment period must be published in a major local newspaper. After the public comment period is closed, the USEPA will issue an Action Memorandum. It is anticipated that issuance of the Action Memorandum by USEPA might occur during the ~~early Fall~~ late Summer of 1994. The Settling Parties may then elect to prepare a removal action design work plan that clearly defines the scope of design activities to be performed based on the Action Memorandum. Design and construction of the selected removal action alternative, as identified in the Action Memorandum, then commences. It is anticipated that the removal action design might commence during the ~~early Fall~~ Winter of 1994 and could be completed during the ~~early Winter~~ Summer of 1995. The preliminary construction removal action schedule presented on Figure 3-1 was prepared assuming a removal action design process consisting of Preliminary (30%), ~~Pre-Final (90%)~~ and Final (100%) removal action design submittals. In addition, the preliminary schedule was developed assuming that the USEPA selected alternative and resultant removal action work plan will not require treatability studies, pilot-scale studies or additional data outside of the scope of the approved Phase 1B Work Plan. It is anticipated that any removal action alternative, will be constructed in ~~less than~~ approximately one year. Following removal action construction, the O&M (PRSC) report will be prepared and finalized.

3.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.4.1 Introduction

Under Section 300.415(i) of the NCP, the selection of an NTCRA at National Priorities List (NPL) sites must comply with ARARs of Federal and State environmental laws, to the extent practicable considering the urgency and scope of the action. These environmental laws include those established by USEPA and other federal agencies and those established by the State of Vermont, where Vermont's standards are promulgated and more stringent than federal standards. The purpose of this section of the EE/CA is to preliminarily identify potential federal ARARs and State of Vermont ARARs which may apply to the removal action objectives.

ARARs are classified according to the NCP Sec. 300.5 as:

> "Applicable Requirements" which are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

> "Relevant and Appropriate Requirements" which are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Applicable requirements imply that the jurisdictional prerequisites of a requirement are satisfied by a circumstance of the site or a remedial response action. Relevance and appropriateness can be judged by comparing the characteristics of the remedial response action, the hazardous substances in question, or the physical circumstances at the site with those addressed by a requirement. It is helpful to consider the origin and objective of the requirement. For example, while Resource Conservation and Recovery Act (RCRA) regulations are not applicable to closing undisturbed hazardous waste in place, the RCRA requirement for closure by capping may be deemed relevant and appropriate.

Relevant and appropriate requirements must be complied with to the same degree as applicable requirements. However, there is greater discretion in the determination of relevance and appropriateness. It is possible for only part of a requirement to be considered (TBC) relevant and appropriate and for the rest of the requirement not to be not considered.

ARARs can be placed into three categories: chemical-specific, location-specific and action-specific. The following USEPA guidance documents have been consulted as part of the ARAR identification process:

- CERCLA Compliance with Other Laws Manual: Draft Guidance, (August 1988, USEPA/540/G-89/006).

- CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements (August 1989, USEPA/540/G-89/009).

- Conducting RI/FS for CERCLA Municipal Landfill Sites, USEPA/540/P-91/001, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-11, February 1991.

- Section 4 of Guidance of Feasibility Studies Under CERCLA (USEPA, 1985c - EPA/540/G-85/003), and Appendix E of the Guidance for Conducting RI/FS Under CERCLA (USEPA/540/G-89/004, OSWER Directive 9355.3-01, USEPA October 1988)

These documents provide a list of potential ARARs. A definition of these ARARs and identification of potential ARARs for the Bennington Landfill are discussed below.

3.4.2 Identification of Potential ARARs

3.4.2.1 Location-Specific ARARs

Location-specific ARARs restrict the concentrations of hazardous substances or the type of activities conducted at a site based solely on the site's location. Examples of these types of locations include floodplains, wetlands, historic places and sensitive ecosystems or habitats. Table 3-1 lists the potential Federal and State location-specific ARARs.

3.4.2.1 Chemical-Specific ARARs

Chemical-specific ARARs set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances. These requirements generally set protective cleanup levels for the chemicals of concern in the designated media, or indicate an acceptable level of chemical discharge to an environmental medium occurring as a result of a remedial activity. If a chemical has more than one ARAR, the more stringent requirement is generally complied with. Table 3-1 lists the potential Federal and State chemical-specific ARARs.

3.4.2.2 Chemical-Specific ARARs

Chemical-specific ARARs set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances. These requirements generally set protective cleanup levels for the chemicals of concern in the designated media, or indicate an acceptable level of chemical discharge to an environmental medium occurring as a result of a

~~remedial activity. If a chemical has more than one ARAR, the more stringent requirement is generally complied with. Table 3-2 lists the potential Federal and State chemical-specific ARARs.~~

3.4.2.2 Location-Specific ARARs

Location-specific ARARs restrict the concentrations of hazardous substances or the type of activities conducted at a site based solely on the site's location. Examples of these types of locations include floodplains, wetlands, historic places and sensitive ecosystems or habitats. Table 3-4-2 lists the potential Federal and State location-specific ARARs.

3.4.2.3 Action-Specific ARARs

Action-specific ARARs are those requirements associated with the preliminary response actions under consideration for the Bennington Landfill Site. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances (i.e. RCRA requirements). Table 3-3 lists the potential Federal and State action-specific ARARs.

3.4.3 Other Criteria Or Guidelines To Be Considered

In addition to ARARs, preliminary determinations on the extent that other publicly available criteria, advisories and guidances are pertinent to the hazardous substances, location of the Site and ~~remedial~~ response actions will be made. Non-promulgated criteria, advisories or guidance issued by Federal or State agencies do not have ARAR status, however, they may be considered in determining necessary cleanup levels for the protection of public health or the environment.

These criteria, advisories and guidances are "to be considered" TBC where no specific ARARs exist for a chemical or situation or where ARARs are not sufficient to be protective of public health and the environment. ~~Federal and State criteria, advisories and guidance TBC is provided in Table 3-4.~~

4.0 IDENFICATION OF REMOVAL ACTION TECHNOLOGIES AND SELECTION OF REMOVAL ACTION ALTERNATIVES

4.1 INTRODUCTION

The purpose of this section is to identify the potentially applicable technologies and determine the technologies that can be used to satisfy the response action objectives for the Site. The identification of the applicable technologies is based upon: site specific conditions as known to exist at this time or reasonably anticipated; the ~~remedial~~ removal action objectives; the presumptive remedy ~~remedies~~ for municipal landfills, and McLaren/Hart's experience on similar sites. The removal action technologies considered are presented below:

1. Containment
   - Composite Barrier Cap
   - Single Barrier Cap
   - Maintain/Upgrade the Existing Soil ~~Cap~~ Cover
   - Erosion and Sedimentation (E&S) Control (common element of the three containment options described above)

2. Landfill Leachate Collection and Treatment
   - Leachate Collection
     - ~~Existing Leachate Collection System~~
     - ~~Well Point Network~~
   - Leachate/~~Groundwater~~ Treatment
     - Off-Site Treatment
     - ~~On-Site Treatment~~
     - ~~Chemical Treatment Process~~ Industrial Wastewater Treatment Facility
     - ~~Physical Treatment Process~~ POTW.

- On-Site Pre-Treatment
- Chemical Treatment Processes
- Physical Treatment Processes

3. Leachate/Groundwater Isolation

- Slurry Walls
- Grouting
- Interceptor Trenches

4. Landfill Gas Management

- Passive Gas Venting System
- Active Gas Collection System
- Landfill Gas Treatment

5. ~~Remediation of~~ Soils/Sediments Response Measures

- Excavation and Consolidation
- On-Site Solidification/Stabilization
- Off-Site Treatment and Disposal
- Containment

6. Management and Institutional Controls

- Access Restrictions
- Institutional Controls
- Monitoring
- O&M

A description of the removal action technologies considered is provided in the following sections. The technologies retained will be screened in Section 4.3. The final screened technologies will subsequently be grouped into removal action alternatives for analysis.

4.2 IDENTIFICATION OF REMOVAL ACTION TECHNOLOGIES

4.2.1 Containment

The containment (landfill cap) technology is the primary presumptive remedy for CERCLA municipal landfill sites. Capping technologies are designed to provide a barrier to prevent direct contact with landfill contents, restrict the percolation of water through the contents of the landfill (and thereby reduce the migration of contaminants to the groundwater), control emissions of gas and odors, and reduce erosion. Grading of the landfill contents and surrounding topography may be required prior to cap installation to achieve a slope configuration which is acceptable. Landfill caps are designed to promote surface water drainage, minimize surface water infiltration, minimize the potential for erosion, accommodate settlement, and result in a stable slope. The selection of an appropriate cap is a function of the potential risks posed by the Site, the response ~~remedial~~ action objectives and ARARs. Typical landfill cap components include a top layer, drainage layer, and barrier (low hydraulic conductivity) layer which are described below.

Top Layer

A two-component top layer is recommended by USEPA in the technical guidance document titled "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA 530-SW-89-047, July 1989) and is typically used in multilayer final covers. The upper component is typically a vegetated layer designed to impede erosion and allow for surface water runoff from storm events. Grass is common surface material for the landfills although in some areas the prevailing climate may inhibit the establishment and maintenance of vegetation in which case an armored surface may be used. The lower (subsurface) component of the top layer must be capable of supporting the vegetative layer and can consist of a variety of material types (e.g., soil, papermill sludge). Specific materials are selected based upon local availability and frost susceptibility.

Drainage Layer

The drainage layer is designed to minimize the amount and residence time of water coming into contact with the barrier (low permeability) layer, which thereby decreases the potential for leachate generation. Drainage layers typically consist of granular soil or geosynthetic drainage material (geonet).

Barrier (Low Hydraulic Conductivity) Layer

Barrier (low hydraulic conductivity) layers are used to minimize the infiltration of water into a landfill. Barrier layers may consist of native soil, clay, synthetic materials [i.e., flexible membrane liners (FMLs)], native soil augmentation, imported anthropogenic material, and manufactured clay. Synthetic layers include, but are not limited to, polyvinylchloride (PVC), high density polyethylene (HDPE), very low density polyethylene (VLDPE) and chlorinated polyethylene (CPE).

A composite barrier cap, single barrier cap, and maintaining/upgrading the existing soil ~~cap~~ cover are described below. In addition, erosion and sediment (E&S) control is included within this section as E&S control is common to all three removal action containment technologies.

Composite Barrier Cap

RCRA Subtitle C final cover performance requirements (40 CFR §264.310) state that final covers be designed and constructed to "provide long-term minimization of migration of liquids through the closed landfill; function with minimum maintenance; promote drainage and minimize erosion or abrasion of the cover; accommodate settling and subsidence so that the cover's integrity is maintained; and, have a permeability less than or equal to the permeability of any bottom liner system or natural soils present." In addition, ~~the RCRA guidance specifies, that at a minimum, the cover should consist of a vegetated top cover, middle drainage layer, and low permeability bottom (or barrier) layer in order to satisfy the performance requirements.~~ ~~USEPA's~~ the To Be Considered technical guidance document titled "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA 530-SW-89-047, July 1989) recommends a multilayer design comprised of, from top to bottom:

- a top layer consisting of two components: (1) either a vegetated or armored surface component, selected to minimize erosion and, to the extent possible, promote drainage off the cover, and (2) a soil component with a minimum thickness of 60 cm [24 in], comprised of topsoil and/or fill soil as appropriate, the surface of which slopes uniformly at least 3 percent but not more than 5 percent; a soil component of greater thickness may be required to assure that the underlying low-permeability layer is below the frost zone;

- either a soil drainage (and FML-protective bedding) layer with minimum thickness of 30 cm (12 in) and a minimum hydraulic conductivity of 1×10^{-2} cm/sec that will effectively minimize water infiltration into the low-permeability layer, and will have a final slope of at least 3 percent after settlement and subsidence; or a drainage layer consisting of geosynthetic materials with equivalent performance characteristics; and

- a two-component low-permeability layer, lying wholly below the frost zone, that provides long-term minimization of water infiltration into the underlying wastes, consisting of (1) a 20-mil [0.5 mm] minimum thickness flexible membrane liner [FML] component and (2) a compacted soil component with a minimum thickness of at least 60 cm [24 in.] and a maximum in-place saturated hydraulic conductivity of 1×10^{-7} cm/sec."

USEPA's technical guidance acknowledges that other final cover designs may be acceptable depending upon site-specific conditions and upon a determination by USEPA that an alternative design adequately fulfills the regulatory requirements. Furthermore, USEPA's technical guidance states that it is the responsibility of the facility owner or operator to demonstrate that the alternate design will provide a level of performance that is at least equivalent to that of the final cover system described in the technical guidance document. In addition, USEPA makes provisions for optional layers that may be used on a site-specific basis which may include a biotic layer to protect the cover from animal or plant intrusion, and a gas vent layer to remove gases produced within the landfill.

In addition to the requirements of the technical guidance document, (USEPA, July 1989) USEPA Region I requires that a non-woven geotextile be provided between the drainage and vegetative (top) layers and that the FML have a minimum thickness of 40 mils.

The Vermont Hazardous Waste Management Regulations, Chapter 7, Subchapter 5, do not generally contain capping requirements more stringent than those found under Subtitle C regulations ~~requires that hazardous waste facilities comply with the design, construction, operation and maintenance requirements of 40 CFR §264 through §266 and §270 as appropriate; the land disposal restrictions of Chapter 7-106; and the State of Vermont Environmental Protection Rules, Chapters 1 through 19.~~

Chapter 6 of the VTANR Solid Waste Management Rules, specifically address closure and post-closure requirements for state certified facilities. These rules do not generally contain capping requirements more stringent than those found under Subtitle C regulations with the exception that FMLs must have a minimum thickness of 40 mils.

The barrier layer ~~is typically~~, as recommended by the USEPA's technical guidance document, is a composite layer which consists of a ~~Flexible Membrane Liner (~~FML) underlain by low permeability soil. The composite barrier (FML and soil) provides a system which offers redundant protection from percolation of water through the cap and containment of gases and odors. The components of a conceptual composite barrier cap which satisfies the RCRA Subtitle C (40 CFR §264.310) final cover performance requirements, USEPA's recommendations for multilayer caps (USEPA, July 1989), specific requirements of USEPA Region I, Vermont Hazardous Waste Regulations, Chapter 7, Subchapter 5, and Vermont Solid Waste Management Rules, Chapter 6 (in descending order) are as follows:

- Vegetative layer - six inch layer of soil capable of supporting vegetation;
- Protective layer - 18 inch (minimum) layer of native soil;
- Separation layer - non-woven geotextile;
- Drainage layer - 12 inch sand layer (permeability $\geq 1 \times 10^{-3-2}$ cm/sec) or a synthetic drainage net (transmissivity $\geq 3 \times 10^{-5}$ m^2/sec);
- Barrier layer (upper component) - ~~20~~ 40 mil (minimum) FML;
- Barrier layer (lower component) - 24 inch layer of low permeability soil (permeability $\leq 1 \times 10^{-7}$ cm/sec) or GCL; and,
- Bedding layer (optional) - 12 inch layer of native soil or granular subgrade.

Alternate materials (such as synthetic drainage net, ~~bentonite matting~~ manufactured clay (GCL), sideslope erosion armoring, etc.) may be used in the composite barrier cap technology if it is demonstrated that the performance of the alternate material is adequate and addresses the removal action objectives. ~~The~~ A conceptual composite barrier cap detail, reflecting the minimum requirements described above, is presented on Figure 4-1

Single Barrier Cap

RCRA Subtitle D final cover requirements (40 CFR §258.60) for management of solid waste state that final covers be designed and constructed to minimize infiltration and erosion. The final cover system must be comprised of an erosion layer underlain by an infiltration layer. The erosion layer must consist of a minimum of 6 inches of earthen material that is capable of sustaining native plant growth. The infiltration layer must be comprised of a minimum of 18 inches of earthen material that has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability less than 1 x 10^{-5} cm/sec, whichever is less.

An approved state may allow alternative final cover designs if the erosion layer provides equivalent protection from wind and water erosion and the infiltration layer achieves an equivalent reduction in infiltration.

In addition to the requirements of the technical guidance document, (USEPA, July 1989) USEPA Region I requires that a non-woven geotextile be provided between the drainage and vegetative (top) layers and that the FML have a minimum thickness of 40 mils.

The single barrier cap will provide increased reduction of infiltration of precipitation through the landfill, reduce the potential for leaching of chemical constituents from the landfill, control emissions of gas, and protect the landfill area from erosion. The single barrier cap technology consists of placement of a low-permeability barrier layer, drainage layer and vegetative soil cover over the landfill contents. The single barrier cap would include a barrier layer with a permeability of less than or equal to 1×10^{-7} cm/sec. The two most commonly used barrier layers are low permeability soils and FMLs.

The performance criteria for a single barrier cap are essentially the same for the composite barrier cap with the primary difference being that either a FML or low permeability soil is used as the barrier layer. ~~State regulations, Site-specific conditions and the RCRA Subtitle C performance criteria cited above are considered in the design of a single barrier cap.~~ The components of a conceptual single barrier cap which satisfies the RCRA Subtitle D (40 CFR §258.60) final cover requirements for solid waste the specific requirements of USEPA Region I and Vermont Solid Waste Management Rules, Chapter 6 (in descending order) are as follows:

~~A typical cross section of a single barrier cap consists of the following (in descending order):~~

- Vegetative layer - six inch layer of soil capable of supporting vegetation;
- Protective layer - 18 inch (minimum) layer of native soil;
- Separation layer - non-woven geotextile;
- Drainage layer (optional) - 12 inch layer of sand or synthetic drainage net;
- Barrier layer - 24 inch layer of low permeability soil or a ~~20~~ 40 mil (minimum) FML; and,
- Bedding layer - 12 inch (minimum) layer of compacted select native soil or sand subgrade (permeability $\leq 1 \times 10^{-4}$ cm/sec). The type of gas management system selected will dictate the technical specifications related to this layer.

A conceptual single barrier cap incorporating the a FML barrier layer is presented on Figure 4-2.

Maintain/Upgrade the Existing Soil ~~Cap~~ Cover

This technology would include upgrading the existing soil ~~cap~~ cover to maintain a cover system which provides a barrier to direct contact with landfill contents, and reduces erosion. Activities would include rehabilitating the areas where erosion has occurred and backfilling settled areas with compacted earthfill. Earthwork activities would be followed by reseeding to establish vegetation. Additionally, this technology may include conditioning the existing soil ~~cap~~ cover to be used as bedding material for the proposed cap system.

Erosion and Sediment Control

Erosion and sedimentation (E&S) control is a common element of the composite barrier cap, single barrier cap, and maintaining/upgrading the existing soil cover remedial action containment technologies described above. ~~above listed containment options.~~ E&S control features typically consist of stormwater diversion channels, culverts, sedimentation basins, stilling basins, hay bales and silt fence. Channels are typically required to divert stormwater, thus minimizing erosion. Culverts can be utilized to direct stormwater flow under roadways, under berms, etc. Basins store sediment laden stormwater flow. Stilling basins are designed to dissipate the energy expected from high volume flow. Channels, culverts and basins are typically used as permanent E&S systems. Hay bales and silt fence are temporary features placed adjacent to and around construction areas. Channels and other E&S structures can be lined with geomaterials, concrete mats, gabions, reno mattresses, riprap or grass.

4.2.2 Landfill Leachate Collection and Treatment

Landfill leachate collection and treatment technologies consist of technologies comprised of systems with a collection technology and treatment technology. Most collection technologies are compatible with most treatment technologies and vice versa. Therefore this section will describe the component technologies separately.

Leachate Collection

Leachate collection technologies are designed to prevent the landfill leachate from impacting groundwater. Potential applicable technologies for the Site include leachate collection utilizing the existing leachate collection piping network and leachate collection through a network of wellpoints. A description of each technology is presented below.

The collection of leachate from the existing landfill underdrain system prior to discharge to the Drainage Pond can be accomplished by ~~upgrading~~ installing a collection sump at the down gradient end of the existing ~~the~~ landfill underdrain system~~. to accommodate a collection sump.~~ The collection sump can consist of a prefabricated tank, manhole or can be a lined earthen structure.

A network of shallow wells may be installed at strategic locations and connected to form a collection system for leachate extraction. A well point system requires a shallow groundwater table or the ability to locate pockets or preferential pathways of leachate inside and/or beneath the landfill to effectively collect leachate. A collection sump could be constructed to contain collected leachate.

Leachate Treatment

Leachate treatment technologies are designed to treat collected leachate to meet discharge requirements. Discharge requirement are determined by the off-site treatment facility or surface water discharge requirements. Leachate treatment options consist of on-site or off-site technologies. On-site pre-treatment/treatment technologies include chemical treatment processes and physical treatment processes. Off-site treatment technologies consist of the use of the local POTW or an industrial treatment facility.

Off-Site Treatment

Off-site treatment may be performed at the local POTW or at an industrial waste treatment facility. Transportation options consist of over-road-transportation, railroad or pipeline. Over-the-road transportation uses tanker trucks to transport collect leachate periodically. Railroad transportation involves staging several tanker cars and subsequent delivery to the facility. Pipeline transportation consists of constructing an underground or aboveground steel or plastic pipe to the nearest treatment facility connection. A description of industrial treatment facility and POTW facilities is provided below.

Industrial Wastewater Treatment Facility

Facility treatment requirements for various physical and chemical parameters determine the off-site treatment options. Industrial facilities are commercial facilities that accept and treat wastewater (leachate) and generally have less stringent acceptance requirements that POTWs and therefore usually do not require pretreatment. Industrial wastewater treatment facilities have the ability to handle a variety of contaminants at high concentrations.

POTW

POTWs generally have more stringent requirements than industrial treatment facilities. The ability to discharge water to the local POTW is contingent upon pretreatment standards, the composition of the leachate/groundwater, and the volume to be treated relative to the capacity of the POTW. Depending on the POTW requirements, on-site pretreatment may be required. Applicable pretreatment processes are presented below as on-site treatment options.

On-Site Pre-Treatment

Chemical, physical and biological processes may be used to remove contaminants from the leachate/groundwater. These processes may be employed separately or combined, where appropriate, to form a process treatment train which will treat the leachate/groundwater to the required levels. The pre-treatment technology selection is based on the discharge or off-site treatment facility requirements.

Understanding the general nature of leachate production in a landfill serves to reinforce the analytical characterization of the leachate formed during the investigations and offers insight into treatment processes that may be appropriate.

Leachate produced in a municipal landfill can vary in composition according to many factors (refuse, precipitation, compaction...etc.). One factor studied extensively is the change in the composition of the leachate as the landfill increases in age. Landfills in the acetic phase (less than 5 years old) create leachate that contains many short-chained organic compounds (volatile fatty acids) which are very biodegradable. The Biological Oxygen Demand (BOD) range to as high as 40,000 mg/l. Older landfills in the methanogenic phase (greater than 10 years old) produce leachate which contain more long-chained (refractory) volatile compounds (BOD less than 550 mg/l), as seen in the Bennington Landfill. The longer-chained volatiles are not broken down as easily in aerobic systems. High concentrations of chemically-reduced inorganic substances, such as ammonia, iron and zinc, are produced in the landfill as a result of anaerobic activities.

Due to the age of the Bennington Landfill and the leachate's ~~reflective~~ low BOD range (8-20 mg/l), it seems appropriate that only chemical and physical treatment options will be considered herein.

Chemical Treatment Processes

Neutralization is the mixing of an acid or a base into an aqueous stream to achieve a desired pH. This can be a batch or a continuous process.

Coagulation/flocculation is the process by which colloidal material agglomerates, with help from chemical additives, to form a small floc (coagulation) which then combines (flocculates) to produce larger particles that separate from the liquid. Lime is a preferred coagulant for the precipitation of heavy metals.

Physical Treatment Processes

Physical separation which includes precipitation, specific gravity separation, filtration and dissolved air flotation (DAF) processes, is used to remove soluble and insoluble matter from aqueous streams. Precipitation is a physical process which transforms soluble matter into a solid phase which can be removed by settling. Sedimentation is a purely physical process which uses gravity and inertia to settle suspended particles from solution. Specific gravity separation refers to the separation of fluids based on the specific gravity of its components. Filtration removes suspended solids from a liquid via disposable or backwashable filter media. DAF is a process which uses the release of dissolved air or other gas to carry suspended particles to the top of a tank where they may removed by skimming.

Air Stripping involves the transfer of volatile compounds from the aqueous phase to the gaseous phase. Air pollution control equipment may be required to contain the volatiles in the gaseous phase.

Adsorption is the process by which material is transferred from a gas or liquid to the surface of a material (sorbent) due to either physical or chemical surface forces. Activated carbon is the most widely accepted sorbent for volatile compounds and can remove metals at low quantity levels. Carbon can be used in both powder or granular form.

4.2.3 Leachate/Groundwater Isolation

Groundwater diversion technologies are implemented to either prevent or control groundwater flow into or through desired locations. Three technology options potentially applicable to the Site are presented. The first option entails the interception of groundwater flow utilizing a slurry wall with an upgradient toe drain to redirect the flow. The second option is the use of grouting for groundwater containment in the near-surface bedrock areas located at the northwestern portion of the Site. The third option is an downgradient interceptor trench in which groundwater is collected and withdrawn from the aquifer. Slurry walls, grouting and interceptor trench technologies are described below.

Slurry Walls

Slurry walls are typically used as low permeability barriers and may be used as load bearing foundations. This technology is widely accepted as an effective low permeability barrier for diversion of groundwater around impacted areas and/or containment of impacted water in shallow conditions (<100 feet deep). These walls are installed using typical trench excavation techniques, and the trench is filled during excavation with a bentonite-based slurry, which holds the excavation open and hardens into a low-permeability vertical zone.

Soil-bentonite slurry walls can only be installed in relatively flat areas since it the slurry will flow under stress (gravity). Cement-bentonite slurry walls set semi-rigid and provide a stronger barrier than soil-bentonite walls. The cement-bentonite slurry walls average higher in cost (30%), have a somewhat lower resistance to chemical degradation and may require disposal of excavated soils, but require less installation area than soil-bentonite walls.

Subsurface drains can be placed upgradient of a slurry wall to prevent overtopping of the wall and to minimize potentially impacted water contact with the wall (the latter in the case of downgradient walls). The groundwater could be discharged to the surface water or reintroduced into an underlying formation. Drains can consist of both perforated piping or gravel drains. Selection of the drain material is dependent on the characteristics of the groundwater and formation.

Slurry walls may be keyed-into low-permeability confining layers. Walls that are not keyed-into confining layers are general utilized in cases where gases or substances are found at or near the water table surface. Where the integrity of a confining layer (*i.e.*, a fractured bedrock) is in doubt, grouting is recommended to cut-off subsurface flow.

Grouting

Grouting is a process during which a cementitious fluid is injected into a rock or soil mass for the purposes of reducing permeability and increasing strength. Grouting is best used for sealing of fractures in rock. Grouting can be performed in formations below the water table, however, due to probable interaction with leachate, this could only be recommended upgradient of impacted waters.

Interceptor Trenches

Interceptor trenches act as buried conduits to convey and collect the groundwater as it flows into the trench. Trenches function as an infinite line of extraction wells and therefore may be utilized to collect impacted water or lower the groundwater table, in lieu of wells. Trenches and drains are more effective than pumping wells in strata with low or variable hydraulic conductivity.

Several technology options exist for interceptor trenches. A standard arrangement for subsurface drains consists of perforated pipe that is surrounded by a permeable aggregate wrapped in a geotextile fabric to prevent the migration of fine grained soils to the system. Biopolymer slurry may be utilized during trench excavation to reduce excavation volumes and in areas where there is inadequate room to perform traditionally cut-back excavation. The biopolymer slurry maintains the integrity of the trench while the gravel layer is installed. The trench is then backfilled as the slurry naturally biodegrades and seeps into the groundwater. Generally, collection sumps are installed at low points in the trenches to permit pumping of the collected water and transport.

4.2.4 Landfill Gas Management

The landfill gas management technology is a component of the presumptive remedy for CERCLA municipal landfills. Landfill gas management will be incorporated into the containment system to minimize the buildup of gas below the cap system and/or control migration of gas off-site. Landfill gas is produced naturally when organic matter from the landfill decomposes. Either a passive gas venting system or an active gas collection treatment system can be installed.

Several factors may be considered when determining whether to select an active or a passive gas management system including: (1) State or Federal requirements (including the EPA proposed rule and Vermont Air Division guidance), (2) existing or potential off-site gas migration, (3) the gas generating potential of the landfill (including waste volume, waste age, and type of waste), (4) the existing or expected contaminants and/or odors of the gas, (5) the location of existing or planned structures and the potential threat of either an explosion or inhalation hazard, and (6) the final proposed usage of the Site.

A general description of the applicable gas management technologies is described below.

Passive Gas Venting System

Passive systems are functional due to the natural pressure gradient (i.e. internal landfill pressure created due to landfill gas generation) or concentration gradient to convey the landfill gas to the atmosphere or a control system. A passive gas venting system consists of installing a series of vertically oriented perforated collection pipes surrounded by granular material directly into the landfill contents to affect collection of gas. The collected gas is typically vented directly into the atmosphere. Additionally, activated carbon canisters can be installed onto the vent for treatment of the gas. Passive gas venting systems can be designed such that they can be converted into an active system (if needed).

Active Gas Collection System

Active gas collection systems consist of vertically oriented venting systems and/or horizontal trench systems. The collection piping employs mechanical blowers or compressors to provide a pressure gradient to extract the landfill gas via a pipe header system. This network of extraction wells, trenches and pipes is designed to provide the capability of inducing negative pressure within the landfill. When the water saturated gas is extracted through the landfill, the decrease in pressure and temperature will result in the generation of condensate. The condensate is pumped through a force main to a collection vessel for subsequent treatment. The collected landfill gas is typically transported via piping to a gas treatment system (described below).

Landfill Gas Treatment

The most common technology used at CERCLA municipal landfill sites for the treatment of landfill gases is thermal treatment using ground flares. Enclosed ground flare systems consist of a refractory-lined flame enclosure or stack with a burner assembly at the base.

4.2.5 ~~Remediation~~ of Soils/Sediments Response Measures

In order to meet the RA objectives identified in Section 3.2 four technologies will be considered potentially applicable response measures for ~~to remediate the~~ soils/sediments in the drainage pond and culvert area at the Site. These technologies are:

- excavation of the impacted soils/sediments and consolidation within the limits of the existing landfill;
- on-site solidification/stabilization of the impacted soils/sediments by in-situ or ex-situ methods;
- off-site treatment or disposal at a permitted Treatment, Storage and Disposal (TSD) facility; and,
- containment of impacted soils/sediments in-place via capping.

Information contained in the LFI, and the Phase 1A RI indicates that constituent(s) of concern at the drainage pond and culvert area to be soils/sediments containing PCBs. The origination of the PCBs that are present in the soils and sediments is presumed to be the landfill underdrain, which discharges directly to the Drainage Pond. For the purpose of this EE/CA, it is assumed that approximately 1,500 cy of impacted soils/sediments exist in the Drainage Pond and culvert area that will be subject to removal. The affected soils/sediments were estimated assuming an action level of 1 ppm and an average depth of excavation of three (3) feet for the Drainage Pond and culvert area. Data acquired during the Phase 1B delineation may result in an increase or decrease in the volume of impacted soils/sediments.

The removal action technologies for the impacted soils/sediments in the drainage pond and culvert area are described below.

Excavation and Consolidation

The excavation and consolidation technology consists of identifying, excavating, hauling and placing at a pre-determined location within the existing landfill limits the soils/sediments from the Drainage Pond and culvert area with PCB levels greater than the action limits. The pond will be dewatered (if needed) prior to excavation and consolidation. The soils/sediments could be excavated via backhoe, hydraulic excavator, dredging via dragline, or pumping depending on the moisture content and condition of the material. Solidification/stabilization prior to excavation may be required to facilitate materials handling. Excavated materials would be loaded-out to a haul truck or conveyor and transported to the landfill for potential use as fill to regrade the landfill prior to cap placement.

Subsequent to the excavation activity, confirmatory screening or sampling would be performed. Upon verification of the adequacy of the removal of the soils/sediments, the pond area would be backfilled with general earthfill and vegetated.

On-Site Solidification/Stabilization

Another removal action alternative to address the affected soils/sediments is on-Site solidification/stabilization (s/s). On-Site s/s options include in-situ treatment and ex-situ treatment. In-situ and ex-situ s/s options that are potentially applicable to PCB impacted soils are identified on Figure 3-1 of the document entitled "Stabilization Technologies for RCRA Corrective Actions" (USEPA/625/6-91/026). These applicable technologies include:

- In-situ solidification/stabilization;
- Ex-situ solidification/stabilization; and.
- soil flushing.

In-situ removal technologies involve the application of the technology to soils in-place. The application of any in-situ technology requires an understanding of the horizontal and vertical delineation of the treatment area and verification sampling. In-situ removal technologies may also require treatability or pilot study programs to evaluate the effectiveness and implementability of the technology.

Ex-situ removal action technologies require the delineation of the area, removal via excavation of the impacted material, treatment, verification of treatment, and the placement of treated materials back to the excavation area, or to other areas. Solidification/stabilization is analogous to in-situ s/s except that the reagents and cementitious additives are mixed in a more controlled manner in a hopper or batch plant. Depending on the s/s mix, the treated soils can be pumped and placed in a manner similar to concrete.

Chemical s/s consists of the addition of chemical reagents via mixing with a hydraulic excavator, backhoe or rotary drilling methods, usually with cementitious additives to stabilize or solidify the constituents of concern, prevent their migration, and reduce their exposure potential.

Soil flushing utilizes the injection of groundwater with the addition of surfactants to increase the mobility of the constituent of concern. The contaminants are then recovered in the groundwater by extraction wells and pumped to the surface for subsequent treatment.

Off-Site Treatment and Disposal

Off-site treatment and disposal consists of the excavation and transportation of impacted soils/sediments with PCB concentrations greater than the action limits to a permitted TSD facility. The TSD facility (depending on the PCB concentration) could consist of a municipal waste landfill, a chemical waste landfill, incinerator, or other facility. The excavated area could then be backfilled with general earthfill and revegetated.

Containment

Currently, the Drainage Pond and culvert area are not considered potential source areas based on the findings presented in the ISCR. Capping (containment) of the Drainage Pond could be utilized to limit the potential direct contact with the impacted soils/sediments. Capping could consist of the use of a single barrier cap, or composite barrier cap.

4.2.6 Management and Institutional Controls

The management and institutional controls are a common element of all of the alternatives. The management and institutional controls technology consists of Site-specific activities which may include maintaining access restrictions; securing deed restrictions; securing land-use restrictions or easements; and, performing monitoring activities necessary to verify the performance of the removal action. This technology is used to restrict site access or to ensure future site accesses are conducted in an approved manner. Institutional controls typically specify that future development be restricted or conducted with sound design and construction practices that would not adversely affect post-removal action conditions. Following implementation of the containment technology, institutional controls provide an effective means to control future use of the Site. The management and institutional controls identified and assessed for the Site are described below.

Access Restrictions

Fencing would provide a low-cost, easily constructed technology to rapidly secure the Site and limit unauthorized access. This technology would typically include installation of continuous chain-link fence around the Site perimeter. The fencing would be equipped with lockable gates and warning signs. Typically, a six-feet high chain link fence would provide a barrier to prevent unauthorized access. Access gates are already present at Site access road locations. Fencing may be necessary around the Site perimeter or at specific Site locations during removal activities to limit access and further minimize the risks of possible direct contact with the waste materials.

Institutional Controls

Institutional controls identified for the Site include the implementation of local health ordinances, local zoning ordinances, and/or deed restrictions.

Monitoring

Monitoring of the implemented removal action provides information needed to determine whether the removal action objectives are being satisfied by the selected and implemented removal action technologies and to determine if additional or reduced removal action is necessary. Monitoring activities may include periodic sampling of air, surface water, soil, sediment, and groundwater.

Technology specific monitoring requirements for the selected removal action should be consistent with the overall monitoring requirements for overall remediation of the Site. Technology specific monitoring may include monitoring of landfill gases from a venting system and periodic inspection of the containment (cap) as required.

Post-Removal Site Control (Operation and Maintenance)

Post-Removal Site Control (Operation and Maintenance), hereinafter referred to as PRSC, would include the activities required to sustain the removal action during the post-removal action period. Operational procedures would include the functional tasks required for the performance of any systems that are in-place. Maintenance procedures would include the routine inspections and follow-up actions necessary to maintain the removal action technologies.

4.3 SCREENING OF TECHNOLOGIES

This section provides the criteria necessary to screen the potential removal action technologies. The document titled "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA" (USEPA/540/R-93/057, Publication 9360.0-32, August, 1993) was used to establish a procedure for screening the technologies. Section 2.6 of this document provides information pertinent to the screening process. Based upon McLaren/Hart's review of this document, the following criteria will be used to screen the technologies described in Section 4.2:

- Applicability of the technology to the specific media or contamination characteristics (i.e. evaluated against the removal action objectives);

- The selection of the technology at similar sites with similar sources of contamination; and,

- Site characterization information.

The technologies which were identified in Section 4.2 and summary of technology screening results which are described within this Section are presented on Table 4-1.

Examples of contaminant characteristics may include: soil/contaminant characteristics; quantity/concentration; chemical composition; treatability; and persistence. Examples of site characteristics that may affect the technology include: contaminant volume and site area; climate and precipitation; geologic/hydrogeologic conditions; slopes; and, surface water conditions. Additionally, McLaren/Hart has screened the technologies based upon our review of the available technical literature including the USEPA's Presumptive Remedy information. The technologies that have and have not been retained and the basis for their inclusion or exclusion are given below.

4.3.1 Containment

An evaluation of containment technologies which are potentially feasible for use at the Site are presented below for the composite barrier cap, single barrier cap and maintain/upgrade the existing soil cover. As the screening of the barrier layer component is common to all three containment technologies, they are screened herein as appropriate. As stated in the introduction of Section 4.2.1, hydraulic barriers may consist of native soil, clay, FMLs (e.g. PVC, HDPE, VLDPE and CPE), native soil augmentation, imported anthropogenic material, and manufactured clay. The barrier layer component of the containment technology is screened below:

- Native soil augmentation was eliminated from consideration as a barrier layer due to constraints posed by Site conditions. Only limited amounts of open and available working areas exist at the Site, and landfill sideslopes are sufficiently steep to preclude soil augmentation activities thereon. In addition, a relatively large area is required to successfully perform soil augmentation and it is therefore judged technically infeasible for the Site.

- A FML manufactured from PVC was eliminated due to vendor information indicating that PVC cannot achieve necessary interface friction angles for the design slopes. A FML manufactured from CPE was eliminated due to seam reliability concerns and delamination potential. FMLs manufactured from polyethylene (e.g. VLDPE and HDPE) are retained.

- Imported anthropogenic material was eliminated due to potential limited availability and lack of homogeneity, and uncertainties associated with these materials to meet minimum performance criteria.

- Manufactured clay barrier layers (GCLs) are eliminated on sloped areas due to slope stability concerns as product vendors have indicated that GCLs should be installed on slopes which are approximately 6 horizontal to 1 vertical or flatter. GCLs are feasible for the flatter (plateau) area of the landfill and are therefore retained.

Screening of the native soil, clay, FML and GCL barrier layer components is presented below within the screening of the technology, as appropriate.

Composite Barrier Cap

The applicable ARARs relative to the selection of the containment technology are dependent on the date and nature of waste disposed on-Site. No documentation is available that suggests that RCRA Hazardous Waste was accepted after November 19, 1980, which would trigger 40 CFR §264 closure. However, USEPA believes that the nature of the wastes disposed at the Site prior to November 19, 1980 was sufficiently similar to currently regulated RCRA Hazardous Wastes and therefore certain RCRA Subtitle C regulations and Vermont Hazardous Waste Management Regulations Chapter 7, Subchapter 5 would be relevant and appropriate.

The composite barrier landfill cap technology satisfies the response action objectives for the Site and is potentially applicable. The landfill cap profile described in Section 4.2.1, which illustrates a ~~typical~~ conceptual composite barrier cap, ~~may require modification to satisfy State guidelines and Site-specific climatic and topographic conditions~~ will require further evaluation during the removal action design to ensure that the minimum performance requirements described in Section 4.2.1 are satisfied.

Calculations were performed to preliminarily evaluate the hydrologic performance of the composite barrier cap using USEPA's Hydrologic Evaluation of Landfill Performance (HELP) software and an infinite slope stability analyses was performed to preliminarily assess the stability of the cap. Based on the results of the HELP analysis, the material comprising the drainage layer should have a permeability of 1 x 10^{-3} cm/sec or greater. If a synthetic drainage layer or composite (natural/synthetic) drainage layer is used, the required minimum permeability of the drainage layer should be evaluated as part of the removal action design. Based on the infinite slope stability analysis and assuming a maximum sideslope grade of 4H:1V after regrading, textured FML should be installed on the landfill sideslopes to provide acceptable slope stability. Smooth FML was judged to be adequate on the upper reaches (top or plateau) of the landfill considering that the plateau area may be regraded to have a minimum slope of five percent.

HELP and infinite slope stability calculations are provided in Appendix B. A ~~Very Low Density Polyethylene (~~VLDPE~~)~~ FML, or ~~High-Density Polyethylene (~~HDPE~~)~~ FML, ~~Polyvinyl Chloride (PVC) FML, or other FML~~ should be evaluated during the removal action design. Based on experience at similar sites, USEPA Region I and VTANR requirements, a FML with a minimum thickness of approximately 40 mils should be used (assuming a polyethylene FML). The FML would be underlain by a low permeability clay on the landfill sideslopes and by a GCL on the landfill plateau.

Based on discussion with regulatory personnel and review of available frost penetration maps, a minimum of approximately three feet of cover material should be provided above the barrier layer to provide protection against the average depth of frost in the Bennington area. The Solid Waste Management Rules of 10 VSA Chapter 159 (Section 6-702(b)(9) of VTANR, February 7, 1994) and the USEPA's technical guidance document (USEPA, July 1989) require that landfills have a "minimum slope of five (5) per cent and a maximum slope of thirty-three and one third (33 1/3) percent." Surface regrading, and placement of an engineered fill obtained from an on-site or off-site source will therefore be required to achieve the minimum plateau grading requirements. The composite barrier cap technology is retained for alternative analysis.

Single Barrier Cap

It is acknowledged that the single barrier cap, by definition, does not satisfy the USEPA's recommendation for a "two-component low-permeability layer" which is prescribed in the technical guidance document titled "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA 530-SW-89-047, July 1989), does not provide the redundant protection offered by a composite barrier cap, and may offer less long-term protectiveness than a composite barrier cap. However, the single barrier landfill cap technology satisfies the response action objectives for the Site, ~~and~~ is potentially applicable and can be designed to comply with the RCRA Subtitle C final cover performance requirements (40 CFR §264.310). ~~The single barrier~~

~~cap technology is therefore retained. The landfill cap profile described in Section 4.2.1, which illustrates the typical components of a single barrier cap, may require modification to satisfy State guidelines and Site-specific climatic and topographic conditions. In addition, the single barrier cap would be designed to satisfy the RCRA Subtitle C final cover performance requirements.~~

The USEPA recognizes that equivalent alternate cap designs may be acceptable depending upon Site-specific conditions and upon a USEPA determination that the alternate cap design adequately satisfies regulatory requirements. It should be the responsibility of the design engineer, on behalf of the Settling Parties, to demonstrate that the alternate design will provide a level of performance that meets or exceeds the RCRA Subtitle C final cover performance requirements.

As with the composite barrier cap, the single barrier cap ~~may require modification to satisfy State guidelines and Site specific climatic and topographic conditions.~~ will require further evaluation during the removal action design to ensure that the minimum performance requirements are satisfied. ~~Specifically, the typical single barrier cap described in Section 4.2.1 should be further refined to include a 40 mil FML (textured on landfill sideslopes) with an overlying drainage layer having a permeability of 1 x 10^-3^ cm/sec or greater based on calculations performed as described above.~~ The single barrier cap is retained for use in development of alternatives.

Maintain/Upgrade the Existing Soil ~~Cap~~ Cover

The landfill contents were previously ~~capped~~ covered with a two feet thick soil cover as described in Section 2.2.3. The findings of the ISCR indicated that the plateau region of the landfill ~~cap~~ cover and a major portion of the landfill sideslopes are intact. Additionally, the vegetative growth above the ~~cap~~ cover is well established. However, some areas of erosion and exposed landfill contents were noted along the eastern and northern slope. A large depression was also documented (possibly due to settlement) along the northeastern corner of the plateau region. Measurements recorded along several locations of the eastern and northern sideslopes indicate that the existing grade is in excess of 25 percent (4H:1V).

This technology potentially satisfies the response action objectives for the Site by reducing the effects of long-term erosion and limiting the potential for direct contact with waste constituents near the surface. However, this technology has limited effectiveness in restricting the percolation of water through the landfill contents and in controlling emissions of gas. Upgrading the existing ~~cap~~ cover with the intent of satisfying the RCRA Subtitle C final cover performance requirements may be cost prohibitive and is therefore eliminated from further consideration.

Erosion and Sedimentation Control

The erosion and sedimentation control technology is common to all three removal action containment technologies described above. The Erosion and Sediment~~ation~~ (E&S) control/technology is used to reduce erosion and promote surface water drainage thus resulting in a reduction in the potential for direct contact with landfill contents and reduction of the percolation of water though the landfill contents, respectively. Installation of erosion and sediment features to control surface water runoff will protect the landfill cap from extensive erosion and subsequent soil loss and should be incorporated into the design of the single barrier cap or composite barrier cap. In addition, the design will address the shallow diversion channel constructed along the western edge of the landfill as described in Section 2.2.1. Since this technology potentially satisfies the response action objectives for the Site by reducing the effects of long-term erosion and is potentially applicable to the Site, this technology was selected for further evaluation. This option is considered a subset of the removal action containment technology, and it is assumed to be an element of the two containment technologies which have been retained. Therefore, E&S control is not specifically called out in the subsequent alternative descriptions. The possibility exists that during the implementation of this removal technology wetlands may be disturbed as the Site is surrounded by a complex vegetative community

~~including 13 identifiable wetlands as shown on Figure 3 in Appendix D. The wetland areas which may be disturbed during the removal action consist of wetland areas which abut the southern limit of the landfill and Drainage Pond area. These areas would potentially be disturbed during regrading activities, cap construction and soils/sediments removal activities.~~ This Site includes 13 identifiable wetlands, as described in ISCR.

~~4.3.2~~ Landfill Leachate Collection and Treatment

~~Leachate Collection~~

Existing Leachate Collection System

The existing landfill underdrain system satisfies the response action objectives for the Site by preventing the migration of contaminated groundwater and leachate beyond the boundary of compliance. The existing system has proven it can effectively collect landfill leachate and transmit it to the Drainage Pond.

The areal extent of the underdrain system appears to be adequate to collect landfill leachate. The installation of a collection sump, pump and control system may be required to collect and withdrawal leachate to a treatment system. This technology has therefore been retained.

Well Point Network

The use of well points to collect groundwater is a proven implementable technology. Placement of the well points is dependent on a the subgrade topography of the landfill and the location of the leachate underdrain within the landfill. The location of the underdrain and the subgrade topography have not been established and therefore, the ability of a well point system to effectively achieve the removal action goals cannot be evaluated at this time.

Potential disadvantages of a well point system include: 1) wells can act as conduits to impact groundwater not previously impacted; 2) potential hazards associated with drilling within the landfill contents; 3) installation and operational costs of new, active collection system (wells, pumps and piping); and 4) operational and maintenance concerns with low-flow pumping system. Based on these disadvantages and existing unknowns, this technology has been eliminated from further evaluation.

Downgradient Interceptor Trenches

The installation of an interceptor trench along the eastern boundary of the landfill and only downgradient of areas known to carry groundwater impacted by the landfill is an effective technology to prevent the migration of leachate and shallow groundwater. However, this technology does not meet the second landfill removal action objective: "prevent to the extent practicable, the potential for water to infiltrate through the landfill debris mass and reduce the resultant leachate generation". Use of a interceptor trench instead of a line of extraction wells reduces the volume of extracted water by approximately one-half since only upgradient water is extracted. Extensive groundwater characterization and modelling, in addition to knowledge of landfill base topography, would be needed to adequately design and install the system. Interceptor trenchs have been eliminated as a downgradient isolation technology because this option cannot satisfy the removal action objective described above.

Leachate Treatment

From the leachate collection systems, the leachate would be transferred to equalization or storage tanks. These tanks would serve to equalize influent concentrations and provide storage prior to implementation of the chosen treatment/disposal option.

Off-Site Treatment

Off-site treatment of the leachate is a removal technology which achieves the removal action goal of prevention of migration of leachate outside the boundary of compliance. Off-site treatment consists of either an industrial wastewater treatment facility or a POTW as described below.

Industrial Wastewater Treatment Facility

The leachate can be effectively treated at an approved industrial wastewater treatment facility without pretreatment. Therefore, off-site treatment via an industrial wastewater treatment facility has been retained.

POTW

The quantity of leachate/groundwater which will require pretreatment and/or off-site treatment is the primary factor in the selection of the appropriate off-site treatment location. Previous studies indicate that the standard treatment processes within a local POTW can effectively treat leachate if the flow accounts for less than five percent of the POTW's influent. The ~~expected~~ estimated collection rate from the Site is approximately one percent of the current POTW loading of 3.8 MGD (5.1 MGD maximum). Therefore, it is anticipated that the local POTW can effectively treat the leachate.

Pretreatment of the leachate may be required for discharge to the POTW depending on final flow rates and concentrations. Comparison of the leachate analysis with the POTW acceptance criteria indicates that pretreatment would be required for heavy metals (arsenic, iron, magnesium, manganese, and zinc). Additional treatment for barium is expected since levels greater than the MCL have been found. Off-site treatment to the POTW has therefore been retained.

On-Site Treatment

On-site treatment may consist of the use of chemical or physical treatment process to treat collected leachate for discharge to surface waters or off-site treatment. Treatment requirements for the leachate regulatory requirements or facility requirements. Based on applicable ARARs listed in Section 3.4, the likely pretreatment requirements may include: metals removal (arsenic, barium, iron, magnesium, manganese and zinc), pH adjustment and filtration. Additional treatment requirements may be required for VOCs (total xylenes, benzene, and acetone) and small quantities of SVOCs, particularly, bis (2)-ethylhexelphthalate.

The effective treatment technologies presented below are selected based on past experience and published studies. As with most treatment plant designs, bench scale studies are recommended on several processes/vendor equipment to evaluate their effectiveness on the specific leachate/groundwater to be treated. Design considerations such as process chemical requirements and sludge disposal requirements would be evaluated to determine the optimal treatment processes.

Chemical Treatment Processes

Neutralization of the leachate/groundwater may be necessary to aid in the treatment of metals. This is a standard pretreatment process which should be considered based on previous treatment system designs.

Coagulation/Flocculation with lime is an effective removal mechanism of heavy metals in the leachate/groundwater based on past experience. This is a primary pretreatment process for disposal to the POTW. The primary equipment required for this process includes a mixing tank, clarifier, and sludge filter press.

At this point in time, it is unknown whether chemical treatment processes are required. A final decision will be made during the design phase. Chemical treatment processes are considered a possibility and are retained for further consideration.

Physical Treatment Processes

Physical separation is an applicable process removal action. Analysis of the leachate indicates the necessity of specific gravity separation via an oil/water separator. A storage tank for the removed oil and any accumulated sediments would be needed with this pretreatment process.

Suspended solids in the leachate/groundwater can be effectively removed by filtration in bag filters and would be considered a necessary pretreatment process. DAF would also process suspended sediment, but in addition, the DAF process can provide some air stripping of the low levels of VOCs found in the leachate. Therefore, this process is retained for use in a primary treatment process train alternative.

Air stripping is an effective removal technology of all levels of VOCs. Since air stripping simply transfers the contaminants from the liquid to the vapor phase, some additional processes may be required to control the release of VOCs into the atmosphere. Due to the low level of VOCs encountered in the leachate/groundwater, the DAF process may prove to be the more efficient process upon evaluation of bench scale testing and vendor equipment, however, this process is recommended for further evaluation in a primary treatment process train.

Adsorption by activated carbon is a process which will effectively treat both VOCs and low levels of metals. Treatment may be performed in the liquid phase as a primary treatment unit for VOCs and as a polishing step for metals removal. Liquid phase carbon is available in both granular and powered form. The benefit with powdered carbon is the additional BOD treatment capability. Since the BOD of the leachate is representative of an older landfill (less than 500 mg/l), this treatment option is of no additional use and therefore is eliminated.

Vapor phase activated carbon treatment would typically follow an air stripper or DAF unit. Vapor phase treatment permits more efficiently VOC removal, but since the metals remain the water phase after air stripping or DAF, the vapor phase carbon cannot aid in the metals removal process. This treatment is recommended only to provide control of air emissions required as part of the regulations.

In summary, on-site treatment of collected leachate has not been retained due to the elimination of downgradient groundwater collection (refer to Section 4.3.3) ~~has been retained.~~ However, once the Phase 1B results have been evaluated, more definitive conclusions relative to groundwater/leachate conditions can be made. If the results indicate that the flow from the discharge pipe will extend beyond the estimated one year, then, the on-site system will be reevaluated. A combination of a variety of technologies is effective in treating the leachate to discharge or off-site facility requirements.

4.3.3 Leachate/Groundwater Isolation

Slurry Walls

Slurry walls can be used to meet the response action objectives of preventing additional groundwater movement into the landfill mass and to prevent the migration of contaminated leachate/groundwater beyond the boundary of compliance. Based on the hydraulic gradient of the groundwater upgradient of the landfill (west and north), an upgradient toe drain may be required to collect the groundwater and redirect it around the landfill. Upgradient slurry walls have been installed in many similar projects and have proven to be effective. A cement-bentonite slurry wall may be required in this case due to Site conditions.

The wall should extend approximately five feet into the underlying confining layer to effectively block the flow of groundwater. The slurry wall would be keyed-in to the underlying till in the southwest and northern landfill perimeter. In the northwest corner of the landfill where bedrock is exposed the wall would be keyed-into a competent surface. Grouting may be required to effective cut-off upgradient flow in the bedrock fractures. An upgradient isolation slurry wall has been retained.

Application of the slurry wall down gradient of the landfill (along the eastern boundary) would require an interceptor trench and active pumping system to prevent the groundwater from mounding within the landfill. Since an effective downgradient collection system would perform the same function, this application is not eliminated as a down gradient isolation technology. The possibility exists that during the implementation of this removal technology wetlands may be disturbed. The site includes 13 identifiable wetlands, as described in ISCR.

Grouting

The use of grouting to seal voids in fractured bedrock is a technology which will aid in the achievement of the response action objectives. It has been applied in conjunction with slurry walls in the past to obtain a competent upgradient groundwater barrier in areas where bedrock is the confining layer. Sole use of grouting to form a groundwater barrier is typically recommended only in bedrock applications for short lengths due to the high cost and its lack of competence and high permeability in sand and gravel applications. Grouting has been eliminated as an upgradient or downgradient isolation technology.

Upgradient Interceptor Trenches

Interceptor trenches provide a hydraulic barrier much like slurry walls which can achieve the response action objectives both for prevention of groundwater flow on and off the Site. Installation of an interceptor trench upgradient of the landfill would require an active collection and discharge system in order to maintain the hydraulic barrier. An active upgradient system is judged to be unnecessary because the same objective can be accomplished with a passive upgradient system. Because interceptor trenches are not effective as a passive upgradient technology (unless a barrier system is included) they have been eliminated from consideration. Additionally, leachate may be extracted from the landfill if an active upgradient system were used which is judged to be undesirable.

4.3.4 Landfill Gas Management

This technology could satisfy the removal action objectives for the Site by: controlling landfill gas so that methane gas does not cause a fire or explosion hazard; preventing the inhalation of landfill gas containing hazardous substances; and, meeting state and federal air quality standards. Currently, a passive gas venting system is in-place at the Site that was approved by the Vermont Agency of Natural Resources in 1990.

In order to confirm the requirement of an active versus a passive gas management system, additional field testing of the gas directly below the existing ~~cap~~ soil cover may be conducted. The methodologies for gas collection and sampling is provided in 40 CFR Parts 51, 52 and 60. Basically, this procedure includes the "punch bar" methods typically employed for soil gas surveys with a sampling train/vacuum pump setup to collect a sample for a known duration. The concentration (pounds per eight hours) of the gas is typically required for fourteen (14) different organic compounds prescribed by the Vermont Air Pollution Control Division. The complete list of the Hazard Ambient Air Standards is provided in Appendix C of the State of Vermont Agency of Natural Resources Air Pollution Control Regulations (August 13, 1993). The results of this analysis is compared to the action level concentrations for the fourteen compounds. If any of the compound concentrations exceed the action levels then an active system is required. Additionally, in the absence of Site-specific data, theoretical calculations can be used to estimate the organic compound concentrations of the gas.

The screening of three specific options for the gas management technology is provided below.

Existing Passive Gas Venting System

The existing vents (consisting of three) were installed as part of the VTANR-approved closure in 1990. The passive system has been operational since 1990 with no apparent problems. The existing system meets the removal action objectives. However, it is unknown at this time whether the gas vents would meet the organic compound discharge criteria established by the State and Federal requirements. The existing system could be upgraded as needed to meet the air quality standards by installing activated carbon canisters to treat the gas. Therefore, because the existing system satisfies the removal action objectives, this option will be retained for further evaluation.

Upgraded Passive Gas Venting System

Additional vents may need to be installed as part of the closure plan. Following installation of additional passive vents, the gas emissions would be monitored to determine the composition of the gas. If the concentrations were below the action level, then, monitoring of the gas would continue at the required time interval.

An implementation risk exists associated with designing a passive gas system and then determining that, following installation, the system must be converted to an active system. If the concentration of the fourteen priority organics in the gas from the passive system exceeds the action levels, then, a source of gas treatment must be retrofitted and/or the vents must be converted to an active gas collection/treatment system. The potential exists for the concentration of the organic compounds in the landfill to increase over time

The retrofitted treatment option would typically include the placement of organic carbon canisters on the vent port. The collection/treatment conversion option would be designed and installed based upon the existing conditions of the vents and other site specific conditions.

Based upon the discussions presented herein, this option is retained for further analysis.

Active Gas Collection System ~~/~~Gas Treatment

Active gas collection/treatment is applicable to the specific site conditions. Active gas collection/treatment systems have been utilized at municipal landfill facilities. Installation of an active system could control the landfill gas so that methane does not present a fire or explosion hazard.

However, active gas collection systems can be very operation and maintenance intensive. Additionally, the condensate collected from the process must be treated. An active system would be more effective than a passive system in preventing off-site migration of gases following capping.

Therefore, this option is also retained for further analysis pending evaluation of site data.

4.3.5 ~~Remediation of~~ Soils/Sediments Response Measures

Excavation and Consolidation

This technology is effective in preventing contact with impacted soils/sediments and utilizes established materials handling techniques. The quantity of impacted soils/sediments is minimal relative to the landfill waste volume. This technology meets 40 CFR Subpart 6 (PCB Spill Cleanup Policy) for the disposal of soils with PCB concentrations greater than 50 ppm.

Excavation of impacted soils/sediments in the Drainage Pond and culvert area and consolidation within the limits of the landfill prior to capping has been retained for further evaluation as a part of a removal alternative.

On-Site Solidification/Stabilization

On-Site solidification/stabilization has been eliminated from further consideration as the technologies discussed have little proven effectiveness in the treatment of PCBs. In addition, the minimal volume and variable concentration of contaminants of concern within impacted soils/sediments does not warrant consideration of in-situ or ex-situ treatment.

Off-Site Treatment and Disposal

Soils/sediments with concentrations greater than 50 ppm PCBs by weight are hazardous waste designated VT 01 as defined by Section 7-210 of the Vermont Hazardous Waste Management Regulations (10 VSA Chapter 159) and would require disposal at an approved incinerator or hazardous waste disposal facility. Soils/sediments with concentrations less than 50 ppm PCBs can be disposed of at an approved municipal solid waste landfill. ~~While off-site TSD facilities offer effective technologies, the technology would distribute liability of the Settling Parties to other sites and also increase exposure risks to the public and environment associated with transportation.~~ The off-site treatment and disposal of the impacted sediments has therefore been eliminated from consideration.

Containment

Considering the ground surface topography in the pond area, containment via capping would require the addition of fill to properly grade the area and would require separate monitoring apart from the main landfill area. Extension of the landfill cap to include the Drainage Pond and culvert is cost prohibitive and technically difficult. Containment via capping has therefore been eliminated from consideration.

4.3.6 Management and Institutional Controls

Institutional controls can provide an effective means to control future use of and access to the Site. Technology-specific monitoring requirements may be used to adequately assess site conditions to assess the effectiveness of the removal action, and assess whether further removal action is necessary. The technology specific monitoring should be consistent with the overall remedial action for the site. Installation of chain-link fencing provides a low-cost, easily implementable deterrent system to rapidly secure the area and limit unauthorized access to the Site. Management and institutional controls are therefore retained for further analysis.

4.3.7 Summary of Technology Screening

The results of the technology screening has been presented in Table 4-1. This summary table includes: a description of the removal action technology and the associated process options; a description of the process options; and, a description of the critical screening criteria. In summary, the screening results include:

<u>Containment</u>

The composite barrier cap and the single barrier cap have been retained because these options satisfy the removal action objectives. Because maintaining the existing soil cover would only partially satisfy the removal action objectives, this technology has been eliminated from further consideration. Erosion and sediment control is common to all containment options, therefore it will be retained for both the composite and single barrier containment options.

Landfill Leachate Collection and Treatment

Upgrading the existing leachate collection system will be retained because this option will aid in satisfying the removal action objectives. The well point collection network has been eliminated because this technology may impact groundwater; and, drilling into the landfill may be hazardous. Off-site and on-site treatment have been retained because each option will satisfy the removal action objectives.

Leachate/Groundwater Isolation

The slurry wall process technology has been retained because it satisfies the removal action objectives. Grouting has been eliminated from consideration because this option is not effective in sand and gravel and would not be structurally sound as a sole technology. Both upgradient and downgradient interceptor trenches have been eliminated from further consideration. These systems would not be effective as a sole passive technology (i.e. must be accompanied by a low permeability unit such as a slurry wall to be effective). Additionally, interceptor trench systems would not satisfy the removal action objective.

Landfill Gas Management

The passive gas management system option may satisfy the removal action objective. Additional analytical information would be required to determine if this option is acceptable. At this point in time, this option has been retained. An active gas collection/treatment system would satisfy the removal action objective, therefore, this option has been retained.

Soils/Sediments Response Measures

Excavation and consolidation (within the existing landfill) of the PCB-impacted soils/sediments would satisfy the removal action objectives. Therefore, this option has been retained for further evaluation. The effectiveness of the on-site solidification is unproven, therefore, this option will no longer be considered. Off-site treatment and disposal is not practical for the limited volume of impacted soils/sediments anticipated and has been eliminated.

Management and Institutional Controls

This technology is a common element of all the alternatives and will be retained for each alternative.

4.4 SUMMARY OF REMOVAL ACTION ALTERNATIVES SELECTED

The purpose of this section is to combine the removal action technologies which have been identified and referred in Section 4.2 and 4.3 into removal action alternatives. The technologies that were retained have been grouped into four removal action alternatives. The abbreviated description for each alternative has been presented below for simplification purposes. The technologies which were identified in Section 4.1, screened in Section 4.2 and combined into removal action alternatives in this section are presented on Table 4-2. The alternatives described below shall be referred to as Alternative I through Alternative IV henceforth throughout this document. The following alternatives have been developed for screening purposes:

Note: The four alternatives associated with downgradient groundwater isolation have been eliminated. The four following alternatives represent upgradient groundwater isolation.

I. Composite Barrier Cap / Upgradient Groundwater Isolation / Existing Discharge Pipe Collection with Off-site Treatment / Active Gas Management / Excavation of Impacted Soils with On-site Landfill Consolidation / Management and Institutional Controls

II. Single Barrier Cap / Upgradient Groundwater Isolation / Existing Discharge Pipe Collection with Off-site Treatment / Active Gas Management System / Excavation of Impacted Soils with On-site Landfill Consolidation / Management and Institutional Controls

III. Composite Barrier Cap / Upgradient Groundwater Isolation / Existing Discharge Pipe Collection with Off-site Treatment / Passive Gas Management / Excavation of Impacted Soils with On-site Landfill Consolidation / Management and Institutional Controls

IV. Single Barrier Cap / Upgradient Groundwater Isolation / Existing Discharge Pipe Collection with Off-site Treatment / Passive Gas Management System / Excavation of Impacted Soils with On-site Landfill Consolidation / Management and Institutional Controls

The primary technology/option variables which distinguish each of the alternatives are as follows:

- active versus passive gas management; and
- composite versus single barrier cap.
- ~~upgradient versus downgradient groundwater isolation; and.~~
- ~~Off-site versus On-site leachate treatment.~~

Alternatives I and II ~~III and IV~~ incorporate the active gas management technology option whereas Alternatives III and IV ~~V, VI, VII and VIII~~ incorporate a passive gas management technology. ~~The technology/option variables for leachate treatment are described below.~~

Alternatives I and III ~~II, V and VI~~ incorporate the composite barrier cap whereas Alternatives II and IV ~~III, IV, VII and VIII~~ incorporate the single barrier cap.

All four Alternatives include ~~Alternative I, Alternative III, Alternative V and Alternative VII consists of~~ an upgradient groundwater isolation (slurry wall) option. The purpose of the slurry wall is to prevent groundwater from contacting the landfill contents. A toe drain may be ~~is~~ required to redirect the groundwater flow upgradient of the slurry wall. The cap system will minimize any future infiltration of surface water into the landfill contents. Over time with no influent water, the leachate flow from the landfill should attenuate, eventually resulting in a stoppage of flow from the discharge pipe. This assumption is based upon best professional judgement and preliminary evaluation of the Phase IB investigation data which indicates that this assumption is reasonable. (A one year duration for leachate flow was assumed for costing purposes). ~~This conclusion, however, may be changed based on the outcome of the Phase IB investigation.~~

The assertion of short-term leachate production in the four Alternatives ~~I, III, V and VII~~ brings a temporal view to the leachate collection and disposal portion of the Alternatives. Given the estimated ~~expected~~ duration to zero leachate discharge (less than one year), the selection of the on-site treatment options is not logical. The only remaining option is off-site treatment at an industrial treatment facility. The estimated average flow rate from the discharge pipe is three gallons per minute. The assumed cost to dispose of the leachate at an industrial treatment facility is three dollars per gallon. However, at this point in time, a specific industrial treatment facility has not been identified. Double-contained tanks and a truck loading facility would be installed near the discharge point as part of this option to facilitate the transfer process.

~~The unique component of Alternatives II, IV, VI and VIII (relative to Alternatives I, III, V and VII) consists of a downgradient groundwater collection system (interceptor trench) followed by continuous treatment of the impacted groundwater collected from the trench. The interceptor~~

~~trench would be designed to collect groundwater that has contacted the landfill contents. Because treatment of the impacted groundwater will be continuous, on-site treatment prior to disposal to the POTW or an NPDES discharge point appears to be the logical option. The full extent of the treatment requirements cannot be delineated at this time.~~

NOTE: THIS ENTIRE SECTION HAS BEEN REVISED. HOWEVER, ONLY CRITICAL MODIFICATIONS HAVE BEEN RED-LINED AND STRUCK-OUT.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

5.1 INTRODUCTION

This section provides a detailed analysis of the ~~eight~~ four alternatives using the effectiveness, implementability, and cost criteria identified in the document titled "Guidance on Conducting NTCRAs under CERCLA". The main criteria and subcriteria recommended for analysis have been extracted from this document. The criteria/subcriteria that are applicable to the Site have been analyzed for each Alternative where appropriate.

5.1.1 Effectiveness

Effectiveness addresses the degree to which the Alternative: meets the objective within the scope of the removal action (identified in Section 3.2); complies with ARARs and other criteria, advisories and guidance; and, long term effectiveness and permanence. The objectives/criteria to be used in the comparative analysis for effectiveness of the alternatives are described in section 2.6 and Exhibit 7 of the NTCRA Guidance. These subcriteria (from Exhibit 7) are listed below.

A. Protectiveness

- Protective of public health and the community
- Protective of workers during implementation
- Protective of environment
- Complies with ARAR's

B. Ability to Achieve Removal Objectives

- Level of treatment/containment expected
- No residual effect concern
- Will maintain control until long term solution implemented

The sub-factors regarding residual effect concern and maintaining control until long term solution is implemented are not applicable to this Site. Therefore, these issues were not discussed in the subsequent sections.

5.1.2 Implementability

Implementability evaluation of Alternatives includes the an assessment of the technical feasibility, the administrative feasibility, and, the availability of various services and materials. The following subcriteria have been extracted from Exhibit 7 of the NTCRA Guidance.

A. Technical Feasibility

- Construction and operational considerations
- Demonstrated performance/useful life
- Adaptable to environmental conditions
- Contributes to remedial performance
- Can be implemented in 1 year

B. Availability

- Equipment
- Personnel and services
- Outside laboratory testing capability
- Offsite treatment and disposal capacity
- Post Removal Site Control (PRSC)

C. Administrative Feasibility

- Permits required
- Easements or right-of-ways required
- Impact on adjoining property
- Ability to impose institutional controls
- Likelihood impose obtaining exemption from statutory limits (if needed)

The permits and easements or right-of-ways required will essentially be identical for each alternative. Additionally, the impact on adjoining property and the likelihood of obtaining exemptions from the statutory limits (if needed) should be virtually identical for each Alternative. Therefore, these sub-factors are not discussed in the subsequent sections.

5.1.3 Cost

Cost evaluations include an estimation of the capital cost (direct and indirect) and the annual Post-Removal Site Control (PRSC) cost. Specifically, the cost analysis portion of the EE/CA consists of estimating the capital and PRSC costs for the technologies of each alternative, calculating the present worth for each alternative, performing a sensitivity analysis for changes in key parameters, and using the results in the comparative analysis of Section 6.

The cost analysis was performed in accordance with the guidance contained in the documents titled "Remedial Action Costing Procedures Manual" (USEPA/600/8-87/049) and "Superfund Remedial Design and Remedial Action Guidance" (OSWER Directive 9355.0-4A June 1986). Capital costs (direct and indirect) and PRSC costs were estimated using cost estimating information such as vendor information, Means Building Construction Cost Data, McLaren/Hart's past experience at similar sites, estimates for similar projects, and the USEPA documents referenced above.

The present worth analysis was used as a mechanism to relate the long-term expenditures for PRSC to a current dollar value so overall costs of the various alternatives could be compared. Through a present worth analysis the impacts of high PRSC costs can be evaluated against low initial capital costs for any alternative. The present-worth analysis evaluating the PRSC cost after year zero uses a discount rate of 7 ~~and 10~~ percent before taxes and after inflation for a thirty ~~three~~ year period. ~~Although not required by the costing procedures manual, the seven percent discount rate was included as part of the cost to evaluate the sensitivity of the discount rate. A three year period was chosen to reflect the expected time between the completion of the NTCRA and the start of O&M activities under the final Remedial Action (RA). Once the removal action is implemented, the PRSC costs of the NTCRA will be included as part of the RA.~~ A thirty year PRSC was chosen for O&M activities associated with the final removal action for the Site. Consequently, this removal action is self contained and does not rely on subsequent actions.

The variability of the cost estimate is anticipated to be +50 to -30 percent of the actual cost; the actual cost will depend on the final design and contractor bids. A summary of the capital (direct and indirect), annual PRSC, and total present worth cost of each alternative is presented in Table 5.1 with detailed cost tables provided in Appendix C. In addition, the rationale or source used in developing the costs for each Alternative is presented in the notes provided in Appendix C.

5.2 ALTERNATIVE 1 - COMPOSITE BARRIER CAP / UPGRADIENT GROUNDWATER ISOLATION / EXISTING DISCHARGE PIPE COLLECTION WITH OFF-SITE TREATMENT / ACTIVE GAS MANAGEMENT / EXCAVATION OF IMPACTED SOILS WITH ON-SITE LANDFILL CONSOLIDATION / MANAGEMENT AND INSTITUTIONAL CONTROLS

5.2.1 Effectiveness

Protectiveness

This alternative would provide protection of public health and the environment by addressing the potential risks at the Site. To ensure that the overall protection of the public health and environment is preserved for the removal action, a technology specific monitoring program may be implemented to determine the effectiveness of the Alternative.

A moderate short-term risk would exist to on-site workers during the implementation of the removal action. A relatively low short-term risk to the public health of the residents living south of the landfill may occur due to the increased vehicular traffic required to deliver construction materials.

The applicable ARARs relative to the selection of the containment technology are dependent on the date and nature of waste disposed on-Site. No documentation is available that suggests that RCRA Hazardous Waste was accepted after November 19, 1980, which would trigger 40 CFR §264 closure. However, USEPA believes that the nature of the waste disposed at the Site prior to November 19, 1980 was sufficiently similar to currently regulated RCRA Hazardous Wastes and therefore certain RCRA Subtitle C regulations and Vermont Hazardous Waste Management Regulations Chapter 7, Subchapter 5 would be relevant and appropriate. The RCRA Subtitle C capping regulations are generally more stringent than the Vermont Hazardous Waste Management Regulations (Chapter 7, Subchapter 5) and VTANR Solid Waste Management Rules. Therefore, the containment technology will satisfy both the Federal and State closure requirements. Installation of an active gas management system would conform to the applicable State and Federal requirements. The Act 250 requirements would be met with this Alternative.

Ability to Achieve Removal Objectives

The composite barrier cap system will prevent direct contact and ingestion of soil and debris within and beneath the landfill. The cap will aid in minimizing stormwater infiltration, prevent the generation of leachate, and contain landfill generated gas and odors. Implementation of the stormwater management system will control surface water runoff to minimize erosion. Installation of an upgradient slurry wall will prevent contact of the groundwater with landfill contents, therefore, controlling potential leachate production. The upgradient groundwater isolation unit will prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater. The upgradient groundwater isolation unit will divert the groundwater around the landfill. This will result in minimizing the migration of contaminated groundwater beyond the boundary of compliance. The existing landfill underdrain system will be fitted with a system to collect, equalize and store leachate for transportation to an industrial wastewater treatment system. This system will prevent the migration of leachate and prevent leachate from affecting shallow groundwater. The active landfill gas system will control the off-site migration of gas and prevent build-up of gas below the cap. The gas management system will also minimize the potential for fire and explosion hazards and aid in preventing the inhalation of landfill gas. Excavation/consolidation of the impacted soils/sediments from the Drainage Pond will address the removal action objectives at this location.

5.2.2 Implementability

Technical Feasibility

Implementation of this Alternative is technically feasible. Specialty contractors will be required to install the geomembrane components of the cap system, the active gas management system and the upgradient groundwater isolation system. Assuming that proper operation and maintenance to the active gas management system. Additional operational considerations for the active gas management system includes the management of the condensate that will be generated.

Availability

The services, equipment and materials required for construction should be readily available. Low permeability soil and other soil material sources have been preliminarily identified within a reasonable distance of the Site. Post removal site control would be relatively straight forward. The availability of industrial wastewater treatment facility within a reasonable distance to the site may be a concern.

Administrative Feasibility

The administrative feasibility of obtaining permission to dispose of the impacted groundwater at an industrial facility is not anticipate to be problematic. This Alternative is not in compliance with the statutory limit of $2 million for removal actions. Securing institutional controls at the Site is not considered to be an issue. Institutional controls such as access and/or deed restrictions will restrict site access and regulate future site access. Potential administative issues may exist associated with the permits required to manage the condensate generated from the active gas management system.

5.2.3 Cost

The estimated capital **cost for** Alternative I is ~~$6,580,153~~ estimated to range from $4,221,646 to $4,586,960. The **PRSC cost** is estimated to range from $1,735,000 to $4,035,000 which includes the following:

- $15,000/year for cap maintenance including mowing and cap repair.

- $20,000/year for erosion and sedimentation control maintenance and repair;

- $1,600,000 ~~(min.)~~ to $3,900,000 ~~(max.)~~ for leachate collection and treatment; and,

- $50,000/year for Barrier Performance Analytical Costs.

- $50,000/year for the gas extraction system O&M.

The present worth cost is estimated to range from a minimum of ~~$8,534,735~~ $9,333,274 to a maximum of ~~$10,834,735,~~ $12,1555,673 assuming a ~~3~~ 30 year period with a 7 percent discount rate ~~and from a minimum of $8,516,178 to a maximum of $10,816,178 with a 10 percent discount rate (both~~ before taxes and after inflation) The results of this cost estimate ~~is~~ are summarized in Table 5-1. The calculations that were performed to estimate material costs and quantities are provided in Appendix C.

5.3 ALTERNATIVE II - SINGLE BARRIER CAP / UPGRADIENT GROUNDWATER ISOLATION / EXISTING DISCHARGE PIPE COLLECTION WITH OFF-SITE TREATMENT / ACTIVE GAS MANAGEMENT SYSTEM / EXCAVATION OF IMPACTED SOILS WITH ON-SITE LANDFILL CONSOLIDATION / MANAGEMENT AND INSTITUTIONAL CONTROLS

5.3.1 Effectiveness

Protectiveness

This alternative would provide protection of public health and the environment by addressing the potential risks at the Site. To ensure that the overall protection of the public health and environment is preserved for the removal action, a technology specific monitoring program may be implemented to determine the effectiveness of the Alternative.

A moderate short-term risk would exist to on-site workers during the implementation of the removal action. A relatively low short-term risk to the public health of the residents living south of the landfill may occur due to the increased vehicular traffic requred to deliver construction materials.

It is acknowledged that the single barrier cap, by definition, does not satisfy the USEPA's recommendation for a "two-component low-permeability layer" which is described in the technical guidance document titled "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA 530-SW-89-047, July 1989), does not provide the redundant protection offered by a composite barrier cap, and may offer less long-term protectiveness than a composite barrier cap. However the single barrier landfill cap technology satisfies the response action objectives for the Site, is potentially applicable and can be designed to comply with the RCRA Subtitle C final cover performance requirements (40 CFR §264.310). The RCRA Subtitled capping regulations are generally more stringent than the VTANR Solid Waste Management Rules. Therefore, the containment technology will satisfy both the Federal and State closure requirements. Installation of an active gas management system would conform to the applicable State and Federal requirements. The Act 250 requirements would be met with this Alternative.

Ability to Achieve Removal Objectives

The single barrier cap system will prevent direct contact and ingestion of soil and debris within and beneath the landfill. The cap will aid in minimizing stormwater infiltration, prevent the generation of leachate, and contain landfill generated gas and odors. Implementation of the stormwater management system will control surface water runoff to minimize erosion. Installation of an upgradient slurry wall will prevent contact of the groundwater with landfill contents, therefore, controlling potential leachate production. The upgradient groundwater isolation unit will prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater. The upgradient groundwater isolation unit will divert the groundwater around the landfill. This will result in minimizing the migration of contaminated groundwater beyond the boundary of compliance. The existing landfill underdrain system will be fitted with a system to collect, equalize and store leachate for transportation to an industrial wastewater treatment system. This system will prevent the migration of leachate and prevent leachate from affecting shallow groundwater. The active landfill gas system will control the off-site migration of gas and prevent build-up of gas below the cap. The gas management system will also minimize the potential for fire and explosion hazards and aid in preventing the inhalation of landfill gas. Excavation/consolidation of the impacted soils/sediments from the Drainage Pond will address the removal action objectives at this location.

5.3.2 Implementability

Technical Feasibility

Implementation of this Alternative is technically feasible. Specialty contractors will be required to install the geomembrane components of the cap system, the active gas management system and the upgradient groundwater isolation system. Assuming that proper operation and maintenance of the installed systems are performed the performance/useful life of this Alternative should be acceptable. A relatively significant operation and maintenance component is anticipated relative to the active gas management system. Additional operational considerations for the active gas management system includes the management of the condensate that will be generated.

Availability

The services, equipment and materials required for construction should be readily available. Low permeability soil and other soil material sources have been preliminarily identified within a reasonable distance of the Site. Post removal site control would be relatively straight forward. The availability of industrial wastewater treatment facility within a reasonable distance to the site may be a concern.

Administrative Feasibility

The administrative feasibility of obtaining permission to dispose of the impacted groundwater at an industrial facility is anticipated to be problematic. This Alternative is not in compliance with the statutory limit of $2 million for removal actions. Securing institutional controls at the Site is not considered to be an issue. Institutional controls such as access and/or deed restrictions will restrict site access and regulate future site access. Potential administative issues may exist associated with the permits required to manage the condensate generated from the active gas management system.

5.3.3 Cost

The estimated capital cost for Alternative II is ~~$5,429,303~~ $3,781,960. The estimated PRSC cost is estimated to range from $1,735,000 to $4,035,000 which includes the following:

- $15,000/year for cap maintenance including mowing and cap repair;
- $20,000/year for erosion and sedimentation control maintenance and repair;
- $50,000/year barrier performance analytical costs;
- $1,600,000 ~~(min.)~~ to $3,900,000 ~~(max.)~~ for leachate disposal to an off-site Industrial Treatment Facility; and,
- $50,000/year for the gas extraction system O&M

The present worth cost is estimated to range from ~~$7,383,585~~ $8,704,523 to ~~$9,683,585~~ $11,004,523 assuming a ~~3~~ 30 year period with a 7 percent discount rate ~~and from $7,365,028 to $9,665,028 with a 10 percent discount rate (both~~ before taxes and after inflation~~)~~. The results of this cost estimate ~~is~~ are summarized in Table 5-1. The calculations that were performed to estimate material costs and quantities ~~is~~ are provided in Appendix C.

5.4 ALTERNATIVE III - COMPOSITE BARRIER CAP / UPGRADIENT GROUNDWATER ISOLATION / EXISTING DISCHARGE PIPE COLLECTION

WITH OFF-SITE TREATMENT / PASSIVE GAS MANAGEMENT / EXCAVATION OF IMPACTED SOILS WITH ON-SITE LANDFILL CONSOLIDATION / MANAGEMENT AND INSTITUTIONAL CONTROLS

5.4.1 Effectiveness

Protectiveness

This alternative would provide protection of public health and the environment by addressing the potential risks at the Site. To ensure that the overall protection of the public health and environment is preserved for the removal action, a technology specific monitoring program may be implemented to determine the effectiveness of the Alternative.

A moderate short-term risk would exist to on-site workers during the implementation of the removal action. A relatively low short-term risk to the public health of the residents living south of the landfill may occur due to the increased vehicular traffic required to deliver construction materials.

The applicable ARARs relative to the selection of the containment technology are dependent on the date and nature of waste disposed on-Site. No documentation is available that suggests that RCRA Hazardous Waste was accepted after November 19, 1980, which would trigger 40 CFR §264 closure. However, USEPA believes that the nature of the wastes disposed at the Site prior to November 19, 1980 was sufficiently similar to currently regulated RCRA Hazardous Wastes and therefore certain RCRA Subtitle C regulations and Vermont Hazardous Waste Management Regulations Chapter 7, Subchapter 5 would be relevant and appropriate. The RCRA Subtitle C capping regulations are generally more stringent than the Vermont Hazardous Waste Management Regulations (Chapter 7, Subchapter 5) and VTANR Solid Waste Management Rules. Installation of a passive gas management system may conform to the applicable State and Federal air quality criteria. However, additional analytical data for the landfill gas would be required to determine if passive gas venting is acceptable. The Act 250 requirements would be met with this Alternative.

Ability to Achieve Removal Objectives

The composite barrier cap system will prevent direct contact and ingestion of soil and debris within and beneath the landfill. The cap will aid in minimizing stormwater infiltration, prevent the generation of leachate, and contain landfill generated gas and odors. Implementation of the stormwater management system will control surface water runoff to minimize erosion. Installation of an upgradient slurry wall will prevent contact of the groundwater with landfill contents, therefore, controlling potential leachate production. The upgradient groundwater isolation unit will prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater. The upgradient groundwater isolation unit will divert the groundwater around the landfill. This will result in minimizing the migration of contaminated groundwater beyond the boundary of compliance. The existing landfill underdrain system will be fitted with a system to collect, equalize and store leachate for transportation to an industrial wastewater treatment system. This system will aid in preventing the migration of leachate and prevent leachate from affecting shallow groundwater. The passive landfill gas system may control the off-site migration of gas and prevent build-up of gas below the cap. The passive system will also minimize the potential for fire and explosion hazards. However, the inhalation of landfill gas containing hazardous substances may not be prevented. Excavation/consolidation of the impacted soils/sediments from the Drainage Pond will address the removal action objectives at this location.

5.4.2 Implementability

Technical Feasibility

Implementation of this Alternative is technically feasible. Specialty contractors will be required to install the geomembrane components of the cap system and the upgradient groundwater isolation system. Assuming that proper operation and maintenance of the installed systems are performed the performance/useful life of this Alternative should be acceptable.

Availability

The services, equipment and materials required for construction should be readily available. Low permeability soil and other soil material sources have been preliminarily identified within a reasonable distance of the Site. Post removal site control would be relatively straight forward. The availability of industrial wastewater treatment facility within a reasonable distance to the site may be a concern.

Administrative Feasibility

The administrative feasibility of obtaining permission to dispose of the impacted groundwater at an industrial facility is not anticipated to be problematic. This Alternative is not in compliance with the statutory limit of $2 million for removal actions. Securing institutional controls at the Site is not considered to be an issue. Institutional controls such as access and/or deed restrictions will restrict site access and regulate future site access.

5.4.3 Cost

The estimated capital cost for Alternative III is estimated to ~~be $6,151,453.~~ range from $3,921,646 to $4,286,960. The estimated annual PRSC cost is estimated to range from $1,745,000 to $4,045,000 which includes the following:

- $15,000/year for cap maintenance including mowing and cap repair;
- $20,000/year for erosion and sedimentation control maintenance and repair;
- $1,600,000 ~~(min.)~~ to $3,900,000 ~~(max.)~~ for leachate collection and treatment; and,
- $50,000/year for Barrier Performance Analytical Costs.
- $60,000/year for the gas extraction system O&M.

The present worth cost is estimate to range from ~~$8,131,979~~ $9,028,365 to ~~$10,431,979~~ $11,850,764 assuming a ~~3~~ 30 year period with a 7 percent discount rate ~~and from $8,112,046 to $10,412,046 with a 10 percent discount rate (both~~ before taxes and after inflation~~)~~. The results of this cost estimate ~~is~~ are summarized in Table 5-1. The calculations that were performed to estimate material costs and quantities are provided in Appendix C.

5.5 ALTERNATIVE IV - SINGLE BARRIER CAP / UPGRADIENT GROUNDWATER ISOLATION / EXISTING DISCHARGE PIPE COLLECTION WITH OFF-SITE TREATMENT / PASSIVE GAS MANAGEMENT SYSTEM / EXCAVATION OF IMPACTED SOILS WITH ON-SITE LANDFILL CONSOLIDATION / MANAGEMENT AND INSTITUTIONAL CONTROLS

5.5.1 Effectiveness

Protectiveness

This alternative would provide protection of public health and the environment by addressing the potential risks at the Site. To ensure that the overall protection of the public health and environment is preserved for the removal action, a technology specific monitoring program may be implemented to determine the effectiveness of the Alternative.

A moderate short-term risk would exist to on-site workers during the implementation of the removal action. A relatively low short-term risk to the public health of the residents living south of the landfill may occur due to the increased vehicular traffic required to deliver construction materials.

It is acknowledged that the single barrier cap, by definition, does not satisfy the USEPA's recommendation for a "two-component low-permeability layer" which is described in the technical guidance document titled "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA 530-SW-89-047, July 1989), does not provide the redundant protection offered by a composite barrier cap, and may offer less long-term protectiveness than a composite barrier cap. However the single barrier landfill cap technology satisfies the response action objectives for the Site, is potentially applicable and can be designed to comply with the RCRA Subtitle C final cover performance requirements (40 CFR §264.310). The RCRA Subtitled capping regulations are generally more stringent than the VTANR Solid Waste Management Rules. Therefore, the containment technology will satisfy both the Federal and State closure requirements. Installation of an active gas management system would conform to the applicable State and Federal requirements. However, additional analytical data for the landfill gas would be required to determine if passive gas venting is acceptable. The Act 250 requirements would be met with this Alternative.

Ability to Achieve Removal Objectives

The single barrier cap system will prevent direct contact and ingestion of soil and debris within and beneath the landfill. The cap will aid in minimizing stormwater infiltration, prevent the generation of leachate, and contain landfill generated gas and odors. Implementation of the stormwater management system will control surface water runoff to minimize erosion. Installation of an upgradient slurry wall will prevent contact of the groundwater with landfill contents, therefore, controlling potential leachate production. The upgradient groundwater isolation unit will prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater. The upgradient groundwater isolation unit will divert the groundwater around the landfill. This will result in minimizing the migration of contaminated groundwater beyond the boundary of compliance. The existing landfill underdrain system will be fitted with a system to collect, equalize and store leachate for transportation to an industrial wastewater treatment system. This system will prevent the migration of leachate and prevent leachate from affecting shallow groundwater. The passive landfill gas system may control the off-site migration of gas and prevent build-up of gas below the cap. The passive system will also minimize the potential for fire and explosion hazards. However, the inhalation of landfill gas containing hazardous substances may not be prevented. Excavation/consolidation of the impacted soils/sediments from the Drainage Pond will address the removal action objectives at this location.

5.5.2 Implementability

Technical Feasibility

Implementation of this Alternative is technically feasible. Specialty contractors will be required to install the geomembrane components of the cap system and the upgradient groundwater isolation system. Assuming that proper operation and maintenance of the installed systems are performed the performance/useful life of this Alternative should be acceptable.

Availability

The services, equipment and materials required for construction should be readily available. Low permeability soil and other soil material sources have been preliminarily identified within a reasonable distance of the Site. Post removal site control would be relatively straight forward. The availability of industrial wastewater treatment facility within a reasonable distance to the site may be a concern.

Administrative Feasibility

The administrative feasibility of obtaining permission to dispose of the impacted groundwater at an industrial facility is not anticipated to be problematic. This Alternative is not in compliance with the statutory limit of $2 million for removal actions. Securing institutional controls at the Site is not considered to be an issue. Institutional controls such as access and/or deed restrictions will restrict site access and regulate future site access.

5.5.3 Cost

The estimated capital cost for Alternative IV is estimated to be ~~$5,036,053~~ $3,506,960. The estimated PRSC cost is estimated to range from $1,745,000 to $4,045,000 which includes the following:

- $15,000/year for cap maintenance including mowing and cap repair;
- $20,000/year for erosion and sedimentation control maintenance and repair;

- $50,000/year barrier performance analytical costs;

- $1,600,000 ~~(min.)~~ to $3,900,000 ~~(max.)~~ for leachate disposal to an off-site Industrial Treatment Facility; and,

- $60,000/year for the gas extraction system O&M.

The present worth cost estimated to range from ~~$7,016,579~~ $8,435,364 to ~~$9,316,579~~ $10,735,364 assuming a ~~3~~ 30 year period with a 7 percent discount rate ~~and from $6,996,646 to $9,296,646 with a 10 percent discount rate (both~~ before taxes and after inflation~~)~~. The results of this cost estimate ~~is~~ are summarized in Table 5-1. The calculations that were performed to estimate material costs and quantities ~~is~~ are provided in Appendix C.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The goal of the comparative analysis of removal action alternatives is to evaluate the relative performance of each alternative in relation to each of the response action objectives. The purpose of this section is to identify the advantages and disadvantages of each alternative relative to one another so that important tradeoffs that affect the removal action can be identified. The Alternative evaluations are based on effectiveness, implementability and cost.

The advantages and disadvantages of removal action technologies which are constant among the alternatives (E&S Control, ~~Gas Management~~, Leachate/Groundwater Collection, Treatment and Isolation/Containment, Soils/Sediments Remediation, and Management and Institutional Controls) are not presented below, but can be found in Section 4.3. The relative advantages and disadvantages of the Containment~~Capping~~, and Landfill Gas Management~~Leachate/Groundwater Collection, Treatment, and Isolation/Containment~~ portions of the Aalternatives are presented below.

6.1 Effectiveness

Protectiveness

Containment

All four Alternatives identified would provide protection of public health and the environment by addressing the potential risks at the Site. A moderate short-term risk would exist to on-site workers for all four alternatives during the implementation of the removal action. A relatively low short-term risk to the public health of the residents living south of the landfill may occur for each Alternative due to the increased vehicular traffic required to deliver construction materials. The two landfill caps selected in Alternatives Iand III ~~, II, V and VI~~ (composite barrier), and II and IV ~~III, IV, VII and VIII~~ (single barrier) are considered effective in the short- and long-term and provide a permanent remedy for the Site by containing the landfill contents and minimizing the migration of landfill gases and infiltration through the landfill. Proven technologies and construction practices exist to place both caps and the gas management system effectively. USEPA guidance specifies that containment is the presumptive remedy for municipal waste landfills like the Bennington Municipal Landfill Superfund Site (Site).

Given the characteristics of the Site, no significant differences in the ability of the composite barrier cover over the single barrier cover to protect public health and the environment at the Site were identified. Both containment options will satisfy the applicable State and Federal requirements.

Landfill Gas Management

Installation of an active gas management/treatment system would conform to the applicable ARAR's. However, it is unknown wheather the installation of a passive gas management system would conform to the applicable State and Federal air quality criteria. Additional analytical data for the landfill gas would be required to determine if passive gas venting is acceptable.

~~The combined leachate/groundwater isolation, collection and treatment options are both considered effective (short-term and long-term) in preventing the migration of contaminated leachate/groundwater beyond the boundary of compliance. The Alternatives (II, IV, VI and VII) which have the downgradient interceptor trench will not, however, meet the objective of preventing saturation of the landfill debris from upgradient groundwater, if this condition exists. The overall difference between Alternatives (I, III,V and VII) and Alternatives (II, IV, VI, and VII) is in the approach to groundwater management. Alternatives (I, III,V and VII) provide a proactive approach, preventing further impact to waters. Alternatives (II, IV, VI, and VII) provide a reactive approach combining some continued impact to waters with an effective treatment and disposal system.~~

Ability to Achieve Removal Objectives

Containment

Both cap system options will prevent direct contact and ingestion of soil and debris within and beneath the landfill. Both caps will aid in minimizing stormwater infiltration, prevent the generation of leachate, and contain landfill generated gas and odors.

Landfill Gas Management

The active gas management system (if properly designed and operated) will meet all the applicable removal action objectives. The passive landfill gas system may control the off-site migration of gas and prevent build-up of gas below the cap. The passive system will also minimize the potential for fire and explosion hazards. However, the inhalation of landfill gas containing hazardous substances may not be prevented.

6.2 Implementability

Technical Feasibility

Containment

The two landfill caps are technically feasible and relatively easy to implement since limited construction and operations are required. Specialty contractors will be required to install the geomembrane components of the cap system. The amount of grading required would effect the cost and time of implementation of the two capping technologies. The availability of suitable low permeability soil (clay) in the local area can also effect the cost and time of implementation.

Clay may be substituted for FMLs in the single barrier cover. Placement of the composite barrier may requires the use of both low permeability soil and GCL in combination with ~~and~~ the FML.

Landfill Gas Management

Implementation of both gas management systems is technically feasible. A specialty contractor would be required to install the gas management system. The operation and maintenance considerations for the active system would be relatively high. Assuming that proper operation and maintenance of the installed systems are performed the performance/useful life of both gas management systems should be acceptable.

Availability

Containment

The services, equipment and materials required for construction of both caps should be readily available. Low permeability soil and other soil material sources have been preliminarily identified within a reasonable distance of the Site. Post removal site control would be relatively straight forward.

Landfill Gas Management

The services and equipment for the passive system would be more readily available compared to the active system.

Administrative Feasibility

Containment

Administative issues are not considered to be comparitively different for either cap alternative.

Landfill Gas Management

Administrative issues are not considered to be comparitively different for either gas management system with the potential exception of offsite disposal of the condensate from the active system.

~~The leachate/groundwater isolation, collection, treatment and disposal technologies presented within the Alternatives are all technically feasible at the site. With the additional data performed during the Phase IB investigation and pre-design bench studies, implementation of the interceptor trench, and treatment/disposal systems should offer no major problems. Construction of the slurry wall and grout injection in the northwest corner of the landfill may offer some technical challenges, but these are proven construction techniques which should not pose any significant problem.~~

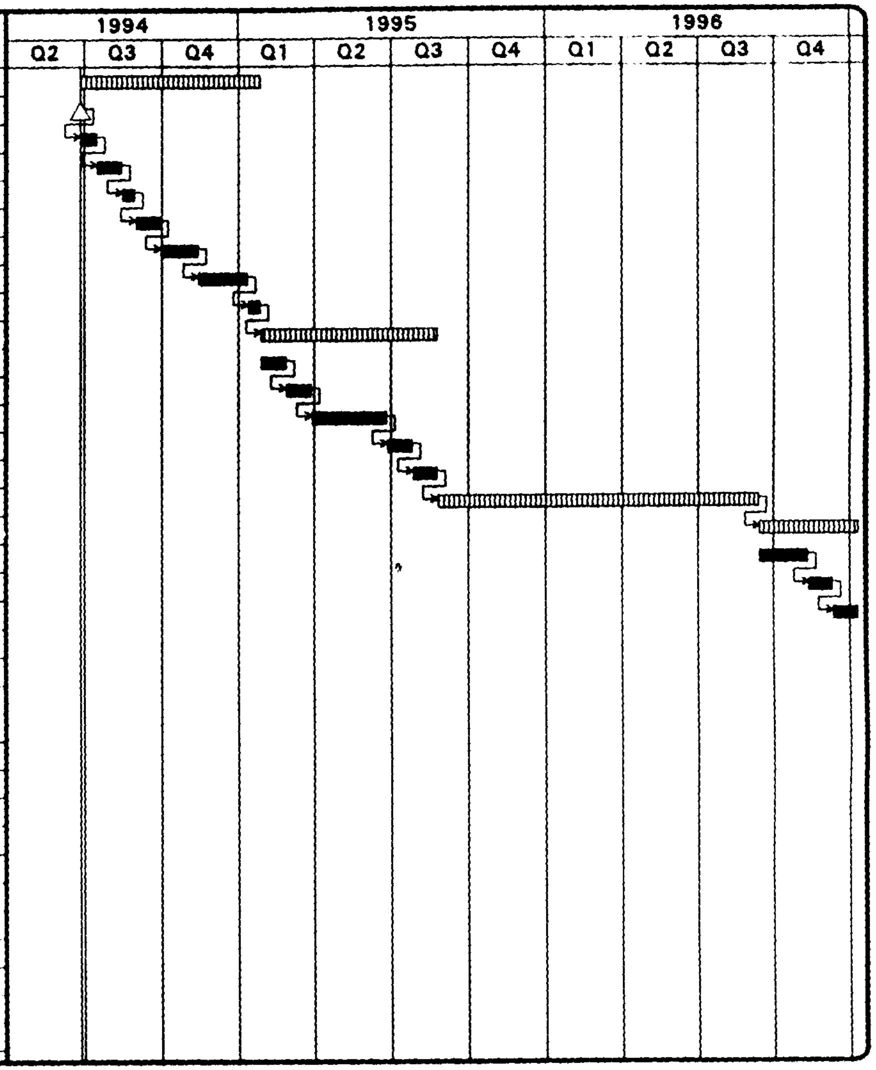
6.3 Cost

The direct cost for the composite barrier and single barrier capping varies by approximately $440,000 to $805,000 ($2.25 and $2.62 million (for composite barrier cap options) verses $1.81 millionfor the single barrier cap). Alternatives I and III ~~, II, V and VII~~ provide greater capping protection because the composite barrier system provides redundancy in minimizing the rate of infiltration. However, it is not clear that the increased direct cost associated with providing a redundant barrier layer is warranted. Results of HELP analyses indicate that the single barrier cap does minimizes infiltration and therefore satisfies the RCRA Subtitle C final cover performance criteria. The present-worth cost for an active and passive gas managment system varies by approximately $300,000.

~~Evaluating the differences between Alternatives I, III, VI, and VII the combined present worth cost (3 years, 10% discount) for the upgradient slurry wall and off-site disposal ranges from $7.0 million to $10.8 million. Evaluating the difference between alternatives II, IV, VI and VII, the combined present worth cost (3 years, 10% discount) for the downgradient collection, on-site treatment and POTW disposal ranges from $5.8 million to $7.5 million. The latter costs are much less than the former costs, especially at the maximum anticipated flow rates. Changing the evaluation of those costs, though, to a 30 year period with a 7 percent discount reveals a much smaller differential between the different options; $8.4 to $12.2 million (Alternatives I, III, VI and VII) verses $7.88 to $10.2 million (Alternatives II, IV, VI and VII).~~

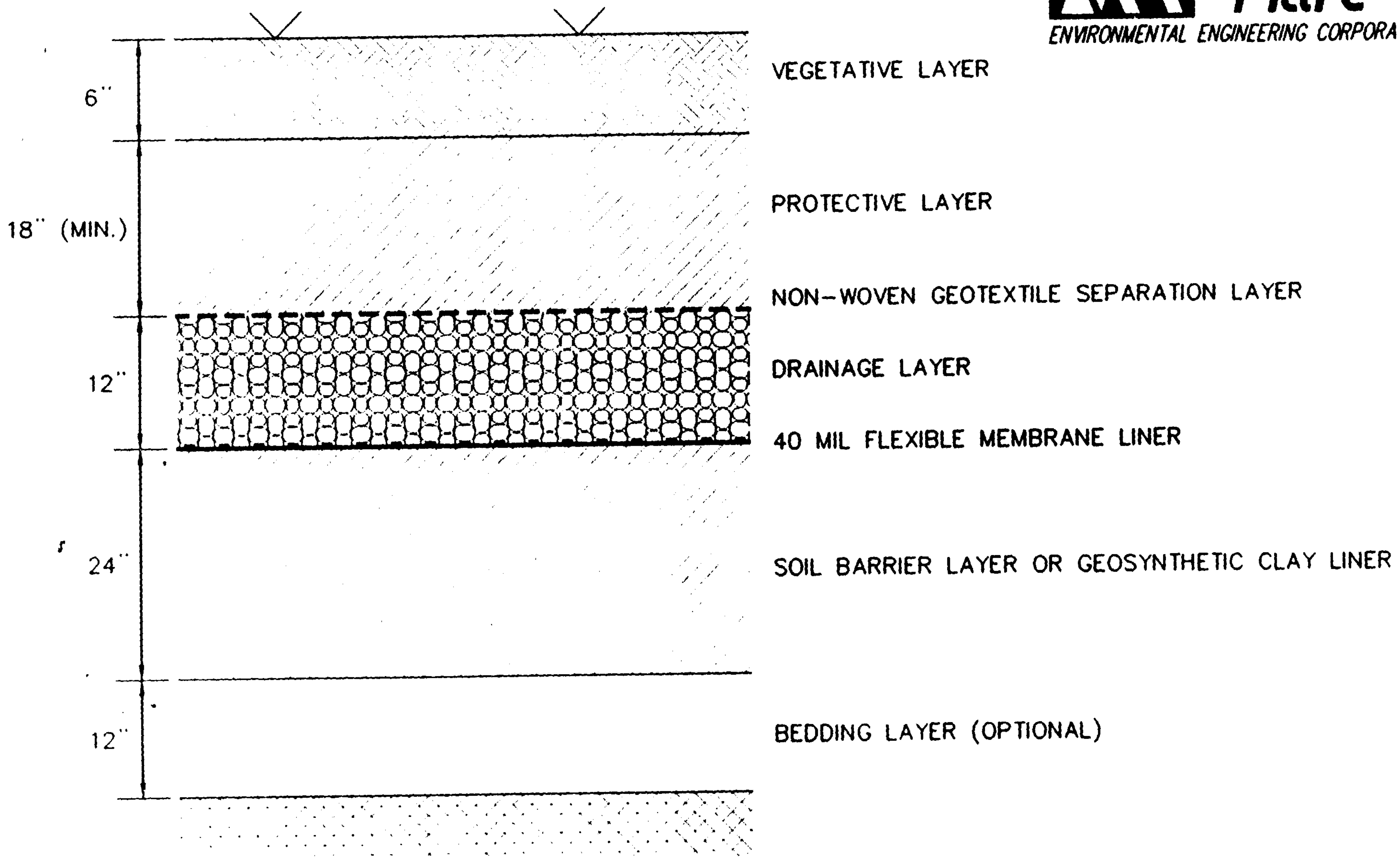
FIGURE 3-1
Preliminary Removal Action Schedule
EE/CA - Bennington Superfund Site

Ro #	Task Name	Duration	Start	End
1	EE/CA			
2	Final EE/CA Report	0.00 d	Jun/27/94	Jun/27/94
3	EPA Issuance of Proposed Plan	20.00 d	Jun/27/94	Jul/16/94
4	Public Comment Period	30.00 d	Jul/17/94	Aug/15/94
5	EPA Action Memorandum	15.00 d	Aug/16/94	Aug/30/94
6	Administrative Order Negotiation	30.00 d	Sep/01/94	Sep/30/94
7	Removal Action Design Engineer Procurement	45.00 d	Oct/01/94	Nov/14/94
8	Removal Action Work Plan	60.00 d	Nov/15/94	Jan/13/95
9	Agency Review	15.00 d	Jan/14/95	Jan/28/95
10	DESIGN			
11	30% Removal Action Design	30.00 d	Jan/29/95	Feb/27/95
12	Agency Review	30.00 d	Feb/28/95	Mar/29/95
13	100% Removal Action Design	90.00 d	Mar/30/95	Jun/27/95
14	Agency Review	30.00 d	Jun/28/95	Jul/27/95
15	Removal Action Contractor Procurement	30.00 d	Jul/28/95	Aug/26/95
16	CONSTRUCTION	385.00 d	Aug/27/95	Sep/14/96
17	POST CONSTRUCTION			
18	Draft Construction And O&M Plan	60.00 d	Sep/15/96	Nov/13/96
19	Agency Review	30.00 d	Nov/14/96	Dec/13/96
20	Final Construction and O&M Plan	30.00 d	Dec/14/96	Jan/12/97



Note: This schedule assumes that the USEPA selected alternative and resultant removal action work plan will not require treatability or pilot-scale studies or additional data outside the scope of the Phase 1B Work Plan.

Milestone △ Summary



McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

FIGURE 4-1
COMPOSITE BARRIER CAP
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

ENVIRONMENTAL ENGINEERING CORPORATION

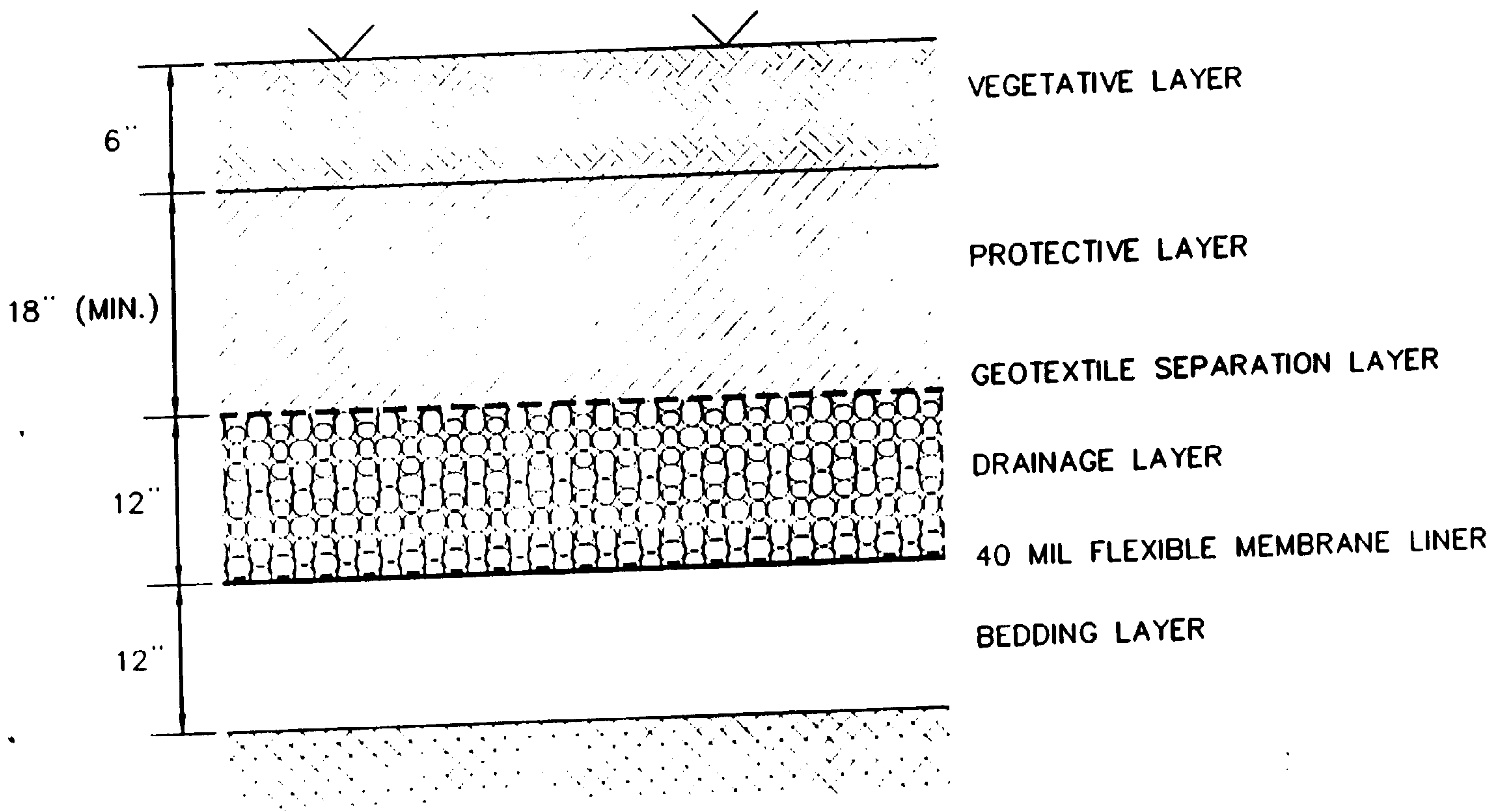


FIGURE 4-2
SINGLE BARRIER CAP
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TABLE 3-1
CHEMICAL SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Groundwater		Applicable		Vermont Hazardous Waste Management Act (10 V.S.A. Chapter 159, EPR Chapter 7).	Regulates the storage, transport, treatment, disposal, recycling, and managing of hazardous waste. Incorporates requirements of RCRA, 40 CFR Part 264, Subpart F, groundwater protection standards.
		Applicable		Vermont Groundwater Protection Act (10 V.S.A. Chapter 48, EPR Chapter 12).	Act protects groundwater through existing regulatory programs and provides restrictions, prohibitions, standards and criteria for groundwater protection for programs which regulate activities which may affect groundwater.
		Relevant and Appropriate		Federal RCRA Subpart F Groundwater Protection Standards (40 CFR Part 264)	Establishes, among other requirements, groundwater protection standard requirements for groundwater monitoring, detection monitoring, and compliance monitoring.
		Relevant and Appropriate		Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (40 CFR Part 141).	MCLs have been promulgated for a number of organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies. MCLs are considered relevant and appropriate for groundwater aquifers potentially used for drinking water.
		Relevant and Appropriate		Federal Safe Drinking Water Act Maximum Contaminant Level Goals (MCLGs) (40 CFR Part 141).	MCLGs are health based goals (non enforceable for public water supplies. The USEPA has promulgated non-zero MCLGs for specific contaminants.
		To Be Considered		Federal Safe Drinking Water Act proposed MCLs (40 CFR Part 141).	These regulations would establish MCLs for certain chemical species.
		To Be Considered		USEPA Human Health Assessment Cancer Slope Factors (CSFs).	EPA develops CSFs for health effects assessments or evaluation by the Human Health Assessment Group (HHAG).
		To Be Considered		USEPA Reference Doses (RfDs).	RfDs are dose levels developed by EPA for use in the characterization of risks due to non-carcinogens in various media.

TABLE 3-1 3-2
POTENTIAL LOCATION-SPECIFIC ARARS FOR BENNINGTON LANDFILL

Location	Requirement	Status	Prerequisite(s)	Citation	Comments
Wetland	Action to minimize the destruction, loss, or degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without permit.	Applicable	Wetland as defined by Executive Order 11990 Section 7.	Executive Order 11990, Protection of Wetlands. (40 CFR 6, Appendix A) Clean Water Act Section 404; 40 CFR Parts 230, 231	Applicable if wetlands are present next to or on the site.
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts.	Action to recover and preserve artifacts.	Applicable	Alternation of terrain that threatens significant scientific, prehistorical, historical, or archaeological data.	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	Should scientific, prehistorical, or historical artifacts be found at the site, this will become applicable
Area affecting stream or river	Action to protect fish or wildlife.	Applicable	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302	The Fish and Wildlife coordination Act requires consultation with the Department of Fish and Wildlife prior to any action that would alter a body of water of the United States.

TABLE ~~3-1~~ 3-2 (CONT'D)
POTENTIAL LOCATION-SPECIFIC ARARS FOR BENNINGTON LANDFILL

Location	Requirement	Status	Prerequisite(s)	Citation	Comments
Critical Habitat	Protects listed species and unique environments.	Applicable	Determination of listed species and unique environments.	Endangered Species and Habitats (~~TIO~~ 10 VSA Sec 5401)	Need to identify whether listed species or unique environments exist on the site.
Wetland	Identifies and regulates activities in wetlands.	Applicable	Wetland as defined by ~~TIO~~ 10 VSA Chapt. 37 Sec. 905 (7-9)).	Vermont Wetland Rules (~~TIO~~ 10 VSA Chapt. 37, Sec. 905 (7-9))	Applicable if wetlands are present next to or on the site
Stream	Regulates and permits activities in streams	Applicable	Activity that takes place in a stream.	10 VSA Chapt. 4	Need to identify any stream located activity.
Site-wide	Regulates development of the Site	Relevant and Appropriate	Determination that action constitutes "development"	Vermont Land Use and Development Law Act 250 10 VSA Chapt. 151	Need to determined whether actions at site constitute development

TABLE 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Air Stripping	Design system to provide odor-free operation.	Relevant and Appropriate		CAA Section 101*	Odor regulations are intended to limit nuisance conditions from air pollution emissions.
	File an Air Pollution Emission Notice (APEN) with State to include estimation of emission rates for each pollutant expected.	Relevant and Appropriate		40 CFR 52*	State will have particular interest in emissions for compounds on their hazardous, toxic, or odorous list. Preliminary meeting with state prior to filing APEN is recommended in the regulation. Meeting would identify additional issues of concern to State.
	Include with filed APEN the following: Modeled impact analysis of source emissions. Provide a Best Available Control Technology (BACT) review for the source operation.	Relevant and Appropriate	This additional work and information is normally applicable to sources meeting the "Major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52*	State may identify further requirements for permit issuance after first review. These provisions follow the federal Prevention of Significant Deterioration (PSD) framework with some modifications. Additional requirements could include ambient monitoring and emission control equipment design revisions to match Lowest Achievable Emission Requirements (LAER). While a permit is not required for an onsite CERCLA action, the substantive requirements identified during the permitting process are applicable.
	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Relevant and Appropriate	Source operation must be in an ozone nonattainment area.	40 CFR 52*	The control technology review for this regulation (RACT) could coincide with the BACT review suggested under the PSD program.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	Relevant and Appropriate		40 CFR 61*	

TABLE 3-3 ~~(Cont'd)~~
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Air Stripping (cont'd)	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.	Relevant and Appropriate		40 CFR 61*	Regulation 8 indicates any source emitting the regulated compounds is subject to this regulation. However, some of the specific regulations further restrict the scope of applicability.
Air	Vermont Air Pollution Control Regulations (10 V.S.A. Section 551 et seq. EPR Chapter 5):	Relevant and Appropriate		Lists hazardous contaminants and sets Hazard Limiting Values and Action Limits (establishes air quality standards and allowable discharges).	

TABLE 3-3 (~~Cont'd~~)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Capping	Placement of a cap over hazardous waste (e.g., closing a landfill, or closing a surface impoundment or waste pile as a landfill, or similar action) requires a cover designed and constructed to: Provide long-term minimization of infiltration of liquids through the capped area. Function with minimum maintenance. Promote drainage and minimize erosion or abrasion of the cover. Accommodate settling and subsidence so that the cover's integrity is maintained. Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	Relevant and Appropriate	RCRA waste in landfill. Significant management (treatment, storage, or disposal) of hazardous waste will make requirements applicable, capping without disturbance will not make requirements applicable, but technical requirements may be relevant and appropriate.	40 CFR 264.228(a) (Surface Impoundments) 40 CFR 264.258(b) (Waste Piles) 40 CFR 264.310(a) (Landfills)	RCRA capping requirements could be relevant and appropriate to capping hazardous wastes in place. RCRA is generally considered relevant if it can be verified, through review of records, interviews, or other means, that the landfill accepted RCRA wastes after November 19, 1980. The appropriateness of RCRA requirements is based also on each requirement's technical merit in a given situation. If a groundwater containment problem exists, a RCRA cap would serve to isolate and contain landfill solids and contaminated soils and limit infiltration of precipitation. EPA ~~guidance on RCRA caps for new RCRA landfill cells includes multibarrier caps of clay and liners.~~ Excavation and reconsolidation of the wastes onsite, in a location outside of the current area of contamination, would make these requirements, as well as the landfill construction and operation requirements applicable for wastes that can be designated as hazardous. If the wastes are excavated and reconsolidated in their current location, the capping requirements are applicable. The major determining factors are the location of the final disposal, and the classification of the waste materials.

TABLE 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Capping (Cont'd)	Eliminate free liquids, stabilize wastes before capping (surface impoundments).	Relevant and Appropriate		40 CFR 264.228(a)	
	Restrict post-closure use of property as necessary to prevent damage to the cover.			40 CFR 264.117(c)	
	Prevent run-on and run-off from damaging cover.			40 CFR 264.228(b) 40 CFR 264.310(b)	
	Protect and maintain surveyed benchmarks used to locate waste cells (landfills, waste piles).			40 CFR 264.310(b)	
	Disposal or decontamination of equipment, structures, and soils.			40 CFR 264.111	
	USEPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments	To Be Considered		EPA/530-SW-89-047	Presents technical specifications for the design of multilayer covers at landfills where hazardous wastes were disposed of.
	Federal RCRA Criteria for Municipal Solid Waste Landfills.	Relevant and Appropriate		(40 CFR Part 258, Subpart E)	Establishes groundwater monitoring requirements for municipal solid waste landfills.
	USEPA Evaluating Cover Systems for Solid and Hazardous Waste	To Be Considered		EPA SW-867 NTIS PB 87-154894	
	Vermont Hazardous Waste Management Act	Applicable		(10 V.S.A. Chapter 159, EPR Chapter 7).	These regulations establish requirements for hazardous waste facilities, including facility standards, emergency preparedness and prevention and contingency planning. Closure of landfill disposal units shall be implemented to accomplish the objectives detailed in 40 CFR Part 264, including Subpart F (Releases from waste management units), Subpart G (Closure and post-closure), and Subpart N (Landfills).

TABLE 3-3 ~~(Cont'd)~~
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Capping (Cont'd)	Vermont Land Use and Development Law	Relevant and Appropriate		(Act 250-10 V.S.A. Chapter 151).	Construction of improvements on tracts of land larger than 10 acres are required to comply with criteria specified in the Act, including no undue air or water pollution, no disposal of harmful or toxic substances to groundwater, no unreasonable soil erosion, compliance with wetlands rules, and no adverse affects on aesthetic values.
Closure with Waste in Place (Capping)	Eliminate free liquids by removal or solidification.	Relevant and Appropriate		40 CFR 264.228(a)(2)	See discussion under capping.
	Stabilization of remaining waste and waste residues to support cover.			40 CFR 264.228(a)(2) and 40 CFR 264.258(b)	
	Installation of final cover to provide long-term minimization of infiltration.			40 CFR 264.310	
	Post closure care and groundwater monitoring.			40 CFR 264.310	
Closure	Vermont Solid Waste Management Rules	Applicable	Management of solid waste facility, site or activity	10 VSA Chapt. 159	
	Vermont Hazardous Waste Management ~~Regulations~~ Act	Applicable	Management of hazardous wastes	10 VSA Chapt. 159	State equivalent to Federal RCRA regulations
	Guidelines for Municipal Solid Waste Landfills	To Be Considered	Management of Municipal Solid Waste Landfills	Vermont Agency of Natural Resources, March, 1991	

TABLE 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Clean Closure (Removal)	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products.	Relevant and Appropriate	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination. May apply to surface impoundment or to contaminated soil, including solid from dredging or soil disturbed in the course of drilling or excavation and returned to land.	40 CFR 264.111	Clean closure removal of contaminated materials does not appear to be feasible for most municipal landfill sites because of the large volume of wastes. However, clean closure removal may be considered for portions of the site, such as hot spot areas. The RCRA clean closure requirements would be considered relevant and appropriate to contaminated wastes which are not hazardous, but which are similar to hazardous wastes.
	Disposal or decontamination of equipment, structures, and soils.	Relevant and Appropriate		40 CFR 264.111 and 268	The RCRA Land Disposal Restrictions require treatment of RCRA wastes to be specified levels or by specified technologies. The RCRA requirements would be considered relevant and appropriate to wastes that are not RCRA hazardous wastes, but which are similar (same constituents) as RCRA wastes. RCRA Land Disposal Restrictions require treatment of RCRA wastes to specified levels or by specified technologies before land disposal. If treatment to the specified level or by the specified technology is not achievable or appropriate, a variance must be obtained from the EPA. If the wastes are determined to be RCRA wastes, these requirements would be applicable.
	Removal or decontamination of all waste residues, contaminated containment system components (e.g. liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste. Meet health-based levels at unit.	Relevant and Appropriate	Not applicable to undisturbed material. Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR 264.228(a)1 and 40 CFR 264.258	In the event that the wastes being removed are determined to be hazardous wastes, the requirements of this section would be applicable

TABLE 5-5 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Consolidation	Area from which materials are removed should be remediated.	Relevant and Appropriate	Disposal by disturbance of hazardous waste (listed or characteristic) and moving it outside unit or boundary of contaminated area.	See Closure.	If nonhazardous wastes are excavated and moved outside the current area of contamination, these requirements will become relevant and appropriate. These regulations are intended to insure that when wastes are consolidated at a central location, the satellite areas (former locations of the wastes) are remediated. If the wastes which are excavated for consolidation are determined to be hazardous, this regulation will be applicable.
	Placement on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions.	Relevant and Appropriate	After November 8, 1988.	40 CFR 286 (Subpart D)	Certain listed hazardous wastes are not eligible for disposal in landfills or other land-based facilities unless treated to RCRA specified criteria. The requirement may be relevant and appropriate to some nonhazardous wastes at municipal landfill sites which are contaminated with hazardous constituents at levels similar to those in listed wastes, and are excavated for reconsolidation and disposal outside the current area of contamination. If any of the wastes are determined to meet the definitions of the restricted hazardous wastes, the requirements will be applicable.
	Include with the filed APEN the following: Modeled impact analysis of source emissions A Best Available Control Technology (BACT) review for the source operation	Relevant and Appropriate	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52*	See discussion under Air Stripping.
	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emissions levels from similar sources using Reasonably Available Control Technology (RACT).	Relevant and Appropriate	Source operation must be an ozone nonattainment area.	40 CFR 52*	See discussion under Air Stripping.

TABLE 3-3 ~~(Cont'd)~~
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Consolidation (Cont'd)	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	Relevant and Appropriate		40 CFR 61*	See discussion under Air Stripping.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected form sources in compliance with hazardous air pollution regulations.	Relevant and Appropriate		40 CFR 61*	See discussion under Air Stripping.
~~Dike Stabilization~~	~~Design and operate facility to prevent overtopping due to overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, or other equipment; and human error.~~		~~Existing surface impoundment containing hazardous waste or creation of new surface impoundments.~~	~~40 CFR 264.221~~	~~These requirements would be relevant and appropriate to the construction and operation of a new surface impoundment or the operation and maintenance of an existing surface impoundment onsite to contain groundwater, surface water, leachate, or the influent or effluent of a treatment system that is not a hazardous waste.~~
Direct Discharge of Treatment System Effluent	Discharge limitations must be established for all toxic pollutants that are or may be discharge at levels greater than those that can be achieved by technology-based standards.	Applicable	Surface discharge of treated effluent.	40 CFR 122.44(e)	Exact limitations are based on review of the proposed treatment system and receiving water characteristics, and are usually determined on a case-by-case basis. The permitting authority should be contacted to determine effluent limitations.
	~~Discharger must be monitored to assure compliance. Discharge will monitor:~~ ~~The mass of each pollutant discharged.~~ ~~The volume of effluent discharged.~~ ~~Frequency of discharge and other measurements as appropriate.~~		~~Surface discharge of treated effluent.~~	~~40 CFR 122.44(i)~~	~~These requirements are generally incorporated into permits, which are not required for onsite discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that the discharge standards are being met. The permitting authority should be contacted to determine monitoring and operational requirements.~~

TABLE (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (Cont'd)	Applicable federal water quality criteria for the protection of aquatic life must be compiled with when environmental factors are being considered.	Applicable	Surface discharge of treated effluent.	50 FR 30784 (July 29, 1985)	
	Applicable federal approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Applicable	Surface discharge of treated effluent.	40 CFR 122.44, 122.41, 122.41 and state regulations approved under 40 CFR 131	If state regulations are more stringent than federal water quality standards, the state standards will be applicable to direct discharge. The state has authority under 40 CFR 131 to implement direct discharge requirements within the state, and should be contacted on a case-by-case basis when direct discharges are contemplated.
	The discharge must be consistent with the requirements of a Water Quality Management plan approved by EPA under Section 208(b) of the Clean Water Act.	Applicable		CWA Section 208(b)	Discharge must comply with substantive but not administrative requirements of the management plan.
	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology based limitations may be determined on a case-by-case basis.	Applicable	Surface discharge of treated effluent.	40 CFR 122.44(a)	If treated effluent is discharged to surface waters, these treatment requirements will be applicable. Permitting and reporting requirements will be applicable only if the effluent is discharged at an offsite location. The permitting authority should be contacted on a case-by-case basis to determine effluent standards.
	Vermont Water Quality Standards	Applicable	Discharge of wastes directly or indirectly into waters of the State	10 VSA Chapter 47	Establishes surface water classifications, and water quality criteria
	Vermont Water Supply and Wastewater Permit	Relevant and Appropriate		10 V.S.A. Chapter 6	Regulates water supply and wastewater facility design and construction.
	Vermont National Pollution Discharge Elimination System (NPDES) Regulations	Applicable		EPR Chapter 13	Regulates the discharge of any waste into the waters of Vermont and the terms and conditions of permits. Requirements include monitoring, recording, and reporting compliance.

TABLE 3-3 ~~(Cont'd)~~
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (Cont'd)	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided. Permit application information must be submitted, including a description of activities, listing of environmental permits, etc. Monitor and report results as required by permit (at least annually).	Relevant and Appropriate		40 CFR 122.21 40 CFR 122.44(i)	
	Comply with additional permit conditions such as: Duty to mitigate any adverse effects of any discharge. Proper operation and maintenance of treatment systems.	Relevant and Appropriate		40 CFR 122.41(i)	

TABLE 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Discharge of Treatment System Effluent (Cont'd)	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters. The BMP program must: Establish specific procedures for the control of toxic and hazardous pollutant spills. Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure. Assure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA.	Relevant and Appropriate	Surface water discharge.	40 CFR 125.100 40 CFR 125.104	These issues are determined on a case-by-case basis by the NPDES permitting authority for any proposed surface discharge of treatment wastewater. Although a CERCLA site remediation is not required to obtain an NPDES permit for onsite discharges to surface waters, the substantive requirements of the NPDES permit program must be met by the remediation action if possible. The permitting authority should be consulted on a case-by-case basis to determine BMP requirements.
	Sample preservation procedures container materials, and maximum allowable holding times are predescribed.		Surface water discharge.	40 CFR 136.1-136.4	These requirements are generally incorporated into permits, which are not required for onsite discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that standards are being met. The permitting authority should be consulted on a case by case basis to determine analytical requirements.
Discharge to POTW[a]	Pollutants that pass through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited	Applicable		40 CFR 403.5	If any liquid is discharged to a POTW, these requirements are applicable. In accordance with guidance, a discharge permit will be required even for an onsite discharge, since permitting is the only substantive control mechanism available to a POTW.

TABLE ..3 ~~(Cont'd)~~
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Discharge to POTW[a] (Cont'd)	Specific prohibitions preclude the discharge of pollutants to POTWs that: Create a fire or explosion hazard in the POTW. Are corrosive (Ph < 5.0). Obstruct flow resulting in interference. Increase the temperature of wastewater entering the treatment plant that would result in interference, but in no case raise the POTW influent temperature above 104°F (40°C).	Applicable			Categorical standards have not been promulgated for CERCLA sites, so discharge standards must be determined on a case-by-case basis, depending on the characteristics of the waste stream and the receiving POTW. Some municipalities have published standards for non-categorical, non domestic discharges. Changes in the composition of the waste stream due to pretreatment process changes or the addition of new waste streams will require renegotiation of the permit conditions
	Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements.			40 CFR 403.5 and local POTW regulations	
	RCRA permit-by-rule requirements must be complied with for discharges of RCRA hazardous wastes to POTWs by truck, rail or dedicated pipe.			40 CFR 264.71 and 40 CFR 264.72	
~~Dredging~~	~~Removal of all contaminated sediment.~~		~~Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.~~	~~See discussions under Clean Closure, Consolidation, Capping~~	
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements.	Relevant and Appropriate	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	40 CFR 264 Disposal and Closure Requirements.	If contaminated materials that are not hazardous wastes are excavated from the site during remediation, the RCRA requirements for disposal and site closure (of the excavated area) may become relevant and appropriate. See discussions under Capping, Clean Closure, Closure with Waste In-Place, etc. If the excavated materials can be classified as hazardous wastes, the disposal closure requirements would be applicable.

TABLE ..3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Excavation (cont'd)	Movement of excavated materials to a previously uncontaminated,onsite location, and placement in or on land may trigger land disposal restrictions.	Relevant and Appropriate	Materials containing RCRA hazardous wastes subject to land disposal restrictions.	40 CFR 268 (Subpart D)	The land disposal restrictions restrict disposal of certain hazardous wastes. Some municipal landfill wastes may be derived from or may be *sufficiently* similar to restricted wastes to make the land disposal restrictions relevant and appropriate. For wastes that can be classified as restricted hazardous wastes, land disposal is prohibited unless they are treated to defined standards. Chemical characterization of the wastes will be necessary to determined the applicability or relevance of this requirement.
	All listed and characteristic hazardous wastes or soils and debris contaminated by a RCRA hazardous waste and *removed* from a CERCLA site may not be land disposed until treated as required by Land Ban. If alternative treatment technologies can achieve treatment similar to that required by Land Ban. and if this achievement can be documented. then a variance may not be required.	Relevant and Appropriate	Waste disposed was RCRA waste.	40 CFR 268	If soil is a characteristic waste, and if waste disposed prior to November 1980 is now designated as a RCRA waste, then soils/sediment and leachate contamination from those wastes *must* be managed as a RCRA waste.
	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.	Relevant and Appropriate		CAA Section 101* and 40 CFR 52*	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	Relevant and Appropriate		40 CFR 52*	See discussions under Consolidation.
	Include with the filed APEN the following: Modeled impact analysis of source emissions. A Best Available Control Technology (BACT) review for the source operation.	Relevant and Appropriate	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52*	See discussions under Consolidation.

TABLE 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Excavation (cont'd)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emissions levels from similar sources using Reasonably Available Control Technology (RACT).	Relevant and Appropriate	Source operation must be in an ozone nonattainment area.	40 CFR 52*	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	Relevant and Appropriate		40 CFR 61*	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.	Relevant and Appropriate		40 CFR 61*	See discussions under Consolidation
Groundwater Diversion	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	Relevant and Appropriate	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See Consolidation. Excavation in this table.	If waste materials or contaminated soil that are not hazardous wastes are excavated or otherwise disturbed during the construction of a groundwater diversion structure, the requirements of this section would be relevant and appropriate. If the excavated wastes or contaminated soil can be classified as hazardous wastes, these requirements would be applicable.

Table 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Land Treatment	Ensure that hazardous constituents are degraded, transformed, or immobilized within the treatment zone.	Relevant and Appropriate	RCRA hazardous waste.	40 CFR 264.271	See discussions under Consolidation
	Maximum depth of treatment zone must be no more than 1.5 meters (5 feet) from the initial soil surface, and more than 1 meter (3 feet) above the seasonal high water table.			40 CFR 264.271	
	Demonstrate that hazardous constituents for each waste can be completely degraded, transformed, or immobilized in the treatment zone.			40 CFR 264.272	
	Minimize run-off of hazardous constituents.			40 CFR 264.273	
	Maintain run on/run-off control and management system.			40 CFR 264.273	
	Special application conditions if food-chain crops are grown in or on treatment zone.			40 CFR 264.276	
	Unsaturated zone monitoring.			40 CFR 264.278	
	Special requirements for ignitable or Requirement Column reactive wastes.			40 CFR 264.281	
	Special requirements for incompatible wastes.			40 CFR 264.282	
	Special requirements for RCRA hazardous wastes.			40 CFR 264.283	
	Design system to operate odor free.			CAA Section 101 and 40 CFR 52	

Table 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Operation and Maintenance (O&M)	Post-closure care to ensure that site is maintained and monitored	Relevant and Appropriate		40 CFR 264.118 (RCRA, Subpart (i)	Post-closure requirements for operation and maintenance of municipal landfill sites are relevant and appropriate to new disposal units with nonhazardous waste, or existing units capped in-place. In cases where municipal landfill site wastes are determined to be hazardous wastes, and new disposal units are created, the post closure requirements will be applicable.

Table 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Removal	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products.	Relevant and Appropriate	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination.	40 CFR 264.111	Clean closure removal of contaminated materials does not appear to be feasible for municipal landfill sites in general due to the lack of suitable offsite treatment or disposal facilities to accept the large volume of wastes typically found at municipal landfill sites and the impossibility of meeting he requirement at a site with portions (hot spots) of municipal landfill sites. The RCRA clean closure requirements would be considered relevant and appropriate to contaminated wastes which are not hazardous, but which are similar to hazardous wastes.
	Disposal or decontamination of equipment, structures, and soils.		May apply to surface impoundment or to contaminated soil, including soil from dredging or soil disturbed in the course of drilling or excavation and returned to land.	40 CFR 264.111	
	Removal or decontamination of all waste residues, contaminated containment system components (e.g., liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste.		Not applicable to undisturbed material. Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR 264.228(a)(1) and 40 CFR 264.258	In the event that the wastes being removed are determined to be hazardous wastes, the requirements of this section would be applicable.
	Meet health-based levels at unit.				
	RCRA hazardous wastes are subject to land disposal restrictions. Land disposal restrictions set performance requirements on treatment of the wastes before land disposal. The effective date for final group of RCRA wastes is May, 8, 1990. Extensions to the effective dates have been granted for specific RCRA wastes that are contained in soil and/or debris.		Management of listed hazardous waste.	40 CFR 244.11 40 CFR 268 and 40 CFR 261	If the wastes found at the municipal landfill site are found to be RCRA wastes, the Land Disposal Restrictions will be applicable. If the wastes are not RCRA wastes but contain the same or similar constituents to those in RCRA wastes, then the Land Disposal Restrictions may be relevant and appropriate.

Table 3-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Surface Water Control	Prevent run-on and control and collect runoff from a 24-hour, 25-year storm (waste piles, land treatment facilities, landfills)	Relevant and Appropriate	Land based treatment, storage, or disposal units.	40 CFR 264.251(c)(d) 40 CFR 264.273(c)(d) 40 CFR 264.301(c)(d)	The requirements for control of run-on and run-off will be relevant and appropriate to all remediation alternatives that manage nonhazardous waste and include onsite landbased treatment, storage, or disposal The requirements will be applicable to any remediation measures that include landbased treatment, storage, or disposal of hazardous wastes.
	~~Prevent over-topping of surface impoundment.~~			~~40 CFR 264.221(c)~~	~~This requirement will be relevant and appropriate to the construction and operation of an onsite surface impoundment, or to operation of an existing onsite surface impoundment managing nonhazardous wastes.~~ ~~These requirements would be applicable to the construction or operation of a surface impoundment for the storage or treatment of hazardous waste.~~
Treatment	Standards for miscellaneous units(long-term retrievable storage, thermal treatment other than incinerators, open burning, open detonation, chemical, physical, and biological treatment units using other than tanks, surface impoundments, or land treatment units) require new miscellaneous units to satisfy environmental performance standards by protection of groundwater, surface water, and air quality, and by limiting surface and subsurface migration.	Relevant and Appropriate	Use of other units for treatment of hazardous wastes. These units do not meet the definitions for units regulated elsewhere under RCRA.	40 CFR 264 (Subpart X)	The requirement will be relevant and appropriate to the construction, operation, maintenance, and closure of any miscellaneous treatment unit (a treatment unit that is not elsewhere regulated) constructed on municipal landfill site for treatment and/or disposal of nonhazardous wastes. These requirements would be applicable to the construction and operation of a miscellaneous treatment unit for the treatment and/or disposal of hazardous wastes.

Table 5-3 (Cont'd)
POTENTIAL ACTION-SPECIFIC ARARs FOR BENNINGTON LANDFILL

Actions	Requirement	Status	Prerequisites	Citation	Comments
Treatment (Cont'd)	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies (BDAT) for each hazardous constituent in each listed waste.	Relevant and Appropriate	Effective date for CERCLA actions is November 8, 1988, for F001-F005 hazardous wastes, dioxin wastes, and certain "California List" wastes. Other restricted wastes have different effective dates as promulgated in 40 CFR 268.	40 CFR 268 (Subpart D)	These regulations are applicable to the disposal of any municipal landfill site waste that can be defined as restricted wastes. These requirements are relevant and appropriate to the treatment prior to land disposal of any wastes that contain components of restricted wastes in concentrations that make the site wastes sufficiently similar to the regulated wastes. The requirements specify levels of treatment that must be attained prior to land disposal.
	Prepare fugitive and odor emission control plan for this action.	Relevant and Appropriate		CAA Section 101[3] and 40 CFR 52[4]	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	Relevant and Appropriate		40 CFR 52[4]	See discussions under Consolidation.
	Include with the filed APEN the following: Modeled impact analysis of source emissions. A Best Available Control Technology (BACT) review for the source operation.	Relevant and Appropriate	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[4]	See discussions under Consolidation.
Treatment (Cont'd)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Relevant and Appropriate	Source operation must be in an ozone nonattainment area.	40 CFR 52[4]	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.01 ppm.	Relevant and Appropriate		40 CFR 61[5]	See Discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.	Relevant and Appropriate		40 CFR 61[5]	See Discussions under Consolidation.

Table ‑ ‑ (Cont'd)
ACTION-SPECIFIC ARARs: CRITERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Actions	Citation	Status	Alternatives	Citation	Comments
Waste	Federal RCRA Subtitle C, 40 CFR Part 264.	Applicable	2; 3; 4; 5; 8A; 8B	RCRA Subtitle C establishes standards applicable to treatment, storage, transport, and disposal of hazardous waste and the closure of hazardous waste facilities.	Regulates the storage, transport, treatment, disposal, recycling, and managing of hazardous waste. Incorporates requirements of RCRA, 40 CFR Part 264, Subpart F, groundwater protection standards.
	Federal RCRA Criteria for Municipal Solid Waste Landfills (40 CFR Part 258, Subpart E).	Relevant and Appropriate		Establishes groundwater monitoring requirements for municipal solid waste landfills.	Act protects groundwater through existing regulatory programs and provides restrictions, prohibitions, standards and criteria for groundwater protection for programs which regulate activities which may affect groundwater.
	Federal RCRA Identification and Listing of Hazardous Waste (40 CFR Part 261).	Applicable		Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265.	Establishes, among other requirements, groundwater protection standard requirements for groundwater monitoring, detection monitoring, and compliance monitoring.
	Federal RCRA Interim Status TSDF Standards; Chemical, Physical and Biological Treatment (40 CFR Part 265, Subpart Q).	Applicable		General operating, waste analysis and trial test, inspection and closure requirements for facilities which treat hazardous waste by chemical, physical or biological methods in other tanks, surface impoundment; and land treatment facilities.	MCLs have been promulgated for a number of organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies. MCLs are considered relevant and appropriate for groundwater aquifers potentially used for drinking water.
	USEPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047).	To Be Considered		Presents technical specifications for the design of multilayer covers at landfills where hazardous wastes were disposed of.	MCLGs are health based goals (non-enforceable for public water supplies. The USEPA has promulgated non-zero MCLGs for specific contaminants.
Surface Waters	Federal Clean Water Act National Pollution Discharge Elimination System (NPDES) (40 CFR Parts 122, 125, 131, and 136).	Applicable		Imposes limitations on discharge to surface water.	These regulations would establish MCLs for certain chemical species.
	Federal Clean Water Act Ambient Water Quality Criteria (AWQC) (40 CFR Part 120)	Applicable		Remedial actions involving contaminated surface water or groundwater most consider the uses of the water and the circumstances of the release or threatened release.	EPA develops CSFs for health effects assessments or evaluation by the Human Health Assessment Group (HHAG).

TABLE 4-1
TECHNOLOGY SCREENING
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

REMOVAL ACTION TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
CONTAINMENT	COMPOSITE BARRIER CAP	FML and Soil or GCL Barrier Layer	Satisfies Removal Action Objectives
	SINGLE BARRIER CAP	FML or Soil Barrier Layer	Satisfies Removal Action Objectives
	MAINTAIN/UPGRADE THE EXISTING SOIL CAP	Regrading, Backfill and Vegetation	Partially Satisfies Removal Action Objectives
	EROSION AND SEDIMENTATION CONTROL	Construction practices, engineering controls	Satisfies Removal Action Objectives Common to all containment options
LANDFILL LEACHATE COLLECTION AND TREATMENT	EXISTING LEACHATE COLLECTION SYSTEM	Installation of collection sump with level controls	Satisfies Response Action Objectives
	WELL POINT NETWORK (COLLECTION)	Shallow wells with collection sump and level controls	May impact groundwater, drilling into the landfill could be hazardous.
	OFF-SITE TREATMENT	POTW or industrial treatment facility	Satisfies Removal Action Objectives
	ON-SITE TREATMENT	Chemical and/or physical treatment process /surface or POTW discharge	Satisfies Removal Action Objectives
LEACHATE/GROUNDWATER ISOLATION	SLURRY WALLS	Soil/bentonite, cement/bentonite, installed to confining subsurface layers	Satisfies Removal Action Objectives
	GROUTING	Cementious fluid injected into rock formation	Permeable in sand and gravel, and not structurally sound as a sole technology
	INTERCEPTOR TRENCHES	Perforated pipe with collection sump and level controls	Not effective as a sole passive upgradient technology. Downgradient system will not satisfy removal action objectives.
LANDFILL GAS MANAGEMENT	PASSIVE GAS SYSTEM	Perforated collection wells, vented to atmosphere or activated carbon	May Satisfy Removal Action Objectives
	ACTIVE GAS SYSTEM	Perforated collection wells and/or trench system, header transfer system, to treatment system	Satisfies Removal Action Objectives
	LANDFILL GAS TREATMENT	Thermal treatment consisting of ground flares	Satisfies Removal Action Objectives
SOILS/SEDIMENTS RESPONSE MEASURES	EXCAVATION AND CONSOLIDATION	Indentification, excvation, transportation and placement on the landfill	Satisfies Removal Action Objectives
	ON-SITE SOLIDIFICATION/STABILIZATION	In-situ s/s, ex-situ s/s or soil flushing	Effectiveness unproven
	OFF-SITE TREATMENT AND DISPOSAL	Indentification, excvation, transportation and treatment or disposal at an approved off-site facility	Not practical for limited volumes
MANAGEMENT AND INSTITUTIONAL CONTROLS	ACCESS RESTRICTIONS	Site security fencing and gates	Satisfies Removal Action Objectives
	INSTITUTION CONTROLS	Health ordinances, zoning, and/or deed restrictions	Satisfies Removal Action Objectives
	MONITORING	Periodic air, surface water, soil, sediment and/or groundwater monitoring	Satisfies Removal Action Objectives
	OPERATION AND MAINTENANCE	Inspection and follow-up actions	Satisfies Removal Action Objectives

RETAINED ELIMINATED

TABLE 4-2
BENNINGTON LANDFILL SUPERFUND SITE
ENGINEERING EVALUATION/COST ANALYSIS
ALTERNATIVES SUMMARY

REMOVAL ACTION TECHNOLOGY	PROCESS OPTION	ALTERNATIVES			
		I	II	III	IV
CONTAINMENT	COMPOSITE BARRIER CAP	X		X	
	SINGLE BARRIER CAP		X		X
	EROSION AND SEDIMENTATION CONTROL	X	X	X	X
LANDFILL LEACHATE COLLECTION AND TREATMENT	EXISTING LEACHATE COLLECTION SYSTEM	X	X	X	X
	OFF-SITE TREATMENT	X	X	X	X
LEACHATE/GROUNDWATER ISOLATION	SLURRY WALLS	X	X	X	X
LANDFILL GAS MANAGEMENT	PASSIVE GAS SYSTEM			X	X
	ACTIVE GAS SYSTEM	X	X		
	LANDFILL GAS TREATMENT	X	X	?	?
SOILS/SEDIMENTS RESPONSE MEASURES	EXCAVATION AND CONSOLIDATION	X	X	X	X
MANAGEMENT AND IN'STITUTIONAL CONTROLS	ACCESS RESTRICTIONS	X	X	X	X
	INSTITUTION CONTROLS	X	X	X	X
	MONITORING	X	X	X	X
	OPERATION AND MAINTENANCE	X	X	X	X

TABLE 5-1
COST ESTIMATE SUMMARY
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON MUNICIPAL LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

ALTERNATIVE	DIRECT COST $	INDIRECT COST $	PRSC $	PRESENT WORTH DISCOUNTED FOR 330 YEARS ($)	
				7%	~~10%~~
I (minimum)	4,221,646	1,836,408	1,735,000	9,333,274	~~8,516,178~~
I (maximum)	4,586,960	1,993,493	4,035,000	12,155,673	~~10,816,178~~
II (minimum)	3,781,960	1,647,343	1,735,000	8,704,523	~~7,269,714~~
II (maximum)	3,781,960	1,647,343	4,035,000	11,004,523	~~7,501,545~~
III (minimum)	3,921,646	1,707,408	1,745,000	9,028,365	~~7,365,028~~
III (maximum)	4,286,960	1,864,493	4,045,000	11,850,764	~~9,665,028~~
IV (minimum)	3,506,960	1,529,093	1,745,000	8,435,364	~~6,118,564~~
IV (maximum)	3,506,960	1,529,093	4,045,000	10,735,364	~~6,350,395~~
~~V (minimum)~~	~~4,286,960~~	~~1,864,493~~	~~1,745,000~~	~~8,131,979~~	~~8,112,046~~
~~V (maximum)~~	~~4,286,960~~	~~1,864,493~~	~~4,045,000~~	~~10,431,979~~	~~10,412,046~~
~~VI (minimum)~~	~~4,427,460~~	~~1,964,068~~	~~205,000~~	~~6,929,513~~	~~6,901,332~~
~~VI (maximum)~~	~~4,481,460~~	~~1,992,688~~	~~265,000~~	~~7,169,592~~	~~7,133,164~~
~~VII (minimum)~~	~~3,506,960~~	~~1,529,093~~	~~1,745,000~~	~~7,016,579~~	~~6,996,646~~
~~VII (maximum)~~	~~3,506,960~~	~~1,529,093~~	~~4,045,000~~	~~9,316,579~~	~~9,296,646~~
~~VIII (minimum)~~	~~3,622,460~~	~~1,617,918~~	~~205,000~~	~~5,778,363~~	~~5,750,182~~
~~VIII (maximum)~~	~~3,676,460~~	~~1,646,538~~	~~265,000~~	~~6,018,442~~	~~5,982,014~~

Note: The minimum and maximum costs reflect the potential sensitivity of the Alternatives.

APPENDIX A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
ONE CONGRESS STREET
BOSTON, MASSACHUSETTS 02203-2211

By Facsimile and Certified Mail

March 1, 1994

Geoff Seibel
Project Coordinator,
Bennington Landfill Superfund Site
de maximis, Inc.
186 Center Street
Clinton, NJ 08809

Re: Correction to February 18, 1994 Engineering Evaluation/Cost Analysis Letter, Bennington Landfill Superfund Site, Bennington, VT.

Dear Mr. Seibel:

Enclosed is a revision to Table 1 of the statement of work (Attachment A of the consent order) to replace Table 1 enclosed with the February 18, 1994 Engineering Evaluation/Cost Analysis (EE/CA) letter. The February 18, 1994 Table 1 due date for the Final EE/CA deliverable was incorrect. The correct due date is 5 weeks following EPA Approval of the Draft EE/CA. Please replace the incorrect Table 1 with the revised table.

Please do not hesitate to contact me at (617) 573-5768 should you have any questions regarding this matter.

Sincerely,

Indira G. Balkissoon, RPM
ME and VT Superfund Section

Enclosure

cc: Mary Jane O'Donnell/EPA Section Chief
Andrew Raubvogel/ EPA Assistant Regional Counsel
Stan Corneille/VTDEC
Bruce Mackie/McLaren/Hart

TABLE 1

STEP		DELIVERABLE	DUE DATE
1. Scoping the RI/FS	+	Work Plan for the Limited Field Investigation	6 weeks after the effective date of the Consent Order
	+	RI/FS Work Plan	12 weeks after EPA approval of the LFI Work Plan
2. Phase IA RI	+	Initial Site Characterization Report, Long Term Monitoring Work Plan, Phase 1B Work Plan (if necessary)	36 weeks after EPA approval the RI/FS Work Plan May 1, 1994 March 7, 1994
3. Phase 1B Field Work (Phase 1B RI) (Phase 1 FS)	+	Draft RI, Development and Screening of Alternatives Technical Memo, Post-Screening Field Investigation Work Plan (if necessary)	18 weeks EPA notice to proceed with Step 3
4. Draft EE/CA		First draft EE/CA	April 15, 1994
5. Final EE/CA		Final EE/CA	5 weeks following EPA Approval of Draft EE/CA

TABLE 1 (Continued)

STEP		DELIVERABLE	DUE DATE
6. Post-screening Field Investigation and FS Development (Phase 2 RI) (Phase 2 FS)	+	First draft RI/FS	to be determined by EPA
7. Additional RI/FS Drafts, Reviews, and Revisions		Second draft RI/FS and subsequent draft of the RI/FS until a final RI/FS is accepted by EPA for public review and comment, a responsiveness summary is completed and a Record of Decision is signed	to be determined by EPA

+ Major Deliverable

de maximis inc.

MAR 09 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
ONE CONGRESS STREET
BOSTON, MASSACHUSETTS 02203-2211

VIA TELECOPIER AND FIRST CLASS MAIL

March 7, 1994

Mr. Geoff Seibel
Project Coordinator
Bennington Landfill Superfund Site
de maximis, Inc.
186 Center Street
Clinton, NJ 08809

Re: Response Action Objectives for the Removal Action at the Bennington Landfill Superfund Site ("Site")

Dear Mr. Seibel:

The purpose of this letter is to summarize the Response Action Objectives for the Non-Time-Critical Removal Action (NTCRA) at the Bennington Landfill Superfund Site (the Site) as discussed during our telephone conversation on February 14, 1994.

The Presumptive Remedy Guidance states that the presumptive remedy for CERCLA municipal landfill sites relates primarily to "containment of landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected groundwater at the perimeter of the landfill, and/or upgradient groundwater that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy."

In general, the response objectives for the Site are to minimize future potential impacts from the landfill to the shallow groundwater aquifer and the drainage pond area. To address these potential future impacts, the following NTCRA Response Action Objectives should be incorporated into the Engineering Evaluation/Cost Analysis (EE/CA) for this Site.

Landfill (Source Area) Response Action Objectives:

- Prevent, to the extent practicable, direct contact with and ingestion of soil/debris within the landfill and beneath the landfill;
- Prevent, to the extent practicable, the potential for water to infiltrate through the landfill debris mass;
- Control, to the extent practicable, surface water run

off to minimize erosion.

- Control landfill gas so that methane gas does not present a fire or explosion hazard. Prevent, to the extent practicable, the inhalation of landfill gas containing hazardous substances, pollutants or contaminants to the extent necessary to meet state and federal standards;

- Prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater;

- Prevent, to the extent practicable, the migration of contaminated ground water and leachate beyond the boundary of compliance.

Drainage Pond and Culvert Area Response Action Objectives:

- Prevent, to the extent practicable, the migration of contaminants from the soils and sediments in the drainage pond and culvert area to the groundwater;

- Prevent, to the extent practicable, direct contact with and ingestion of soil and sediments in the drainage pond and culvert area;

- Prevent, to the extent practicable, ecological impacts from contaminants in the drainage pond and culvert area.

For purposes of these objectives, the "Boundary of Compliance" shall be the edge of the waste management unit, i.e., the landfill area. In the future, the boundaries of the waste management unit may be expanded to included any upgradient shallow groundwater control system and downgradient leachate collection system and/or vertical barrier that is part of the selected remedy for this Site.

As we discussed, during the week of March 7th you will send me an outline of the EE/CA. The outline should indicate the specific response alternatives that you propose to evaluate in the EE/CA.

Please do not hesitate to contact me at (617) 573-5768 should you have any questions regarding this matter.

Sincerely,

Indira G. Balkissoon, RPM
ME and VT Superfund Section

cc: Mary Jane O'Donnell/EPA Section Chief
Andrew Raubvogel/EPA Assistant Regional Counsel
Stan Corneille/VTDEC
Bruce Mackie/McLaren/Hart

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F.K. FEDERAL BUILDING, Boston, MA 02203

de maximis, inc.
11 1994

MEMORANDUM

DATE: May 9, 1994

SUBJ: Bennington Landfill Superfund Site - Approval Memorandum to Perform an Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action

FROM: Indira Balkissoon, Remedial Project Manager
Andrew Raubvogel, Assistant Regional Counsel

TO: John P. DeVillars
Regional Administrator

THRU: Frank Ciavattieri, Acting Director
Waste Management Division

Edward Conley, Director
Environmental Services Division

Pam Hill
Deputy Regional Counsel

This memorandum recommends that you authorize the preparation of an engineering evaluation/cost analysis (EE/CA) for a non-time critical removal action at the Bennington Landfill Superfund Site. The EE/CA will evaluate cleanup alternatives for source control measures (operable unit #1) at this Site. The decision to proceed with an EE/CA was concurred on by the Superfund Accelerated Clean-up Model (SACM) Regional Decision Team (RDT) at a meeting on January 27, 1994, and is consistent with EPA guidance documents regarding SACM actions.

This memorandum is not a final Agency decision regarding the selection of response actions at Bennington. The Superfund decision making process for this Site will proceed as follows:

Operable Unit # 1 (Source Control):

-- RDT concurs that Site conditions warrant a non-time critical removal action (NTCRA).
-- Initiate an EE/CA to evaluate NTCRA options.
-- Finalize EE/CA Report and conduct 30 day comment period.
-- Select the NTCRA in an Action Memorandum.

Operable Unit # 2 (Management of Migration):

-- Finalize RI/FS and conduct comment period on Proposed Plan.
-- Select a final remedial action in a Record of Decision.

I. Site Description and History

The Bennington Landfill Superfund Site (the Site) is located three miles north of the Bennington, Vermont town center (see Attachment 1). It is bounded to the north by an inactive sand and gravel pit; to the east by a wetland and Hewitt Brook; to the south by Houghton Lane, and to the west by a rural residential area and apple orchards. The landfill occupies 15 acres of a 28 acre parcel owned and operated by the Town of Bennington (see Attachment 2). A brief chronology of significant events related to the Site is detailed below:

Pre-1969	The Site was used as a sand and gravel pit.
1969-1987	The Site began operations as a municipal landfill, receiving residential, commercial and industrial wastes.
1969-1975	Liquid industrial wastes from Bennington area industries were disposed of in an excavated area ("lagoon").
1975	Disposal of liquids into the lagoon area ceased. The area was filled in with 30 feet of municipal refuse.
1976	A buried drainage system (underdrain) was installed to divert surface water and shallow groundwater away from the landfill. The lagoon was buried below 30 feet of landfill waste.
1989	EPA listed the Site on the National Priorities List.
1990	The landfill was closed under the State of Vermont's Solid Waste Program.
1991	The PRP Group began conducting the RI/FS under EPA oversight.
1994	EPA approved the Initial Site Characterization Report of the Remedial Investigation.

II. Nature and Extent of Contamination

The source area for the contamination migrating from the Site is contained within the 15 acre landfill. Although Site historical information indicates that the "lagoon" is a potential hot spot, sampling of the underdrain and leachate break-outs at four locations along the landfill perimeter indicates that the total landfill is acting as one source. In addition, the drainage pond area east of the landfill which receives surface water and shallow groundwater diverted away from the landfill by the underdrain may be a potential hot spot.

During the 1st Phase of the Remedial Investigation, the Phase 1A Investigations, groundwater, surface water, soil, sediment and air media were each investigated for the presence of site contaminants. The following data summarizes the media and contaminants which may pose a potential threat to human or ecological health as derived from those investigations. All listed compounds are "hazardous substances" as defined by CERCLA § 101(14) and 40 C.F.R. § 300.5:

Groundwater - overburden groundwater:

Contaminant	Max. Conc.	Federal MCL
vinyl chloride	77	2
trichloroethene	53	5
tetrachloroethene	66	5
methylene chloride	180	5
1,1 DCE	9	7
1,1 DCA	1800	-
benzene	25	5
arsenic	17	50
PCBs	6	0.5

All data is expressed in parts per billion (ppb).

Sediments

Drainage Pond Area:

- PCBs detected in sediments of the drainage pond area at a maximum concentration of 100,000 ppb.

Underdrain Portion of the Drainage Pond Area:

- PCBs detected in sediments at the discharge point of the underdrain at a maximum concentration of 14,000,000 ppb.

Culvert Southeast of the Landfill:

- PCBs detected in sediments at the culvert southeast of the landfill at a maximum concentration of 1,940 ppb.

III. Basis for EE/CA and Non-Time Critical Removal Action

Section 300.415(b)(2) of the National Contingency Plan (NCP) lists a number of factors for EPA to consider in determining whether a removal action is appropriate, including:

- (i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;
- (ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

.
.
.

- (iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;
- (v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

The site conditions discussed above (and as described in greater detail in the Initial Site Characterization Report) demonstrate that there is a continuing release and migration of hazardous substances from the source area at the landfill to groundwater and to the sediments in the drainage pond area. The release of hazardous substances to the groundwater has resulted in exceedances of federal and state drinking water standards, and thereby poses a potential threat to future residential users of the overburden groundwater.

EPA initiated a baseline risk assessment for this Site (through its contractor, TRC), using groundwater and sediment data derived from Phase IA of the Remedial Investigation. The draft findings indicate that the estimated cancer risk posed by contamination at the Site is 3x10-3, based upon a reasonable maximum exposure to ingestion of shallow groundwater by a future residential user. The risk is primarily due to the presence of vinyl chloride, PCBs, arsenic and beryllium. The risk data further indicates that the release of hazardous substances to sediments in the underdrain area adjacent to the landfill (which is dry part of the year) presents a threat to youth trespassers. The estimated cancer risk is 2x10-3, based on a reasonable maximum exposure (dermal contact and ingestion) with sediments by a current trespasser. The risk is due to the presence of PCBs.

Attachments 3 and 4 provide a summary of the estimated risks for this Site, as detailed in the draft risk assessment report prepared by TRC. An EPA risk assessor has reviewed and confirmed the results contained in the draft risk assessment report.

Consideration was also given to EPA's "Presumptive Remedy for CERCLA Municipal Landfill Sites" (OSWER Dir. 9355.0-49FS, September 1993) (Attachment 5). This guidance supports the use of a streamlined risk evaluation which primarily focuses on the groundwater pathway and does not attempt to quantify all pathways (including direct contact with soil or releases of hazardous substances into the air). The presumptive remedy guidance states that once an unacceptable risk is identified through the groundwater pathway, other risks associated with soil and landfill gas can be identified using the conceptual site model which has been developed for municipal landfills.

Consequently, based upon the NCP factors listed above, a potential threat exists to public health or welfare or the environment. A removal action is therefore appropriate to abate, prevent, minimize, stabilize, mitigate, or eliminate such threat(s). In particular, a removal action is necessary to control and contain the release of hazardous substances from the landfill at the Site through source control measures.

This removal action is designated as non-time critical because more than six months planning time is available before on-site activities must be initiated. Prior to the actual performance of a non-time critical removal action at this Site, section 300.415(b)(4) of the NCP requires that an engineering evaluation/cost analysis (EE/CA) be performed in order to weigh different response options.

IV. Scope of EE/CA

The purpose of the EE/CA will be to evaluate alternatives for source control response measures at the Site. The EE/CA will consider alternatives which will meet the following removal action objectives:

Landfill Area:

- Prevent, to the extent practicable, direct contact with and ingestion of soil/debris within the landfill and beneath the landfill;
- Prevent, to the extent practicable, the potential for water to infiltrate through the landfill debris mass;
- Control, to the extent practicable, surface water run off to minimize erosion.
- Control landfill gas so that methane gas does not present a fire or explosion hazard. Prevent, to the extent practicable, the inhalation of landfill gas containing hazardous substances, pollutants or contaminants to the extent necessary to meet state and federal standards;
- Prevent, to the extent practicable, the saturation of the landfill debris mass from upgradient groundwater;
- Prevent, to the extent practicable, the migration of contaminated ground water and leachate beyond the boundary of compliance.

Drainage Pond and Culvert Area:

- Prevent, to the extent practicable, the migration of contaminants from the soils and sediments in the drainage pond and culvert area to the groundwater;
- Prevent, to the extent practicable, direct contact with and ingestion of soil and sediments in the drainage pond and culvert area;
- Prevent, to the extent practicable, ecological impacts from contaminants in the drainage pond and culvert areas.

Pursuant to EPA guidance on EE/CAs, alternatives will be evaluated based upon effectiveness, implementability, cost, and compliance with ARARs. Further, alternatives which exceed $2 million will be evaluated to determine their consistency with future remedial actions to be taken at the Site.

In developing the range of alternatives to be evaluated in the EE/CA, EPA will consider section 300.415(d) of the NCP as well as relevant guidances (including the Presumptive Remedy Guidance). Section 300.415(d) of the NCP identifies various removal actions which may be appropriate in given situations, including:

(2) Drainage controls, for example, run-off or run-on diversion - where needed to reduce migration of hazardous substances . . . ;

(4) Capping of contaminated soils or sludges - where needed to reduce migration of hazardous substances or pollutants or contaminants into soil, ground or surface water, or air;

.
.
.

(6) Excavation consolidation, or removal of highly contaminated soils from drainage or other areas - where such actions will reduce the spread of the release; and

.
.
.

(8) Containment, treatment, disposal, or incineration of hazardous materials - where needed to reduce the likelihood of human, animal, or food chain exposure.

These alternatives and others may be evaluated in the EE/CA.

V. Other Considerations

EPA will continue to examine the need for other response actions (e.g., remediation of the groundwater) through the ongoing RI/FS process. EPA will embody its decision regarding other response actions in a ROD.

The current schedule is to have a ROD for both SC and MOM signed by the Spring 1995, with RD/RA negotiations completed by December 1995 and RA beginning in 1997. If a non-time critical removal action were initiated, an Action Memorandum could be issued in August 1994, consent order negotiations conducted in September 1994, and the removal action completed by the Spring 1995. A SACM early action would thus save at least two years in the implementation of the source control remedy.

The PRP Group that is currently performing the RI/FS has agreed to perform the EE/CA under the terms of the existing Administrative Consent Order. The existing order provides for the reimbursement of EPA's oversight costs.

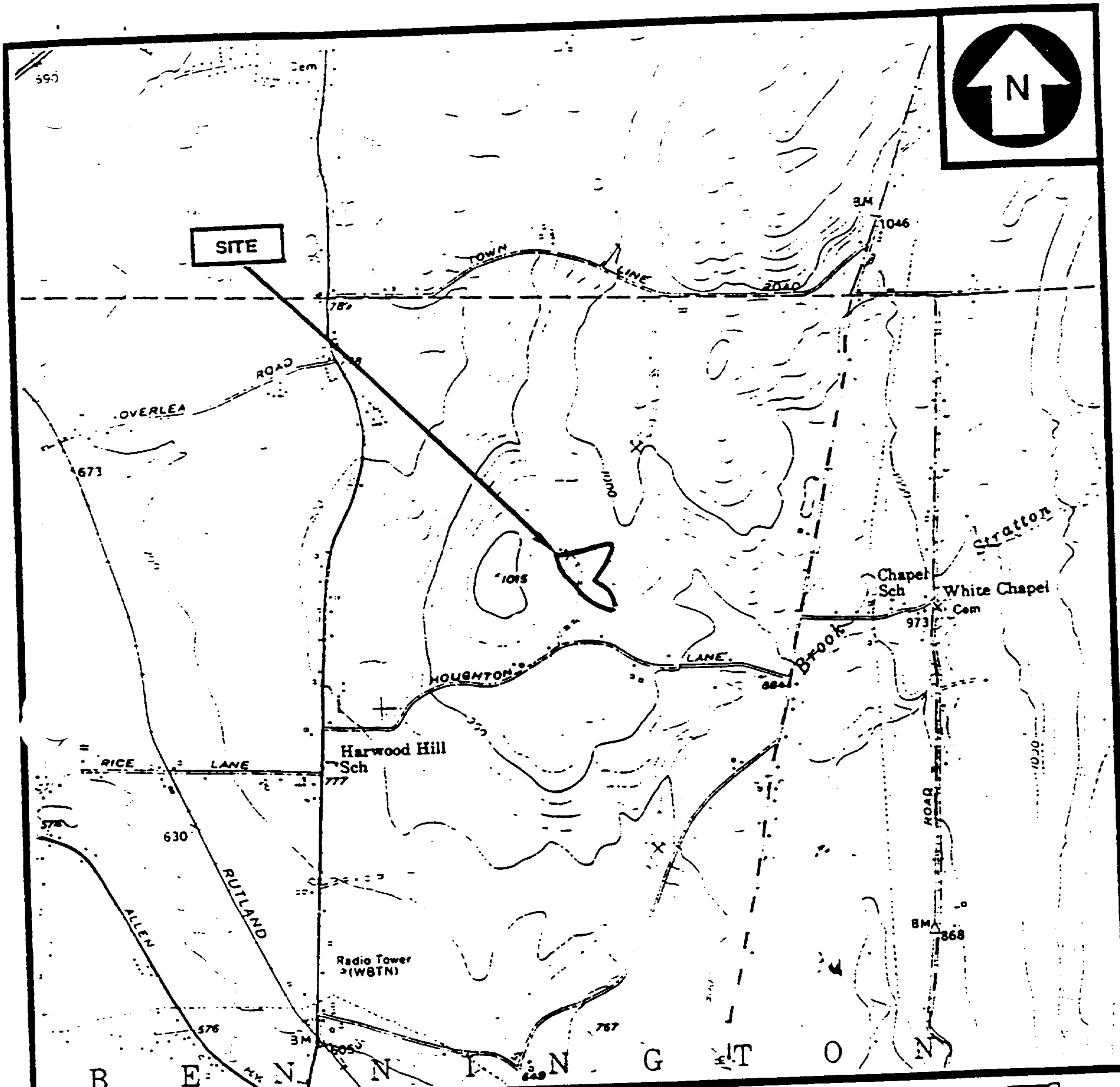
Finally, the State supports a SACM early action at the Site.

VI. Recommendation

In light of the facts discussed above, the case team recommends that you approve the initiation of an EE/CA for this Site.

5/8/94
Date

Patricia Meaney
for John DeVillars
Regional Administrator



BASE MAP IS A PORTION OF THE FOLLOWING USGS 7.5' SERIES QUADRANGLE:
BENNINGTON, VT, 1954

0 1000 2000 3000

SCALE = feet

VT

QUADRANGLE LOCATION

LOCATION MAP

BENNINGTON LANDFILL SITE
BENNINGTON, VERMONT

TRC

Figure 1-1.

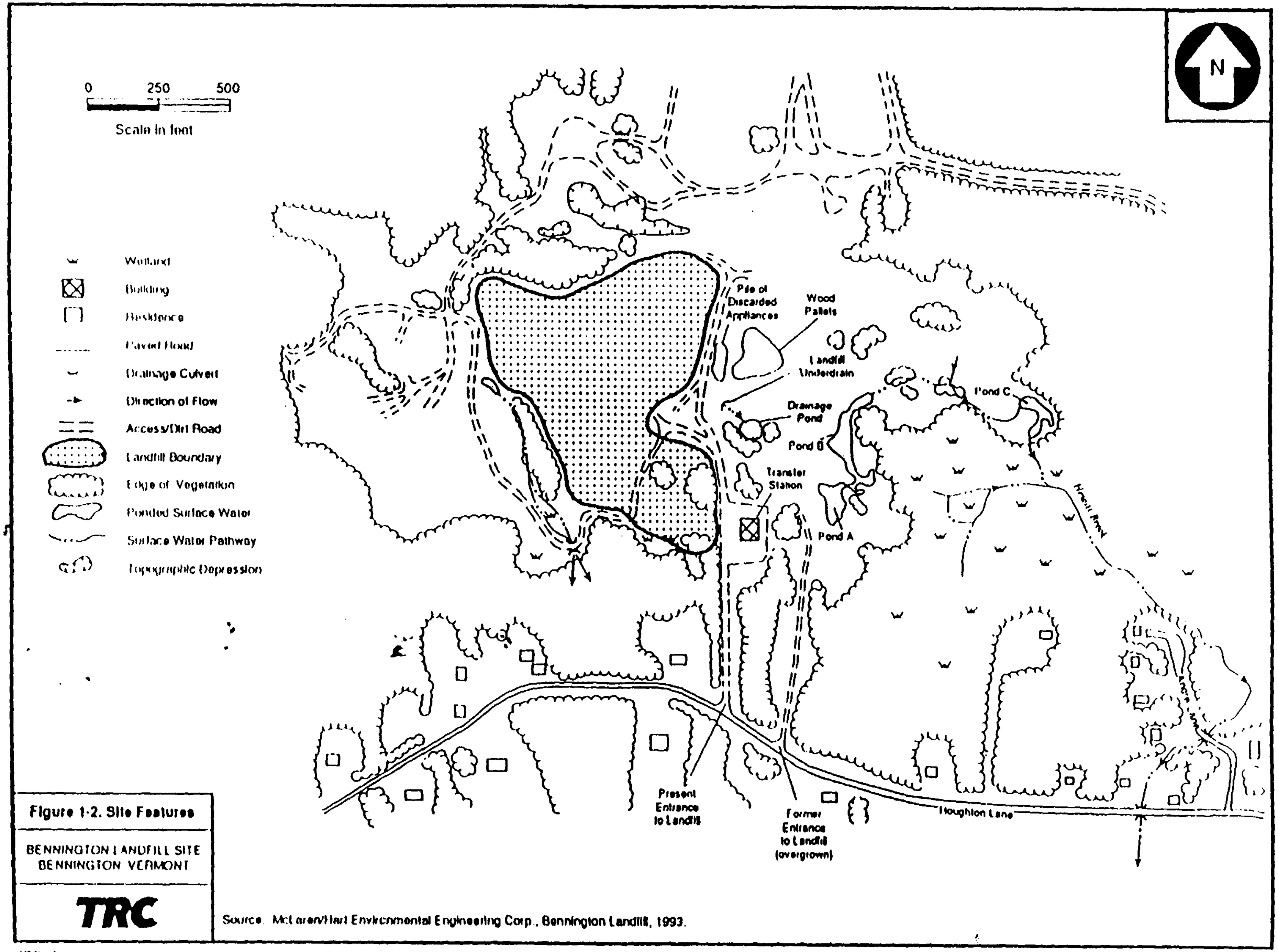


Figure 1-2. Site Features

BENNINGTON LANDFILL SITE
BENNINGTON VERMONT

TRC

TABLE 3-23. SUMMARY OF CARCINOGENIC RISK ESTIMATED FOR THE BENNINGTON SITE

Scenario	Receptor	Present/ Future		Total Risk Average	Maximum
GROUND WATER - OVERBURDEN					
Ingestion	Adjacent Resident	F		#	3E-3*
GROUND WATER - BEDROCK					
Ingestion	Adjacent Resident	F		#	1E-5
SURFACE SOILS AND EXPOSED SEDIMENTS					
Ingestion	Youth Trespasser	P		5E-7	4E-6
Dermal Contact	Youth Trespasser	P		8E-7	1E-5
			Total	1E-6	1E-5
Ingestion	Adjacent Resident	F		1E-5	1E-4
Dermal Contact	Adjacent Resident	F		1E-5	1E-4
			Total	2E-5	2E-4*
BROOK AND POND SUBMERGED SEDIMENTS					
Ingestion	Youth Trespasser	P		4E-7	1E-6
Dermal Contact	Youth Trespasser	P		NC,	NC,
			Total	4E-7	1E-6
Ingestion	Adjacent Resident	F		4E-6	1E-5
Dermal Contact	Adjacent Resident	F		NC,	NC,
			Total	4E-6	1E-5
UNDERDRAIN EXPOSED SEDIMENTS					
Ingestion	Youth Trespasser	P		1E-3*	1E-3*
Dermal Contact	Youth Trespasser	P		1E-3*	1E-3*
			Total	2E-3*	2E-3*
Ingestion	Adjacent Resident	F		1E-2*	1E-2*
Dermal Contact	Adjacent Resident	F		5E-3*	5E-3*
			Total	3E-2*	2E-2
DRAINAGE POND EXPOSED SEDIMENTS					
Ingestion	Youth Trespasser	P		7E-6	8E-6
Dermal Contact	Youth Trespasser	P		7E-6	9E-6
			Total	1E-5	2E-5

TABLE 3-23. (CONTINUED)

Scenario	Receptor	Present/ Future		Total Risk Average	Maximum
Ingestion	Adjacent Resident	F		7E-5	8E-5
Dermal Contact	Adjacent Resident	F		3E-5	4E-5
			Total	1E-4	1E-4
POND AND BROOK SURFACE WATER					
Ingestion	Youth Trespasser	P		NCs	NCs
Dermal Contact	Youth Trespasser	P		1E-7	4E-7
			Total	1E-7	4E-7
Ingestion	Adjacent Resident	F		NCs	NCs
Dermal Contact	Adjacent Resident	F		5E-7	2E-6
			Total	5E-7	2E-6
AMBIENT AIR					
Inhalation	Transfer Station Employee	P		3E-7	8E-7
tion	Adjacent Resident	F		2E-6	6E-6

*Exceeds 10⁻⁴ risk

NC, - Not calculated. EPA guidance calls for assessment of dermal exposure of cadmium, PCBs, and dioxins only.

NC, - Not calculated because brook and ponds are too shallow for swimming, thus precluding incidental ingestion

- Averages not calculated due to limited number of data points.

TABLE 3-24. SUMMARY OF NONCARCINOGENIC HAZARD INDICES (HIs) ESTIMATED FOR THE BENNINGTON SITE

Scenario	Receptor	Present/ Future		Chronic HI Average	Maximum
GROUND WATER - OVERBURDEN					
Ingestion	Adjacent Resident	F			6E+1*
GROUND WATER - BEDROCK					
Ingestion	Adjacent Resident	F			5E+0*
SURFACE SOILS AND EXPOSED SEDIMENTS					
Ingestion	Youth Trespasser	P		1E-02	7E-02
Dermal Contact	Youth Trespasser	P		1E-2	1E-1
			Total	5E-2	3E-1
Ingestion	Adjacent Child Resident	F		2E-1	2E+0*
Dermal Contact	Adjacent Child Resident	F		7E-2	9E-1
			Total	1E-0	5E+0*
ngestion	Adjacent Adult Resident	F		3E-02	2E-1
Dermal Contact	Adjacent Adult Resident	F		4E-2	5E-1
			Total	1E-1	1E-0
POND AND BROOK SUBMERGED SEDIMENTS					
Ingestion	Youth Trespasser	P		9E-3	3E-2
Dermal Contact	Youth Trespasser	P		NC	NC
			Total	5E-2	2E-1
Ingestion	Adjacent Child Resident	F		1E-1	4E-1
Dermal Contact	Adjacent Child Resident	F		NC	NC
			Total	1E-1	4E-1
Ingestion	Adjacent Adult Resident	F		6E-3	2E-2
Dermal Contact	Adjacent Adult Resident	F		NC	NC
			Total	6E-3	2E-2
LANDFILL UNDERDRAIN SEDIMENTS					
Ingestion	Youth Trespasser	P		1E+1*	1E+1*
Dermal Contact	Youth Trespasser	P		2E+1*	2E+1*
			Total	3E+1*	3E+1*

TABLE 3-24. (CONTINUED)

Scenario	Receptor	Present/ Future		Chronic HI Average	Maximum
Ingestion	Adjacent Child Resident	F		2E+2*	2E+2*
Dermal Contact	Adjacent Child Resident	F		5E+1*	5E+1*
			Total	3E+2*	3E+2*
Ingestion	Adjacent Adult Resident	F		1E+1*	1E+1*
Dermal Contact	Adjacent Adult Resident	F		1E+1*	1E+1*
			Total	2E+1*	2E+1*
DRAINAGE POND SEDIMENTS					
Ingestion	Youth Trespasser	P		9E-2	1E-1
Dermal Contact	Youth Trespasser	P		1E-1	1E-1
			Total	2E-1	2E-1
Ingestion	Adjacent Child Resident	F		1E+0	1E+0
Dermal Contact	Adjacent Child Resident	F		3E-1	4E-1
			Total	1E+0	1E+0
In[illegible]ion	Adjacent Adult Resident	F		7E-2	8E-2
[illegible] Contact	Adjacent Adult Resident	F		9E-2	1E-1
			Total	2E-1	2E-1
POND AND BROOK SURFACE WATER					
Ingestion	Youth Trespasser	P		NC,	NC,
Dermal Contact	Youth Trespasser	P		2E-2	8E-2
			Total	2E-2	8E-2
Ingestion	Adjacent Child Resident	F		NC,	NC,
Dermal Contact	Adjacent Child Resident	F		6E-2	3E-1
			Total	6E-2	3E-1
Ingestion	Adjacent Adult Resident	F		NC,	NC,
Dermal Contact	Adjacent Adult Resident	F		2E-2	7E-2
			Total	2E-2	7E-2

TABLE 3-24. (CONTINUED)

Scenario	Receptor	Present/ Future	Chronic HI Average	Maximum
AMBIENT AIR				
Inhalation	Transfer Station Employee	P	1E-4	1E-4
Inhalation	Adjacent Resident	F	8E-4	6E-4

*HI and/or HQ exceeds one (1)
NC, - Not calculated due to lack of available toxicity values
NC, - Not calculated because brook and ponds are to shallow for swimming, thus precluding incidental ingestion.

DRAFT

APPENDIX B

Hydrologic Evaluation of Landfill Performance (HELP) Calculations

****
****

EE/CA
BENNINGTON, VERMONT

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001560000004 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3418 VOL/VOL
WILTING POINT	=	0.2099 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3418 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000042000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

WILTING POINT = 0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC
SLOPE = 5.00 PERCENT
DRAINAGE LENGTH = 200.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 0.20 INCHES
POROSITY = 0.4000 VOL/VOL
FIELD CAPACITY = 0.3560 VOL/VOL
WILTING POINT = 0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000000000 CM/SEC
LINER LEAKAGE FRACTION = 0.00000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 74.26
TOTAL AREA OF COVER = 43560. SQ FT
EVAPORATIVE ZONE DEPTH = 20.00 INCHES
UPPER LIMIT VEG. STORAGE = 9.4320 INCHES
INITIAL VEG. STORAGE = 6.5291 INCHES
INITIAL SNOW WATER CONTENT = 1.5805 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS = 8.3114 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR ALBANY NEW YORK

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 137
END OF GROWING SEASON (JULIAN DATE) = 278

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.10	23.40	33.80	46.60	57.50	66.70
71.40	69.20	61.20	50.50	39.30	26.50

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.10	2.36	3.46	2.74	3.11	3.99
	4.15	4.25	4.22	3.99	2.79	3.38
STD. DEVIATIONS	2.22	0.98	1.48	0.82	1.15	1.00
	1.88	1.21	1.97	1.85	1.63	0.02
RUNOFF						
TOTALS	0.457	1.037	3.184	0.489	0.009	0.027
	0.002	0.001	0.014	0.379	0.485	0.661
STD. DEVIATIONS	0.628	0.669	1.803	0.480	0.012	0.061
	0.004	0.001	0.031	0.824	0.750	0.923
EVAPOTRANSPIRATION						
TOTALS	0.382	0.746	2.284	2.965	3.386	4.113
	5.512	5.041	3.015	1.933	1.197	0.665
STD. DEVIATIONS	0.051	0.225	0.303	0.481	1.276	0.945
	0.871	0.944	0.629	0.404	0.198	0.107
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.4224	0.4262	0.4756	0.3625	0.3113	0.2733
	0.2673	0.2545	0.2427	0.2784	0.3221	0.3710
STD. DEVIATIONS	0.0866	0.0433	0.0276	0.0287	0.0259	0.0043
	0.0094	0.0073	0.0026	0.0471	0.1036	0.1264
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	41.54	(5.308)	150790.	100.00
RUNOFF	6.743	(3.477)	24478.	16.23
POTRANSPIRATION	31.240	(2.180)	113403.	75.21
LATERAL DRAINAGE FROM LAYER 3	4.0073	(0.2415)	14547.	9.65
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	-0.451	(2.103)	-1637.	-1.09

****

****

PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.45	8893.5
RUNOFF	2.264	8218.2
LATERAL DRAINAGE FROM LAYER 3	0.0167	60.7
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	36.7	
SNOW WATER	5.45	19797.8

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4716
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1781

****

****

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.66	0.2775
2	6.22	0.3454
3	4.64	0.3866
4	0.08	0.4000

SNOW WATER 0.46

****
****

****
****

EE/CA
BENNINGTON, VERMONT

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001560000004 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3418 VOL/VOL
WILTING POINT	=	0.2099 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3418 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000042000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	200.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000000001 CM/SEC
LINER LEAKAGE FRACTION	=	0.00000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	74.26
TOTAL AREA OF COVER	=	43560. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.4320 INCHES
INITIAL VEG. STORAGE	=	6.4829 INCHES
INITIAL SNOW WATER CONTENT	=	1.5805 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	17.8314 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR ALBANY NEW YORK

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	137
END OF GROWING SEASON (JULIAN DATE)	=	278

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.10	23.40	33.80	46.60	57.50	66.70
71.40	69.20	61.20	50.50	39.30	26.50

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.10	2.36	3.46	2.74	3.11	3.99
	4.15	4.25	4.22	3.99	2.79	3.38
STD. DEVIATIONS	2.22	0.98	1.48	0.82	1.15	1.00
	1.88	1.21	1.97	1.85	1.63	0.02
RUNOFF						
TOTALS	0.000	0.006	0.108	0.006	0.000	0.008
	0.001	0.000	0.014	0.115	0.000	0.000
STD. DEVIATIONS	0.000	0.012	0.219	0.014	0.000	0.018
	0.002	0.000	0.031	0.237	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.382	0.746	2.287	2.968	3.399	4.108
	4.052	4.624	3.068	1.932	1.213	0.668
STD. DEVIATIONS	0.051	0.226	0.303	0.480	1.284	0.946
	1.538	0.867	0.581	0.434	0.200	0.108
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.2600	1.2218	2.0129	2.0397	1.5327	0.9957
	0.7026	0.3173	0.1155	0.3344	0.7711	1.0468
STD. DEVIATIONS	0.4706	0.4172	0.3281	0.4745	0.3542	0.1820
	0.1869	0.1389	0.0411	0.3083	0.5764	0.7433
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	41.54	(5.308)	150790.	100.00
RUNOFF	0.258	(0.301)	935.	0.62
APOTRANSPIRATION	29.448	(2.424)	106895.	70.89
LATERAL DRAINAGE FROM LAYER 3	12.3504	(2.1181)	44832.	29.73
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	-0.515	(2.485)	-1871.	-1.24

****

****

PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.45	8893.5
RUNOFF	0.469	1702.4
LATERAL DRAINAGE FROM LAYER 3	0.0888	322.2
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	30.8	
SNOW WATER	5.45	19765.9

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4522
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1779

****

****

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.66	0.2775
2	6.10	0.3388
3	0.76	0.0633
4	9.60	0.4000

SNOW WATER 0.46

****
****

****
****

EE/CA
BENNINGTON, VERMONT

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001560000004 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3418 VOL/VOL
WILTING POINT	=	0.2099 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3418 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000042000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

```
WILTING POINT                          =       0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT             =       0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =       0.001000000047 CM/SEC
SLOPE                                  =      25.00 PERCENT
DRAINAGE LENGTH                        =     200.0 FEET
```

LAYER 4

```
         BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER
THICKNESS                              =       0.20 INCHES
POROSITY                               =       0.4000 VOL/VOL
FIELD CAPACITY                         =       0.3560 VOL/VOL
WILTING POINT                          =       0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT             =       0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =       0.000000000000 CM/SEC
LINER LEAKAGE FRACTION                 =       0.00000000
```

GENERAL SIMULATION DATA

```
SCS RUNOFF CURVE NUMBER                =        74.26
TOTAL AREA OF COVER                    =    43560. SQ FT
EVAPORATIVE ZONE DEPTH                 =        20.00 INCHES
UPPER LIMIT VEG. STORAGE               =         9.4320 INCHES
INITIAL VEG. STORAGE                   =         6.4829 INCHES
INITIAL SNOW WATER CONTENT             =         1.5805 INCHES
INITIAL TOTAL WATER STORAGE IN
  SOIL AND WASTE LAYERS                =         8.3114 INCHES

          SOIL WATER CONTENT INITIALIZED BY PROGRAM.
```

CLIMATOLOGICAL DATA

```
DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR      ALBANY              NEW YORK

MAXIMUM LEAF AREA INDEX                     = 2.00
START OF GROWING SEASON (JULIAN DATE)       =  137
END OF GROWING SEASON (JULIAN DATE)         =  278
```

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.10	23.40	33.80	46.60	57.50	66.70
71.40	69.20	61.20	50.50	39.30	26.50

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.10	2.36	3.46	2.74	3.11	3.99
	4.15	4.25	4.22	3.99	2.79	3.38
STD. DEVIATIONS	2.22	0.98	1.48	0.82	1.15	1.00
	1.88	1.21	1.97	1.85	1.63	0.02
RUNOFF						
TOTALS	0.000	0.006	0.108	0.008	0.000	0.008
	0.001	0.000	0.014	0.115	0.000	0.000
STD. DEVIATIONS	0.000	0.012	0.219	0.019	0.000	0.018
	0.002	0.000	0.031	0.237	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.382	0.746	2.287	2.968	3.399	4.108
	4.069	4.624	3.068	1.931	1.213	0.668
STD. DEVIATIONS	0.051	0.226	0.303	0.480	1.284	0.946
	1.566	0.868	0.581	0.434	0.200	0.108
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.2778	1.2396	2.0739	2.0812	1.5085	0.9119
	0.5838	0.3538	0.2103	0.3588	0.7472	1.0473
STD. DEVIATIONS	0.4854	0.4337	0.3124	0.4977	0.3616	0.2035
	0.1218	0.0700	0.0392	0.2770	0.5825	0.7706
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	41.54	(5.308)	150790.	100.00
RUNOFF	0.260	(0.304)	942.	0.62
/APOTRANSPIRATION	29.464	(2.440)	106953.	70.93
LATERAL DRAINAGE FROM LAYER 3	12.3942	(2.1230)	44991.	29.84
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	-0.578	(2.470)	-2097.	-1.39

****

****

PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.45	8893.5
RUNOFF	0.469	1702.9
LATERAL DRAINAGE FROM LAYER 3	0.1045	379.2
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	31.8	
SNOW WATER	5.45	19766.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4522

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1779

****

****

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.66	0.2775
2	6.10	0.3388
3	0.82	0.0686
4	0.08	0.4000

SNOW WATER 0.46

****

****

****
****

EE/CA
BENNINGTON, VERMONT

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001560000004 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3418 VOL/VOL
WILTING POINT	=	0.2099 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3418 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000042000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC
SLOPE	=	25.00 PERCENT
DRAINAGE LENGTH	=	400.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	0.20 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000000000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	74.26
TOTAL AREA OF COVER	=	43560. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.4320 INCHES
INITIAL VEG. STORAGE	=	6.4829 INCHES
INITIAL SNOW WATER CONTENT	=	1.5805 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	8.3114 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR ALBANY NEW YORK

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	137
END OF GROWING SEASON (JULIAN DATE)	=	278

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.10	23.40	33.80	46.60	57.50	66.70
71.40	69.20	61.20	50.50	39.30	26.50

PRECIPITATION	41.54	(5.308)	150790.	100.00
RUNOFF	0.255	(0.298)	927.	0.61
VAPOTRANSPIRATION	29.417	(2.396)	106783.	70.82
LATERAL DRAINAGE FROM LAYER 3	12.2159	(3.1457)	44344.	29.41
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	-0.348	(0.739)	-1263.	-0.84

****

****

PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.45	8893.5
RUNOFF	0.468	1700.1
LATERAL DRAINAGE FROM LAYER 3	0.2531	918.7
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	7.6	
SNOW WATER	5.45	19766.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4523

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1779

****

****

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.66	0.2775
2	6.10	0.3388
3	0.75	0.0627
4	0.08	0.4000

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.10	2.36	3.46	2.74	3.11	3.99
	4.15	4.25	4.22	3.99	2.79	3.38
STD. DEVIATIONS	2.22	0.98	1.48	0.82	1.15	1.00
	1.88	1.21	1.97	1.85	1.63	0.02
RUNOFF						
TOTALS	0.000	0.006	0.107	0.004	0.000	0.008
	0.001	0.000	0.014	0.115	0.000	0.000
STD. DEVIATIONS	0.000	0.012	0.218	0.010	0.000	0.018
	0.002	0.000	0.031	0.236	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.382	0.746	2.287	2.969	3.399	4.091
	4.035	4.623	3.069	1.933	1.213	0.668
STD. DEVIATIONS	0.051	0.226	0.304	0.480	1.285	0.929
	1.511	0.866	0.582	0.434	0.201	0.108
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.4135	1.3067	3.5619	1.8054	0.4479	0.1539
	0.0826	0.0413	0.0309	0.7742	1.1746	1.4231
STD. DEVIATIONS	0.3659	0.6555	1.2174	0.8340	0.0948	0.0268
	0.0268	0.0103	0.0143	0.8777	0.8585	1.1598
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT

SNOW WATER 0.46

****
****

Infinite Slope Stability Calculations

BENNINGTON LANDFILL
EE/CA
INFINITE SLOPE ANALYSIS

RCRA CAP

STRENGTH PROPERTIES

	Layer	USCS	THICK FT	dry pcf min	dry pcf max	mstr min	mstr max	dnst in,max avg	mstr in,max avg	MST DNST PCF	STR ENVLP deg	CHS psf	CMPCT %	STR ENVLP deg	CHS psf
1	Vegetative	SC	0.5	105	125	11	19	max	max	148.75	31	230	85%	26.35	195.5
2	Protective	CL	1.5	95	120	12	24	max	max	148.8	28	270	95%	26.6	256.5
3	Non-Woven/Prot		0								37		100%	37	0
4	Non-Wov/Gran		0								25		100%	25	0
5	Granular	SP	1	100	120	12	21	max	max	145.2	37	0	100%	37	0
6	Gran/Textured		0								26		100%	26	0
7	Text/Low Perm		0								24		100%	24	0
8	Low Perm	CH	2	75	105	19	36	max	max	142.8	19	230	95%	18.05	218.5

Soil Strength Parameter from "Design Manual - Soil Mechanics, Foundations and Earth Structures, NAVFAC DM 7.2, Mar. 1971
Geotextile Properties from "Designing with Geotextiles" Koerner, Trevira Tech Note, and Gundle Tech Note

BENNINGTON LANDFILL
EE/CA
INFINITE SLOPE ANALYSIS

RCRA CAP

BASED ON THE ABOVE STREGTH PARAMETERS, DETERMINE THE FACTORS OF SAFETY

FS = C/(COS(B)*SIN(B)) + TAN(P)/TAN(B) - (W * H * TAN(P))/(W * TAN(B))

B (slope) = 4 H 1 V
B (deg) = 14.04

		C psf	B deg	P deg	W lbs	H ft	FS	
1	Vegetative	195.5	14.036	26.35	74.375	0	8.59	
2	Protective	256.5	14.036	26.6	297.58	0	4.16	
3	Non-Woven/Prot	0	14.036	37	297.58	0	3.01	
4	Non-Wov/Gran	0	14.036	25	297.58	0	1.87	
5	Granular	0	14.036	37	442.78	1	2.59	
6	Gran/Textured	0	14.036	26	442.78	0	1.95	
7	Text/Low Perm	0	14.036	24	442.78	0	1.78	CRITICAL INTERFACE
8	Low Perm	218.5	14.036	18.05	728.38	0	2.32	

BENNINGTON LANDFILL
EE/CA
INFINITE SLOPE ANALYSIS

SINGLE BARRIER

STRENGTH PROPERTIES

	Layer	USCS	THICK FT	dry pcf min	dry pcf max	mstr min	mstr max	dnst in,max avg	mstr in,max avg	MST DNST PCF	STR ENVLP deg	CHS psf	CMPCT %	STR ENVLP deg	CHS psf
1	Vegetative	SC	0.5	105	125	11	19	max	max	148.75	31	230	85%	26.35	195.5
2	Protective	CL	1.5	95	120	12	24	max	avg	141.6	28	270	95%	26.6	256.5
3	Non-Woven/Prot		0								37		100%	37	0
4	Non-Wov/Gran		0								25		100%	25	0
5	Granular	SP	1	100	120	12	21	max	max	145.2	37	0	100%	37	0
6	Gran/Textured		0								26		100%	26	0
7	Text/Bedding		0								24		100%	24	0
8	Bedding	SP	2	100	120	12	21	max	max	145.2	37	0	95%	35.15	0

Soil Strength Parameter from "Design Manual - Soil Mechanics, Foundations and Earth Structures, NAVFAC DM 7.2, Mar. 1971
Geotextile Properties from "Designing with Geotextiles" Koerner, Trevira Tech Note, and Gundle Tech Note

BENNINGTON LANDFILL
EE/CA
INFINITE SLOPE ANALYSIS

SINGLE BARRIER

BASED ON THE ABOVE STREGTH PARAMETERS, DETERMINE THE FACTORS OF SAFETY

FS = C/(COS(B)*SIN(B)) + TAN(P)/TAN(B) - (W * H * TAN(P))/(W * TAN(B))

B (slope) = **4** **H** **1** **V**
B (deg) = **14.04**

		C psf	B deg	P deg	W lbs	H ft	FS	
1	Vegetative	195.5	14.036	26.35	74.375		8.59	
2	Protective	256.5	14.036	26.6	286.78		4.24	
3	Non-Woven/Prot	0	14.036	37	286.78		3.01	
4	Non-Wov/Gran	0	14.036	25	286.78	0	1.87	
5	Granular	0	14.036	37	431.98	1	2.58	
6	Gran/Textured	0	14.036	26	431.98		1.95	
7	Text/Low Perm	0	14.036	24	431.98	0	1.78	CRITICAL INTERFACE
8	Low Perm	0	14.036	35.15	722.38	0	2.82	

TABLE 1
Typical Properties of Compacted Soils

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression: At 1.4 tsf (20 psi) — Percent of Original Height	Typical Value of Compression: At 3.6 tsf (50 psi) — Percent of Original Height	Typical Strength Characteristics: Cohesion (as compacted) psf	Typical Strength Characteristics: Cohesion (saturated) psf	Typical Strength Characteristics: Ø (Effective Stress Envelope Degrees)	Typical Strength Characteristics: Tan Ø	Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k lbs/cu in.
GW	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	14 - 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-6}$	20 - 60	100 - 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.6	.....	.....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 - 40	100 - 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 - 30	100 - 300
SC	Clayey sands, poorly graded sand-clay-mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 - 20	100 - 300
ML	Inorganic silts and clayey silts.	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 - 200
ML-CL	Mixture of inorganic silt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
CL	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 - 200
OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 - 100
MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 - 100
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 - 150
OH	Organic clays and silty clays	65 - 100	45 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 - 100

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown. (..) indicates insufficient data available for an estimate.

Reference: Foundations and Earth Structures, Design Manual 7.2 (NAVFAC DM-7.2) May 1982.

(REF. # 2)

THEVIRA SPUNBOND

TECH NOTE

006-90 (CJS)

Hoechst Celanese Corporation P.O. Box 5887 Spartanburg, SC 29304

SOIL/GEOSYNTHETIC INTERFACE FRICTION by DIRECT SHEAR

Test Procedure: The coefficient of friction between a geosynthetic and soil (see Table 1) or between any combination of geosynthetics selected by the user is determined by placing the geosynthetic and one or more contact surfaces within a 12" x 12" direct shear box. A constant, normal compressive stress is applied to the specimen and a tangential (shear) force is applied to the apparatus so that one section of the box moves in relation to the other section. The shear force is recorded as a function of the deflection of the moving section of the shear box. The test is performed for a minimum of three different, normal stresses selected by the user (100, 200, and 250 psf were used here) to model appropriate field conditions. The peak (or residual) shear stresses recorded are plotted against the applied, normal compressive stresses used for testing. The test data generally forms a straight line whose slope is the coefficient of friction, μ, between the two materials where the shearing occurred. The y-intercept of the plot is the adhesion, a. The equivalent friction angle, δ, is calculated as: $\delta = \tan^{-1}(\mu)$.

Related Test: Interlock Friction by Pullout is a related test used primarily with geogrids. Generally, for geotextiles, the direct shear test provides more conservative (lower) results than the pullout test.

Results of Tests Performed by Georgia Institute of Technology

SLIDING SURFACE	μ	δ(deg.)	a(psf)
Ottowa Sand/TREVIRA® 1114	0.51	27	68
Ottowa Sand/Trevira 1155	0.68	34	21
Glatial Till/Trevira 1114	0.76	37	32
Glatial Till/Trevira 1155	0.75	37	10
Gulf Coast Clay/Trevira 1114	0.96	43	62
Gulf Coast Clay/Trevira 1155	1.26	52	45
HDPE Geonet*/Trevira 1114	0.46	25	29
HDPE Geonet*/Trevira 1114	0.32	18	39
HDPE Geomembrane/Trevira 1155	0.17	10	0
Embossed HDPE Geomembrane/Trevira 1155	0.72	36	18
TREVIRA® 1155/Trevira 1155**	0.33	18	13
Typar 3401/Typar 3401**	0.19	11	44
Mirafi 600X/Mirafi 600X**	0.29	16	60

*avg. of three different confining soils. **Glacial Till used as confining soil.

TABLE 1 -- PROPERTIES of CONFINING SOIL

CONFINING SOIL	USCS CLASSIFI-CATION	ATTERBERG LIMITS LL	PL	PI	COMPACTION CHAR. γ max. (pcf)	w opt. (%)	DR(%)	SHEAR TEST RESULTS μ	δ(deg)	a(psf)
Ottawa Sand	SP	-	-	NP	-	-	104	0.78	38	0
Glacial Till	CL-ML	15-31	13-20	0-13	138†	8†	-	0.73	36	31
Gulf Coast Clay	CL	42	28	14	113†	16††	-	0.38	20	57

† Modified Proctor ††Standard Proctor

Hoechst

11 of 12

ExF #5

TABLE 5.5 FRICTION VALUES AND EFFICIENCIES (IN PARENTHESES) FOR (a) SOIL-TO-GEOMEMBRANE, (b) GEOMEMBRANE-TO-GEOTEXTILE, AND (c) SOIL-TO-GEOTEXTILE COMBINATIONS*

(a) Soil-to-geomembrane friction angles

Geomembrane	Soil types: Concrete sand ($\phi = 30°$)	Ottawa sand ($\phi = 28°$)	Mica schist sand ($\phi = 26°$)
EPDM	24° (0.77)	20° (0.68)	24° (0.91)
PVC			
rough	27° (0.88)	—	25° (0.96)
smooth	25° (0.81)	—	21° (0.79)
CSPE	25° (0.81)	21° (0.72)	23° (0.87)
HDPE	18° (0.56)	18° (0.61)	17° (0.63)

(b) Geomembrane-to-geotextile friction angle

Geotextile	Geomembrane: EPDM	PVC: Rough	PVC: Smooth	CSPE	HDPE
nonwoven, needle-punched	23°	23°	21°	15°	8°
nonwoven, heat-bonded	18°	20°	18°	21°	11°
woven, monofilament	17°	11°	10°	9°	6°
woven, slit film	21°	28°	24°	13°	10°

(c) Soil-to-geotextile friction angle

Geotextile	Soil types: Concrete sand ($\phi = 30°$)	Ottawa sand ($\phi = 28°$)	Mica schist sand ($\phi = 26°$)
nonwoven, needle-punched	30° (1.00)	26° (0.92)	25° (0.96)
nonwoven, heat-bonded	26° (0.84)	—	—
woven, monofilament	26° (0.84)	—	—
woven, slit film	24° (0.77)	24° (0.84)	23° (0.87)

Source: After Martin, et al. [8]

*Efficiency values in parentheses are based on the relationship $E = (\tan \delta)/(\tan \phi)$.

on smooth geotextiles giving the lowest friction values. For reference purposes, Part c of Table 5.5 gives the soil-to-geotextile friction values that are necessary for slope design of lined slopes with geotextiles under or over the liner.

The frictional behavior of geomembranes placed on clay soils is of considerable importance in the composite liners of waste landfills. Current requirements are for the

Table 3 - Results of Geomembrane to Fine Grained Soil Shear Strengths

scription	Soil #1 ML-CL				Soil #2 CL-ML				Soil #3 CL				Soil #4 SP-CH				Soil #5 CH-SP			
	c	E_c	ϕ	E_ϕ	c	E_c	ϕ	E_ϕ	c	E_c	ϕ	E_c	c	E_c	ϕ	E_ϕ	c	E_c	ϕ	E_ϕ
OIL-TO SOIL	.09	100%	38	100%	.27	100%	34	100%	.2	100%	30	100%	.25	100%	24	100%	.28	100%	22	100%
MEMBRANE-TO-SOIL	c_a	E_c	δ	E_ϕ	c_a	E_c	δ	E_ϕ	c_a	E_c	δ	E_ϕ	c_a	E_c	δ	E_ϕ	c_a	E_c	δ	E_ϕ
PVC	.085	94%	39	100%	.037	14%	23	69%	.14	70%	16	53%	.07	28%	24	100%	.12	43%	17	77%
CPE	.08	89%	40	100%	.032	12%	24	71%	.13	65%	17	57%	.08	32%	23	96%	.10	36%	19	86%
EPDM	.05	55%	33	87%	.05	18%	23	67%	.08	40%	23	77%	.075	30%	20	83%	.09	32%	16	82%
HDPE	.08	88%	26	68%	.02	8%	23	67%	.14	70%	15	50%	.03	12%	21	88%	.14	50%	15	68%
EMBOSSED HDPE	.09	100%	35	92%	.11	41%	29	85%	.18	90%	27	90%	.15	60%	26	100%	.16	57%	25	100%

c and c_a in units of kg/sq cm

ϕ and δ in degrees

Textured Gundline® HDT Maximizes Slope Stability

Gundle Lining Systems has developed a method for adding a rough texture to the surface of our durable High Density Polyethylene (HDPE) liners. The result is a high performance product called Gundline HDT which increases slope stability in engineered landfills and other lining applications.

Gundline HDT's special textured surface dramatically improves slope stability by increasing friction between the synthetic liner and soils, geotextiles, and other geosynthetics. Cover soils are held on the liner with the greatly increased friction, and safety-conscious engineers can improve factors of safety on slopes of varying steepness. Table 1 lists the improvements in friction angle for Gundline HDT, determined by direct shear box testing.

The innovative friction surface of Gundline HDT is manufactured simultaneously with extrusion of the solid barrier portion of the liner as opposed to being added after extrusion. It's a rough surface, fully integrated with the sheet during the molten phase of manufacture. As a result, it has excellent abrasion resistance and remains intact regardless of chemicals contacting the sheet surface.

Textured Gundline® VLT

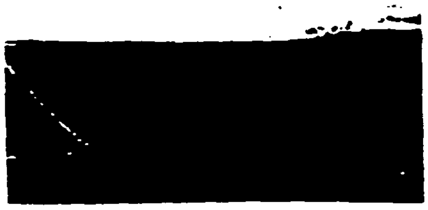
Gundline VLT combines the exceptional elongation and elastic properties of Gundline® VL (Very Low Density Polyethylene Liner) with a textured surface to offer the outstanding friction characteristics and slope stabilizing qualities of Gundline® HDT! The combination makes the liner ideal for landfill closures and other applications where elongation, flexibility, and slope stability are important. The excellent multi-axial elongation of Gundline VLT accommodates differential settlement while the textured surface provides long term slope stability.

TABLE 1: DIRECT SHEAR BOX FRICTION ANGLES

SLIDING SURFACE	*FRICTION ANGLE (DEGREES)* POLYETHYLENE	*TEXTURED*
Gundline/H.R. Clay	16	24
Gundline/Ottawa Sand	17	26
Gundline/Geotextile (Nonwoven)	11	29

*Note: Friction angles for the products listed are typical only and may vary with local soil conditions. Accordingly, engineers must test friction angles for the product using site specific soil composition for all designs incorporating the product.

Gundline HDT Provides Solutions To Difficult Applications.



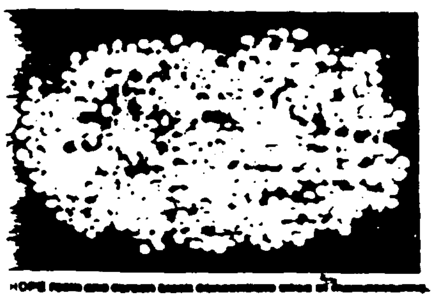
A recent problem at Islip, New York illustrates the effectiveness of Gundline HDT. It began when the city's municipal landfill neared capacity. The problem was then compounded by the lack of available land for expansion. But Gundle provided the solution. After considering all available options, it was decided to expand vertically—a process dubbed "piggybacking." A new cell would be created to sit atop the existing closed and capped landfill. However, it was critical to establish slope stability for the new, steep slopes of this 80-foot high addition. So Gundle manufactured and installed 1.2 million square feet of Gundline HDT and successfully increased the friction angle between the liner and the sand over sixty percent.

Today, not only does Islip have 1.8 million cubic yards of new refuse disposal capacity, but they also have peace of mind knowing it's lined with the industry's most stable and durable liner.

Gundline HDT Retains The Important Advantages Of Gundline® HD.

Manufactured in 22.5 foot wide seamless rolls and in thicknesses ranging from 40-100 mils of barrier wall. Gundline HDT features the same important qualities that have made Gundline HD the world's leading lining system. Tensile strength before yielding, biaxial elongation, tear resistance, puncture resistance, ultraviolet light resistance, chemical resistance, dimensional stability, heat resistance, and stress crack resistance are all excellent. So is resistance to microorganisms and rodent damage.

As with Gundline HD, Gundle manufactures Gundline HDT with only the top performing pipe grade HDPE resin. The superior high grade resin creates an ideal structure to the finished sheet.



HDPE [illegible]

APPENDIX C

ALTERNATIVE I COST ESTIMATE
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	NOLOGY/Component	Quantity Min.	Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
1.0	COMPOSITE BARRIER CAP						$2,250,621	$2,615,935
1.1	Appurtenance Decommissioning/Extension		1 LS	$10,000 LS		$10,000		
1.2	Clearing and Grubbing		17 ac	$3,500 ac		$59,500		
1.3	Structural Fill Placement		30,000 cy	$8.00 cy		$240,000		
1.4	Vegetative Layer		13,750 cy	$18.00 cy		$247,500		
1.5	Protective Layer		40,500 cy	$9.00 cy		$364,500		
1.6	Geotextile		78,700 sy	$1.25 sy		$98,375		
1.7	Drainage Layer		27,000 cy	$8.00 cy		$216,000		
1.8	First Barrier Layer		78,700 sy	$3.80 sy		$299,060		
1.9	Second Barrier Layer							
1.9.1	Second Barrier Layer		57,500 cy	$14.00 cy		$805,000		
1.9.2	Second Barrier Layer		11,130 cy	$14.00 cy	$155,820			
			61,710 sy	$4.60 sy	$283,866			
1.10	Bedding Layer		27,000 cy	$8.00 cy		$216,000		
1.11	Miscellaneous		1 LS	$60,000 LS		$60,000		
2.0	EROSION AND SEDIMENT CONTROL						$197,500	$197,500
2.1	Channels		6,000 lf	$15.00 lf		$90,000		
2.2	Basins		2 ea	$20,000 ea		$40,000		
2.3	Silt Barriers		4,500 lf	$3.00 lf		$13,500		
2.4	Wetlands Mitigation		1 ac	$15,000 ac		$15,000		
2.5	Seeding and Mulching		17 ac	$2,000 ac		$34,000		
2.6	Miscellaneous		1 LS	$5,000 LS		$5,000		
3.0	UPGRADIENT GROUNDWATER ISOLATION						$771,100	$771,100
3.1	West Slurry Wall		15,000 sf	$10 sf		$150,000		
3.2	North Slurry Wall		11,250 sf	$10 sf		$112,500		
3.3	Grouting		2,250 sf	$25 sf		$56,250		
3.4	West Biopolymer Trench and Toe Drain		15,000 sf	$15 sf		$225,000		
3.5	North Biopolymer Trench and Toe Drain		11,250 lf	$15 lf		$168,750		
3.6	West Drain Pipe		700 lf	$8 lf		$5,600		
3.7	North Drain Pipe		300 LS	$10 LS		$3,000		
3.8	Miscellaneous		1 LS	$50,000 LS		$50,000		
4.0	LEACHATE COLLECTION AND TREATMENT	Min.	Max.				$211,000	$211,000
4.1	Existing Collection System						$21,000	$21,000
4.1.1	Collection Sump	1.0 LS	1.0 LS	$20,000 sf	$20,000	$20,000		
4.1.2	Miscellaneous	1.0 LS	1.0 LS	$1,000 LS	$1,000	$1,000		
4.2	No Pre-treatment, Off-site Industrial Treatment Facility						$190,000	$190,000
4.2.1	Storage Tanks	1.0 LS	1.0 LS	$100,000 LS	$100,000	$100,000		
4.2.2	Loading Facility	1.0 LS	1.0 LS	$80,000 LS	$80,000	$80,000		
4.2.3	Miscellaneous	1.0 LS	1.0 LS	$10,000 LS	$10,000	$10,000		
5.0	ACTIVE GAS MANAGEMENT						$675,000	$675,000
5.1	Active Gas Management System		1 LS	$650,000 LS		$650,000		
5.2	Miscellaneous		1 LS	$25,000 LS		$25,000		
6.0	EXCAVATION AND CONSOLIDATION						$55,625	$55,625
6.1	Delineation		1 LS	$5,000 LS		$5,000		
6.2	Dewatering		1 LS	$25,000 LS		$25,000		
6.3	Excavation		1,500 cy	$4.50 cy		$6,750		
6.4	Hauling		1,500 cy	$3.25 cy		$4,875		
6.5	Placement and Compaction		1,500 cy	$1.00 cy		$1,500		
6.6	Verification		1 LS	$5,000 LS		$5,000		
6.7	Restoration		1 LS	$2,500 LS		$2,500		
6.8	Miscellaneous		1 LS	$5,000 LS		$5,000		
7.0	MANAGEMENT AND INSTITUTIONAL CONTROLS						$60,800	$60,800
7.1	Security Fence		4,000 lf	$10 lf		$40,000		
7.2	Warning Signs		20 ea	$40 ea		$800		
7.3	Access Road		1 LS	$10,000 LS		$10,000		
7.4	Miscellaneous		1 LS	$10,000 LS		$10,000		
SUBTOTAL DIRECT CAPITAL COSTS							$4,221,646	$4,586,960

ALTERNATIVE I COST ESTIMATE
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TECHNOLOGY/Component	Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost	
...gineering and Design (5% of Direct Cost)					$211,082	$229,348	
...Supervision and Administration (6% of Direct Cost)					$253,299	$275,218	
10.0 Construction Quality Assurance (5% of Direct Cost)					$211,082	$229,348	
11.0 Start-Up and Shake-Down (10% of Technology)					$21,100	$21,100	
12.0 Legal Fees, Licensing and Permits (2% of Direct Cost)					$84,433	$91,739	
13.0 Insurance/Bonding (2% of Direct Cost)					$84,433	$91,739	
14.0 Bid Contingency (15% of Direct Cost)					$633,247	$688,044	
15.0 Change Orders and Claims (8% of Direct Cost)					$337,732	$366,957	
SUBTOTAL INDIRECT CAPITAL COSTS					**$1,836,408**	**$1,993,493**	12
16.0 Cap Maintenance Including Mowing and Cap Repair					$15,000	$15,000	
17.0 Erosion and Sedimentation Control Maintenance and Repair					$20,000	$20,000	
18.0 Barrier Performance Analytical Costs					$50,000	$50,000	
19.0 Leachate Disposal Industrial Treatment Facility (one year only)					$1,600,000	$3,900,000	
20.0 Gas Management System Operation and Maintenance					$50,000	$50,000	
SUBTOTAL PRSC COSTS					**$1,735,000**	**$4,035,000**	12
Total present worth cost for a 30 year period using a 7% discount rate before taxes and after inflation equals					**$9,333,274**	**$12,155,673**	12

Notes:
ac = acre
cy = cubic yards
ea = each
sf = square foot
sy = square yards
lf = lineal foot
LS = Lump Sum

ALTERNATIVE I COST ESTIMATE
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	Description
	All labor open shop. 15.5 ac landfill surface area.
1.1	*Past Experience (gas vents, piezometers and monitoring wells)*
1.2	*Assume entire surface area of landfill. Past experience.*
1.3	*Vender Quote. Placement $3.00/cy from Means. Assume 1.5 feet over surface area of landfill.*
1.4	*Assume topsoil. Vender Quote. Placement $2.00/cy from Means. Assume 0.5ft + 10% (3% slope factor, 10% material for compaction)*
1.5	*Assume select native soil or sand. Vender Quote. Placement $3/cy from Means. Assume 1.5ft+8% (3% slope factor, 10% on materials for compaction)*
1.6	*Vendor Quote. Assume 6oz/sy non-woven + 5% (3% slope factor + overlap + waste)*
1.7	*Vendor Quote. Assume 1 x 10-3 cm/sec sand. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
1.8	*Vendor Quote. Assume 40 mil HDPE + 5% (3% slope factor and overlap and waste)*
1.9	
1.9.1	*Assume clay with 1x10-7 cm/sec. perm. Vender Quote. Placement $4/cy from Means. Assume 2ft + 15% (3% slope factor, 20% material for compaction)*
1.9.2	*Clay on sideslope/GCL on Plateau or GCL and geogrid on sideslope/GCL on plateau. Use former. Assume clay with 1x10-7 cm/sec perm. Vendor quote. Placement $4/cy from Means. Assume 2 ft+15% (3% slope factor, 20% material for compaction). Sideslope area 3 acres. Vendor quote. 15.5ac - 3ac=12.5ac +2% (overlap + waste)*
1.10	*Assume select native soil or sand. Vender Quote. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
1.11	*Mob/Demob and Site/Temp. Facilities. Facilities include temp./perm. utilities, port-a-john, garbage dumpster, field office, etc.*
2.0	
2.1	*Assume channels lined with grass, erosion control matting and riprap. Past Exp. Assume 2 channels around landfill circumference at plateau and midslope.*
2.2	*Assumes 2 basins. Past Experience*
2.3	*Vender Quote. Assume 200 horizontal feet spacing.*
2.4	*Past Experience*
2.5	*Past Experience*
2.6	*Mob/Demob*
3.0	
3.1	*Assume slurry wall 1000' long and 15' deep. Past experience.*
3.2	*Assume slurry wall 750' long and 15' deep. Past experience.*
3.3	*Assume bedrock grouting 150' long and 15' deep. Past experience.*
3.4	*Assume biopolymer trench 1000' long and 15' deep. Past experience.*
3.5	*Assume biopolymer trench 750' long and 15' deep. Past experience.*
3.6	*Assume drainage pipe 700' long. Past experience. Includes dewatering costs from Means.*
3.7	*Assume drainage pipe 300' long. Past experience. Includes dewatering costs from Means.*
3.8	*Mob/Demob*
4.1	
4.1.1	*Past Experience*
4.1.2	*Mob/Demob*
4.2	
4.2.1	*Assume 3 steel tanks. Past experience.*
4.2.2	*Past experience.*
4.2.3	*Mob/Demob*
5.0	
5.1	*Past experience*
5.2	*Mob/Demob*
6.0	
6.1	*Past experience*
6.2	*Assume pumped to landfill, past experience.*
6.3	*Assume pond area only, 022-238-0200 + 15%(trk) + 50%(wt) + 25%(level C)*
6.4	*022-266-2020, 1/2 mi round trip, +25%(level C) + 50%(rough grade)*
6.5	*022-208-4040, 50' haul, + 25%(level C). assume tracked in*
6.6	*Past experience*
6.7	*Past experience*
6.8	*Mob/Demob*
7.0	
7.1	*Assumes six foot chain link galv. w/3 strand barbed wire, double 12 foot gate around perimeter of landfill. Past experience*
7.2	*Assume 200 foot intervals. Past experience.*
7.3	*Assume 1 access road 725sy geotextile @ $2.10/sy and 250cy stone @ $35.00/cy.*
7.4	*Mob/Demob*

	Description
[illegible]	*OSWER Directive 9355.0-4A for projects over $2 million*
9.0	*OSWER Directive 9355.0-4A*
10.0	*Past experience*
11.0	*Past experience, EPA/600/8-87/049 recommends 5% to 20% of technology direct cost; use 10% based on past experience.*
12.0	*EPA/600/8-87/049 recommends 1% to 5%*
13.0	*Past experience*
14.0	*OSWER Directive 9355.0-4A for projects over $2 million, (EPA/600/8-87/049 recommends 15% to 25%)*
15.0	*OSWER Directive 9355.0-4A for projects over $2 million*
16.0	*Past experience*
17.0	*Past experience*
18.0	*Past experience*
19.0	*Past experience*
20.0	*Past Experience*

ALTERNATIVE II COST ESTIMATE (FORMERLY ALTERNATIVE III)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	NOLOGY/Component		Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
	NGLE BARRIER CAP						$1,810,935	$1,810,935
1.1	Appurtenance Decommissioning/Extension		1 LS	$10,000 LS		$10,000		
1.2	Clearing and Grubbing		17 ac	$3,500 ac		$59,500		
1.3	Structural Fill Placement		30,000 cy	$8.00 cy		$240,000		
1.4	Vegetative Layer		13,750 cy	$18.00 cy		$247,500		
1.5	Protective Layer		40,500 cy	$9.00 cy		$364,500		
1.6	Geotextile		78,700 sy	$1.25 sy		$98,375		
1.7	Drainage Layer		27,000 cy	$8.00 cy		$216,000		
1.8	Barrier Layer		78,700 sy	$3.80 sy		$299,060		
1.9	Bedding Layer		27,000 cy	$8.00 cy		$216,000		
1.10	Miscellaneous		1 LS	$60,000 LS		$60,000		
2.0	EROSION AND SEDIMENT CONTROL						$197,500	$197,500
2.1	Channels		6,000 lf	$15.00 lf		$90,000		
2.2	Basins		2 ea	$20,000 ea		$40,000		
2.3	Silt Barriers		4,500 lf	$3.00 lf		$13,500		
2.4	Wetlands Mitigation		1 ac	$15,000 ac		$15,000		
2.5	Seeding and Mulching		17 ac	$2,000 ac		$34,000		
2.6	Miscellaneous		1 LS	$5,000 LS		$5,000		
3.0	UPGRADIENT GROUNDWATER ISOLATION						$771,100	$771,100
3.1	West Slurry Wall		15,000 sf	$10 sf		$150,000		
3.2	North Slurry Wall		11,250 sf	$10 sf		$112,500		
3.3	Grouting		2,250 sf	$25 sf		$56,250		
3.4	West Biopolymer Trench and Toe Drain		15,000 sf	$15 sf		$225,000		
3.5	North Biopolymer Trench and Toe Drain		11,250 lf	$15 lf		$168,750		
3.6	West Drain Pipe		700 lf	$8 lf		$5,600		
3.7	North Drain Pipe		300 LS	$10 LS		$3,000		
3.8	Miscellaneous		1 LS	$50,000 LS		$50,000		
4.0	LEACHATE COLLECTION AND TREATMENT	Min.	Max.				$211,000	$211,000
	4.1 Existing Collection System						$21,000	$21,000
	4.1.1 Collection Sump	1.0 LS	1.0 LS	$20,000 sf	$20,000	$20,000		
	4.1.2 Miscellaneous	1.0 LS	1.0 LS	$1,000 LS	$1,000	$1,000		
	4.2 No Pre-treatment, Off-site Industrial Treatment Facility						$190,000	$190,000
	4.2.1 Storage Tanks	1.0 LS	1.0 LS	$100,000 LS	$100,000	$100,000		
	4.2.2 Loading Facility	1.0 LS	1.0 LS	$80,000 LS	$80,000	$80,000		
	4.2.3 Miscellaneous	1.0 LS	1.0 LS	$10,000 LS	$10,000	$10,000		
5.0	ACTIVE GAS MANAGEMENT						$675,000	$675,000
5.1	Active Gas Management System		1 LS	$650,000 LS		$650,000		
5.2	Miscellaneous		1 LS	$25,000 LS		$25,000		
6.0	EXCAVATION AND CONSOLIDATION						$55,625	$55,625
6.1	Delineation		1 LS	$5,000 LS		$5,000		
6.2	Dewatering		1 LS	$25,000 LS		$25,000		
6.3	Excavation		1,500 cy	$4.50 cy		$6,750		
6.4	Hauling		1,500 cy	$3.25 cy		$4,875		
6.5	Placement and Compaction		1,500 cy	$1.00 cy		$1,500		
6.6	Verification		1 LS	$5,000 LS		$5,000		
6.7	Restoration		1 LS	$2,500 LS		$2,500		
6.8	Miscellaneous		1 LS	$5,000 LS		$5,000		
7.0	MANAGEMENT AND INSTITUTIONAL CONTROLS						$60,800	$60,800
7.1	Security Fence		4,000 lf	$10 lf		$40,000		
7.2	Warning Signs		20 ea	$40 ea		$800		
7.3	Access Road		1 LS	$10,000 LS		$10,000		
7.4	Miscellaneous		1 LS	$10,000 LS		$10,000		
SUBTOTAL DIRECT CAPITAL COSTS							$3,781,960	$3,781,960

ALTERNATIVE II COST ESTIMATE (FORMERLY ALTERNATIVE III)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TECHNOLOGY/Component	Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
Engineering and Design (5% of Direct Cost)					$189,098	$189,098
Supervision and Administration (6% of Direct Cost)					$226,918	$226,918
10.0 Construction Quality Assurance (5% of Direct Cost)					$189,098	$189,098
11.0 Start-Up and Shake-Down (10% of Technology)					$21,100	$21,100
12.0 Legal Fees, Licensing and Permits (2% of Direct Cost)					$75,639	$75,639
13.0 Insurance/Bonding (2% of Direct Cost)					$75,639	$75,639
14.0 Bid Contingency (15% of Direct Cost)					$567,294	$567,294
15.0 Change Orders and Claims (8% of Direct Cost)					$302,557	$302,557
SUBTOTAL INDIRECT CAPITAL COSTS					**$1,647,343**	**$1,647,343**
16.0 Cap Maintenance Including Mowing and Cap Repair					$15,000	$15,000
17.0 Erosion and Sedimentation Control Maintenance and Repair					$20,000	$20,000
18.0 Barrier Performance Analytical Costs					$50,000	$50,000
19.0 Leachate Disposal Industrial Treatment Facility (one year only)					$1,600,000	$3,900,000
20.0 Gas Management System Operation and Maintenance					$50,000	$50,000
SUBTOTAL PRSC COSTS					**$1,735,000**	**$4,035,000**
Total present worth cost for a 30 year period using a 7% discount rate before taxes and after inflation equals					$8,704,523	$11,004,523

Notes:
ac = acre
cy = cubic yards
ea = each
sf = square foot
sy = square yards
lf = lineal foot
LS = Lump Sum

ALTERNATIVE II COST ESTIMATE (FORMERLY ALTERNATIVE III)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

		Description
		All labor open shop. 15.5 ac landfill surface area.
	1.1	*Past Experience (gas vents, piezometers and monitoring wells)*
	1.2	*Assume entire surface area of landfill. Past experience.*
	1.3	*Vender Quote. Placement $3.00/cy from Means. Assume 1.5 feet over surface area of landfill.*
	1.4	*Assume topsoil. Vender Quote. Placement $2.00/cy from Means. Assume 0.5ft + 10% (3% slope factor, 10% material for compaction)*
	1.5	*Assume select native soil or sand. Vender Quote. Placement $3/cy from Means. Assume 1.5ft+8%(3% slope factor, 10% on materials for compaction)*
	1.6	*Vendor Quote. Assume 6oz/sy non-woven + 5% (3% slope factor + overlap + waste)*
	1.7	*Vendor Quote. Assume 1 x 10-3 cm/sec sand. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
	1.8	*Vendor Quote. Assume 40 mil HDPE + 5% (3% slope factor and overlap and waste)*
	1.9	*Assume select native soil or sand. Vender Quote. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
	1.10	*Mob/Demob and Site/Temp. Facilities. Facilities include temp./perm. utilities, port-a-john, garbage dumpster, field office, etc.*
2.0		
	2.1	*Assume channels lined with grass, erosion control matting and riprap. Past Exp. Assume 2 channels around landfill circumference at plateau and midslope.*
	2.2	*Assumes 2 basins. Past Experience*
	2.3	*Vender Quote. Assume 200 horizontal feet spacing.*
	2.4	*Past Experience*
	2.5	*Past Experience*
	2.6	*Mob/Demob*
3.0		
	3.1	*Assume slurry wall 1000' long and 15' deep. Past experience.*
	3.2	*Assume slurry wall 750' long and 15' deep. Past experience.*
	3.3	*Assume bedrock grouting 150' long and 15' deep. Past experience.*
	3.4	*Assume biopolymer trench 1000' long and 15' deep. Past experience.*
	3.5	*Assume biopolymer trench 750' long and 15' deep. Past experience.*
	3.6	*Assume drainage pipe 700' long. Past experience. Includes dewatering costs from Means.*
	3.7	*Assume drainage pipe 300' long. Past experience. Includes dewatering costs from Means.*
	3.8	*Mob/Demob*
4.0		
	4.1	
	4.1.1	*Past Experience*
	4.1.2	*Mob/Demob*
	4.2	
	4.2.1	*Assume 3 steel tanks. Past experience.*
	4.2.2	*Past experience.*
	4.2.3	*Mob/Demob*
5.0		
	5.1	*Past experience*
	5.2	*Mob/Demob*
6.0		
	6.1	*Past experience*
	6.2	*Assume pumped to landfill, past experience.*
	6.3	*Assume pond area only, 022-238-0200 + 15%(trk) + 50%(wt) + 25%(level C)*
	6.4	*022-266-2020, 1/2 mi round trip, +25%(level C) + 50%(rough grade)*
	6.5	*022-208-4040, 50' haul, + 25%(level C). assume tracked in*
	6.6	*Past experience*
	6.7	*Past experience*
	6.8	*Mob/Demob*
7.0		
	7.1	*Assumes six foot chain link galv. w/3 strand barbed wire, double 12 foot gate around perimeter of landfill. Past experience*
	7.2	*Assume 200 foot intervals. Past experience.*
	7.3	*Assume 1 access road 725sy geotextile @ $2.10/sy and 250cy stone @ $35.00/cy.*
	7.4	*Mob/Demob*

ALTERNATIVE II COST ESTIMATE (FORMERLY ALTERNATIVE III)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	Description
'.0	*OSWER Directive 9355.0-4A for projects over $2 million*
9.0	*OSWER Directive 9355.0-4A*
10.0	*Past experience*
11.0	*Past experience, EPA/600/8-87/049 recommends 5% to 20% of technology direct cost; use 10% based on past experience.*
12.0	*EPA/600/8-87/049 recommends 1% to 5%*
13.0	*Past experience*
14.0	*OSWER Directive 9355.0-4A for projects over $2 million, (EPA/600/8-87/049 recommends 15% to 25%)*
15.0	*OSWER Directive 9355.0-4A for projects over $2 million*
16.0	*Past experience*
17.0	*Past experience*
18.0	*Past experience*
19.0	*Past experience*
20.0	*Past Experience*

ALTERNATIVE III COST ESTIMATE (FORMERLY ALTERNATIVE V)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TEC~OLOGY/Component			Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
	MPOSITE BARRIER CAP						$2,250,621	$2,615,935
1.1	Appurtenance Decommissioning/Extension		1 LS	$10,000 LS		$10,000		
1.2	Clearing and Grubbing		17 ac	$3,500 ac		$59,500		
1.3	Structural Fill Placement		30,000 cy	$8.00 cy		$240,000		
1.4	Vegetative Layer		13,750 cy	$18.00 cy		$247,500		
1.5	Protective Layer		40,500 cy	$9.00 cy		$364,500		
1.6	Geotextile		78,700 sy	$1.25 sy		$98,375		
1.7	Drainage Layer		27,000 cy	$8.00 cy		$216,000		
1.8	First Barrier Layer		78,700 sy	$3.80 sy		$299,060		
1.9	Second Barrier Layer							
1.9.1	Second Barrier Layer		57,500 cy	$14.00 cy		$805,000		
1.9.2	Second Barrier Layer		11,130 cy	$14.00 cy	$155,820			
			61,710 sy	$4.60 sy	$283,866			
1.10	Bedding Layer		27,000 cy	$8.00 cy		$216,000		
1.11	Miscellaneous		1 LS	$60,000 LS		$60,000		
2.0	EROSION AND SEDIMENT CONTROL						$197,500	$197,500
2.1	Channels		6,000 lf	$15.00 lf		$90,000		
2.2	Basins		2 ea	$20,000 ea		$40,000		
2.3	Silt Barriers		4,500 lf	$3.00 lf		$13,500		
2.4	Wetlands Mitigation		1 ac	$15,000 ac		$15,000		
2.5	Seeding and Mulching		17 ac	$2,000 ac		$34,000		
2.6	Miscellaneous		1 LS	$5,000 LS		$5,000		
3.0	UPGRADIENT GROUNDWATER ISOLATION						$771,100	$771,100
3.1	West Slurry Wall		15,000 sf	$10 sf		$150,000		
3.2	North Slurry Wall		11,250 sf	$10 sf		$112,500		
3.3	Grouting		2,250 sf	$25 sf		$56,250		
3.4	West Biopolymer Trench and Toe Drain		15,000 sf	$15 sf		$225,000		
3.5	North Biopolymer Trench and Toe Drain		11,250 lf	$15 lf		$168,750		
3.6	West Drain Pipe		700 lf	$8 lf		$5,600		
3.7	North Drain Pipe		300 LS	$10 LS		$3,000		
3.8	Miscellaneous		1 LS	$50,000 LS		$50,000		
	'ACHATE COLLECTION AND TREATMENT	Min.	Max.				$211,000	$211,000
4.1	Existing Collection System						$21,000	$21,000
4.1.1	Collection Sump	1.0 LS	1.0 LS	$20,000 sf	$20,000	$20,000		
4.1.2	Miscellaneous	1.0 LS	1.0 LS	$1,000 LS	$1,000	$1,000		
4.2	No Pre-treatment, Off-site Industrial Treatment Facility						$190,000	$190,000
4.2.1	Storage Tanks	1.0 LS	1.0 LS	$100,000 LS	$100,000	$100,000		
4.2.2	Loading Facility	1.0 LS	1.0 LS	$80,000 LS	$80,000	$80,000		
4.2.3	Miscellaneous	1.0 LS	1.0 LS	$10,000 LS	$10,000	$10,000		
5.0	PASSIVE GAS MANAGEMENT						$375,000	$375,000
5.1	Passive Gas Management System		1 LS	$370,000 LS		$370,000		
5.2	Miscellaneous		1 LS	$5,000 LS		$5,000		
6.0	EXCAVATION AND CONSOLIDATION						$55,625	$55,625
6.1	Delineation		1 LS	$5,000 LS		$5,000		
6.2	Dewatering		1 LS	$25,000 LS		$25,000		
6.3	Excavation		1,500 cy	$4.50 cy		$6,750		
6.4	Hauling		1,500 cy	$3.25 cy		$4,875		
6.5	Placement and Compaction		1,500 cy	$1.00 cy		$1,500		
6.6	Verification		1 LS	$5,000 LS		$5,000		
6.7	Restoration		1 LS	$2,500 LS		$2,500		
6.8	Miscellaneous		1 LS	$5,000 LS		$5,000		
7.0	MANAGEMENT AND INSTITUTIONAL CONTROLS						$60,800	$60,800
7.1	Security Fence		4,000 lf	$10 lf		$40,000		
7.2	Warning Signs		20 ea	$40 ea		$800		
7.3	Access Road		1 LS	$10,000 LS		$10,000		
7.4	Miscellaneous		1 LS	$10,000 LS		$10,000		
SUBTOTAL DIRECT CAPITAL COSTS							$3,921,646	$4,286,960

ALTERNATIVE III COST ESTIMATE (FORMERLY ALTERNATIVE V)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

TECHNOLOGY/Component	Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
Engineering and Design (5% of Direct Cost)					$196,082	$214,348
Supervision and Administration (6% of Direct Cost)					$235,299	$257,218
10.0 Construction Quality Assurance (5% of Direct Cost)					$196,082	$214,348
11.0 Start-Up and Shake-Down (10% of Technology)					$21,100	$21,100
12.0 Legal Fees, Licensing and Permits (2% of Direct Cost)					$78,433	$85,739
13.0 Insurance/Bonding (2% of Direct Cost)					$78,433	$85,739
14.0 Bid Contingency (15% of Direct Cost)					$588,247	$643,044
15.0 Change Orders and Claims (8% of Direct Cost)					$313,732	$342,957
SUBTOTAL INDIRECT CAPITAL COSTS					**$1,707,408**	**$1,864,493**
16.0 Cap Maintenance Including Mowing and Cap Repair					$15,000	$15,000
17.0 Erosion and Sedimentation Control Maintenance and Repair					$20,000	$20,000
18.0 Barrier Performance Analytical Costs					$50,000	$50,000
19.0 Leachate Disposal Industrial Treatment Facility (one year only)					$1,600,000	$3,900,000
20.0 Gas Management System Operation and Maintenance					$60,000	$60,000
SUBTOTAL PRSC COSTS					**$1,745,000**	**$4,045,000**
Total present worth cost for a 30 year period using a 7% discount rate before taxes and after inflation equals					$9,028,365	$11,850,764

Notes:
ac = acre
cy = cubic yards
ea = each
sf = square foot
sy = square yards
lf = lineal foot
LS = Lump Sum

ALTERNATIVE III COST ESTIMATE (FORMERLY ALTERNATIVE V)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	Description
	All labor open shop. 15.5 ac landfill surface area.
1.1	*Past Experience (gas vents, piezometers and monitoring wells)*
1.2	*Assume entire surface area of landfill. Past experience.*
1.3	*Vender Quote. Placement $3.00/cy from Means. Assume 1.5 feet over surface area of landfill.*
1.4	*Assume topsoil. Vender Quote. Placement $2.00/cy from Means. Assume 0.5ft + 10% (3% slope factor, 10% material for compaction)*
1.5	*Assume select native soil or sand. Vender Quote. Placement $3/cy from Means. Assume 1.5ft+8% (3% slope factor, 10% on materials for compaction)*
1.6	*Vendor Quote. Assume 6oz/sy non-woven + 5% (3% slope factor + overlap + waste)*
1.7	*Vendor Quote. Assume 1 x 10-3 cm/sec sand. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
1.8	*Vendor Quote. Assume 40 mil HDPE + 5% (3% slope factor and overlap and waste)*
1.9	
1.9.1	*Assume clay with 1x10-7 cm/sec. perm. Vender Quote. Placement $4/cy from Means. Assume 2ft + 15% (3% slope factor, 20% material for compaction)*
1.9.2	*Clay on sideslope/GCL on Plateau or GCL and geogrid on sideslope/GCL on plateau. Use former.* *Assume clay with 1x10-7 cm/sec perm. Vendor quote. Placement $4/cy from Means. Assume 2 ft+15% (3% slope factor, 20% material for compaction).* *Sideslope area 3 acres. Vendor quote. 15.5ac - 3ac=12.5ac +2% (overlap + waste)*
1.10	*Assume select native soil or sand. Vender Quote. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
1.11	*Mob/Demob and Site/Temp. Facilities. Facilities include temp./perm. utilities, port-a-john, garbage dumpster, field office, etc.*
2.0	
2.1	*Assume channels lined with grass, erosion control matting and riprap. Past Exp. Assume 2 channels around landfill circumference at plateau and midslope.*
2.2	*Assumes 2 basins. Past Experience*
2.3	*Vender Quote. Assume 200 horizontal feet spacing.*
2.4	*Past Experience*
2.5	*Past Experience*
2.6	*Mob/Demob*
3.0	
3.1	*Assume slurry wall 1000' long and 15' deep. Past experience.*
3.2	*Assume slurry wall 750' long and 15' deep. Past experience.*
3.3	*Assume bedrock grouting 150' long and 15' deep. Past experience.*
3.4	*Assume biopolymer trench 1000' long and 15' deep. Past experience.*
3.5	*Assume biopolymer trench 750' long and 15' deep. Past experience.*
3.6	*Assume drainage pipe 700' long. Past experience. Includes dewatering costs from Means.*
3.7	*Assume drainage pipe 300' long. Past experience. Includes dewatering costs from Means.*
3.8	*Mob/Demob*
4.0	
4.1	
4.1.1	*Past Experience*
4.1.2	*Mob/Demob*
4.2	
4.2.1	*Assume 3 steel tanks. Past experience.*
4.2.2	*Past experience.*
4.2.3	*Mob/Demob*
5.0	
5.1	*Past experience*
5.2	*Mob/Demob*
6.0	
6.1	*Past experience*
6.2	*Assume pumped to landfill, past experience.*
6.3	*Assume pond area only, 022-238-0200 + 15%(trk) + 50%(wt) + 25%(level C)*
6.4	*022-266-2020, 1/2 mi round trip, +25%(level C) + 50%(rough grade)*
6.5	*022-208-4040, 50' haul, + 25%(level C). assume tracked in*
6.6	*Past experience*
6.7	*Past experience*
6.8	*Mob/Demob*
7.0	
7.1	*Assumes six foot chain link galv. w/3 strand barbed wire, double 12 foot gate around perimeter of landfill. Past experience*
7.2	*Assume 200 foot intervals. Past experience.*
7.3	*Assume 1 access road 725sy geotextile @ $2.10/sy and 250cy stone @ $35.00/cy.*
7.4	*Mob/Demob*

	Description
8.0	*OSWER Directive 9355.0-4A for projects over $2 million*
9.0	*OSWER Directive 9355.0-4A*
10.0	*Past experience*
11.0	*Past experience, EPA/600/8-87/049 recommends 5% to 20% of technology direct cost; use 10% based on past experience.*
12.0	*EPA/600/8-87/049 recommends 1% to 5%*
13.0	*Past experience*
14.0	*OSWER Directive 9355.0-4A for projects over $2 million, (EPA/600/8-87/049 recommends 15% to 25%)*
15.0	*OSWER Directive 9355.0-4A for projects over $2 million*
16.0	*Past experience*
17.0	*Past experience*
18.0	*Past experience*
19.0	*Past experience*
20.0	*Past Experience*

ALTERNATIVE IV COST ESTIMATE (FORMERLY ALTERNATIVEVII)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

T	NOLOGY/Component		Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
	INGLE BARRIER CAP						$1,810,935	$1,810,935
1.1	Appurtenance Decommissioning/Extension		1 LS	$10,000 LS		$10,000		
1.2	Clearing and Grubbing		17 ac	$3,500 ac		$59,500		
1.3	Structural Fill Placement		30,000 cy	$8.00 cy		$240,000		
1.4	Vegetative Layer		13,750 cy	$18.00 cy		$247,500		
1.5	Protective Layer		40,500 cy	$9.00 cy		$364,500		
1.6	Geotextile		78,700 sy	$1.25 sy		$98,375		
1.7	Drainage Layer		27,000 cy	$8.00 cy		$216,000		
1.8	Barrier Layer		78,700 sy	$3.80 sy		$299,060		
1.9	Bedding Layer		27,000 cy	$8.00 cy		$216,000		
1.10	Miscellaneous		1 LS	$60,000 LS		$60,000		
2.0	EROSION AND SEDIMENT CONTROL						$197,500	$197,500
2.1	Channels		6,000 lf	$15.00 lf		$90,000		
2.2	Basins		2 ea	$20,000 ea		$40,000		
2.3	Silt Barriers		4,500 lf	$3.00 lf		$13,500		
2.4	Wetlands Mitigation		1 ac	$15,000 ac		$15,000		
2.5	Seeding and Mulching		17 ac	$2,000 ac		$34,000		
2.6	Miscellaneous		1 LS	$5,000 LS		$5,000		
3.0	UPGRADIENT GROUNDWATER ISOLATION						$771,100	$771,100
3.1	West Slurry Wall		15,000 sf	$10 sf		$150,000		
3.2	North Slurry Wall		11,250 sf	$10 sf		$112,500		
3.3	Grouting		2,250 sf	$25 sf		$56,250		
3.4	West Biopolymer Trench and Toe Drain		15,000 sf	$15 sf		$225,000		
3.5	North Biopolymer Trench and Toe Drain		11,250 lf	$15 lf		$168,750		
3.6	West Drain Pipe		700 lf	$8 lf		$5,600		
3.7	North Drain Pipe		300 LS	$10 LS		$3,000		
3.8	Miscellaneous		1 LS	$50,000 LS		$50,000		
4.0	LEACHATE COLLECTION AND TREATMENT	Min.	Max.				$211,000	$211,000
	4.1 Existing Collection System						$21,000	$21,000
	4.1.1 Collection Sump	1.0 LS	1.0 LS	$20,000 sf	$20,000	$20,000		
	4.1.2 Miscellaneous	1.0 LS	1.0 LS	$1,000 LS	$1,000	$1,000		
	4.2 No Pre-treatment, Off-site Industrial Treatment Facility						$190,000	$190,000
	4.2.1 Storage Tanks	1.0 LS	1.0 LS	$100,000 LS	$100,000	$100,000		
	4.2.2 Loading Facility	1.0 LS	1.0 LS	$80,000 LS	$80,000	$80,000		
	4.2.3 Miscellaneous	1.0 LS	1.0 LS	$10,000 LS	$10,000	$10,000		
5.0	PASSIVE GAS MANAGEMENT						$400,000	$400,000
5.1	Passive Gas Management System		1 LS	$375,000 LS		$375,000		
5.2	Miscellaneous		1 LS	$25,000 LS		$25,000		
6.0	EXCAVATION AND CONSOLIDATION						$55,625	$55,625
6.1	Delineation		1 LS	$5,000 LS		$5,000		
6.2	Dewatering		1 LS	$25,000 LS		$25,000		
6.3	Excavation		1,500 cy	$4.50 cy		$6,750		
6.4	Hauling		1,500 cy	$3.25 cy		$4,875		
6.5	Placement and Compaction		1,500 cy	$1.00 cy		$1,500		
6.6	Verification		1 LS	$5,000 LS		$5,000		
6.7	Restoration		1 LS	$2,500 LS		$2,500		
6.8	Miscellaneous		1 LS	$5,000 LS		$5,000		
7.0	MANAGEMENT AND INSTITUTIONAL CONTROLS						$60,800	$60,800
7.1	Security Fence		4,000 lf	$10 lf		$40,000		
7.2	Warning Signs		20 ea	$40 ea		$800		
7.3	Access Road		1 LS	$10,000 LS		$10,000		
7.4	Miscellaneous		1 LS	$10,000 LS		$10,000		
SUBTOTAL DIRECT CAPITAL COSTS							$3,506,960	$3,506,960

ALTERNATIVE IV COST ESTIMATE (FORMERLY ALTERNATIVEVII)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

T‾ ›LOGY/Component	Quantity	Unit Price	Item Cost Min.	Item Cost Max.	Technology Min. Cost	Technology Max. Cost
Engineering and Design (5% of Direct Cost)					$175,348	$175,348
. Supervision and Administration (6% of Direct Cost)					$210,418	$210,418
10.0 Construction Quality Assurance (5% of Direct Cost)					$175,348	$175,348
11.0 Start-Up and Shake-Down (10% of Technology)					$21,100	$21,100
12.0 Legal Fees, Licensing and Permits (2% of Direct Cost)					$70,139	$70,139
13.0 Insurance/Bonding (2% of Direct Cost)					$70,139	$70,139
14.0 Bid Contingency (15% of Direct Cost)					$526,044	$526,044
15.0 Change Orders and Claims (8% of Direct Cost)					$280,557	$280,557
SUBTOTAL INDIRECT CAPITAL COSTS					**$1,529,093**	**$1,529,093**
16.0 Cap Maintenance Including Mowing and Cap Repair					$15,000	$15,000
17.0 Erosion and Sedimentation Control Maintenance and Repair					$20,000	$20,000
18.0 Barrier Performance Analytical Costs					$50,000	$50,000
19.0 Leachate Disposal Industrial Treatment Facility (one year only)					$1,600,000	$3,900,000
20.0 Gas Management System Operation and Maintenance					$60,000	$60,000
SUBTOTAL PRSC COSTS					**$1,745,000**	**$4,045,000**
Total present worth cost for a 30 year period using a 7% discount rate before taxes and after inflation equals					$8,435,364	$10,735,364

Notes:
ac = acre
cy = cubic yards
ea = each
sf = square foot
sy = square yards
lf = lineal foot
LS = Lump Sum

ALTERNATIVE IV COST ESTIMATE (FORMERLY ALTERNATIVE VII)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

		Description
1.0		*All labor open shop. 15.5 ac landfill surface area.*
	1.1	*Past Experience (gas vents, piezometers and monitoring wells)*
	1.2	*Assume entire surface area of landfill. Past experience.*
	1.3	*Vender Quote. Placement $3.00/cy from Means. Assume 1.5 feet over surface area of landfill.*
	1.4	*Assume topsoil. Vender Quote. Placement $2.00/cy from Means. Assume 0.5ft + 10% (3% slope factor, 10% material for compaction)*
	1.5	*Assume select native soil or sand. Vender Quote. Placement $3/cy from Means. Assume 1.5ft+8% (3% slope factor, 10% on materials for compaction)*
	1.6	*Vendor Quote. Assume 6oz/sy non-woven + 5% (3% slope factor + overlap + waste)*
	1.7	*Vendor Quote. Assume 1 x 10-3 cm/sec sand. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
	1.8	*Vendor Quote. Assume 40 mil HDPE + 5% (3% slope factor and overlap and waste)*
	1.9	*Assume select native soil or sand. Vender Quote. Placement $2.00/cy from Means. Assume 1.0ft + 8% (3% slope factor, 10% material for compaction)*
	1.10	*Mob/Demob and Site/Temp. Facilities. Facilities include temp./perm. utilities, port-a-john, garbage dumpster, field office, etc.*
2.0		
	2.1	*Assume channels lined with grass, erosion control matting and riprap. Past Exp. Assume 2 channels around landfill circumference at plateau and midslope.*
	2.2	*Assumes 2 basins. Past Experience*
	2.3	*Vender Quote. Assume 200 horizontal feet spacing.*
	2.4	*Past Experience*
	2.5	*Past Experience*
	2.6	*Mob/Demob*
3.0		
	3.1	*Assume slurry wall 1000' long and 15' deep. Past experience.*
	3.2	*Assume slurry wall 750' long and 15' deep. Past experience.*
	3.3	*Assume bedrock grouting 150' long and 15' deep. Past experience.*
	3.4	*Assume biopolymer trench 1000' long and 15' deep. Past experience.*
	3.5	*Assume biopolymer trench 750' long and 15' deep. Past experience.*
	3.6	*Assume drainage pipe 700' long. Past experience. Includes dewatering costs from Means.*
	3.7	*Assume drainage pipe 300' long. Past experience. Includes dewatering costs from Means.*
	3.8	*Mob/Demob*
4.0		
	4.1	
	4.1.1	*Past Experience*
	4.1.2	*Mob/Demob*
	4.2	
	4.2.1	*Assume 3 steel tanks. Past experience.*
	4.2.2	*Past experience.*
	4.2.3	*Mob/Demob*
5.0		
	5.1	*Past experience*
	5.2	*Mob/Demob*
6.0		
	6.1	*Past experience*
	6.2	*Assume pumped to landfill, past experience.*
	6.3	*Assume pond area only, 022-238-0200 + 15%(trk) + 50%(wt) + 25%(level C)*
	6.4	*022-266-2020, 1/2 mi round trip, +25%(level C) + 50%(rough grade)*
	6.5	*022-208-4040, 50' haul, + 25%(level C). assume tracked in*
	6.6	*Past experience*
	6.7	*Past experience*
	6.8	*Mob/Demob*
7.0		
	7.1	*Assumes six foot chain link galv. w/3 strand barbed wire, double 12 foot gate around perimeter of landfill. Past experience*
	7.2	*Assume 200 foot intervals. Past experience.*
	7.3	*Assume 1 access road 725sy geotextile @ $2.10/sy and 250cy stone @ $35.00/cy.*
	7.4	*Mob/Demob*

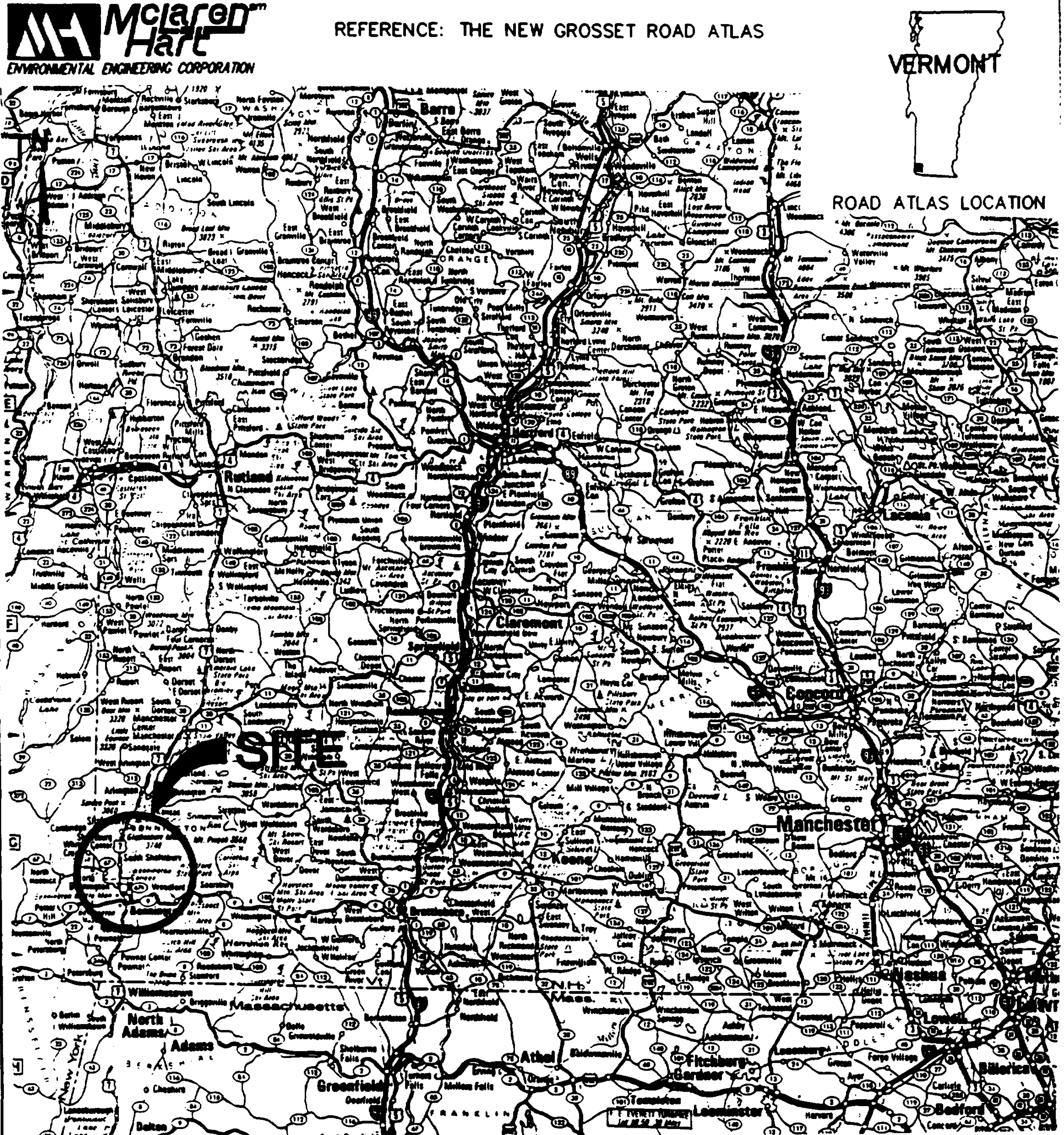
ALTERNATIVE IV COST ESTIMATE (FORMERLY ALTERNATIVE VII)
ENGINEERING EVALUATION/COST ANALYSIS
BENNINGTON LANDFILL SUPERFUND SITE
BENNINGTON, VERMONT

	Description
.0	*OSWER Directive 9355.0-4A for projects over $2 million*
٭.0	*OSWER Directive 9355.0-4A*
10.0	*Past experience*
11.0	*Past experience, EPA/600/8-87/049 recommends 5% to 20% of technology direct cost; use 10% based on past experience.*
12.0	*EPA/600/8-87/049 recommends 1% to 5%*
13.0	*Past experience*
14.0	*OSWER Directive 9355.0-4A for projects over $2 million, (EPA/600/8-87/049 recommends 15% to 25%)*
15.0	*OSWER Directive 9355.0-4A for projects over $2 million*
16.0	*Past experience*
17.0	*Past experience*
18.0	*Past experience*
19.0	*Past experience*
20.0	*Past Experience*

APPENDIX D

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

REFERENCE: THE NEW GROSSET ROAD ATLAS



SCALE

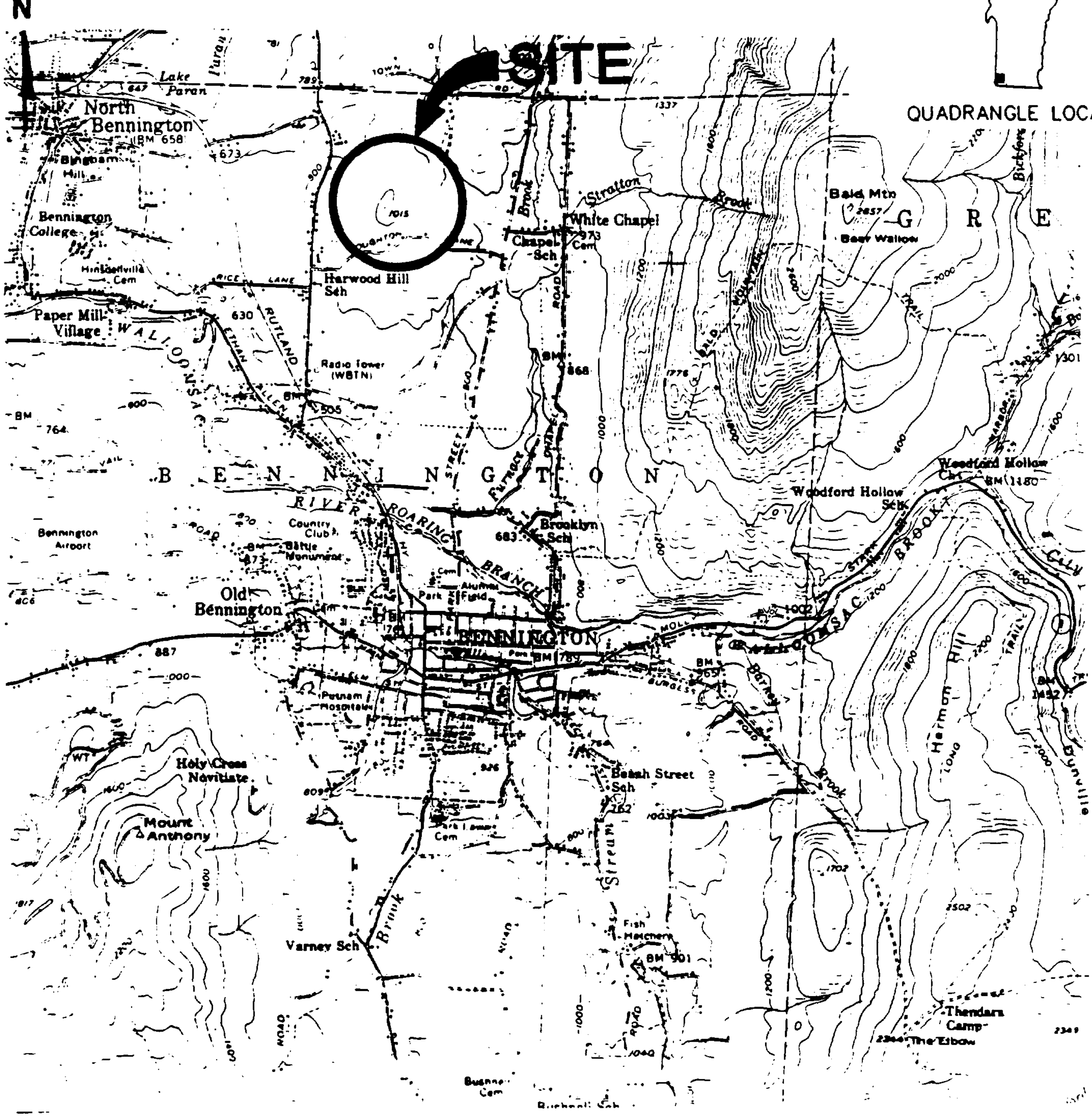
34 17 0 34 MILES

BENNINGTON LANDFILL SITE BENNINGTON, VERMONT	DRWN MJH	CHKD	APPD
	SCALE AS SHOWN		DATE 6/21/94
	SITE VICINITY MAP		DRAWING NUMBER 12.0000657 FIGURE 1

0657A002.DWG

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

REFERENCE: U.S.G.S. QUADRANGLE BENNINGTON, VT.



SCALE

2 1 0 2 MILES

2000 0 2000 6000 10000 14000 FEET

2 1 0 2 KILOMETERS

BENNINGTON LANDFILL SITE
BENNINGTON, VERMONT

DRWN MJH	CHKD		APPD
SCALE	AS SHOWN		DATE 6/21/94
SITE LOCATION MAP			DRAWING NUMBER 12.0000657 FIGURE 2

0657A002.DWG

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 19805, Appendix D - Figures - Figure 3 - Sample and Monitoring Well

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC# 19805, Appendix D - Figures - Figure 4 - Geologic Cross - Sections

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

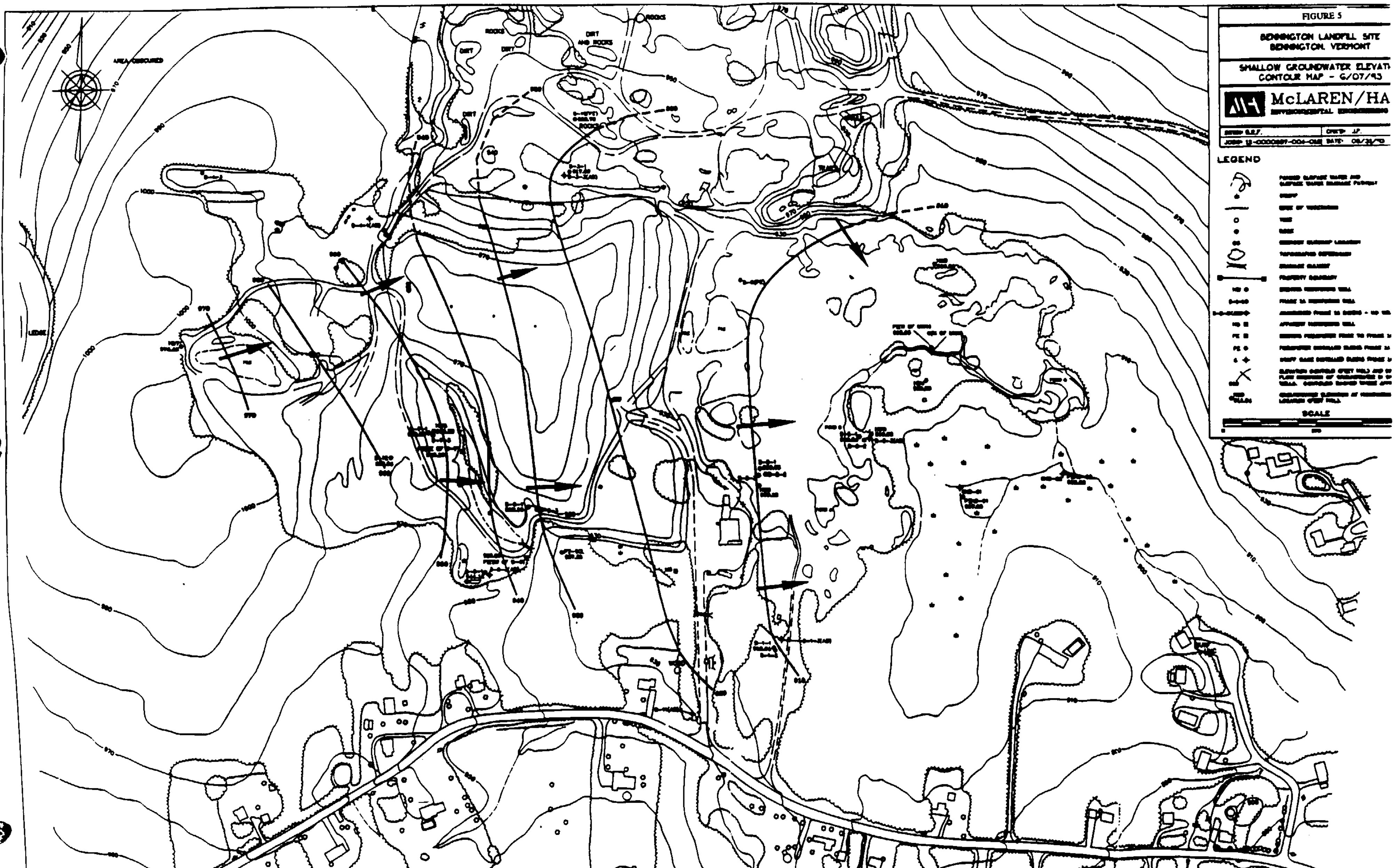
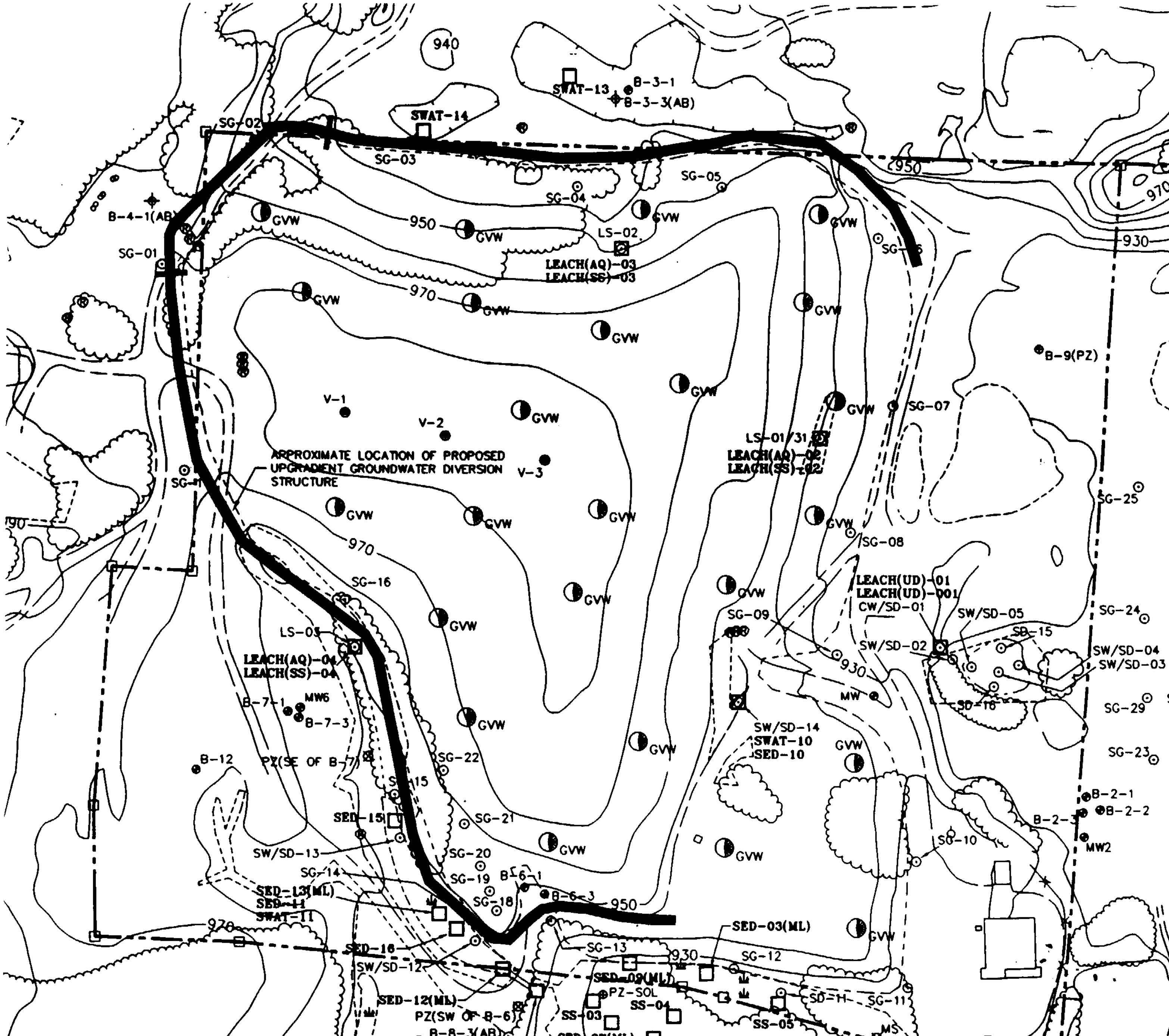


FIGURE 5
BENNINGTON LANDFILL SITE
BENNINGTON, VERMONT
SHALLOW GROUNDWATER ELEVATI
CONTOUR MAP - 6/07/93
McLAREN/HA
LEGEND
SCALE
AREA OBSCURED
DIRT
ROCKS
DIRT AND ROCKS
LEDGE



REV	DATE	DESCRIPTION	APP'D

BENNINGTON LANDFILL SITE
BENNINGTON, VERMONT

McLAREN/HART ENVIRONMENTAL ENGINEERING CORP
WARREN, NEW JERSEY

ENGINEERING EVALUATION / COST ANALYSIS

UPGRADIENT DIVERSION STRUCTURE AND GAS MANAGEMENT

FIGURE 6

LEGEND:

V-3 EXISTING GAS VENT

GVW PROPOSED GAS VENT/WELL

NOTES:

1. SEE FIGURE 3 FOR COMPLETE LEGEND.

2. LOCATION OF UPGRADIENT DIVERSION STRUCTURE AND GAS MANAGEMENT VENTS/WELLS ARE CONCEPTUAL AND PRESENTED FOR REFERENCE ONLY.

SCALE

0 120 240 FEET

Appendix E has been removed.

Considered not applicable for inclusion in the EE/CA.

APPENDIX F

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

VIA FAX AND CERTIFIED MAIL

May 24, 1994

de maximis, inc.

MAY 27 1994

Mr. Geoffrey C. Seibel
Project Coordinator
186 Center Street, Suite 290
Clinton, NJ 08809

Subject: Review of the Draft Engineering Evaluation/Cost Analysis for the Bennington Landfill Superfund Site, Bennington, Vermont.

Dear Geoff:

The United States Environmental Protection Agency (EPA) has completed the review of the document entitled "Draft Engineering Evaluation/Cost Analysis, Bennington Landfill Superfund Site, Bennington, Vermont" (the EE/CA) and the enclosed cover letter dated April 15, 1994. This document was prepared by the Bennington Landfill Superfund Site Settling Parties (Settling Parties) to undertake efforts to expedite response actions at the Bennington Landfill Superfund Site (the Site) within the Superfund Accelerated Cleanup Model (SACM) program.

EPA has formatted the comments of this review into three enclosures. Enclosure I summarizes EPA general comments. Enclosure II lists page specific comments. Enclosure III provides examples of several ARARs tables. All comments have been numbered with the appropriate page and paragraph number.

EPA requires the Settling Parties address each comment. EPA reserves the right to make additional comments if appropriate upon receipt of Vermont Department of Environmental Conservation (VTDEC) comments. Following receipt of this letter EPA requires that the Final EE/CA be resubmitted on June 27, 1994

If you have any questions please do not hesitate to call me at (617) 573-5768.

Sincerely,

Indira G. Balkissoon, RPM
ME & VT Superfund Section

Enclosures

cc: Stan Corneille/VTDEC
Gregory Kennan/EPA
Mary Jane O'Donnell/EPA
Lynne Jennings/EPA

ENCLOSURE I

General Comments

1. The April 15, 1994 cover letter raises serious concerns regarding the intent of the Settling Parties. In particular, EPA is puzzled by the statement that "the landfill cap and the landfill underdrain may be acting as effective measures to reducing leachate generation by infiltration and minimizing the contact of the landfill mass with the underlying groundwater... that there may be minimal benefit to disturbing the existing cap...".

The current cap has been tested and found to be less than 24" in thickness and exceed 1×10^{-4} cm/sec. This would not even meet the current U.S. EPA 40 C.F.R. 258, Subtitle D, Solid Waste Closure, standards. The controlling factors in determining the components of the cover for a landfill are (1) the nature of the threat, and (2) the ARARs. The nature of the threat evaluation is based upon whether the source material represents a threat to ground water.
If the source material represents a groundwater threat, then reducing infiltration and waste containment remain the closure objectives in addition to direct contact or gas control. The controlling ARARs are determined by the date and nature of waste disposal. Most CERCLA landfills did not receive RCRA Hazardous Waste after 1980, which would trigger 40 C.F.R. 264 closure as applicable. However, most CERCLA landfills in this Region did receive wastes sufficiently similar to currently regulated wastes that the use of the 40 C.F.R. landfill closure and compliance requirements in Subparts F,G, and N would be relevant to the situation and appropriate for use.

The cover requirements of 40 C.F.R. 264.310 are further described in the technical guidance document: Final Covers on Hazardous Waste Landfill and Surface Impoundments, EPA 530-SW-89-047, July 1989. This document sets the precedent for the requirement of a multi-layer cap with two low conductivity barrier layers. The two component barrier layer is required to provide a redundant barrier in the event the upper barrier layer is compromised. The technical guidance does allow site specific factors (steep slopes, frost depth) to influence the exact nature of each component. EPA is always willing to have a technical dialogue regarding the components. However, a double barrier system is the cornerstone of the Subtitle C cap.

2. It is unclear whether or not the Settling Parties have screened out the single barrier cap. Provide a more detailed discussion to support the statement that the added protection provided by the composite cap is not worth the added costs. The composite barrier cap provides improved long-term effectiveness not provided by the single barrier cap.

3. The Draft EE/CA must describe the scope of the EE/CA and the non-time-critical removal actions (NTCRA)(i.e. source control and specific risks to groundwater and sediment) and how the EE/CA differs from the scope of the Remedial Investigation/Feasibility Study (RI/FS)/long-term action (groundwater remediation and other remaining risks). This discussion should be brief and included in the Executive Summary and a more detailed discussion should be included in Section 3 with the appropriate change in the title of this section to Scope of Removal Action, Removal Response Objectives and Regulatory Requirements.

4. The Draft EE/CA must include figures to aid the reader in understanding the Site. At a minimum the following figures must be included:

a. Figure indicating general site location in Vermont
b. Figure indicating major site features including boundaries of landfill, boundaries of property, all source areas (i.e. culvert and drainage pond), surface water bodies and wetlands
c. Figure indicating surface water, sediment and leachate sampling locations and groundwater monitoring wells
d. Figure identifying the general location of the existing groundwater and surface water diversion structures
e. Figures indicating proposed location of upgradient diversion structures and landfill gas collection wells

5. The Draft EE/CA must include tables which summarize the data collected during the LFI, Phase 1A, Phase 1B and any interim monitoring. To minimize the volume of information, the EE/CA could present average and maximums for each media. Summarization of both the groundwater and soil data is particularly important since the basis for conducting the EE/CA stemmed from risks posed from exposure to groundwater and soil in the drainage pond.

6. The ARARs tables must be presented in the same format as is required for an RI/FS. The table should identify the authority (i.e. state or federal), the requirement's name and citation, the status (i.e. applicable, relevant and appropriate, or to be considered), a synopsis of the requirement and the action to be taken. The ARARs table for the Parker Site in Vermont is provided in Attachment III as an example.

7. The method utilized to develop and assemble the eight alternatives in Section 4.4 is confusing and will not assist EPA in the selection of an alternative. In addition, it is difficult for the reader to keep track of the differences between the alternatives. Of the eight alternatives listed in the Draft EE/CA there appears to ultimately be 5 different categories which require further comparison and analysis. EPA requires that the EE/CA evaluate the technologies according to the categories specified below:

1. <u>Containment</u>

composite barrier cap
single barrier cap

Erosion and sedimentation control would be a common element of both options

2. Landfill Leachate Collection
   upgradient groundwater isolation
   downgradient groundwater collection

3. Treatment Options
   off-site treatment
   on-site treatment and discharge to a POTW

4. Landfill Gas Management
   passive venting
   active collection and treatment

5. Soils/Sediments Response Measures
   Excavation and Consolidation

Management and Institutional Controls would be a common element of all the alternatives.

9. The analysis of alternative does not follow the NTCRA Guidance. The EE/CA must fully assess all effectiveness and implementability sub-factors. As a result, the advantages and disadvantages of each of the alternatives is not clearly presented.

ENCLOSURE II

Page Specific Comments

Executive Summary

1. Page ES-1, 1st ¶ -- In the 2d and 4th lines, delete "Municipal". In the 10th line, delete the sentence beginning "The purpose..." and the next sentence and replace with:

> Ultimately, EPA will use the EE/CA to select its preferred alternative for source control measures at this Site. As detailed in the "Presumptive Remedy for CERCLA Municipal Landfill Sites" (Dir. No. 9355.0-49FS, September 1993), EPA believes that the most appropriate way to address the source contamination at a municipal landfill site is the containment of landfill contents and collection and/or treatment of landfill gases and leachate (if present).

At the end of the same ¶, add new sentence: "The presumptive remedy does not address the cleanup of contaminated groundwater beyond the facility boundaries."

2. Page ES-1, 2d ¶ -- Delete "remedial" from the first sentence.

3. Page ES-2, 1st bullet -- Replace "remediation" with "response measures".

4. Page ES-2, 1st full ¶ -- In 1st line, after "are" add "intended".

5. Page ES-2, 2d full ¶ -- Replace "contends" with "has stated". In the 4th line, after "environment", add "and potential dermal exposure to the landfill contents through direct contact."

6. Page ES-2, 2d to last bullet, 2d line -- Delete "and" and replace with "in order to". In the 3d bullet, after "runoff" add "in order to".

7. Page 1-1, Section 1.0 -- Include an explanation of the presumptive remedy. The Presumptive Remedy Fact Sheet OSWER Directive 9355.0-48FS contains some good language. For example, "Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions."

8. Page 1-1, 2d ¶ -- In 2d line, delete "Municipal". In the 5th line, after "that" add "based upon the presumptive remedy for

municipal landfills,". In the same line, replace "will not result in" with "should not involve". In the 6th line, replace "contaminants" with "the landfill contents". In the same line, replace "will" with "rather should".

9. Page 1-1, 2d ¶ -- The third sentence should be deleted.

10. Page 1-1, 3d ¶ -- in the 2d line, replace "remedial" with "response". In the 5th line, delete "response action objectives" as it was already stated in the previous line.

11. Page 2-1, 1st ¶ -- In the fifth line, after "including" add "but not limited to". In the sixth line, after "waste inks" add "scrap batteries with metals, waste oils, lead waste, paint wastes,"

12. Page 2-2 -- At a minimum, include a site map and a waste iso-contour map would provide a better presentation of the thickness of the landfill.

13. Page 2-2, 1st full ¶ -- In first line after "landfill" add "pursuant to state solid waste regulations." In the next ¶, 1st line, change "the 28" to "a 28". Is it accurate to characterize the existing landfill cover as "low permeability" since the permeability has been found to exceed 1 x 10^{-4} cm/sec? Correct this statement in the text. In the last ¶, 1st line, add "Current" to the beginning of the sentence. Change "west of the Site" to "Abutting the Site". In the last line of the ¶, be more specific regarding the tarps. Specify when the tarps were placed on the sludge, when they blew off and how long the piles existed exposed without tarps covering the sludge.

14. Page 2-3, 3d ¶ -- Correct the 2nd line to state that since 1987, the VTDEC sampled a well along Willow Brook which may intake surface water. This well was sampled in 1991. No contamination was detected in this well in 1991. This well was again sampled in 1992 by EPA. Again no contamination was detected in this well.

15. Page 2-4 -- Include a paragraph which discuss the listing of the Site on the NPL.

16. Page 2-4, carryover ¶ -- Provide a more accurate description of Site sampling results. In addition to PCBs, other contaminants have been detected at the Site which exceed drinking water standards. At a minimum provide a summary tables of analytical results and a text description of the range of contaminants.

17. Page 2-6, 1st ¶ -- Correct the statement that analysis indicates "that off-site groundwater has not been impacted by the

landfill" to state that domestic wells adjacent to the Site have not been impacted.

18. Page 2-9, 3d and 4th ¶s -- Remove "and therefore warrant no further investigation." EPA will make that determination.

19. Page 2-11 -- Discuss the levels of metals and VOCs which do not have MCLS as compared to risk based levels.

20. Page 2-11, 4 ¶ -- What is the basis for the Vermont background levels of benzene?

21. Page 2-12, carryover ¶ -- Deficiencies in the cap as described here undercut earlier general statement that the cap is a low permeability cap. Revise the text to reflect this change.

22. Page 2-13 -- At a minimum, include a cross-section and a groundwater flow diagram.

23. Page 2-14 -- The information regarding the surface water diversion indicates that historical information supports periodic saturation of certain areas of the landfill prior to surface water diversion. Consider this issue in the cap evaluation.

24. Page 2-14, 1st heading -- Delete "REMEDIAL". In that ¶, same comment re "low permeability" cap.

25. Page 2-17, top 5 bullets -- These are described on the previous page as "design components". Were these "design components" implemented and satisfied?

26. Page 2-20 -- Discuss any exceedances of acute exposures AWQC.

27. Page 2-22, last ¶ -- Replace last line with "EE/CA Approval Memorandum for this Site."

28. Page 2-23, 2d ¶, 3d line -- Change "estimates" to "estimated". In the 3d ¶, first line, list the NCP factors referenced in the EE/CA Approval Memo.

29. Page 3-1 -- Regarding the exemption from the $2 million statutory limit, additional text should be added which discusses in a general way how the source control alternatives evaluated in the EE/CA would be consistent with potential long term remedial action to be taken at this Site.

30. Page 3-1, 1st ¶ -- After "However," add "CERCLA § 104(c) and". Replace "specifically states" with "provide". In the last line, change "an exemption" to "one of the enumerated exemptions". In the 2d ¶, 2d line, change "104(b)(5)(i)" to "104(c)(1)(A)". In the 6th line, change "104(b)(5)(i)" to "104(c)(1)(C)".

31. Page 3-2, 1st ¶, 2d line -- After "environment", add "through source control measures."

32. Page 3-3, Schedule of Removal Action -- According to the NTCRA guidance, this section should discuss the schedule for implementing the ultimate NTCRA, <u>not</u> the schedule for preparing the EE/CA. Thus the text should read:

"The components of <u>the</u> removal action schedule consist of:

- preparation of the EE/CA Report (final version by 6/94);
- EPA issuance of Proposed Plan (7/94);
- public comment period (7-8/94);
- EPA issuance of Action Memorandum (9/94);
- NTCRA negotiations (10-11/94);
- NTCRA design period (11/94-5/95);
- NTCRA construction (5/95-11/95)

33. Page 3-4 -- The schedule does not anticipate construction activity in 1995. Revise the schedule to decrease the design time frame. It is anticipated that the design shall commence during the early fall 1994 and completed by early spring 1995 so that construction might begin in summer 1995.

34. Fig. 3-1 -- Redo the dates to match the planned EE/CA schedule.

35. Page 3-7, 1st ¶ -- In the 2d and 3d lines, replace "remedial" with "response". In 2d ¶, 3d line - delete "(TBC)". In the 4th line, replace "to be not" with "not to be".

36. Page 3-8 -- Chemical-specific ARARs should be listed first.

37. Page 3-9, 1st full ¶, 3d line -- Replace "remedial" with "response". Last line -- TBCs should not be in a separate table; rather, they should be incorporated into the chemical, action, and location-specific tables.

38. Page 3-10 -- In general, the ARARs tables are too broad in that they include ARARs that EPA may determine do not apply to the bennington site, e.g., if the site is not in a floodplain or not in a federal wilderness area. The tables must only include ARARs that can apply to this Site. Attachment III provides example tables from the Old Southington Landfill Superfund Site case which show the proper format for ARARs tables and also included are examples of ARARs for a source control landfill remedy. Attachment III also includes a table from the Parker Superfund Site. Many of the VT ARARs should be the same for the two sites. [Note however that Parker is not just source control but is a comprehensive remedy. Consequently, there are groundwater ARARs included which would not apply to the Bennington Site].

39. Page 3-10, Table 3-1, 1st row, last column -- If the Site is not in a floodplain, delete this row. Re 5th and 6th rows, same comment.

40. Page 3-11, 1st, 3d, and 4th rows -- Same as previous comment.

41. Page 3-32 -- Wrong format; see examples attached hereto.

42. Page 3-33, Table 3-5 -- Reference and discuss this table in the text. Also, municipal ordinances are not ARARs - only federal and state laws and regulations.

43. Page 3-33 -- The State of Vermont stormwater discharge rules would also apply.

44. Table 3-3 -- The table is informative. However, the chemical specific ARARs must also be presented in the standard ARAR format.

45. Table 3-3 -- RCRA is relevant and appropriate where wastes are sufficiently similar to RCRA wastes disposed of prior to 1980. Correct the text to reflect this.

46. Page 4-1, 1st ¶, 3d line -- Replace "remedial" with "removal". Replace "presumptive remedies" with "the presumptive remedy".

47. Page 4-2, item 6 -- Replace "Remediation of Soils/Sediments" with "Soils/Sediments Response Measures". Make this same change throughout text.

48. Page 4-3, 1st ¶ -- In the 4th line, after "landfill" add "(and thereby reduce the migration of contaminants to the groundwater),". In the 9th line, change "remedial" to "removal". In the second ¶, 6th line, provide the full title of the RCRA guidance on Subtitle C caps.

49. Page 4-4 -- Reference the Technical Guidance Document: Final Covers on Hazardous Waste Landfill and Surface Impoundments, EPA 530-SW-89-047 and used in the discussion of the cap layer.

50. Page 4-4 -- The drainage layer must have a sand hydraulic conductivity of at least 1×10^{-2} cm/sec or a synthetic material with a transmissivity of 3×10^{-5} m/sec. Correct the text to reflect this.

51. Page 4-4 -- Discuss the conductivity requirements of the barrier layer. Region I also requires a minimum thickness of 40 mil for the geomembrane.

52. Figure 4-1 -- Region I requires a non-woven geotextile filter fabric between the drainage and vegetative layers. Also, change mil thickness to 40.

53. Page 4-6 -- A single layer cap would not meet the performance standards of the technical guidance document on RCRA caps. As that guidance document is EPA's interpretation of the fairly vague 264 standards, not complying with the guidance is akin to not complying with the ARAR. Correct the text to reflect this.

54. Page 4-6 -- The single barrier cap described in this alternative is based upon the 264 closure standards. The controlling ARAR should be more closely specified. The same mil thickness and geotextile requirements apply to the single barrier cap.

55. Page 4-9 -- The current ground water contamination supports that the existing leachate collection system does not collect all leachate. Provide a more detailed of what is meant by upgrading the landfill underdrain system.

56. Page 4-11 -- Provide the BOD range for the Site.

57. Page 4-15 -- The EPA proposed rule and Vermont Air Division guidance should be considered in evaluating air systems.

58. Page 4-17, 1st ¶ -- Provide more information regarding the basis for determining that approximately 1,500 cy of impacted soil/sediments exist in the Drainage Pond and culvert areas.

59. Page 4-21 -- Change heading to"Post-Removal Site Control (Operation and Maintenance)". Make appropriate changes in the text.

60. Page 4-22 -- Specify what State guidelines and climate factors will affect the cap components.

61. Page 4-23 -- While the text describes a very well developed single barrier cap, Region I does not currently accept a single barrier as meeting the requirements of the RCRA Subtitle C technical guidance. The technical guidance does allow for site specific adjustments of the components. However, these adjustments must be technically based (i.e. steep slopes). Correct the text to reflect this.

62. Page 4-25, carryover ¶ -- Provide further discussion regarding the statement that wetlands may be impacted.

63. Page 4-25 -- Consider the leachate collection trench in this section rather than the next section.

64. Page 4-28 -- Indicate in the text whether the chemical treatment processes are retained or eliminated.

65. Page 4-31 -- Provide more discussion regarding the elimination of upgradient interceptor trenches. Why is an active system unacceptable?

66. Page 4-32 -- The installation of a barrier layer above the waste material will change the dynamics of air flow. Consider this in the landfill gas venting system discussions.

67. Page 4-34, 3d ¶ -- Delete the third sentence.

68. Page 4-38, 1st ¶ -- The estimated time for leachate to stop is very optimistic. What is the basis for this less than one year estimate? The text must discuss the residual drainage of the landfill after infiltration is stopped. Also, historical information supports that ground water is very close to the bottom of waste. Some leachate generation may continue due to ground water.

69. Page 5-1, § 5.0 -- List all of the subcriteria of each Criteria -- Effectiveness, Implementability, and Cost, and show that they have been analyzed. See § 2.6 and Exhibit 7 of the NTCRA Guidance.

70. Page 5-2, 2d ¶ -- Operations and Maintenance (O&M) should be costed out for 30 years. There may not be O&M activities under a final remedial action; consequently, this removal action should be self-contained and not rely on a subsequent action. Change the last two sentences of the 2d ¶ to reflect this change.

71. Page 5-2, 2d ¶ -- Current EPA and OMB policy is to use a 7% discount rate. The wording of this ¶ is confusing regarding the use of the discount rate to determine the net present value, and the use of the 7% rate to perform a "sensitivity" analysis (the min-max figures in Table 5-1). Delete all references and calculations for a 10% rate throughout the text and tables.

72. Page 5-4, carryover ¶ -- The discussion of RCRA Subtitle C is not accurate. In 2d ¶, delete second to last sentence regarding the alternative not being in compliance with the statutory limits. Make the same change in subsequent sections that have the same sentence (§ 5.3.2, 5.4.2). The real focus should be whether an alternative would be eligible for the consistency exemption. As source control measures intended to minimize the migration of contaminants to the groundwater and air, the alternatives are consistent with any potential remedial action that addresses groundwater.

73. Page 5-4, 1st ¶ -- The RCRA reference on this page is misleading since RCRA is relevant and appropriate to the action. Correct this in the text.

74. Page 5-4, 2d ¶ -- How can permission to dispose of the impacted groundwater at the local POTW be problematic? This alternative does not include discharge to a POTW.

75. Page 5-4 -- The statutory limit is not a factor for consideration. Correct the text to reflect this.

76. Page 5-5 -- The text on page 4-38 indicates that leachate would only be collected for one year. The cost associated with this one year discharge seems excessive. What is the expected flow rate?

77. Page 5-7 -- Table 5-1 should appear after pg. 5-2 rather than here.

78. Page 5-11, top ¶ -- The single barrier cap does not meet RCRA C requirements. Correct this discussion.

79. Cap cost -- The cost of a GCL in several other sites has been reported between .56 and .9 dollars per square foot installed. This would reduce the cost of the second barrier layer from $805,00 to approx. $120,000 - $240,000. Why does the cost estimate include a bedding layer, when an interim cap exists?

80. Section 6.0 -- Redo the comparative analysis based upon comments above regarding reconfiguring the alternatives.

81. Appendix A -- Include the Final EE/CA Memo and a better copy of 3/7/94 letter from EPA to the Settling Parties.

TA(4-5
CHEMICAL-SPECIFIC ARARs: CRITERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Medium	Requirements	Status	Alternatives	Synopsis of Requirement
STATE REGULATORY REQUIREMENT				
Groundwater	Vermont Hazardous Waste Management Act (10 V.S.A. Chapter 159, EPR Chapter 7).	Applicable	2; 3; 4; 5; 8A; 8B	Regulates the storage, transport, treatment, disposal, recycling, and managing of hazardous waste. Incorporates requirements of RCRA, 40 CFR Part 264, Subpart F, groundwater protection standards.
	Vermont Groundwater Protection Act (10 V.S.A. Chapter 48, EPR Chapter 12).	Applicable	2; 3; 4; 5; 8A; 8B	Act protects groundwater through existing regulatory programs and provides restrictions, prohibitions, standards and criteria for groundwater protection for programs which regulate activities which may affect groundwater.
FEDERAL REGULATORY REQUIREMENTS				
Groundwater	Federal RCRA Subpart F Groundwater Protection Standards (40 CFR Part 264).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	Establishes, among other requirements, groundwater protection standard requirements for groundwater monitoring, detection monitoring, and compliance monitoring.
	Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (40 CFR Part 141).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	MCLs have been promulgated for a number of organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies. MCLs are considered relevant and appropriate for groundwater aquifers potentially used for drinking water.
	Federal Safe Drinking Water Act Maximum Contaminant Level Goals (MCLGs) (40 CFR Part 141).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	MCLGs are health-based goals (non-enforceable) for public water supplies. The USEPA has promulgated non-zero MCLGs for specific contaminants.
	Federal Safe Drinking Water Act proposed MCLs (40 CFR Part 141).	To Be Considered	2; 3; 4; 5; 8A; 8B	These regulations would establish MCLs for certain chemical species.
	USEPA Human Health Assessment Cancer Slope Factors (CSFs).	To Be Considered	2; 3; 4; 5; 8A; 8B	EPA develops CSFs for health effects assessments or evaluation by the Human Health Assessment Group (HHAG).
	USEPA Reference Doses (RfDs).	To Be Considered	2; 3; 4; 5; 8A; 8B	RfDs are dose levels developed by EPA for use in the characterization of risks due to non-carcinogens in various media.

Note:
1. Alternative 1, No Action, is described in detail in Table 4-1. The No Action Alternative is not included in this table.
2. See the appropriate table for each alternative for the action to be taken to attain ARAR.

File:parker/arars/epa/epa-chm-sp.fs
dt/wp

ƨ 4-6
ACTION-SPECIFIC ARARs: CRı ERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Medium	Requirements	Status	Alternatives	Synopsis of Requirement
STATE REGULATORY REQUIREMENT				
Air	Vermont Air Pollution Control Regulations (10 V.S.A. Section 551 et seq. EPR Chapter 5).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	Lists hazardous contaminants and sets Hazard Limiting Values and Action Limits (establishes air quality standards and allowable discharges).
Waste	Vermont Hazardous Waste Management Act (10 V.S.A. Chapter 159, EPR Chapter 7).	Applicable	2; 3; 4; 5; 8A; 8B	These regulations establish requirements for hazardous waste facilities, including facility standards, emergency preparedness and prevention, and contingency planning. Closure of land disposal units shall be implemented to accomplish the objectives detailed in 40 CFR Part 264, including Subpart F (Releases from waste management units), Subpart G (Closure and post-closure), and Subpart N (Landfills).
	Vermont Land Use and Development Law (Act 250 - 10 V.S.A. Chapter 151).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	Construction of improvements on tracts of land larger than 10 acres are required to comply with criteria specified in the Act, including no undue air or water pollution, no disposal of harmful or toxic substances to groundwater, no unreasonable soil erosion, compliance with wetlands rules, and no adverse affects on aesthetic values.
Surface Waters	Vermont Water Quality Standards (10 V.S.A. Chapter 47).	Applicable	2; 3; 4; 5; 8A; 8B	Designates surface water uses and sets ambient water quality standards. Establishes stormwater discharge requirements for discharges to a surface water body.
	Vermont National Pollution Discharge Elimination System (NPDES) Regulations (EPR Chapter 13).	Applicable	3; 4; 5; 8A; 8B	Regulates the discharge of any waste into the waters of Vermont, and the terms and conditions of permits. Requirements include monitoring, recording, and reporting compliance.
	Vermont Stream Alteration (10 V.S.A. Chapter 4).	Applicable	2; 3; 4; 5; 8A; 8B	Regulates and permits activities in streams.
	Vermont Water Supply and Wastewater Permit (10 V.S.A. Chapter 6).	Relevant and Appropriate	3; 4; 5; 8A; 8B	Regulates water supply and wastewater facility design and construction.

Notes: 1. Alternative 1, No Action, is described in detail in Table 4-1. The No Action Alternative is not included in this table.
2. See the appropriate table for each alternative for the action to be taken to attain ARAR.

4-6

ACTION-SPECIFIC ARARs: CRITERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Medium	Requirements	Status	Alternatives	Synopsis of Requirement
FEDERAL REGULATORY REQUIREMENTS				
Air	Federal Clean Air Act - National Emissions Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR Part 61).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	Establishes emission levels for certain hazardous air pollutants.
	Federal Clean Air Act - Non-methane organic compounds (NMOCs) (Proposed rule - 56 FR 24468, to be codified at 40 CFR Part 60 Subpart WWW).	To Be Considered	2; 3; 4; 5; 8A; 8B	Regulations would require NMOC-specific gas collection and control systems, monitoring, and gas generation estimates. The proposed rule would also establish a performance standard for NMOCs emissions from municipal solid waste landfills.
	Federal RCRA Air Emissions Standards for Equipment Leaks, 40 CFR Part 264, Subpart BB.	Applicable	3; 4; 5; 8A; 8B	Standards for air emissions for equipment that contains or contacts RCRA wastes with organic concentrations of at least 10% by weight.
	Federal RCRA Air Emissions Standards for Process Vents, 40 CFR Part 264, Subpart AA.	Applicable	3; 4; 5; 8A; 8B	Standards for air emissions from process vents associated with distillation, fractionation, thin film evaportion, column extraction or air steam stripping operations that treat RCRA substances and have total organic concentrations of 10 ppm or greater.
	Federal RCRA, Air Emissions from Treatment, Storage and Disposal Facilities, 40 CFR, Part 264, Subpart CC (Proposed 56 FR 33490-33598 7/22/91).	To Be Considered	3; 4; 5; 8A; 8B	Proposed standards for air emissions from treatment, storage and disposal facilities with VOC concentrations equal to or greater than 500 ppm.
	USEPA Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites. (OSWER Dir. 9355.0.28, 6/15/89).	To Be Considered	3; 4; 5; 8A; 8B	Provides guidance on the control of air emissions from air strippers used at Superfund sites for groundwater treatment and distinquishes between site located in attainment and non-attainment areas for ozone.
	USEPA Region I Memo, July 12, 1989, Louis Gitto to Merrill Hohman.	To Be Considered	3; 4; 5; 8A; 8B	States that Superfund air strippers in ozone non-attainment areas will generally merit controls on all VOC emissions.

Table 4-6
ACTION-SPECIFIC ARARs: CRITERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Medium	Requirements	Status	Alternatives	Synopsis of Requirement
Waste	Federal RCRA Subtitle C, 40 CFR Part 264.	Applicable	2; 3; 4; 5; 8A; 8B	RCRA Subtitle C establishes standards applicable to treatment, storage, transport, and disposal of hazardous waste and the closure of hazardous waste facilities.
	Federal RCRA Criteria for Municipal Solid Waste Landfills (40 CFR Part 258, Subpart E).	Relevant and Appropriate	2; 3; 4; 5; 8A; 8B	Establishes groundwater monitoring requirements for municipal solid waste landfills.
	Federal RCRA Identification and Listing of Hazardous Waste (40 CFR Part 261).	Applicable	2; 3; 4; 5; 8A; 8B	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265.
	Federal RCRA Interim Status TSDF Standards; Chemical, Physical and Biological Treatment (40 CRF Part 265, Subpart Q).	Applicable	3; 4; 5; 8A; 8B	General operating, waste analysis and trial test, inspection and closure requirements for facilities which treat hazardous waste by chemical, physical or biological methods in other than tanks, surface impoundment; and land treatment facilities.
	USEPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047).	To Be Considered	2; 3; 4; 5; 8A; 8B	Presents technical specifications for the design of multilayer covers at landfills where hazardous wastes were disposed of.
Surface Waters	Federal Clean Water Act National Pollution Discharge Elimination System (NPDES) (40 CFR Parts 122, 125, 131, and 136).	Applicable	3; 4; 5; 8A; 8B	Imposes limitations on discharge to surface water.
	Federal Clean Water Act Ambient Water Quality Criteria (AWQC) (40 CFR Part 120).	Applicable	3; 4; 5; 8A; 8B	Remedial actions involving contaminated surface water or groundwater must consider the uses of the water and the circumstances of the release or threatened release.

TABLE 4-7
LOCATION-SPECIFIC ARARs: CRITERIA, ADVISORIES, AND GUIDANCE
Parker Landfill Feasibility Study
Lyndonville, Vermont

Medium	Requirements	Status	Alternatives	Synopsis of Requirement
STATE REGULATORY REQUIREMENTS				
Wetlands	Vermont Wetlands Rules (10 V.S.A. Chapter 37).	Applicable	2; 3; 4; 5; 8A; 8B	These regulations include procedures for the identification, classification, and protection of significant wetlands.
FEDERAL REGULATORY REQUIREMENTS				
Wetlands	Federal Clean Water Act § 404 - Dredge and Fill Activities (40 CFR Part 230; 33 CFR Parts 320-328).	Applicable	2; 3; 4; 5; 8A; 8B	Requires that for dredging or filling of wetlands: no practicable alternatives exist; the activity will not cause a violation of state water quality standards or significant degradation of the water; and adverse effects will be minimized.
	Federal Fish and Wildlife Coordination Act (40 CFR Part 6).	Applicable	2; 3; 4; 5; 8A; 8B	Establishes requirements for a consultation with U.S. Fish and Wildlife Service and state wildlife agencies to mitigate losses of fish and wildlife that result from modification of a water body.
	Federal Executive Order on Floodplain Management (E.O. 11988, 40 CFR Part 6, App. A).	~~Relevant and Appropriate~~ Applicable	2; 3; 4; 5; 8A; 8B	Requires federal agencies to avoid adversely affecting floodplains. Requirements for floodplains determination, assessment, and preservation or restoration.
	Federal Executive Order on Protection of Wetlands (E.O. 11990, 40 CFR Part 6, App. A).	~~Relevant and Appropriate~~ Applicable	2; 3; 4; 5; 8A; 8B	Requires federal agencies to avoid impacts associated with the destruction or loss of wetlands, minimize potential harm, preserve and enhance wetlands, and avoid support of new construction in wetlands if a practicable alternative exists.

Notes: 1. Alternative 1, No Action is described in detail in Table 4-1. The No Action Alternative is not included in this table.\
2. See the appropriate table for each alternative for the action to be taken to attain ARAR.

TABLE E .A
OLD SOUTHINGTON LANDFILL SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
CHEMICAL-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
ìroundwater	**Federal** Safe Drinking Water Act: Maximum Contaminant Levels (MCLs), 40 CFR Part 141.	**Not an ARAR for OU1**	None	MCLs have been promulgated for a number of organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies. MCLs are considered relevant and appropriate for groundwater because it is federally classified as a potential drinking water source.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.
ìroundwater	**Federal** Safe Drinking Water Act: Maximum Contaminant Level Goals (MCLGs), 40 CFR Part 141.	**Not an ARAR for OU1**	None	MCLGs are non-enforceable health-based goals for public water supplies. The USEPA has promulgated non-zero MCLGs for specific contaminants.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.
ìroundwater	**Federal** Resource Conservation and Recovery Act (RCRA) - Releases from Solid Waste Management Units, 40 CFR Part 264 Subpart F.	**Not an ARAR for OU1**	None	General requirements for groundwater monitoring for releases of specified hazardous constituents from RCRA solid waste management facilities.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.
Groundwater	**Federal** Resource Conservation and Recovery Act - Criteria for Municipal Solid Waste landfills, 40 CFR Part 258 Subpart E.	**Not an ARAR for OU1**	None	Establishes groundwater monitoring requirements for a specified list of contaminants at municipal solid waste landfills.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.
N/A	USEPA Human Health Assessment Cancer Slope Factors (CSFs)	TBC	All Alternatives	CSFs are developed by EPA for health effects assessments or evaluation by the Human Health Assessment Group (HHAG).	These values present the most up to date cancer risk potency information. CSFs were used to compute the individual cancer risk resulting from exposure to contaminants.

TABLE E(
OLD SOUTHINGTON LAND...L SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
CHEMICAL-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
/A	USEPA Reference Doses (RfDs)	TBC	All Alternatives	RfDs are dose levels developed by EPA for use in the characterization of risks due to non-carcinogens in various media.	RfDs are typically employed to characterize risks of groundwater contaminant exposure (for ingestion pathways).
roundwater	<u>Connecticut</u> Drinking Water Regulations [CGS 19-13-B102(e)(2-3)].	**Not an ARAR for OU1**	None	State MCLs have been promulgated for inorganic and organic chemicals and pesticides. These levels regulate the concentrations of contaminants in public drinking water supplies, but may also be appropriate for groundwater aquifers potentially used for drinking water.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.
roundwater	<u>Connecticut</u> Groundwater Standards (CGS 22a-426 IV).	**Not an ARAR for OU1**	None	Standards have been promulgated to preserve and enhance the quality of state waters. The State has classified the aquifer under the Site as GB -- presumed unfit for human consumption without treatment.	As this operable unit will only focus on landfill source control measures, groundwater cleanup will not be addressed and groundwater cleanup goals will not be set until Operable Unit 2.

TABLE I(3
OLD SOUTHINGTON LANDFILL SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
ACTION-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
/aste	Federal RCRA - Closure and Post-Closure of Municipal Solid Waste Landfills (40 CFR Part 258 Subpart F).	Relevant and Appropriate		Requires installation and maintenance of a final cover system that is designed to minimize infiltration and erosion. Also requires leachate collection, groundwater monitoring, and landfill gas monitoring.	Remedial alternatives involving capping can be designed to meet or exceed the closure/post-closure requirements for municipal solid waste landfills. As this operable unit will only focus on landfill source controls, groundwater monitoring requirements will be evaluated in the second operable unit.
/aste	Federal RCRA - Emergency Preparedness and Prevention; Contingency Planning (40 CFR Part 264 Subparts C, D).	Relevant and Appropriate		Requirements for minimizing the possibility of fire, explosion or release of hazardous material; contingency plan requirements in the event of fire, explosion or release from a facility.	Remedial alternatives can be designed to meet the substantive requirements specified in these regulations.
/aste	Federal RCRA - Closure and Post-Closure Requirements (40 CFR Part 264 Subpart G).	Relevant and Appropriate		Details general requirements for closure and post-closure of hazardous waste facilities.	Remedial alternatives can be designed to meet these requirements.
/aste	Federal RCRA - Requirements for Hazardous Waste Landfills (40 CFR Part 264 Subpart N).	Relevant and Appropriate		Specifies design and operating requirements for hazardous waste landfills.	Remedial alternatives involving capping can be designed to meet these requirements.
/aste	USEPA Technical Guidance - Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA/530-SW-89-047.	TBC		Presents technical specifications for the design of multi-layer covers at landfills where hazardous wastes were disposed of.	Remedial alternatives involving capping be designed to meet these design specifications.
ıir	Federal Clean Air Act - National Emission Standards for Hazardous Air Pollutants (NESHAPs), 40 CFR Part 61.	Relevant and Appropriate		Establishes emission levels for eight listed hazardous air pollutants emitted from particular types of facilities.	Remedial alternatives involving gas collection and treatment can be designed to attain the NESHAP numerical standards for potential landfill gases, including benzene and vinyl chloride.

TABLE (₄B
OLD SOUTHINGTON LANDFILL SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
ACTION-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
Air	Federal Clean Air Act - Non-methane organic compounds (NMOCs) (Proposed rule - 56 FR 24468, to be codified at 40 CFR Part 60 Subpart WWW).	TBC		Regulations would require NMOC-specific gas collection and control systems, monitoring, and gas generation estimates. The proposed rule would also establish a performance standard for NMOCs emissions from municipal solid waste landfills.	The proposed regulations will be considered in the design of alternatives that include a landfill gas collection and treatment system.
Air	Federal Noise Control Regulations (40 CFR Parts 204, 205).	Applicable		Establish noise emission standards applicable to portable air compressors and medium and heavy trucks.	Construction equipment will be required to comply with applicable noise emission standards.
Waste	Connecticut Solid Waste Management Regulations (RCSA 22a-209-1 - 15)	Applicable		Establish standards for the closure of solid waste disposal areas.	Those portions of the regulations that are more stringent than the federal RCRA Subtitle D regulations will be complied with.
Waste	Connecticut Hazardous Waste Management Regulations (RCSA 22a-449(c)-100 - 110)	Relevant and Appropriate		Establish standards for the management and closure of hazardous waste facilities.	Those portions of the regulations that are more stringent than the federal RCRA Subtitle C regulations will be complied with.
Air	Connecticut Air Pollution Regulations - Stationary Sources (CGS 22a-174-3).	Applicable		Requires that stationary sources of air pollutants meet specified standards prior to construction and operation. May require controls to abate pollution.	Remedial alternatives that include a landfill gas collection and treatment system can be designed to meet substantive standards established under these regulations.
Air	Connecticut Air Pollution Regulations - Fugitive Dust Emissions (CGS 22a-174-18[b]).	Applicable		Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne during demolition and construction activities and material handling operations.	Alternatives that involve building demolition and landfill cap construction can be conducted in a manner to minimize fugitive dust emissions from the Site.

TABLE E

OLD SOUTHINGTON LANDFILL SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
ACTION-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
ir	Connecticut Air Pollution Regulations - Control of Odors (CGS 22a-174-23).	Applicable		Prohibits the emission of any substance that constitutes a nuisance because of objectionable odor.	Site remediation activities will be planned to control the release of objectionable odors from the Site.

TABLE E. -1C
OLD SOUTHINGTON LANDFILL SUPERFUND SITE
1ST OPERABLE UNIT - LANDFILL SOURCE CONTROL
LOCATION-SPECIFIC ARARS

Medium	Requirements	Status	Alternatives	Synopsis of Requirement	Action to be taken to attain ARAR
Wetlands	Federal Executive Order on Protection of Wetlands (E.O. 11990, 40 CFR Part 6, App. A).	Applicable		Requires federal agencies to avoid impacts associated with the destruction or loss of wetlands, minimize potential harm, preserve and enhance wetlands, and avoid support of new construction in wetlands if a practicable alternative exists.	Remedial alternatives that include a landfill cap can be engineered to minimize impacts to the shoreline of Black Pond during the dredging of waste material. To the extent necessary, wetlands restoration and/or replication can be undertaken.
Wetlands	Federal Clean Water Act §404 - Dredge and Fill Activities (40 CFR Part 230; 33 CFR Parts 320-328).	Applicable		Regulates the dredging or filling of wetlands and waterways, and requires that construction impacts be minimized.	Remedial alternatives that include a landfill cap can be engineered to minimize impacts to the shoreline of Black Pond during the dredging of waste material. To the extent necessary, wetlands restoration and/or replication can be undertaken.
Surface Water	Federal Fish and Wildlife Coordination Act (40 CFR Part 6).	Relevant and Appropriate		Requires consultation with the Fish and Wildlife Service and state wildlife agencies to mitigate losses of fish and wildlife resulting from modification of a water body.	Remedial alternatives that include a landfill cap or dredging activities can be designed to minimize the impact to fish and wildlife habitats in Black Pond.
Surface Water and Wetlands	Connecticut - Inland Wetlands Regulations (RCSA 22a-39-1 through 15).	Applicable		Regulates any operation within or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution of such wetland or watercourse.	Remedial alternatives that include a landfill cap can be engineered to minimize impacts to the shoreline of Black Pond during the dredging of waste material. To the extent necessary, wetlands restoration and/or replication can be undertaken.