Final
Feasibility Study Report for the Luzerne Road Site
Queensbury, New York

Site No. 5-57-010
Contract Number: D003493
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Prepared for:

NEW YORK STATE
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List of Abbreviations and Acronyms

AMG	AMG Industries
AMSL	above mean seal level
APCS	air pollution control system
APEG	glycolate/alkaline polyethylene glycol
ARAR	applicable or relevant and appropriate requirements
BCD	base-catalyzed decomposition
BCY	bank cubic yards
BGS	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
cm/s	centimeters per second
COC	contaminants of concern
CWM	Chemical Waste Management
DPT	direct-push technology
E & E	Ecology and Environment Engineering, P.C.
EPA	United States Environmental Protection Agency
F	Fahrenheit
FS	Feasibility Study
ft^2	square feet
ft/day	feet per day
ft/ft	feet per foot
ft^3/s	cubic feet per second
ft/s	feet per second
GCL	geosynthetic clay liner
gpm	gallons per minute

List of Abbreviations and Acronyms (cont.)

GRA	general response actions
HDPE	high density polyethylene
HOS	halogenated organic compound scan
HTRW	Hazardous, Toxic, and Radioactive Waste
HTTD	high-temperature thermal desorption
ISTD	in situ thermal desorption
ISV	in situ vitrification
KPEG	potassium polyethylene glycol
LTTD	low-temperature thermal desorption
MCL	maximum contaminant levels
MCLS	maximum contaminant level goals
µg/kg	microgram per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NCP	National Contingency Plan
NFECS	Naval Facilities Engineering Service Center
NYCRR	New York State Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O & M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	operable unit
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethylene
POTW	publicly owned treatment works
ppb	parts per billion
PVC	polyvinyl chloride
RAO	remedial action objective
RCC	Resource Conservation Company
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROW	right-of-way

List of Abbreviations and Acronyms (cont.)

SCG	Standards, Criteria, and Guidance
SDWA	Safe Drinking Water Act
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TAGM	Technical and Administrative Guidance Memorandum
TBC	to be considered
TCE	trichloroethylene
TCL/TAL	Target Compound List/Target Analyte List
TCLP	toxicity character leaching procedure
TSCA	Toxic Substance Control Act
UV	ultraviolet
VOC	volatile organic compound

1 Introduction

1.1 Purpose of the Feasibility Study

Ecology and Environment Engineering, P.C. (E & E) was tasked by the New York State Department of Environmental Conservation (NYSDEC), Division of Environmental Remediation, to complete a Feasibility Study (FS) at the Luzerne Road Site (No. 5-57-010) in Glens Falls, New York. The FS report is conducted in accordance with the United States Environmental Protection Agency's (EPA's) Guidance for Conducting Remedial Investigations and Feasibility Studies Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (EPA 540/G-89/004) and NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites.

A Remedial Investigation (RI) was conducted at the site (E & E 2002) to evaluate the nature, level, and extent of contamination. During the course of the RI, it was determined necessary to define the site as three separate but related operable units (OUs):

1. The previously constructed polychlorinated biphenyl (PCB) landfill cell (OU-1);

2. On-site groundwater, along with on-site and off-site soils (OU-2); and

3. Off-site groundwater located in residential areas (OU-3).

The results of the RI for OU-1 and OU-2 were presented in the 2002 RI report (E & E 2002). An additional study is presently being conducted to complete the RI for OU-3. This study will be documented as an addendum to the 2002 RI report. This FS report will address OU-1, OU-2, and OU-3. However, off-site soils that were excavated and disposed of during the RI work have not been addressed as part of this FS.

1.2 Site Background and Previous Investigations

1.2.1 Site Description and Surrounding Land Uses

The Luzerne Road Site is comprised of two contiguous land parcels located at 51 and 53 Luzerne Road in the Town of Queensbury, County of Warren, New York (see Figures 1-1 and 1-2). The New York State Registry of Inactive Hazardous Waste Sites lists the site as Class 2, indicating that the site poses a significant threat to public health or the environment. Confirmed hazardous waste disposal at the site includes PCBs, which have been found in site soils and groundwater during previous investigations.

The Luzerne Road Site is located in the southeastern portion of Warren County, approximately 0.5 mile west of the City of Glens Falls city limit. Land uses surrounding the site area include residential, light industrial, and vacant land. The Hudson River is located approximately 0.5 mile south of the site. The site is bounded to the north and west by the Glens Falls landfill site, also listed as a Class 2 site on the New York State Registry of Inactive Hazardous Waste Sites. The Glens Falls landfill site reportedly received primarily municipal waste as well as an unknown quantity of PCB-containing capacitors and approximately 5 tons of ink sludge.

The 55 and 53 Luzerne Road properties each consist of approximately 3 acres. The southern portion of the 53 Luzerne property contains a single-story building located in the southern third of this property. This building is currently occupied by a furniture manufacturer. A gravel parking lot extends northward from this building to approximately the 55 Luzerne Road property's north-south mid line. The northern half of this property is an open grass-covered field that abuts the southern perimeter of the Glens Falls landfill. This landfill perimeter area abutting 53 Luzerne Road is wooded, while Luzerne Road abuts the southern side. The 53 Luzerne Road property is generally flat; surface drainage flows to the west along an excavated swale. This swale drains south toward Luzerne Road, except near the northern end, where it empties into a pit believed to have been a borrow pit for sand by the operators of the Glens Falls landfill. There is no drainage swale paralleling the south side of 53 Luzerne Road. While site topography near the road slopes toward the road, very little stormwater runoff is expected to accumulate due to the highly porous nature of site surface soils. Thus, significant migration of contaminants via runoff is not expected.

A wooded area and a dirt road leading to the southern boundary of the Glens Falls landfill are located on the western edge of the 53 Luzerne Road property. Note that the Glens Falls landfill abuts the northwest and northern portion of this property.

A secure PCB storage cell approximately 440 feet long by 265 feet wide (fence line of cell), and having an approximate elevation of 12 feet above existing grade is located on the northern end of a 2.7-acre parcel owned by New York State. This parcel is unofficially labeled 51 Luzerne Road as it borders the 53 Luzerne

Road property's east side. The PCB cell is grass-covered and fenced. North and northeast of the cell is a utility-owned right-of-way (ROW); beyond which is an area used by the Town of Queensbury for storing snow. North of the snow storage area lies a topographic depression assumed to be the former borrow pit for daily cover material at the Glens Falls landfill. Located to the east of the 51 Luzerne Road property is a vacant field that extends to the next cross street, Veterans Road. Beyond a densely wooded area due south of the cell lies Luzerne Road. A cemetery and private residences lie south of the site. Pine Street intersects Luzerne Road due south of the western end of the concrete block building.

RI activities were concentrated within a study area encompassing most of 53/55 Luzerne Road as well as the 51 Luzerne Road property and a portion of the property located at the corner of Veteran's Road and Luzerne Road. Existing wells surrounding the Glens Falls landfill to the west were also sampled, although none of the Glens Falls landfill property was considered within the study area boundaries for the RI. In addition to on-site activities, the RI work also included investigation of several residential locations located in various parts of Queensbury. Soil removal actions had been conducted at several of these residences in 1979 due to concern for PCB presence. However, post-cleanup verification sampling had not been conducted as part of the removal action. The purpose of residential sampling activities conducted under the RI was to verify completion of residential cleanup activities. The results of this sampling effort are presented in the RI report (E & E 2002).

1.2.2 Site History

The northern portion of the 53/55 Luzerne Road site was reportedly used as a junkyard by a previous owner. Based on historical photographs of PCB-containing equipment remnants lying on the ground surface, it is believed that the site's PCB contamination resulted from electrical capacitor salvaging activities. The capacitors contained significant amounts of salvageable copper, as well as PCB-containing fluids. Site surface soil PCB concentrations found during previous site soil studies indicate salvage operation staff did not utilize sound waste fluid management practices. PCB soil concentrations indicate PCB-containing fluids were not containerized and were allowed to be released onto the ground surface in the process of extracting copper parts from capacitors and other electrical equipment. Similar salvaging activities are reported to have occurred at some local residences.

PCB contamination at the site was first discovered in the spring of 1979. Sampling conducted in April and June 1979 identified the 53/55 Luzerne Road property (then known as the Alkes property) as well as three private residences as having soils contaminated by PCBs. An article in the Saratogan (undated, but assumed to be shortly thereafter) indicated that 15 shallow water supply wells and 45 homes were within a 500-foot radius of the three contaminated residential properties. In August 1979, Dr. David Axelrod, then Commissioner of the New

York State Department of Health (NYSDOH), declared a public health emergency regarding the PCB-contaminated properties.

On September 9, 1979, NYSDEC, NYSDOH, the County of Warren, the Town of Queensbury, and the City of Glens Falls entered an agreement to construct a secure PCB cell to dispose of contaminated soils. A letter from EPA dated October 23, 1979, stated approval of the cell's construction, outlined waivers for certain construction requirements, and outlined requirements for construction and maintenance of the cell. Excavation and disposal of contaminated soil in the secure cell occurred in late October and early November 1979. Records kept during cleanup activities indicate that the extent of PCB cleanup was based on olfactory evidence. On October 31, 1979 three workers were overcome by fumes while excavating on the 53 Luzerne Road property (Fear 1979). After that incident, workers were required to wear full-faced respirators with supplied air while excavating on the site.

Due to a greater than expected quantity of excavated soil and reaching the cell's capacity, some contaminated soil was left behind in a 2-acre area on the north end of the 53 and 55 Luzerne Road properties. That area was reportedly capped with 1 foot of horse manure and 6 inches of topsoil (Monroe 1982). The total volume of contaminated soil stored in the cell is unknown. Based on historic information on the cell construction, E & E estimated the volume of contaminated soil in the cell to be approximately 49,603 bank cubic yards (BCY). The results and assumptions used in developing this estimate are presented in Section 2.3.3.

The secure landfill cell was monitored for leachate accrual starting in 1979. Leachate was removed periodically and disposed of. However, NYSDEC records indicate that leachate removal was stopped in 1985 and the cap was improved in 1986 to minimize leachate generation. Leachate and groundwater monitoring continued monthly until 1991, then continued on a quarterly basis thereafter. Monitoring included one upgradient shallow well, one downgradient well, and the secure cell center standpipe. Upgradient groundwater PCB concentrations varied up to 22 micrograms per liter (µg/L) (May 1989), but were typically reported as less than 10 µg/L. An upgradient PCB source was never confirmed. Downgradient groundwater PCB concentrations varied up to 400 µg/L in May 1989, but were typically reported less than 100 µg/L. Leachate PCB concentrations showed a significant increase from a typical value of less than 100 µg/L prior to December 1989 to concentrations of more than 100 times that value in June 1991 (NYSDEC 1995).

Leachate levels showed a steady decrease in elevation from a 10.5-foot depth in April 1989 to a 7.2-foot depth in March 1995. This decrease of leachate levels, without pumping, was believed to indicate a leak in the cell liner system. In response to this leachate level drop, approximately 40,000 gallons of leachate were removed from the secure cell during the summer of 1995. In February 1999, the RI was initiated for the site.

1.2.3 Previous Site Investigations

In May 1987, a Phase II investigation of the Glens Falls Landfill, northeast of the site, was completed (Recra Environmental, Inc. 1987). The scope of that study included air monitoring; a geophysical survey; subsurface investigations (including the installation of five shallow groundwater wells and two hand-augured boreholes); and the collection of seven soil, seven groundwater, and two sediment samples. The report findings indicated:

- **Environmental Setting:** There are no critical habitats in the site area.
- **Groundwater Usage:** Most local residences are serviced by the Town of Queensbury and the City of Glens Falls water departments. These departments draw water from the Hudson River, Halfway Creek, and three upland reservoirs. The nearest domestic wells are 1,300 feet north of the 53/55 Luzerne Road site along Sherman Avenue in a place suspected to be either up- or side-gradient to the main landfill site and range from 20 to 40 feet deep. No information was included in the Recra Environmental, Inc. report regarding domestic wells in the downgradient direction.
- **Geophysical Results:** There are no indications of a plume outside the landfill boundary, based on terrain conductivity. Seismic refraction indicated approximately 10 feet of loose sand followed by consolidated sand.
- **Hydrogeology:** Bedrock varies between shale and limestone and ranges in depth from 110 to 130 feet. Shallow soils (to the depth of the water table) are lake sands, very fine sands to pebbly sands, and are well sorted, well drained, and easily excavated. Geotechnical testing indicated 98.8% sand with the remaining 1.2% clay and silt.
- **Groundwater:** Groundwater flow is to the southeast with a hydraulic gradient of 0.005 feet per foot (ft/ft). Water table elevations range between approximately 376 to 363 feet above mean sea level (AMSL).
- **Analytical Results**:
  - **Air:** There were no analytes detected at concentrations above background concentrations.
  - **Subsurface Soil:** 1,1-dichloroethene and 1,1,2,2-tetrachloroethane were detected in soil samples collected during installation of two well boreholes, MW101-4 and MW101-5, located north of the secure cell, adjacent to the eastern side of the Glens Falls landfill.
  - **Surface Soil and Sediment:** PCBs were reported in all samples but one (HA101-1) located northeast of the secure cell. The maximum PCB concentration was reported at HA101-2 (160 milligrams per kilogram [mg/kg]) located on the 53 Luzerne Road property. A halogenated organic compound scan (HOS) (a type of analysis that identifies the presence of

PCBs and other halogenated compounds) indicated that these compounds were present in all samples, with a maximum at sample location HA101-2.

– **Groundwater**: PCBs were reported in groundwater samples collected from two wells, MW101-5 (a downgradient well at the landfill) and MW-101-1 (located west of the AMG Industries [AMG] facility). Aroclor 1016, a light Aroclor, was reported in a sample from MW101-5 at a concentration of 62 parts per billion (ppb). Halogenated organic compounds were reported in samples from both upgradient and downgradient wells maximum concentration was reported in a sample from downgradient well MW101-5.

In November 1991, an RI of the former AMG property (including both 53 and 55 Luzerne Road) was completed for AMG by Clough-Harbour and Associates (CHA 1991). The study included an electromagnetic survey and shallow soil investigation. The results indicated significant contamination remaining on the 53 Luzerne Road property. A maximum concentration of 62,300 mg/kg of PCB in soil was reported at approximately 10 feet deep. No contamination was reported on the 53/55 Luzerne Road property. Subsequent to the investigation, approximately 25 yards of soil were excavated from two locations near the AMG facility (CHA 1993).

In March 1997, supplemental investigations were completed around the Glens Falls landfill (E & E 1997). This study included the northern and western parts of the 53/55 Luzerne Road properties, as well as the Glens Falls landfill northwest of the site. The primary focus of this study was to evaluate groundwater conditions in the vicinity of the Glens Falls landfill. The study included installation of 22 soil borings via a Geoprobe; installation of four piezometers; collection of a total of 36 shallow groundwater samples; and collection of six soil samples from two locations. The results of this study indicated the 53 Luzerne Road property contains PCBs. PCBs are migrating off the site in the groundwater in an east-southeasterly direction at concentrations contravening New York State groundwater standards. Possible groundwater contamination sources include the Glens Falls landfill, the secure cell area, and the 53 Luzerne Road property, or a combination of these. Groundwater flow was reported as being to the east-southeast at a rate of 1.1 feet per day (ft/day).

In 1999, RI activities were initiated at the site. A detailed scope of these activities along with the results of the RI are presented in the 2002 RI report (E & E 2002). The following presents a summary of the major RI findings:

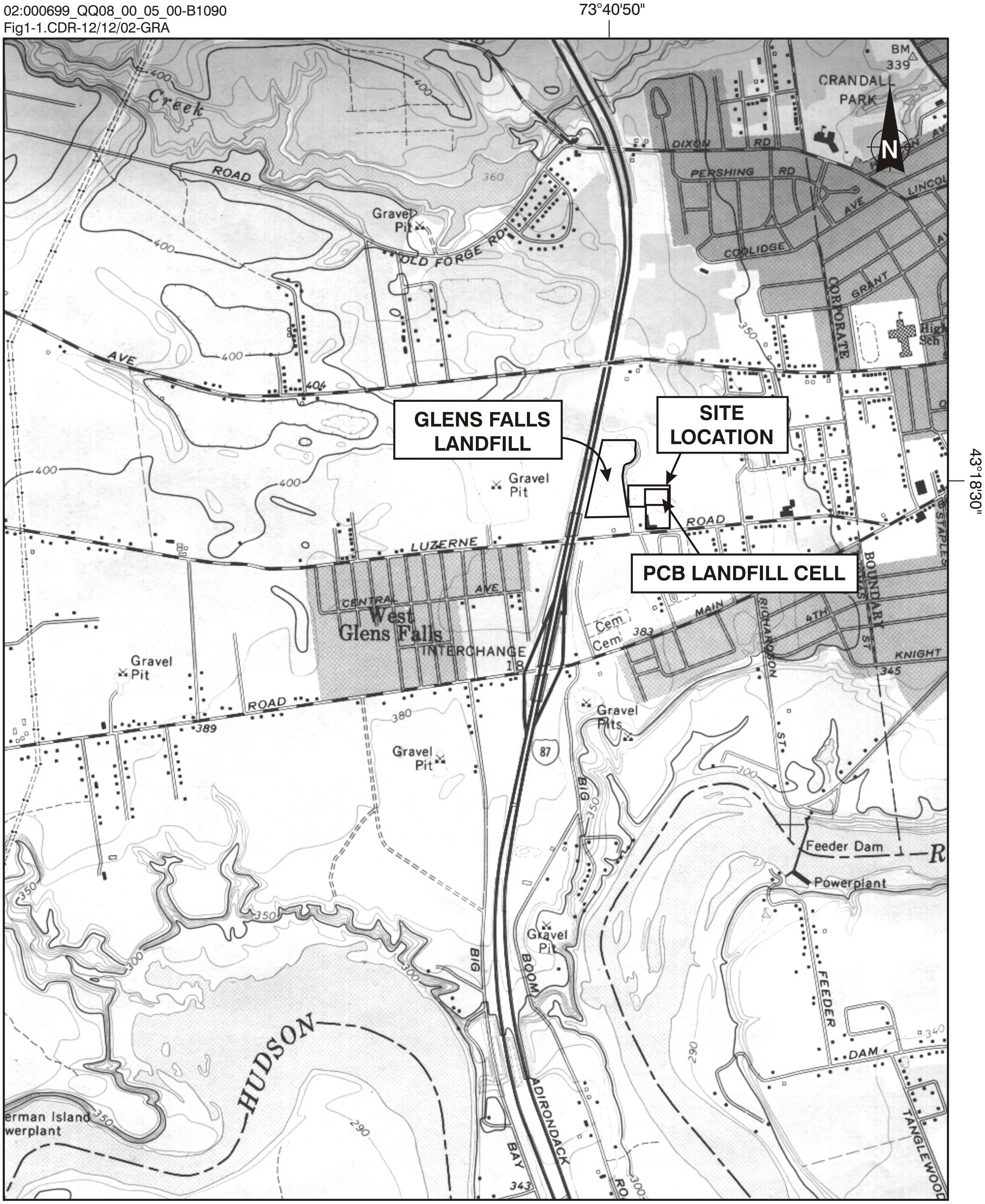
■ PCBs are present in surface soils in the southern area of the site; concentrations range from below detection to 2,984 mg/kg. Access to the area is not restricted; thus PCBs are available for human exposure via foot traffic. Surface soil is the primary exposure medium for wildlife at the site. PCBs were detected in surface soil samples at concentrations exceeding NYSDEC's ecological criteria. Small mammals, songbirds, and raptors potentially could be exposed to the contamination and adversely affected. A toxic effect analysis is recommended. Since there are no fish in the ditch or wetland area, the site does not pose an impact to fish.

- Subsurface soil PCB presence is almost exclusively limited to the western and southern areas; one isolated location in the north area was found to contain PCBs in the 0- to 4-foot depth interval. PCBs were not detected in the eastern area. PCBs were detected to a depth of 12 feet in the middle of the southern area, and to a depth of 16 feet in the western flank of the southern area. However, they were detected to a depth of 24 feet in the western area. The greatest subsurface total PCB concentration was found in western area soil; 17,200 mg/kg was found in the 0- to 4-foot depth interval.

- Field sediment samples did not contain detectable PCB concentrations based on a PCB screening analytical method having a 10 mg/kg detection limit. A duplicate sediment sample was found to contain 0.08 microgram per kilogram (µg/kg) of PCBs. Sediments north of the site may receive some minor PCB contamination due to PCB-containing groundwater seeping from the Glens Falls landfill into the wetland north of the site.

- PCBs were found in groundwater beneath the site ranging from 13 to 24 feet below ground surface (BGS) at upgradient locations and 22 to 35 feet BGS at downgradient on-site locations. PCBs were detected at depths of 40 to 55 feet BGS at off-site locations. However PCBs were not detected in groundwater collected from the 91- to 96-foot depth interval off site, which is consistent with on-site groundwater data from similar depths. As stated earlier, off-site groundwater contamination is not addressed in this FS. On-site groundwater PCB concentrations generally ranged from below the detection limit to 49.1 µg/L directly downgradient of the Glens Falls landfill. Groundwater PCB concentrations downgradient of the PCB cell generally ranged from below detection limit to 2.42 µg/L, although PCBs were detected at a concentration of 151 µg/L in one well immediately adjacent to the cell. However, samples collected from another well 100 feet downgradient of this well showed PCB concentrations ranging from 1.2 µg/L to 2.42 µg/L. Groundwater underlying the site generally moves in a southeast direction. The Glens Falls landfill is located hydraulically upgradient of the site. Groundwater data indicate metal-rich leachate and PCB-containing water enters the shallow portion of the aquifer beneath the Glens Falls landfill and flows beneath the Luzerne Road PCB cell. PCB and metal contribution from the Luzerne Road PCB cell to the groundwater is minimal. Shallow groundwater data does not indicate that the PCB cell provides significant PCB contribution to the underlying groundwater.

- Medium-to-fine sands underlie the site from grade to a depth of approximately 85 to 95 feet BGS. The sand is underlain by a clay layer of unknown thickness; depth to clay varies across the site as the clay layer dips southeast. Bedrock was not encountered during site drilling activities (maximum depth of on-site groundwater monitoring well is 110 feet). Groundwater flow is southeast. Horizontal site hydraulic gradient was calculated by E & E to be approximately 0.0096 ft/ft based on 2001 groundwater elevation data (E & E 2002). An upward vertical gradient exists across the site. Vertical gradients between the intermediate and shallow wells varied from 0.01 ft/ft to 0.1 ft/ft across the site. Vertical gradients between the intermediate and deep wells varied between 0.065 ft/ft to 0.22 ft/ft across the site, increasing in the down-gradient direction. The geometric mean values of hydraulic conductivity values was calculated to be 6.2 x 10^{-2} centimeters per second (cm/sec) in the shallow saturated zone; 1.43 x 10^{-2} cm/sec in the intermediate zone; and 1.3 x 10^{-3} cm/sec in the deep saturated zone. Groundwater velocities are estimated to range between 1 to 6 ft/day.

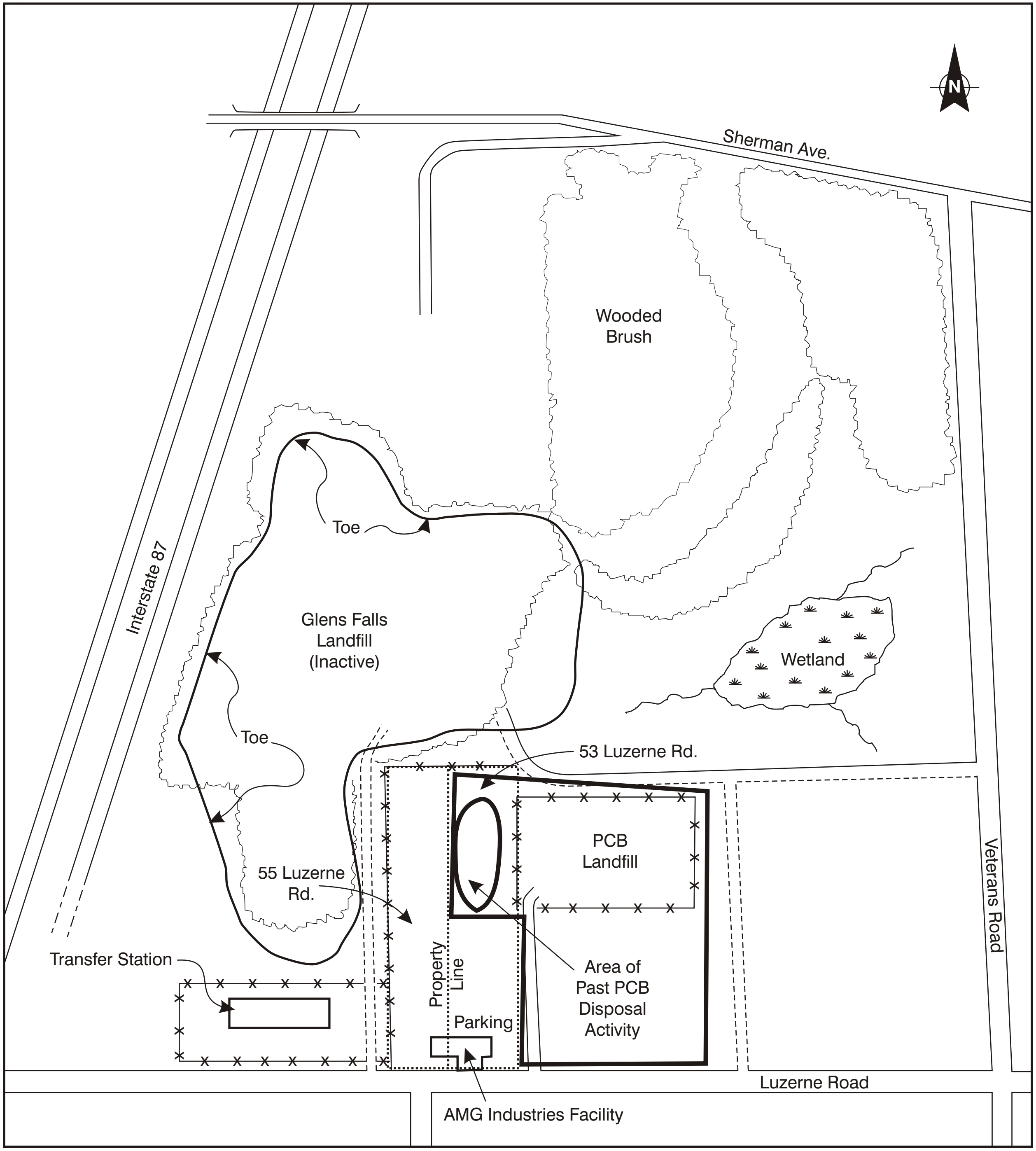


SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Glens Falls, NY, 1966.
Note: Limits of Glens Falls Landfill are approximated based on Site Topography.
Limits of area labeled as Site Location delineate the extent of the on-site study area.

SCALE 1:24,000

Figure 1-1 Site Location Map, Luzerne Road Site, Queensbury, New York

02:000699_QQ08_00_05_00-B1090
Fig1-2.CDR-12/12/02-GRA



SOURCE: RCRA Environmental 1986

Figure 1-2 Site Map, Luzerne Road Site, Queensbury, New York

2 Definition of Remedial Action Objectives and Definition of Contaminated Media of Concern

This section identifies the contaminants of concern (COCs) and media of interest at the site, and establishes proposed cleanup goals and specific Remedial Action Objectives (RAOs) for contaminated on-site media. Also presented are estimates of areas and volumes of contaminated on-site media.

2.1 Remedial Action Objectives

This section presents the objectives for on-site remedial actions that may be taken to protect human health and the environment. The RAOs were developed based on information contained in the RI (E & E 2002), including identified contaminants present in the study area, and existing or potential exposure pathways in which the contaminants may affect human health and the environment.

The RAOs for the site soils (surface and subsurface) and groundwater are:

1. Reduce the potential for direct human or animal contact with the contaminated surface and subsurface soils;

2. Reduce the risk of further contamination of the groundwater by reducing the potential for leaching of contaminants into the groundwater;

3. Reduce further off-site migration of contaminated groundwater to the extent practical; and

4. Reduce the potential for human risk of exposure to overburden groundwater by reducing the potential for ingestion of contaminated groundwater and dermal contact with contaminated groundwater.

Proposed chemical-specific cleanup goals were developed for each medium at the site to estimate the area or volume of each medium that must be addressed to meet the RAOs. These proposed cleanup goals were developed based on an evaluation of applicable or relevant and appropriate requirements (ARARs) and other criteria and guidelines to be considered (TBCs).

The terms “ARARs” and “TBCs” encompass the Standards, Criteria, and Guidance (SCGs) defined by NYSDEC. “ARARs” and “standards” refer to a promulgated and legally enforceable rule or regulation. “TBCs,” “criteria,” and “guidance,” refer to policy documents that are non-promulgated, but are not legally enforceable standards. To distinguish between enforceable and non-enforceable values, the terms “ARARs” and “TBCs” will be used rather than the term “SCGs.”

ARARs were determined in accordance with Section 121(d)(2) of CERCLA. They are also consistent with the EPA guidance set forth in the CERCLA National Contingency Plan (NCP) (40 CFR 300); the two-part guidance document entitled *CERCLA Compliance with other Laws Manual* (OSWER Directives 9234.1-01 [Draft], August 8, 1988, and 9234.1-02, August 1989); and the guidance document entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA-540/G-89/004).

2.2 ARARs and TBCs

2.2.1 Applicable or Relevant and Appropriate Requirements (ARARs)

An ARAR may be either “applicable” or “relevant and appropriate.” Applicable requirements are those substantive environmental protection standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, remedial action, location, or other circumstance at a Superfund site. Relevant and appropriate requirements are those substantive environmental protection requirements promulgated under federal and state law that, although not legally applicable to the circumstances at the site, address situations sufficiently similar to those encountered at the site so that their use is well-suited to the particular site. Administrative requirements such as obtaining permits and agency approvals, record keeping, reporting, and off-site activities such as waste disposal, are not included in the definition of ARARs.

Compliance with ARARs is a threshold requirement that a remedial alternative must meet to be eligible for selection as a remedy. There are three types of ARARs:

- **Chemical-Specific ARARs** are usually health- or risk-based numerical values or methodologies that establish an acceptable amount or concentration of a chemical in the ambient environment. They are used to assess the extent of remedial action required and to establish cleanup goals for a site. Chemical-specific ARARs may be directly used as actual cleanup goals, or as a basis for establishing appropriate cleanup goals for the COCs at a site;

- **Action-Specific ARARs** are usually administrative- or activity-based requirements that guide how remedial actions are conducted. These may include recordkeeping and reporting requirements, design and performance standards for remedial actions, and permitting requirements; and

- **Location-Specific ARARs** are restrictions placed on the concentration of hazardous substances or the conduct of activity solely because they occur in special locations. Location-specific ARARs are commonly associated with features such as wetlands, floodplains, or historic buildings that are located on or in proximity to the site.

Site appropriate chemical-, action-, and location-specific ARARs are discussed in this section and in the evaluations of individual alternative criteria in Sections 5 and 6.

2.2.2 TBCs

TBCs are non-promulgated federal or state standards or guidance documents that are to be used on an as-appropriate basis in developing cleanup standards. Because they are not promulgated or enforceable, they do not have the same status as ARARs and are not considered required cleanup standards. TBCs generally fall into the following three categories.

- Health effects information with a high degree of credibility;

- Technical information on how to perform or evaluate site investigations or response actions; and

- State or federal agency policy documents.

2.2.3 Proposed Cleanup Goals

Cleanup goals for each medium of concern at the site were generally established by evaluating ARARs and TBCs for each contaminant as follows:

- Where ARARs are available, the lowest of the federal or state ARAR was selected as a preliminary screening value; and

- If neither federal nor NYSDEC ARARs were available, the lowest TBC value was used as the preliminary screening value.

- Where appropriate, the preliminary screening values are then compared to site-specific background values for naturally occurring compounds to confirm that no preliminary screening value is set below the background concentrations. If the site-specific background concentration is higher than the ARAR or TBC-based preliminary screening value, then the background concentration is selected as the preliminary screening value.

- Preliminary screening values are then compared to site data to identify which contaminants may require cleanup. These contaminants are then considered with regard to other factors influencing the need for cleanup, including comparison to regional background levels and an evaluation of contamination. The cleanup goals proposed by this process then are compared again to site data in order to identify areas that must be addressed in this FS.

The above process was completed for each medium because ARARs and TBC differ between mediums. The following subsections describe the details of this process and present the extent of contamination by medium. The areas and volumes presented form the basis for the remedial technology selection and alternative development sections in this FS.

2.3 Soils

Surface Soil

Surface soil samples were collected from the site area surrounding the PCB landfill cell, but not on the cell itself, as described in the RI (E & E 2002). All samples were collected from the 0- to 6-inch depth interval. A total of 33 surface soil samples and four duplicate surface soil samples were collected from the site and analyzed for PCBs. The results indicated the presence of PCB contamination in surface soils in the southern area of the site. PCB concentrations ranged from below detection limit to a maximum total PCB concentration of 2,984 mg/kg.

Subsurface Soils

Subsurface soil samples were collected during different stages as described in detail in the RI (E & E 2002). A total of 838 subsurface soil samples were collected from 135 grid nodes near the PCB cell and screened for PCBs. In addition, 87 of these samples were analyzed for PCBs using EPA Method 8082. The shallow grid system soil borings were continuously sampled in 4-foot increments from grade to a maximum depth below grade of 34 feet. An additional 39 subsurface soil samples were collected and submitted for PCB analysis using EPA Method 8082 from the parking lot area southwest of the PCB cell. Finally, split-spooned soil samples were collected during installation of the shallow and groundwater monitoring wells and were submitted for PCB analysis using EPA Method 8082.

The results of the subsurface soil investigation indicated the presence of PCBs primarily in the southern and western areas of the site. PCBs were detected to a maximum depth of 24 feet in the western area of the site. VOCs were also detected at relatively low concentrations in subsurface soils samples collected during the beginning of the site investigation. The other Target Compound List/Target Analyte List (TCL/TAL) (semivolatile organic compounds [SVOCs], metals, and cyanide) were not analyzed for these soil samples.

Since the VOC concentrations were not present at concentrations of concern, and based on guidance from NYSDEC, no further analyses for TCL/TAL was conducted during the RI. Therefore, for the purpose of delineating subsurface soil contamination in this FS, the focus will be PCB contamination. Note that if soil removal/treatment is conducted as part of the on-site remedy, the other contaminants in the removed/treated media would also be treated.

PCB Cell

Subsurface soil samples were also collected from the secured PCB cell by DPT boring installation. A total of eight subsurface soil samples were collected from two DPT soil borings. The highest PCB concentration detected in the cell was 12,150 mg/kg. VOCs were also detected in the soil samples collected from the PCB cell at levels exceeding NYSDEC criteria.

2.3.1 Selection of Soil Cleanup Goals

ARARs

The only promulgated standard established for PCBs in soils or sediments is Title 40, Code of Federal Regulations (CFR), Part 761.125(c) (4)(v), Requirements for PCB Spill Cleanup Toxic Substance Control Act (TSCA). This regulation calls for PCB-contaminated soils in non-restricted access areas to be remediated to 1 mg/kg to a minimum depth of 10 inches, and 10 mg/kg beyond 10 inches.

TBCs

Guidance values identified for soils include EPA Guidance on Remedial Actions for Superfund sites with PCB Contamination (EPA/540/G-90/007), and NYSDEC TAGM 4046 (January 1994). The TAGM states: “The cleanup goal of the Department is to restore inactive hazardous waste sites to predisposal condition to the extent feasible and authorized by law. However, it is required that restoration to predisposal conditions will not always be feasible.” The recommended soil cleanup objective for PCBs is 1 mg/kg for surface soils and 10 mg/kg for subsurface soils.

The above-mentioned EPA guidance document indicates initial action levels of 1 mg/kg PCBs for non-restricted sites and 10 to 25 mg/kg for industrial/remote sites. Other criteria and guidance values identified for soils at the site are contained in NYSDEC TAGM 4046.

Selection Process

The preliminary selected cleanup values for PCB-contaminated soils are 1 mg/kg for depths up to 12 inches, and 10 mg/kg for depths greater than 12 inches. These values were selected because they represent the lowest values identified in ARARs and TBCs. For other low-level contaminants detected on site, the NYSDEC TAGM 4046 was selected as the preliminary cleanup value. The preliminary cleanup values were compared to the maximum observed concentration for each compound in order to determine which compounds may require cleanup. Finally the contaminants identified for cleanup were reviewed to determine whether they are site-related and whether cleanup is warranted.

Based on the above (see Table 2-1), PCBs were detected in surface and subsurface soils. PCBs were detected in 60 of the initial 835 field samples and in 19 of the subsurface duplicate soil samples at concentrations greater than the 10 mg/kg cleanup criteria. Seventeen of the 39 subsurface soil samples collected in the parking lot area also exceeded the 10 mg/kg cleanup criteria. Finally, two of the 39 subsurface soil samples collected during the 1999 groundwater monitoring installation exceeded the proposed cleanup criteria. Aroclors 1242 and 1254 were the primary type of PCB detected, although Aroclor 1260 was also detected in some subsurface soil samples.

In the PCB cell, three out of the eight samples had PCB concentrations above proposed cleanup criteria. VOCs were also detected in the PCB cell above TAGM 4046 criteria. The detected VOCs included: benzene, xylene, chlorobenzene, and 2-butanone. The highest VOC concentration detected was 120 µg/kg for chlorobenzene.

2.3.2 Selection of Contaminants of Concern

Based on the above analysis, it was determined that PCBs are the primary soil contaminants on site. As stated above, some VOCs were detected at relatively low concentrations, but above proposed cleanup criteria in the PCB cell. However, because of the relatively low-level VOC contamination, historic salvage operations at the site, and since any soil removal/treatment remedy conducted at the site would inherently remove other contaminants in the soil, PCBs will be considered the primary COCs at the site. The following discussion will therefore focus on PCB contamination.

Surface soils primarily south of the PCB cell, and subsurface soils in the southern and western areas of the site are considered contaminated with PCBs and in need of remediation. Figures 2-1 and 2-2 present the areas of contamination for surface and subsurface soils respectively. Surface contamination was assumed in the top foot of surface soils. The maximum total PCB concentration detected in surface soils was 2,984 mg/kg.

As shown in Figure 2-2, subsurface PCB contamination extended to 24 feet BGS in the western area of the site, and 4 feet BGS south of the PCB cell. The highest subsurface contamination of 17,200 mg/kg was detected in the 0- to 4-foot depth interval in the western area of the site.

In addition to surface and subsurface soils on site, PCB contamination is present in the existing PCB cell. As stated earlier, three subsurface soil samples were collected from the PCB cell during the RI (E & E 2002). The highest total PCB concentration detected in the cell was 12,150 mg/kg.

A summary of the volume of contamination for the on-site soils and PCB cell is presented in Section 2.3.3.

2.3.3 Determination of Contaminated Soil Volumes

The volume of surface and subsurface soil contamination was estimated using Surfer software. Using analytical data collected during the RI, on-site surface and subsurface soil contour plots were developed using Surfer software as shown in Figures 2-1 and 2-2. The Krieging method was selected for interpolating between data points. Then using Surfer's volume function, planar areas were calculated for each depth interval for the subsurface soils. The planar area represents the projection of contaminated area onto a horizontal plane, above the specified cleanup level. For the calculations, the subsurface cleanup level was set at 10 mg/kg, and 1 mg/kg for surface soils. The volume of contamination for each depth interval was then calculated by multiplying the planar area by the depth of each interval (i.e., 4 feet for subsurface soil and 1 foot for surface soils).

Table 2-2 presents a summary of the volume of contaminated subsurface soils by depth interval for the proposed cleanup goal of 10 mg/kg. For surface soil, with proposed cleanup criteria of 1 mg/kg, the volume was estimated to be 12,311 BCY, based on a planar area of 332,403 ft^2 and a depth of 1 foot. Results from Surfer analysis for surface and subsurface soil are presented in Appendix A.

E & E estimated the volume of contaminated soil in the PCB cell including the base liner and bottom 1 foot of cap system to be approximately 49,603 BCY. This volume was estimated based on E & E's understanding of the cell's construction and review of historic records. Additional assumptions and calculations are included in Appendix B.

Table 2-3 summarizes the total estimated on-site contaminated soil volumes. In addition, the volume of clean material required to be excavated to reach subsurface contamination was calculated. This is further described in Section 5.1.3. Supporting calculations are included in Appendices B & C.

2.4 Groundwater

Six shallow, three intermediate, and three deep groundwater monitoring wells were initially installed on the site to evaluate possible presence of multiple contaminant phases. These wells, along with five wells positioned around the Glens Falls landfill to the northwest, and one well located at the landfill cell perimeter, were initially sampled. All groundwater samples except for the PCB landfill cell sample were submitted for the TCL/TAL analytical suite. The landfill cell produced a low volume so that only the volatile organic compound VOC and PCB analyses could be conducted on the sample. Figure 2-3 shows the existing on-site monitoring wells.

The results of the first groundwater sampling data indicated primarily the presence of PCB contamination on site, with low-level VOC contamination. No free product was observed during installation of the wells or collection of the samples.

PCB contamination was observed in the shallow and intermediate wells only. Following review of the first round of groundwater data and collection of a second round of samples, two additional intermediate wells and five additional shallow groundwater monitoring wells were installed in November 2000 to determine the extent of on-site groundwater contamination. Based on the results of the first round of groundwater samples, samples collected from these wells were analyzed for PCBs only per guidance from NYSDEC. This is further described in Section 2.4.2.

2.4.1 Selection of Groundwater Cleanup Goals

ARARs

Standards identified for groundwater at the site include the NYSDEC Class GA Groundwater Quality Standards (Maximum Contaminant Levels [MCL]) set forth in the NYCRR Part 703.5; the federal Safe Drinking Water Act (SDWA) under title 40 CFR141.147. The primary drinking-water standards address toxicity and are called for MCLs and maximum contaminant level goals (MCLGs).

TBC

Guidance values considered for the site are the NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1) for Class GA groundwater.

Selection Process

The following describes the methodology used in selecting the preliminary cleanup values for on-site groundwater:

- The NYSDEC Class GA standard, if it existed, was selected as the preliminary cleanup value;
- If a groundwater standard did not exist for a constituent, the NYSDEC Class GA guidance value, if it existed, was used;
- The preliminary cleanup values were then compared to the maximum observed concentrations of each compound to determine which compounds may require cleanup; and
- Finally, the contaminants identified for cleanup were reviewed to determine whether they are site related and whether cleanup is warranted.

Based on the above process on-site groundwater was found to contain eight organic compounds and nine metals. As shown in Table 2-4, organic compounds included four VOCs (chloroform, benzene, chlorobenzene, and acetone), one SVOC (bis [2-Ehtylhexyl]phtalate), PCBs, and two pesticides (heptachlor and heptachlor epoxide). The nine metals include arsenic, iron, lead, magnesium, manganese, selenium, sodium, thallium, and zinc.

2.4.2 Selection of Contaminants of Concern

Based on the above analysis, on-site groundwater in the shallow and intermediate zones was considered contaminated and would require remediation. Although some VOCs and inorganics were initially detected in the groundwater samples (September 1999), PCBs are considered the primary COCs for groundwater contamination in this FS. Note that groundwater samples collected subsequent to the September 1999 sampling event were analyzed for PCBs only. The following presents the rationale for selecting PCBs as the primary COCs for groundwater remediation in this FS:

- September 1999 groundwater data indicated the presence of VOC contamination near the Glens Falls landfill. However, groundwater flow direction and the absence of these VOCs in other site wells suggest that the origin of this contamination does not rest at the Luzerne Road Site. A truly effective and complete remediation of these VOCs can only be accomplished by a remedy that addresses their source, which is beyond the scope of this FS. Thus this VOC presence in groundwater is not addressed in this FS.

- Xylene, another VOC, was detected in a low concentration in MW-6S located southwest of the PCB cell. It is suspected that xylene present in site subsurface soils during the 1979 remediation has mostly decayed or volatilized. Given the extremely low concentration detected in the groundwater sample and the absence of xylene detections in any other wells, xylene was not considered further for this FS.

- The SVOC pentachlorophenol was detected in only one well, MW-4S. Its presence does not correlate with other soil or groundwater findings, nor does it correlate with historical usage of the site. Based on these factors, additional analysis of pentachlorophenol was not pursued, and pentrachorophenol is not directly addressed under this FS.

- Of the SVOCs detected, the location of dichlorbenzene in MW101-S west of the site indicates the Glens Falls landfill is the source of this SVOC, based on groundwater flow direction. As noted above, a complete remediation of this contaminant would require addressing its source, which is beyond the scope of this FS.

- Inorganic analytical data indicated elevated concentrations. Concentrations of some metals including iron, aluminum, calcium, magnesium, manganese, potassium, selenium, sodium, and thallium were found in wells upgradient of the PCB landfill cell and downgradient of the Glens Falls landfill. The results suggest that the source of these metals is not the Luzerne Road Site, and are therefore not addressed in this FS.

- Lead, copper, and zinc were detected in elevated concentrations nearest the PCB cell, indicating the cell as a possible source. They are not addressed uniquely under this FS for two primary reasons. First, remediation of the cell will address the source of these metals into the groundwater. Second, there are no known groundwater users downgradient of the cell. NYSDEC and NYSDOH conducted a well survey of the downgradient area in September 2002 to check for private wells.

Table 2-1 Cleanup Goal Screening Process for Surface and Subsurface Soils, Luzerne Road Site

Compound	TAGM 4046[a]	Maximum Concentration	Cleanup Goal
Surface Soils			
PCB (mg/kg)			
Sum of Aroclors	1	2,984	1
Subsurface Soils			
PCB (mg/kg)			
Sum of Aroclors	10	17,200	10
Volatiles (µg/kg)			
Xylene (total)	12	2	12
Methylene Chloride	1	1	1
PCB Cell			
TOC (mg/kg)	—	13,300	—
PCB (mg/kg)			
Sum of Aroclors	10	12,150	10
Volatiles (µg/kg)			
Toluene	15	6	15
Benzene	1	5	1
Ethylbenzene	55	2	55
Xylene (total)	12	20	12
Chlorobenzene	17	120	17
Trichloroethene	7	7	7
Tetrachloroethene	14	2	14
1,2 Dichloro-ethene	12	3	12
Methylene Chloride	1	1	1
2-Butanone	3	34	3

Note: Shaded values exceed NYSDEC regulatory criteria.

[a] NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (Jan 1994) Soil Cleanup Objectives for Total PCBs.

TOC = Total organic carbon.
µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
PCB = Polychlorinated biphenyl.

Table 2-2 Contaminated Subsurface Soil Volume Estimate, Luzerne Road Site

Depth Interval (ft)	Positive Planar Area (ft^2)[1]	Soil Volume (ft^3)	Soil Volume (BCY)
0-4	129,985	519,939	19,257
4-8	62,048	248,193	9,192
8-12	34,838	139,353	5,161
12-16	28,822	115,286	4,270
16-20	35,314	141,255	5,232
20-24	46,422	185,687	6,877
Total			**49,989**

Note

[1] Positive planar area was obtained from SURFER software. A 4-foot depth was conservatively assumed for the first interval, since majority of subsurface contamination is present west of the PCB cell, whereas most of the surface contamination is present south of the cell. Therefore minimal overlap (except for for a very localized area south of the cell) is anticipated from removal of surface soil or subsurface soil in the top 4-foot interval.

BCY = bank cubic yards. (Material as it lies in its natural state. Loose cubic yards [LCY] are materials which have been disturbed and have swelled as a result of movement. The ratio between bank and loose material is expressed as the swell factor or is stated in percent swell.)

ft = feet.
ft^2 = square feet.
ft^3 = cubic feet.

Table 2-3 Summary of On-site Contaminated Soil Volumes, Luzerne Road Site

Operable Unit (OU)	Description	Contaminated Material (BCY)	Contaminated Material[1] (ton)	Volume of Clean Material (BCY)	Source
OU-1: Secured PCB Cell	Volume of Fill, 5-ft Base Liner, 1-ft Cover Liner	49,603	75,400		E & E Estimate[2]
	Top 3 ft of Cover Liner			8,857	E & E Estimate[2]
OU-2: On-Site Soil	Subsurface Soil - 10 mg/kg Cleanup Criteria	49,989	73,490		E & E Estimate[3]
	Additional Clean Soil (incl. Cut-Back)			61,432	E & E Estimate[4]
OU-2: On-Site Soil	Surface Soil - 1 mg/kg Cleanup Criteria	12,311	18,100		E & E Estimate
TOTAL		**111,904**	**166,990**	**70,289**	

BCY = bank cubic yards.
E & E = Ecology and Environment, P.C.
ft = foot.
LCY = Loose cubic yards.
mg/kg = milligrams per kilogram

[1] - Based on geotechnical data from the RI (E&E, 2002), in-situ bulk density of on-site and PCB cell soils is 1.47 tons/BCY and 1.52 tons/BCY, respectively.

[2] - See Appendix B for supporting calculations.

[3] - See Table 2-2 for detailed subsurface soil volume by depth interval.

[4] - See Appendix C for supporting calculations.

Table 2-4 Cleanup Goal Screening Process for Groundwater, Luzerne Road Site

Compound	NYSDEC Class GA Groundwater Criteria [a]	Maximum Concentration	Cleanup Goal
Inorganics (µg/L)			
Aluminum	—	1,950	—
Antimony	3	9	3
Arsenic	25	8	25
Barium	1,000	196	1,000
Cadmium	5	5	5
Calcium	—	161,000	—
Chromium	50	10	50
Cobalt	—	7	—
Copper	200	40	200
Iron	300	45,300	300
Lead	25	102	25
Magnesium	35,000[b]	91,000	35,000[b]
Manganese	300	11,200	300
Nickel	100	15	100
Potassium	—	46,300	—
Selenium	10	25	10
Silver	50	4	50
Sodium	20,000	112,000	20,000
Thallium	0.5[b]	21	0.5[b]
Vanadium	—	11	—
Zinc	2,000[b]	23,500	2,000[b]
Cyanide	200	10	200
TCL Volatiles (µg/L)			
Chloroform	7	35	7
Bromodichloromethane	50	2	50
Benzene	1	3	1
Chlorobenzene	5 [c]	21	5
Acetone	50	5	50
Methylene Chloride	5 [c]	1	5
Xylene (total)	5 [c]	2	5
TCL Semivolatiles (µg/L)			
bis (2-Ethylhexyl)phtalate	5	52	5
Di-n-butylphthalate	50	1	50
Butylbenzylphthalate	50	6	50
1, 2 - Dichlorobenzene	3	2	3
1,4 - Dichlorobenzene	3	5	3
Pentachlorophenol	1	43	1
PCB (µg/L)			
Aroclor 1016	—	3.6	—
Aroclor 1242	—	151	—
Aroclor 1254	—	1.82	—
Sum of Aroclors	0.09 [d]	151	0.09
Pesticides (µg/L)			
Heptachlor	0.04	0.42	0.04
Endosulfan II	—	0.065	—
Heptachlor epoxide	0.03	0.5	0.03

Note: Shaded values exceed NYSDEC regulatory criteria.

[a] NYSDEC, Ambient Water Quality Standard and Guidance Values (June 1998), Class GA Groundwater

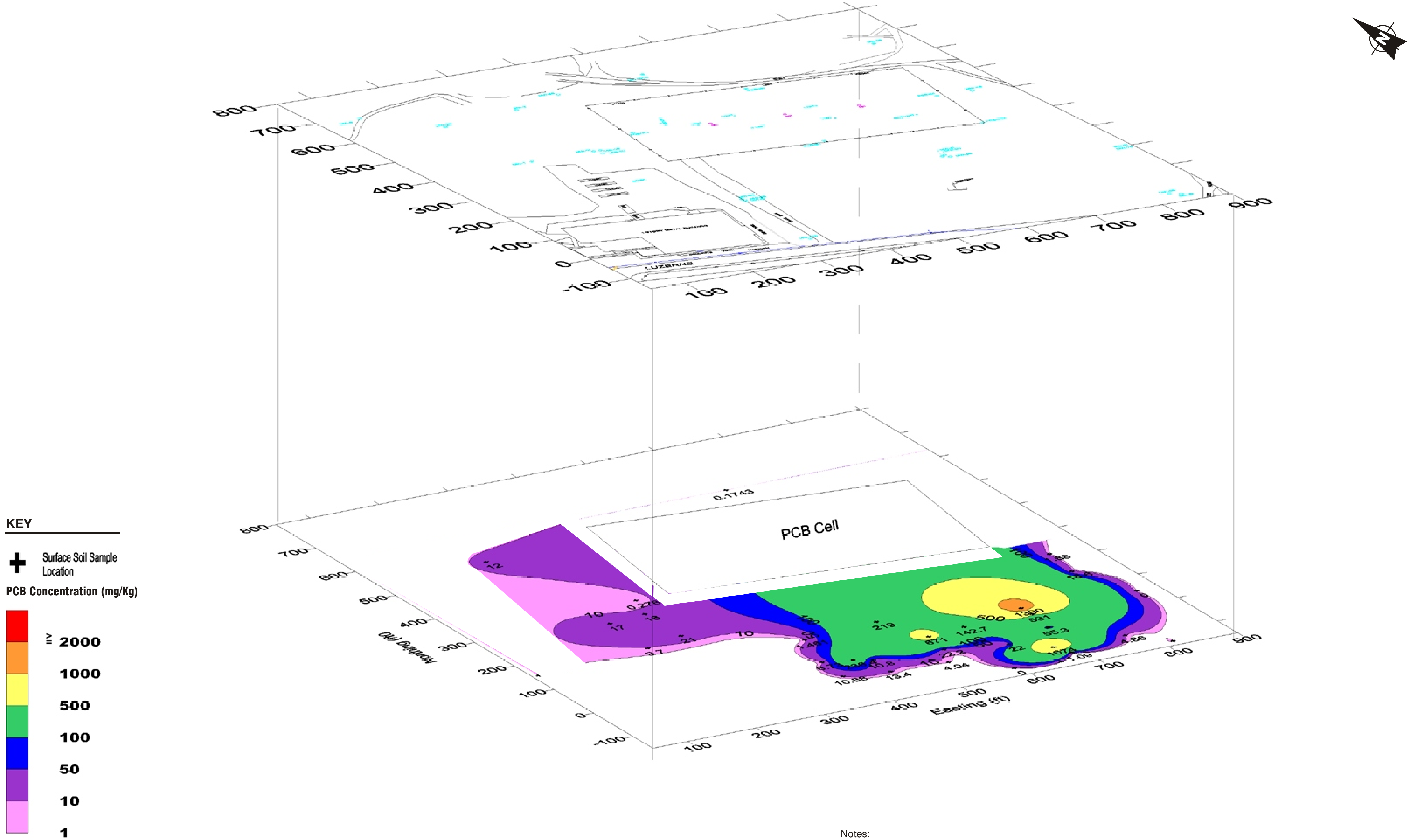
[b] Value provided is a Guidance Value.

[c] The Principal Organic Contaminant standard for groundwater of 5 µg/L applies to this substance.

[d] Criteria applies to sum of aroclors.

µg/L = Micrograms per liter.
PCB = Polychlorinated biphenyl.
TCL = Target compound list.

02:000699_QQ08_00_05
Fig2-1.CDR-12/10/01-GRA

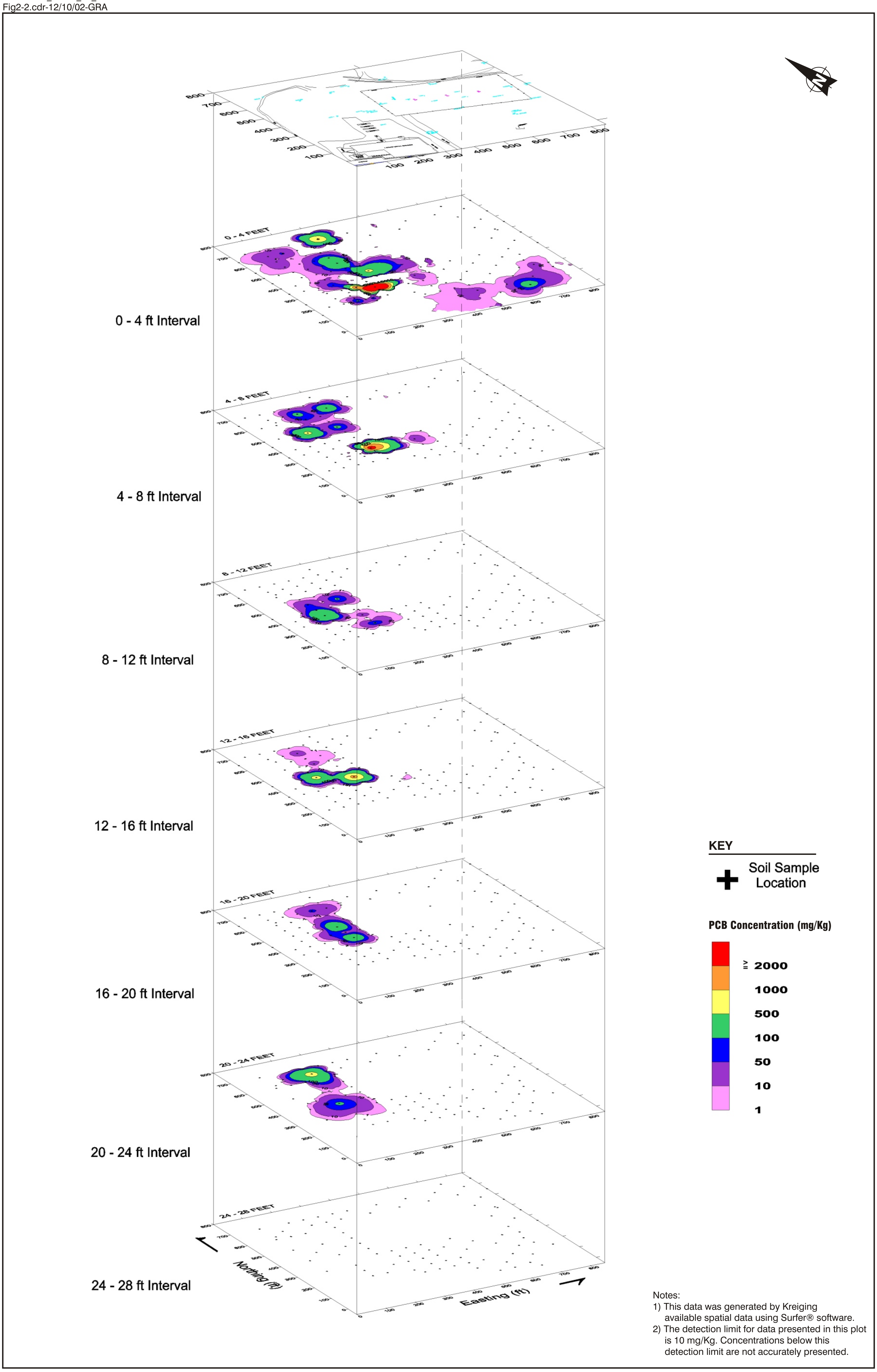


Notes:
1) This data was generated by Kreiging available spatial data using Surfer® software.
2) The detection limit for data presented in this plot is 1 mg/Kg. Concentrations below this detection limit are not accurately presented.

SOURCE: Ecology and Environment, Inc., 2001

Figure 2-1 Total PCB Concentration Distribution in On-site Surface Soils Luzerne Road Landfill Site Queensbury, New York

02:000699_QQ08_00_035
Fig2-2.cdr-12/10/02-GRA

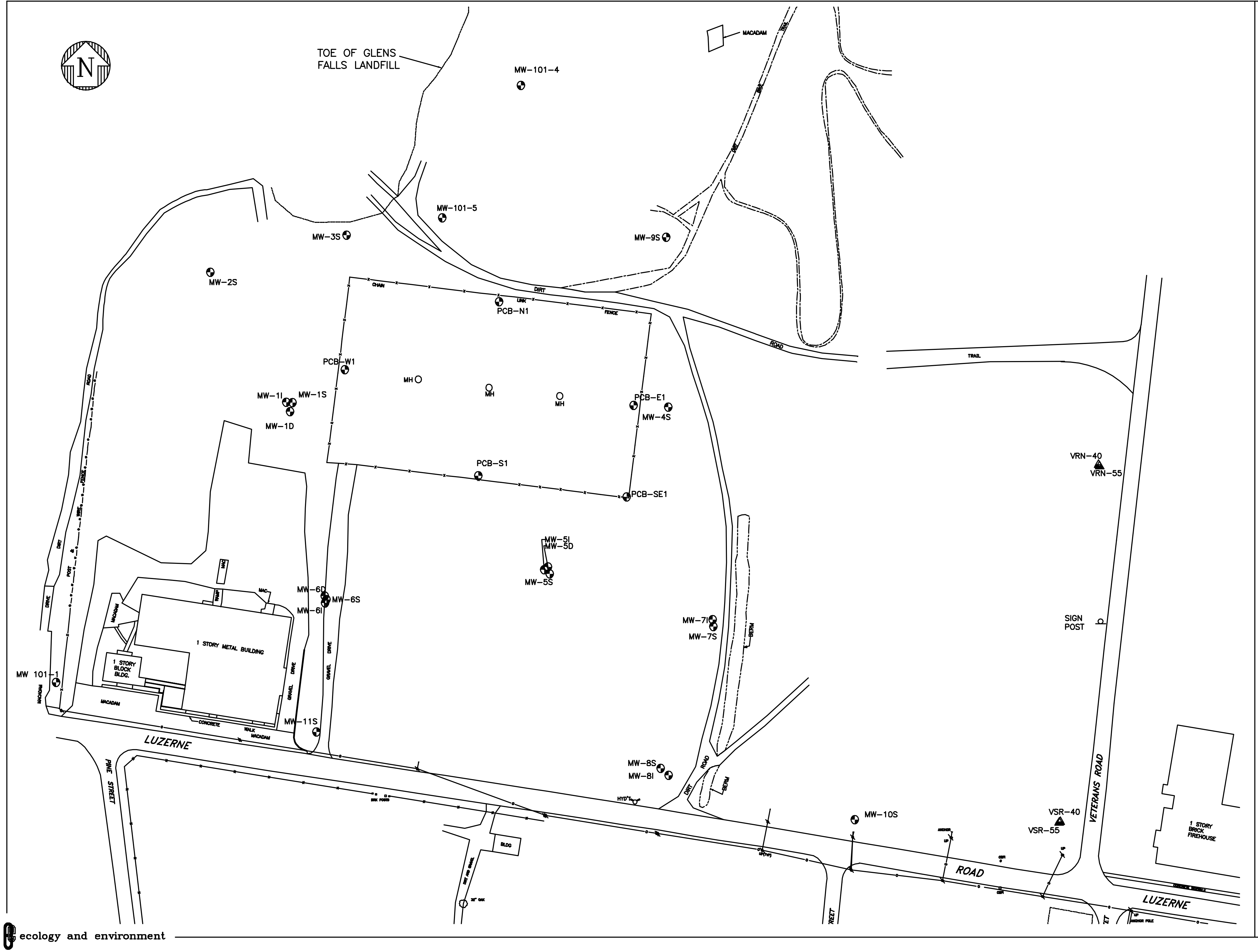


Notes:
1) This data was generated by Kreiging available spatial data using Surfer® software.
2) The detection limit for data presented in this plot is 10 mg/Kg. Concentrations below this detection limit are not accurately presented.

SOURCE: Ecology and Environment, Inc., 2001

Figure 2-2 Total PCB Concentration Distribution in On-site Subsurface Soils
Luzerne Road Landfill Site
Queensbury, New Yrok

F:\qq8000\Draft RI\12-03-02\2-3.dwg



ecology and environment

NOTES

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZURNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.

LEGEND

—x——x—	CHAIN LINK FENCE
—*——*—	POST AND WIRE FENCE
━━━━	CONCRETE WALL
═══	CONCRETE CURB
⊘	UTILITY POLE
——o——	OVERHEAD WIRE
CBFI □ ○	CATCH BASIN FIELD INLET
MH ○	MANHOLE
HYD'T	FIRE HYDRANT
◐ MW-4S	EXISTING GROUNDWATER MONITORING WELL
MAC	MACADAM
▲ VSR-40	GEOPROBE GROUNDWATER COLLECTION POINT

SCALE IN FEET

0 150 300 450

FIGURE 2-3 GROUNDWATER MONITORING WELL LOCATIONS

3 Identification and Screening of Remedial Technologies

3.1 General Response Actions

This section identifies general response actions (GRAs), or classes of responses, to contaminated areas. GRAs describe classes of technologies that can be used to meet the remediation objectives for each medium of concern. Applicable remedial technologies for each medium of concern were identified and initially screened based on their effectiveness, implementability, and cost effectiveness, taking into consideration the site-specific conditions and contaminant characteristics. Past performance (i.e., demonstrated technology) and operating reliability were also considered in identifying and screening applicable technologies. Technologies, which were not initially considered effective and/or technically or administratively feasible, were eliminated from further considerations.

3.1.1 Soil

Six GRAs were identified for soil remediation as follows:

- No action;
- Institutional and Engineering Controls;
- Removal and Disposal;
- Containment;
- In situ Treatment; and
- Ex situ Treatment.

3.1.2 Groundwater

The following GRAs were identified for the on-site contaminated groundwater:

- No action;
- Institutional Controls;

- Natural Attenuation;
- Capture and Control; and
- Ex situ treatment.

3.2 Soil Treatment Technologies

Remedial technologies for the contaminated soil and sediments are used to contain, treat, or remove and dispose of the contamination in these media.

3.2.1 No Action

In accordance with the NCP a no-action response must be evaluated during the course of the FS. No-action alternative is only acceptable when it does not result in an unacceptable risk to human health and the environment.

3.2.2 Removal Technologies

3.2.2.1 Excavation

Excavation, removal, and hauling of contaminated soils and sediments including "hot spot" areas are generally accomplished with conventional heavy construction equipment (e.g., backhoes, bulldozers). Land disposal and/or treatment of contaminated waste materials typically follow excavation operations. These technologies are discussed in detail in the following sections.

Excavation followed by disposal and/or treatment of contaminated waste is a demonstrated and effective technology in remediating contaminated soils, and thus reduces exposure risks. Excavation will be retained as an applicable technology.

3.2.2.2 On- and Off-site Disposal

Land disposal of contaminated wastes has historically been the most common remedial action for hazardous waste sites. The two disposal options: on-site disposal in a constructed landfill, or off-site disposal in a commercial facility, are discussed below.

On-Site Disposal

On-site disposal of material classified as hazardous waste by New York State Hazardous Waste Regulations and TSCA, requires construction of a secure landfill that meets Resource Conservation and Recovery Act (RCRA) and state requirements. These requirements include the following:

- The landfill should be designed so that the local groundwater table will not be in contact with the landfill;
- The landfill should be constructed of, or lined, with natural or synthetic material of low permeability to inhibit leachate migration;

- An impermeable cover should be employed to minimize infiltration and leachate production; and

- Periodic monitoring of surface water, groundwater, and soils adjacent to the facility must be conducted to confirm the integrity of the liner and leachate collection system.

A secure PCB landfill cell currently exists at the Luzerne Road Site. The cell was constructed as a temporary measure to store contaminated soil in 1979. Leachate has been collecting and leaking from the cell. Because of limited land availability at the site, long-term monitoring requirements for a landfill, community concerns, and limitations on future use of the site, on-site disposal of contaminated materials was not retained as an applicable technology.

Off-Site Disposal

Off-site disposal of contaminated soils and sediments involves hauling excavated material to an appropriate commercially licensed disposal facility. The type of disposal facility depends on whether the waste is considered hazardous or non-hazardous. Waste material classified as hazardous waste may only be disposed of in an RCRA-permitted facility. In accordance with New York State Hazardous Waste Regulations and TSCA, materials containing PCBs or above 50 mg/kg, if excavated and removed from the site, are subject to regulation as both hazardous waste and TSCA waste. Contaminated waste material containing less than 50 mg/kg of PCBs is considered non-hazardous waste, and can be disposed of in a non-hazardous/solid waste facility.

Off-site disposal of contaminated materials in a landfill is a demonstrated technology which effectively reduces exposure risks and provide long-term protection. Off-site disposal will be retained as an applicable technology.

3.2.3 Containment Technologies

Containment of impacted soils can be achieved by capping contaminated materials in place, consolidating and capping, or surface sealing. Capping is a means to reduce the potential for contaminants to come into contact with surface water run-off and limit infiltration into groundwater, thus minimizing contaminant mobility and exposure. Capping systems use materials such as soil, synthetic membranes, asphalt, concrete, and chemical sealants.

Capping is generally performed when subsurface contamination at a site precludes excavation and removal of contaminated materials because of potential hazards and/or prohibitive costs. Capping also may be performed as an interim remedial measure to reduce infiltration of precipitation and to control air releases. The main disadvantages of capping are uncertain design life and the need for long-term maintenance and monitoring.

Capping systems (single and multi-layered) considered applicable and represent the range of available options include asphalt cover (single-layered cap), 6 NYCRR Part 360, and 6 NYCRR Part 373 (RCRA cap). These cover systems would be effective in limiting infiltration of surface water, and are described below:

- **Bituminous Concrete Cover (Asphalt):** A standard asphalt cover system typically includes a layer of stone (6 to 8 inches), followed by an asphalt binder course (typically 4 inches), and a final wearing course (typically 2 inches). Site grading is typically required to achieve an adequate slope for drainage. Although asphalt covers serve to limit infiltration into groundwater, they are more permeable than 6 New York Codes, Rules and Regulations (NYCRR) Part 360 composite cap and 6 NYCRR Part 373 RCRA cap. Furthermore, asphalt is susceptible to cracking and settlement, and thus would require more operation and maintenance in the long-term. Because of the relatively higher permeability of this type of system and higher operation and maintenance costs, this capping system was not retained for further consideration.

- **6 NYCRR Part 360 Cap:** A 6 NYCRR Part 360 cap is commonly used in New York State to close municipal solid waste landfills. The cap system consists of the following components:

    1. A 12-inch gas venting layer with a hydraulic conductivity equal or greater than $1x10^{-3}$ cm/sec directly overlying the waste material. A filter fabric is typically directly below and above the venting layer to minimize the migration of fines into the venting layer. This layer is required to transmit methane for high organic waste material, and is therefore optional. This layer is not required for the Luzerne Road Site, since the PCB containing waste material does not readily decompose.

    2. An 18-inch layer of compacted low permeability barrier soil overlying the gas venting layer with a hydraulic conductivity equal to or less than $1x10^{-6}$ cm/sec.

    3. A synthetic 40 mil or thicker geomembrane overlying the low permeability soil barrier.

    4. A 24-inch compacted soil layer to protect the low permeability layer and geomembrane from root penetration, dessication, and freezing.

    5. A final 6-inches of topsoil placed on top of the protective layer to promote vegetative growth for erosion control.

Because PCB concentration at the site exceeds 50 mg/kg, the waste is considered hazardous under New York State and TSCA regulations. Therefore, the Part 360 cap would not be applicable at the site. This cap system will not be retained for further evaluation.

6 NYCRR Part 373 (RCRA) Cap: RCRA caps are typically required at hazardous waste sites as is the case at Luzerne Road. An RCRA cap is most applicable when a significant potential for leaching of contaminants from the unsaturated zone to the saturated zone exists. Subparts G, K, and N of RCRA of Subtitle C regulations (for hazardous waste) form the basic requirements for cover systems being designed and constructed today. These requirements are also consistent with 6NYCRR Part 373 cap system. The recommended design for a RCRA Subtitle C cap system consists of the following (from bottom to top):

1. A low hydraulic conductivity geomembrane/soil layer consisting of a 24-inch layer of compacted natural or amended soil with a hydraulic conductivity of $1x10^{-7}$ cm/sec, and a minimum 20-mil (0.5 mm) geomembrane liner.

2. A minimum 12-inch soil layer having a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec, or a layer of geosynthetic material having the same characteristics.

3. Minimum 24-inch top vegetative soil layer.

Due to the presence of hazardous surface and subsurface soils at the site (i.e., with PCB concentrations equal to or exceeding 50 mg/kg) and potential for further groundwater leaching, a capping system meeting the minimum requirements of RCRA Subtitle C will be retained for further evaluation.

3.2.4 In Situ Treatment Technologies

In situ treatment technologies for soil remediation typically fall in the following three major categories:

- Thermal treatment;

- Physical/chemical treatment; and

- Biological treatment.

The following sections present a discussion of applicable soil remediation technologies under each general response category discussed above.

3.2.4.1 Thermal Treatment

Thermal treatment processes including thermal desorption generally involve application of heat to contaminated material to vaporize the contaminants into a gas stream (i.e., physically separate from the host medium), and then treating the gas stream prior to discharge into the atmosphere. A variety of gas treatment technologies is used to collect, condense, or destroy the volatilized gases. The two common types of in situ thermal treatment technologies are: in situ thermal desorption using thermal blankets and thermal wells, and enhanced soil vapor extraction (SVE). Thermally enhanced SVE is a full-scale technology that uses electrical resistance/electromagnetic/radio frequency heating, or hot-air steam injection to facilitate volatilization and extraction of the contaminants vapors. The process is otherwise similar to soil vapor extraction. Since SVE does not remove heavy hydrocarbon, PCBs (primarily applicable to VOCs and SVOCs with Henry's constant greater than 0.01), thermally enhanced SVE will not be retained for further consideration. In situ thermal treatment using thermal wells and/or blankets is described below.

In Situ Thermal Desorption (ISTD) - Thermal Blankets and Thermal Wells

This type of technology was developed in Shell Research labs over the last 25 years as part of its enhanced oil recovery efforts, and has been one of the few in situ forms of thermal desorption technologies that has been demonstrated to work effectively on a commercial scale. At the present time, thermal blankets and thermal wells are proprietary technologies of Terratherm Environmental Services, an affiliate of Shell Oil Company. The thermal blanket system consists of electric heating "blankets" approximately 8-by-20 feet that are placed on top of the contaminated ground surface. The blankets can be heated to 1,800° Fahrenheit (F), and by thermal conduction are able to vaporize most contaminants down to about 3 feet. Vapors are drawn out of the soil and through the blanket system by means of a vacuum system. The contaminated vapors are then oxidized at high temperature in a thermal oxidizer near the treatment area, and finally cooled and passed through activated carbon beds to collect any trace levels of organics not oxidized prior to discharge to the atmosphere.

Thermal wells use the same process as thermal blankets, except that heating elements are placed in well boreholes drilled at an average spacing of 7 to 10 feet. Similar to the blanket modules, the vacuum is drawn on the manifold so that extracted vapors are collected and destroyed.

ISTD using thermal wells and blankets has been successfully demonstrated by TerraTherm for a number of PCB-contaminated sites. PCB reduction of 99.9% was achieved from initial concentrations of as high as 19,900 mg/kg. Contamination depth varied between 6 to 18 inches for blankets, and up to 12 feet with thermal wells for these demonstrations. Treatment costs for TerraTherm's ISTD range from $100 to $500 per ton, which is higher than costs for more established technologies. In addition, ISTD is a more appropriate technology for volumes of contamination up to 10,000 cubic yards (Naval Facilities Engineering Service Center 1998). To date, no full-scale application of this technology has been demonstrated. This technology will not be retained for further analysis.

3.2.4.2 Biological Treatment

Biological treatment processes use indigenous or selectively cultured microorganisms to reduce hazardous organic compounds into water, carbon dioxide, and chlorinated hydrogen chloride. Available in situ biological treatment technologies include bioventing, enhanced biodegradation (aerobic and anaerobic), natural attenuation, and phytoremediation. Bioventing is the most promising technology but has only been successfully demonstrated for petroleum hydrocarbons and non-chlorinated solvents. Factors that affect the rate of biodegradation include the type of contaminants present and their concentrations, oxygen, nutrients, moisture, pH, and temperature. Treatability studies are typically conducted to determine the effectiveness of bioremediation in a given situation. A review of completed remediation projects and demonstration projects where biological treatment technologies were used for soil remediation indicates that these technologies have primarily been used for soils contaminated with petroleum hydrocarbons, volatile organic compounds (e.g., trichloroethylene [TCE] and perchloroethylene [PCE]), pesticides and wood preservatives. Because PCBs have a relatively higher chlorine content, they are more persistent in the environment and less susceptible to biodegradation.

Since biological treatment technologies are not well demonstrated for PCBs, and due to the relatively longer remediation periods (longer than a year), these technologies were not retained as applicable technologies.

3.2.4.3 Physical/Chemical Treatment

A number of in situ physical/chemical treatment processes for soil have been developed to chemically convert, separate or contain waste constituents. These include solidification/stabilization, in situ vitrification (ISV), and soil flushing.

Solidification/Stabilization

Solidification/stabilization treatment systems, sometimes referred to as fixation systems, seek to trap or immobilize contaminants within their “host” medium instead of removing them through chemical or physical treatment. Solidification is a process whereby contaminants are physically bound or enclosed within a stabilized mass. Stabilization is a process where chemical reactions are induced between the stabilizing agent and contaminants to either neutralize or detoxify the wastes, thus reducing their mobility.

Solidification/stabilization methods used for chemical soil consolidation can immobilize contaminants. Most techniques involve a thorough mixing of the solidifying agent and the waste. Solidification of wastes produces a monolithic block with high structural integrity. The contaminants do not necessarily interact chemically with the solidification reagents but are mechanically locked within the solidified matrix. Stabilization methods usually involve the addition of materials that limit the solubility or mobility of waste constituents even though the physical handling characteristics of the waste may not be improved. Remedial actions involving combinations of solidification and stabilization techniques are often used to yield a product or material for land disposal, or in other cases, that can be applied to beneficial use. Auger/caisson systems and injector head systems are techniques used in soil solidification/stabilization systems.

In situ solidification/stabilization systems have generally targeted inorganics (i.e., heavy metals) and radionuclides. The auger/caisson and reagent/injector head systems have limited effectiveness in treating organics, although systems are currently being developed and tested for this purpose. Treatability studies are also generally required to assess compatibility of waste material and reagent used. Since this technology has not been successfully demonstrated on a full-scale for treating organics and because the solidified material may hinder future site use, this technology will not be retained for further consideration.

Vitrification

ISV is a type of in situ solidification/stabilization process whereby contaminated soils are melted at extremely high temperatures (exceeding 3,000° F) using an electric current, then cooled to form a stable, glassy crystalline end product. Inorganic pollutants are captured within the vitrified end product, while organic pollutants are destroyed by pyrolysis. Water vapor and combustion products are captured in a hood, which are then drawn into an off-gas treatment to remove pollutants and particulates from the gas.

Although ISV has been tested for a range of organic contaminants including PCBs, and has been operated for test and demonstration purposes at the pilot and full scale, only few commercial applications of this technology exist. Treatability studies are generally required to determine the effectiveness of ISV as a remediation technology at a site. ISV is also generally applicable for soils up to depths of 19 feet, assuming relatively homogenous soils. Because most of the subsurface soil contamination at the site is relatively shallow (0 to 4 feet) and not concentrated in a smaller area, the amount of energy required for full-scale implementation of an ISV system would likely be extremely high, and thus costly to implement. Two studies conducted on the West Coast and Midwest estimated ISV costs between $375 to $425 per ton. Since few commercial applications of this technology exist, and because the end product of the technology may hinder future site use, and due to the relatively high implementation cost, ISV will not be retained for further consideration.

Soil Flushing

Soil flushing is an extraction process by which organic and inorganic contaminants are washed from contaminated soils. An aqueous solution is injected into the area of contamination, and the contaminant elutriate is pumped to the surface for removal, re-circulation, or on-site treatment and re-injection. During elutriation, sorbed contaminants are mobilized into solution because of solubility, formation of an emulsion, or chemical reaction with the flushing solution. An in situ soil-flushing system includes extraction wells installed in the area of contamination, injection wells installed upgradient of the contaminated soil areas, tion, injection wells installed upgradient of the contaminated soil areas, and a wastewater treatment system for treatment of recovered fluids.

Cosolvent flushing involves injecting a solvent mixture (e.g., water plus a miscible organic solvent such as alcohol) into vadose zone, saturated zone, or both to extract organic contaminants. Cosolvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it.

Soil flushing had very limited use and commercial success at Superfund sites. Typically treatability studies must be performed under site-specific conditions before this technology is selected. Finally, because PCBs have a strong tendency to adsorb to soil particles, it would be difficult to get PCBs into a solution. This technology will therefore not be retained for further consideration.

3.2.5 Ex Situ Treatment

Ex situ treatment requires soil to be excavated before treatment. Ex situ treatment allows for greater flexibility in establishing the physical, chemical, or biological conditions; or any combination of these conditions that are required to remove or destroy the contaminant. Available ex situ treatment technologies that would be applicable at the site and the contaminant include thermal desorption and incineration (thermal treatment processes), dehalogenation (chemical process), soil washing (physical process), and solvent extraction (physical process).

3.2.5.1 Thermal Treatment

Thermal treatment processes generally involve the application of heat to physically separate, destroy, or immobilize the contaminant. A number of ex situ thermal treatment technologies exist to treat a range of contaminants including high-temperature and low-temperature thermal desorption (ex situ), hot gas decontamination, open burning/open detonation, pyrolysis, and incineration. This section will focus on high temperature thermal desorption and incineration since the other technologies are either not applicable to PCB contamination (hot gas decontamination, open burning/open detonation, low-temperature thermal desorption), or have not been successfully demonstrated on a full-scale for sites contaminated with PCBs (pyrolysis). High-temperature thermal desorption and incineration are described below.

High-Temperature Thermal Desorption

Thermal desorption is a physical separation process that uses heat to volatilize organic wastes, which is subsequently collected and treated in a gas treatment system. It should be emphasized that thermal desorption is not incineration, because the decomposition or destruction of organic material is not the desired result, although some decomposition may occur. A variety of gas treatment technologies are used to collect, condense, or destroy the volatilized gases. A vacuum system is typically used to transport volatilized water and organics to the treatment system. As described above, thermal desorption technologies can be grouped into high-temperature thermal desorption (HTTD) and low-temperature thermal desorption (LTTD) systems. LTTD is primarily used for non-halogenated VOCs and SVOCs with low boiling points (i.e., below 600° F), and is therefore not considered as an applicable technology for PCB contamination.

HTTD systems are able to heat materials to temperatures in the range of 600° F to 1,200°F, and therefore can target SVOCs, PAHs, and PCBs. A variety of these systems are available and have been successfully demonstrated at contaminated sites. In general, thermal systems can be differentiated by the method used to transfer heat to the contaminated material and by the gas treatment system. Direct-contact or direct-fired systems (i.e., rotary dryer) apply heat directly by radiation from a combustion flame. Indirect-contact or indirect-fired systems (rotary dryer and thermal screw conveyor) apply heat indirectly by transferring it from the source (combustion or hot oil) through a physical barrier that separates the heat source from the contaminated material.

HTTD is a full-scale technology that has been successfully demonstrated in the field for treatment of PCB contaminated soils. Typically, systems that have been used for PCB contamination consist of a rotary dryer (primary chamber) to volatilize the contaminated material, and an afterburner (secondary chamber) where the off-gas is oxidized at temperatures in the range of 1,400° F to 1,800° F. The off-gas is then cooled, or quenched, and passed through a baghouse to remove any trace organics not oxidized prior to discharge into the atmosphere. Note that from a permitting perspective, this type of system is considered to be an incinerator, and must meet the more stringent RCRA incinerator emission requirements (40 CFR Parts 264 and 265, Subpart O) rather than Subpart X requirements for thermal desorbers. Thermal desorption however has gained more public acceptance compared to incineration. HTTD will be retained as an applicable technology for further evaluation.

Incineration

Incineration uses high temperatures (1,600° to 2,200° F) to volatilize and destroy organic contaminants and wastes. A typical incineration system consists of the primary combustion chamber into which contaminated material is fed and initial destruction takes place, and a secondary combustion chamber where combustion byproducts (products of incomplete combustion) are oxidized and destroyed. From the secondary chamber, the off-gases are drawn under negative pressure into an air pollution control system (APCS), which may include a variety of units depending on the contaminants and site-specific requirements.

The two primary types of incinerators are rotary kiln and liquid injection incinerators. A third type, the infrared incinerator, was used at the Rose Township Dump site, but is no longer used commercially in the United States. The rotary kiln is a refractory-lined, slightly inclined, rotating cylinder that serves as the primary combustion chamber operating at temperatures up to 1,800° F. The kilns can range in size from 6 to 14 feet in diameter. The liquid injection incinerators are used to used to treat combustible liquid, sludge, and slurries. This system would not be applicable for the contamination at Luzerne Road, since liquid waste or contamination is not present at the site.

Excavation followed by on-site incineration is a demonstrated treatment technology for PCB-contaminated soils. Incineration is considered an effective technology, achieving the 99.9999% reduction requirement of PCBs and dioxins concentrations in soil, thus providing long-term protection. Incinerators burning hazardous wastes must meet the RCRA incinerator regulations (40 CFR Parts 264 and 265, Subpart O) as well as state and local regulations. Furthermore, on-site incinerators used to treat PCB-contaminated material with concentration greater than 50 mg/kg, as is the case at Luzerne Road, may also be subject to the requirements under TSCA set forth in 40 CFR Part 761. Because of the stringent permitting requirements, and the public concern that has been historically associated with incineration systems compared to thermal desorption system, it is unlikely that on-site technology incineration can be implemented at the site. This technology will not be retained for further evaluation.

3.2.5.2 Physical/Chemical Treatment

A number of ex situ physical/chemical treatment processes for soil have been developed to chemically convert, separate or contain waste constituents. These include dehalogenation (or dechlorination), soil washing, and solvent extraction.

Dehalogenation

Dehalogenation is a chemical process that is achieved either by replacement of the halogen molecule of the organic compound or decomposition and partial volatilization of the contaminant through adding and mixing specific reagents. This technology typically consists of excavating, screening and crushing the contaminated soils, mixing with the reagent in a heated reactor, then treating the wastewater or the volatilized contaminants. Two types of dehalogenation technologies exist: base-catalyzed decomposition (BCD) and Glycolate/Alkaline Polyethylene Glycol (APEG).

EPA has been developing the BCD technology since 1990, in cooperation with the Naval Facilities Engineering Service Center (NFECS), as a remedial technology specifically for soils contaminated with chlorinated organic compounds such as PCBs. Although this technology has been approved by EPA's Office of Toxic Substances under TSCA for PCB treatment, and one successful test run in 1994 was completed, BCD has had no commercial application to date. Since BCD technology has not yet been successfully demonstrated, it was not retained as an applicable technology.

Glycolate technology involves the replacement of halogen molecules in the organic contaminant by mixing the contaminant with an APEG-type reagent (commonly Potassium Polyethylene Glycol [KPEG]) in a heated reactor. The byproducts of the reaction include a glycol ether and/or hydroxylated compound and an alkali metal, which are all water soluble. Typically, treatment and disposal of wastewater generated by the process is required. APEG process has been successfully used and demonstrated for cleanup of contaminated soils containing PCBs ranging between 2 and 45,000 mg/kg. This technology has also been approved by EPA's Office of Toxic Substances under TSCA for PCB treatment, and has been selected for cleanup at three Superfund sites. However, this technology is not generally cost-effective for large waste volumes as is the case for Luzerne Road. The full-scale implementation cost of this technology can range from $200 to $500 per ton, not including excavation and material handling cost, which is relatively higher than more established technologies. Therefore, the APEG process will not be retained for further consideration.

Soil Washing

Soil washing is considered treatment for on-site soil contamination as it is a volume reduction technology that segregates the fine solid fractions from the coarser soils through an aqueous washing process and washing water treatment system. This technology is based on the observation that the majority of contaminants are found adsorbed into the fine soils (typically silt and clay size particles) due to their greater specific surface area. The finer, contaminated fraction of soils would require further treatment/disposal. The coarser soils (expected to be relatively free of contamination) would be backfilled on site once site cleanup goals have been achieved, which may require the soil to pass through the soil washing process multiple times. Commercially available surfactants are commonly used in the aqueous washing solution to transfer contaminants from the soil matrix to the liquid phase. Bench-scale studies are generally required prior to implementation of a full-scale soil washing operation to determine site-specific parameters and selection of surfactant(s). Although the commercialization of the process has been limited, NYSDEC has selected soil washing at another state Superfund site as the remedial alternative for PCB-contaminated soils.

Because contaminated site soils are primarily medium-to-fine sands (based on geotechnical data collected during the RI (E & E 2002) as opposed to finer soils such as silt or clay, soil washing is expected to be effective in reducing the volume of contaminated on-site soils. Therefore, soil washing will be retained for further consideration.

Solvent Extraction

Solvent extraction is a type of a chemical extraction process whereby the target contaminant is physically separated from its medium (soil) using an appropriate organic solvent to dissolve the contaminant. This technology therefore does not destroy the waste, but reduces the volume of hazardous waste that must be treated. Solvent extraction is typically accomplished by homogeneously mixing the soil, flooding with the solvent, then mixing thoroughly again to allow the waste to come in contact with the solution. Once mixing is complete, the solvent is drawn off by gravity, vacuum filtration, or some other conventional dewatering process. The solids are then rinsed with a neutralizing agent (if needed), dried, and placed back on site or otherwise treated/disposed of. Solvents and rinse water are processed through an on-site treatment system and recycled for further use.

An on-site demonstration of the solvent extraction technology was completed at Luzerne Road by Environmental Technology Unlimited Corporation between September 18 and 22, 2000. E & E personnel were present during the demonstration. Although analytical results from the demonstration showed on average a 99.1% total PCB removal, operational problems were encountered during start-up, and multiple extractions were needed to achieve the required cleanup criteria. A literature search on the application of solvent extraction technology indicated that this technology has been successfully demonstrated at a number of superfund sites for PCB-contaminated soils and sediments. The performance data currently available are mostly from the Resource Conservation Company's (RCC's) full-scale B.E.S.T. process. However, full-scale application of the technology has been limited, especially to relatively large volumes of soil as is the case at this site. Cost information from various demonstrations of this technology indicates a unit cost ranging anywhere between $270 to $700 per ton (depending on site-specific conditions and volume of treated material), which is relatively higher than more established technologies. Additional concerns with this technology include the potential for presence of solvent in the treated soil, and regeneration and reuse of the spent solvent. Solvent extraction was therefore not retained for further consideration.

3.3 Groundwater Treatment Technologies

The range of potential groundwater treatment technologies considered and evaluated in this FS has been limited since many technologies such as in situ oxidation/reduction, in situ biological treatment, subsurface reactive walls, or air stripping are not applicable/effective to remediate PCB-contaminated groundwater since PCBs are recalcitrant compounds by nature. Furthermore, the relatively low concentrations of PCBs detected in groundwater, and the depth to contamination would not warrant implementation of a comprehensive in situ treatment technology. The applicable technologies are presented in the same order as the GRAs discussed above.

3.3.1 No Action

In accordance with the NCP a no-action response must be evaluated during the course of the FS. The no-action alternative is only acceptable when it does not result in an unacceptable risk to human health and the environment.

3.3.2 Institutional Controls

Institutional controls are not technologies. They consist of cultural factors that reduce or prevent exposure of the human population to the affected groundwater (e.g., deed restrictions, health advisories). Institutional controls are not intended to be used alone or in perpetuity. Rather, they would be used in conjunction with natural attenuation processes that result in the eventual reduction of contaminant concentrations to cleanup levels.

Institutional controls are inappropriate when a valuable natural resource such as a sole-source aquifer would remain unusable for a long period of time. However, because groundwater in the vicinity of the site is not used as a drinking water source, this technology is effective in preventing exposure to groundwater contaminants, and institutional controls are readily implemented, it will be retained for further consideration.

3.3.3 Natural Attenuation

Natural attenuation uses naturally occurring treatment mechanisms to reduce the concentration of contaminants in an aquifer, including physical processes such as dispersion, volatilization, and adsorption, but more importantly relies on the destructive mechanisms of anaerobic biological reduction. Under the right conditions, anaerobic microorganisms can reductively dechlorinate organic solvents, ultimately producing ethene and chloride end products. Alternatively, this mechanism can produce less-chlorinated compounds that are amenable to mineralization through aerobic biological treatment mechanisms. The reductive dechlorination reaction requires anaerobic conditions as well as sufficient electron donors to supply reducing power. Typically, electron donors include hydrocarbon contamination that may be collocated with the solvent contamination, or carbohydrate or organic acid material that may be present either naturally or from the disposal of nonhazardous material.

A protocol was developed by EPA to document the natural attenuation process. This protocol provides the methods needed to verify that natural attenuation occurs, and the conditions under which it can be applied. This technology can be used to clean up a site if the existing processes are suitable to treat contaminants as fast as they are released, and that the plume would not migrate to potential future receptors.

PCBs are by nature recalcitrant compounds, and are less susceptible to biodegradation compared to chlorinated aliphatic hydrocarbons such as chlorinated ethenes. This technology will therefore not be retained for further consideration.

3.3.4 Capture and Control

Subsurface Barriers

Subsurface barriers are typically used to divert the flow of groundwater from a contaminated area or to direct the flow of contaminated groundwater into a capture or treatment system. Typical barriers include slurry walls, sheet piling, and grouting.

Slurry walls are usually constructed by excavating a trench from surface soil while simultaneously replacing the excavated soil with a slurry of soil mixed with bentonite clay or cement mixed with bentonite clay. Slurry walls can also be created by augering a series of intersecting vertical boreholes and mixing the slurry in the boreholes. The overlapping, filled boreholes comprise a slurry wall. The excavation of slurry walls in dense, hard, fractured rock is difficult and often precludes implementation.

Sheet piling with interlocking joints can be driven or vibrated into the ground in granular material to form an effective barrier to groundwater flow. Several materials can be used for sheet pilings, including wood, plastic, precast concrete, and steel, but steel is used most often.

Subsurface barriers are most effective and their success often depends upon their completion within the upper portion of a natural layer of low hydraulic conductivity such as an aquiclude. Where areas of low hydraulic conductivity exist, subsurface barriers capture and control groundwater flow quite effectively, and all three barrier types are equally implementable. However, because the groundwater contamination at the Luzerne Road Site is at a depth greater than 30 feet BGS, and the depth to bedrock exceeds 60 feet in some areas, subsurface barriers would be technically difficult to construct. Subsurface barriers will therefore not be retained for further consideration.

Groundwater Collection

Groundwater is captured and controlled by pumping it out of the ground and creating hydraulic gradients toward the capture point. The capture method considered applicable for the groundwater contamination at the site is extraction wells. Collection trenches would not be effective or readily implementable at the site since the contamination is at depth greater than 30 feet BGS.

Extraction Wells

Extraction wells are constructed with a well screen that opens to the aquifer along the part of the well length placed within the contaminated portion of the aquifer. This is surrounded by a material of high hydraulic conductivity, such as sand or gravel, and a pump is usually inserted in the screened internal well. Shallow wells may have pumps at the surface, with only a production pipe extending below the water table. Well screens and casings, pumps, and pipes are often constructed with polyvinyl chloride (PVC), steel, or stainless steel, depending on the expected corrosivity or aggressiveness of the water and the expected life of the well. The diameter of the well, its anticipated pumping capacity, and the size of the pump are determined based on aquifer properties and the capture zone required.

Extraction wells are both effective and implementable at the site, and are therefore retained for further consideration.

3.3.5 Ex Situ Treatment

After groundwater is captured and pumped out of the ground, it can be treated by a wide variety of on-site and off-site systems.

Physical/Chemical Treatment

The six technologies below are considered for physical/chemical treatment of extracted groundwater.

- **Precipitation/Coagulation/Flocculation.** This process removes metals and colloidal and dissolved solids from wastewater. Precipitation is a chemical (or electrochemical) process by which soluble metallic ions and certain anions are converted to an insoluble form for subsequent removal from the wastewater stream. Various coagulants and coagulant aids such as alum, ferric chloride, sodium sulfide, organic polymers, and sodium hydroxide are selected, depending on the specific waste material to be removed, and rapidly mixed with the wastewater to cause the colloidal particles to agglomerate into a floc large enough to be removed by a subsequent clarification process. The performance of the process is affected by chemical interactions, temperature, pH, solubility variances, and mixing effects. These processes are not applicable for PCB-contaminated groundwater and will not be retained for further consideration.

- **Filtration** is a well-established unit operation for achieving supplemental removal of residual suspended solids from wastewater. Filtration may be employed prior to activated carbon adsorption to reduce the potential for biological growth, clogging, and the suspended solid loads on these units. Filtration could also be used as part of a polishing unit to remove residual floc from the effluent of a precipitation, flocculation, and sedimentation process. This technology will be retained for further consideration

- **Sedimentation** is designed to let water flow slowly and quiescently, permitting solids more dense than water to settle to the bottom and materials less dense than water (including oil and grease) to flow to the surface. Polymers may be added to the wastewater to enhance liquid-solid separation. Settled solids form a sludge at the bottom of the clarifier, which is usually pumped out continuously or intermittently. Oil and grease and other floating materials may be skimmed off the surface. For low-flow applications as would be considered in this study, filtration is more appropriate than sedimentation. Thus, this technology will not be retained for further consideration.

- **Activated Carbon Adsorption** removes organics from aqueous waste streams by adsorbing the compounds onto the large internal pore surface area of activated carbon. This process has been demonstrated on a variety of organics, particularly those exhibiting low solubility and high molecular weight. It is an effective and reliable means of removing low solubility organics over a broad concentration range. Activated carbon can be used in a treatment column or by adding powdered activated carbon directly to contaminated water. In column applications, adsorption involves the passage of contaminated water through a bed of activated carbon that absorbs the contaminants. When the activated carbon has been utilized to its maximum adsorptive capacity (i.e., spent), it is then removed for disposal, destruction, or regeneration. Carbon adsorption can be readily implemented at hazardous waste sites and can remove dissolved organics from aqueous wastes to levels below 1 ppb. This process will be retained for further consideration.

- **Air Stripping/Steam Stripping** includes mass transfer processes in which volatile organic contaminants in water are transferred to gas. Stripping processes maximize contact between contaminated aqueous solutions and air; transferring volatile organics to the air to form a gaseous effluent. Air stripping is effective for diluting waste streams that contain highly volatile organics. Steam stripping and elevated-temperature air stripping are effective for more concentrated waste streams containing less volatile organics. Steam stripping is a variation of distillation that uses steam as both the heating medium and the driving force for the removal of volatile materials. Steam is introduced into the bottom of a tower, and as it passes trough the wastewater, the steam vaporizes, removes volatile materials from the waste, and exits via the top of the tower. Although commonly employed as an in-plant technology for solvent recovery, steam stripping is also used as a wastewater treatment process. Since PCBs have high vapor pressure (i.e., non-volatile) air stripping and steam stripping will not be considered for further consideration.

- **Ultraviolet Oxidation.** The ultraviolet (UV)-light chemical oxidation process is applicable for the removal or destruction of organic contaminants in groundwater. Using hydrogen peroxide or ozone as a reagent, this process reduces the contaminants to acceptable levels or destroys them completely. UV light catalyzes the chemical oxidation of organics in groundwater. The process involves extracting the contaminated groundwater and passing it through an oxidation chamber (the mixture flows past the UV lamps, which are housed in quartz tubes). The contaminants absorb the UV light, and this light energy activates the contaminant so that it is more readily oxidized by hydrogen peroxide or ozone. This technology could be used within the treatment train of a groundwater treatment system, and can be considered within any remedial design of groundwater treatment alternatives. UV technology is generally more expensive than other treatment technologies presented in this section, therefore, will not be retained for further consideration.

4

Development of Alternatives

In this section the technologies selected from Section 3 to address soil and groundwater contamination at the site are combined into alternatives. In collaboration with NYSDEC, four alternatives were identified for the soil contamination and three alternatives were identified for the groundwater contamination. The alternatives are grouped by medium and are described briefly below. A detailed description and evaluation of the alternatives is presented in Sections 5 and 6.

4.1 Surface/Subsurface Soil (OU 2), and PCB Cell (OU 1)

4.1.1 Alternative 1 – No Action

The no-action alternative was carried through the FS for comparison purposes as required by the NCP. This alternative would be acceptable only if it is demonstrated that the contamination at the site is below the remedial action objectives, or that natural processes will reduce the contamination to acceptable levels. This alternative does not include institutional controls.

4.1.2 Alternative 2 - Source Area Capping and Excavation and Off-Site Disposal of the PCB Cell

This alternative consists of consolidating and capping the contaminated surface and subsurface soil material at the site. Since the PCB cell was constructed as an interim remedial measure, this alternative also involves excavation and off-site disposal of contaminated material stored in the cell. This containment alternative reduces direct contact exposure, migration of fugitive dust, and minimizes vertical transport of contaminants into the groundwater. Removal of the PCB cell will also eliminate the potential for leachate to vertically migrate into the groundwater. The cap system will meet the requirements of RCRA Subtitle C and 6 NYCRR part 373 for hazardous waste sites. Institutional controls (to include deed restrictions) will also be implemented in combination with the cap installation to maintain the integrity of the capping system.

4.1.3 Alternative 3 - Excavation and Off-Site Disposal of Contaminated Soils

This alternative consists of excavation and off-site disposal of contaminated soils that exceed the remedial action objective for the COC. Excavated material will be stockpiled, sampled, and properly disposed of accordingly. In accordance with

New York State Hazardous Waste and TSCA regulations, materials containing PCBs at or above 50 mg/kg will be disposed of at an RCRA-permitted facility. Contaminated material with concentrations less than 50 mg/kg is considered non-hazardous waste, and will be disposed of in a non-hazardous waste facility. Off-site clean fill will be used to backfill the excavated areas.

4.1.4 Alternative 4 - Excavation and On-Site Thermal Treatment of Contaminated Soils

This alternative consists of excavating and thermally treating contaminated soils that exceed the remedial action objective for the COC. A high temperature thermal desorption system was selected to treat the contaminated material. This treatment process generally involves the application of heat to contaminated material to volatilize the contaminants (i.e., physical separation process), and then collecting and treating the gas stream. An APCS will also be included as part of the treatment system to ensure that air emissions meet regulatory criteria prior to discharge into the atmosphere.

4.1.5 Alternative 5 - Excavation and On-Site Soil Washing of Contaminated Soils

Prior to implementation of this alternative, a bench-scale study must be performed to determine the optimal process to effectively treat contaminated site soils. Based on positive results of this study, this alternative will consist of excavating and using soil washing technology to reduce the volume of on-site soils that exceed the remedial action objective for the COC. This process generally involves contaminated soils being fed through a washing unit in batches, where water and surfactants are added. The mixture is agitated and process wastes (including fine sediment laden with contamination and wastewater) are segregated from the larger soil particles.

4.2 Groundwater (OU 2 and OU 3)

4.2.1 Alternative 1 - No Action

The no-action alternative was carried through the FS for comparison purposes as required by the NCP. This alternative would be acceptable only if it is demonstrated that the contamination at the site is below the remedial action objectives, or that natural processes will reduce the contamination to acceptable levels. This alternative does not include institutional controls.

4.2.2 Alternative 2 - Long-Term Monitoring

Since the PCB concentrations in groundwater are relatively low, (with the exception of PCB-E1, MW-101-4, MW-101-5), this alternative consists of long-term monitoring of the on-site groundwater. This alternative will not actively reduce contaminant concentration, however, because groundwater in the vicinity of the site is not used as a drinking water source, this alternative is effective in preventing exposure to groundwater contaminants. Since on-site groundwater will not be treated, on-site groundwater exceedences will remain and institutional controls (to include deed restrictions) would be implemented to minimize future potential exposure.

4.2.3 Alternative 3 - Groundwater Extraction and Treatment, and Long-Term Monitoring

With the exception of PCB-E1 (the monitoring point for the PCB cell), and MW-101-4 and 101-5 (located just southeast from the tow of Glens Falls landfill), on-site PCB groundwater concentrations ranged between 0.1 and 1 μg/L. This alternative consists of groundwater extraction and treatment from the area south/southeast of the PCB cell, in combination with long-term monitoring of on site groundwater. A carbon treatment system would be used to treat contaminated groundwater in the shallow groundwater zone where the highest PCB concentrations have been detected. This alternative is effective in preventing exposure to groundwater contaminants, in addition to actively providing contaminant reduction through treatment of the groundwater hot spot area.

5

Detailed Analysis of Soil Alternatives

5.1 Analysis of Individual Alternatives

5.1.1 Alternative 1 - No Action

5.1.1.1 Description

The no-action alternative is presented in accordance with the NCP as a baseline for comparison with other alternatives. This alternative does not include remedial action, institutional or engineering controls, and long-term monitoring.

5.1.1.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is not protective of human health and the environment. Surface and subsurface soil contamination exceeding target risk levels and regulatory standards will remain in place and be available for potential future exposure.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative does not comply with ARARs for the contaminant of concern. PCBs are recalcitrant compounds by nature, and therefore their levels in the surface and subsurface soil are not expected to decrease over time.

Long-term Effectiveness and Performance

Because this alternative does not involve the removal or treatment of contaminated surface and subsurface soil, the volume of contamination, risks associated with direct contact with the soil, and migration of contaminants to groundwater will remain essentially the same. This alternative is therefore not effective in the long term.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not involve removal or treatment of contaminated surface and subsurface soil, and therefore the toxicity, mobility, and volume of contamination will not be reduced.

Short-Term Effectiveness

No short-term impacts are anticipated during implementation of this alternative, since no construction activities to remove or treat the contaminated soil are involved with the alternative.

Implementability

There are no actions to implement under this alternative.

Cost

There is no cost associated with this alternative.

5.1.2 Alternative 2 - Source Area Capping and Excavation and Off-Site Disposal of PCB Cell

5.1.2.1 Description

This alternative involves capping contaminated material at the site in accordance with RCRA Subtitle C and 6 NYCRR part 373 requirements and placing institutional controls to protect the integrity of the cap system. In addition, the PCB cell will be excavated and properly disposed of off site.

In order to minimize the area requiring capping and optimize potential future land use at the site, contaminated surface soils with PCB concentrations equal to or greater than 1 mg/kg and subsurface soils with PCB concentrations equal to or greater than 10 mg/kg in the southern area of the site and under the parking lot will be consolidated and capped in an area north of the existing parking lot (see Figure 5-1). E & E estimated that approximately 20,000 cubic yards of surface and subsurface soil from the southern area of the site would be excavated to a maximum depth of 4 feet and consolidated on site (see Appendix D). An additional 5,000 cubic yards will be excavated from select areas of the existing gravel parking lot to a maximum depth of the finished cap thickness (approximately 2.5 feet) and consolidated so that a cap may be installed with minimal disturbance to the existing parking lot elevation. The consolidated soil will then be graded and compacted for the cap system installation. It is assumed that monitoring wells MW-1S/I/D, MW-2S, PCB-W1, PCB-N1, PCB-E1, PCB-S1, and PCB-SE1 will be decommissioned, without replacement, in the excavated areas.

Contaminated material from the existing PCB cell will also be excavated and disposed of at an off-site hazardous waste disposal facility. Excavation of the PCB cell will extend to approximately 15 feet BGS (see Appendix B). E & E assumed that the top 3 feet of the above-grade PCB cell cap system to be “clean,” and will be reused in the excavation as either topsoil (top foot) or general backfill (bottom 2 feet). Recent monitoring data from the PCB cell indicates that leachate is present at the base of the cell and will need to be treated and/or properly disposed of. Based on limited historical monitoring data for the PCB cell, E & E estimated that approximately 100,000 gallons with 25% contingency equaling 125,000 gallons of leachate maybe present in the cell. Per discussions with Chemical Waste Management (CWM), this large volume of PCB-contaminated leachate will not be accepted at their facility in New York State. CWM indicated however that a disposal facility in Texas may accept the waste at a disposal cost of approximately $0.75 per pound. Based on the estimated 125,000 gallons of leachate, the total estimated cost for disposal using this option would approximately be $730,000 for 1,000,000 pounds of leachate. Another option maybe disposal at a local publicly owned treatment works (POTW), however, this may require pre-treatment of the leachate to acceptable levels. Since both of these options would not likely be cost-effective, E & E assumed that an on-site water treatment system, consisting of pre- and post-filters and carbon drums, would be used to cost-effectively handle the PCB cell leachate. The discharge from the system would then be appropriately disposed of off site. E & E assumed that no free product is present in the PCB cell and permit equivalency for off-site disposal would be obtained by NYSDEC.

As shown in Figure 5-1, the capped area will cover a surface area of approximately 3 acres in the northern area of the site (extending into the former footprint of the PCB cell) and 1 acre in the parking lot area. The proposed cap configuration was selected to cover the existing on-site subsurface soil contamination, in addition to maintain general site topography. The capped system will have maximum side slopes of 3 horizontal to 1 vertical (3H:1V), but no less than 5H:1V to ensure proper drainage.

In order to maintain general site topography, a geosynthetic cap system is proposed instead of a conventional RCRA Subtitle C cap system. The total proposed cap thickness will be approximately 2 feet versus 5 feet for the conventional clay cap system. The proposed cap system will consist of the following (see Figure 5-2):

1. A geosynthetic clay liner (GCL) overlying the compacted waste material with a hydraulic conductivity equal to or less than $1x10^{-7}$ cm/sec. The GCL consists of two geotextiles encapsulating a layer of bentonite with a high density polyethylene (HDPE) liner (40 mil) applied to one of the geotextiles, overlying the compacted waste. A GCL is proposed to replace the clay/HDPE liner in the conventional cap system for the following reasons: 1) GCLs are generally less than 1-inch thick (substantially less when compared to 2-feet thickness for a conventional clay liner), 2) GCLs exhibit self-sealing properties in the event of puncture, 3) GCLs exhibit freeze-thaw resistance properties, and 4) an overall reduction in installation costs (conventional clay liners would require significant compaction and quality control during construction).

2. A synthetic drainage layer overlying the GCL consisting of an HDPE netting with filter fabric on both sides and exhibiting a hydraulic conductivity equivalent to a one-foot sand layer with a minimum hydraulic conductivity of 10^{-2} cm/sec. The filter fabric will allow water to flow through to the netting while at the same time preventing soil material from above from clogging the void space.

3. An 18-inch soil barrier protection layer to support vegetation and protect the GCL. The lower 6 inches of this layer must be reasonably free of cobbles/stones to prevent penetration through the filter fabric of the drainage layer.

4. The final layer will consist of 6 inches of topsoil seeded to promote vegetative growth for erosion control. The surface cover will be seeded with low-maintenance grassy vegetation native to the area.

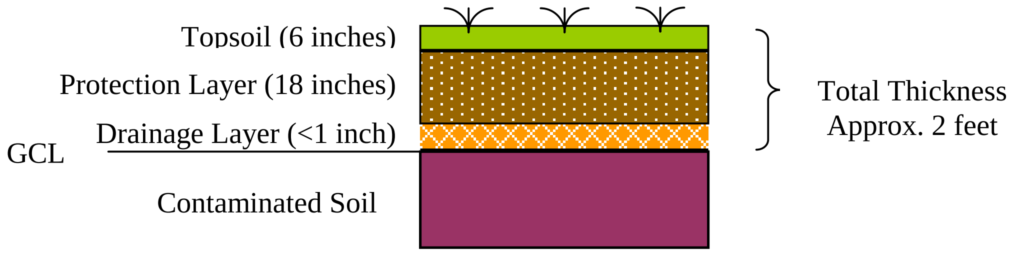


Figure 5-2 Proposed RCRA Cap System

The cap system in the parking lot area will be similar to the above-described cap. However, instead of the final topsoil layer an appropriate crushed stone/binder/pavement layer designed to withstand commercial loads (approximate thickness 12 to 18 inches) will be constructed. The total thickness of the cap system under the parking lot will be approximately 2.5 feet.

Following excavation and removal of designated soil from the site, imported clean fill and clean material from the PCB cell will be used as backfill or topsoil for the site. Backfill material will be compacted in lifts, with the exception of the top 6 inches of topsoil, which will be graded to the final designed elevation. Once backfill operations are completed, all access roads and other intrusions to the site will be restored to pre-construction conditions, and the site will be hydroseeded. A perimeter fence surrounding the new capped area will be installed. E & E assumed that the existing fence along the perimeter of the PCB cell could be reused for the capped area.

Institutional controls will be implemented in combination with the cap installation in order to prevent future uses of the site that would compromise the integrity of the capping system.

5.1.2.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

Although contamination will remain on site after excavation of the PCB cell, this alternative is considered to be protective of human health since capping of the site will significantly reduce potential direct human exposure pathways. This alternative is also considered protective of the environment since the cap design will help to minimize infiltration of rainwater into the subsurface, thus minimizing the potential for vertical migration of contamination into the saturated zone. However, the cap system will not reduce the lateral migration of contaminants due to groundwater flow.

In order to maintain protection of human health and the environment, institutional controls, such as restrictions on subsurface excavation of the capped area, will need to be implemented so that future uses of the site are consistent with the intent of the cap.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative does not comply with ARARs for the contaminant of concern, since contamination will remain on site after removal of the PCB cell. PCBs are recalcitrant compounds by nature, and therefore their levels in the surface and subsurface soil are not expected to decrease over time.

Long-term Effectiveness and Performance

With proper inspection and routine maintenance, this alternative is considered adequate and effective in the long-term. Vertical migration of contaminants into the groundwater would be minimized with a properly constructed and maintained cap. Removal and off-site disposal of the PCB cell from the site will also eliminate a source of PCB contamination to groundwater. However, since contamination would remain on site, the potential for future human exposure remains if the integrity of the cap system is jeopardized or future use of the site changes. Institutional controls along with proper maintenance would minimize the potential for future exposure.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not involve treatment of contaminated material, and therefore the toxicity, mobility, or volume of contamination will not be reduced. Capping is expected to indirectly reduce the mobility of the contaminants into the saturated zone as a result of the expected reduction in rainwater infiltration. Contaminated material stored in the PCB cell will be removed and disposed of in an engineered permitted facility, therefore the mobility of the contaminants would be practically reduced.

Short-Term Effectiveness

Several short-term impacts to the community and workers may arise during consolidation and excavation of contaminated soil, and installation of the cap. These include dust, noise, and potential spills during handling and transportation of contaminants. To minimize short-term impacts, site access will be restricted during construction and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment, and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels will need to be set prior to any intrusive activities, and an appropriate correction action will need to be implemented if these action levels are exceeded.

Off-site transportation of contaminated soil from the PCB cell to the disposal facility will need to be performed by a licensed hauler. While there is a risk of spills due to accidents, this risk will be minimized by using closed and lined containers for transport.

Because this alternative does not involve removal or treatment of all contaminated soil from the site, the preliminary remediation goals will be not be achieved at the completion of this work. Installation of the cap system and excavation and disposal of the PCB cell is estimated to take between 10 to 12 months.

Implementability

This alternative is readily implemented using standard construction means and methods. No technical difficulties are anticipated during consolidation of the contaminated material, installation of the cap system, and removal of the PCB cell. Contaminated soil will be excavated, tested, and segregated for disposal at either a hazardous or non-hazardous waste facility. Several facilities have been identified which can accept the contaminated soil from the site. No capacity or availability problems have been identified. Finally, no delay is anticipated in obtaining the necessary approvals/permits from state and local agencies or in placing institutional controls for implementation of this alternative.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period and a discount rate of 5% is approximately $14,081,000 (or $14,552,000 adjusted to 2004 costs). Table 5-1 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Annual site monitoring costs and maintaining institutional controls were assumed with this alternative.

5.1.3 Alternative 3 - Excavation and Off-Site Disposal of Contaminated Soils

5.1.3.1 Description

This alternative involves excavation and off-site disposal of contaminated soils from Luzerne Road Site. The excavated material will be stockpiled, characterized, and properly disposed of off site. In accordance with New York State and TSCA regulations, hazardous material with PCB concentrations equal to or greater than 50 mg/kg will be disposed of at a hazardous waste disposal facility. Non-hazardous material with PCB concentrations less than 50 mg/kg will be disposed of at an acceptable solid waste landfill. Temporary facilities will be required for on-site storage of contaminated material after excavation. Clean fill will be used to backfill the excavated areas.

Soil excavation will be conducted using conventional construction equipment such as hydraulic excavators and bulldozers. As shown in Figure 5-3, surface soil south of the PCB cell and subsurface soil south and west of the PCB cell will be excavated to accomplish site cleanup goals. The maximum depth of excavation for subsurface soil is 24 feet BGS west of the PCB cell. It is assumed that monitoring wells MW-1S/I/D, MW-2S, PCB-W1, PCB-N1, PCB-E1, PCB-S1, and PCB-SE1 will be decommissioned, without replacement, in the excavated areas. Contaminated material from the existing PCB cell will be excavated and disposed of at an off-site hazardous waste disposal facility. Excavation of the PCB cell will extend to approximately 15 feet BGS (see Appendix B). E & E assumed that the top 3 feet of the above grade PCB cell cap system to be “clean,” and will be re-used in the excavation as either topsoil (top foot) or general backfill (bottom 2 feet). Leachate from the PCB cell will be removed and treated prior to excavation activities in this area, as described in Alternative 2.

Because the aerial extent of subsurface contamination varies with depth, excavation of clean soil material will be required to reach the areas of suspected subsurface contamination. In addition, because of the deep excavation in the western area of the site (maximum 24 feet), cutback of the excavation will be required to ensure safe working conditions in the excavation at all times. Based on a cutback slope of 3:1, E & E estimated that approximately 61,000 BCY of clean soil will need to be excavated from the site (see Appendix C). Along the northern edge of the western area bordering the Glens Falls Landfill, sheet piling was assumed since cutting back the excavation will result in excavation into the landfill slopes. Approximately 6,300 square feet of sheet piling in the western area will be needed to adequately support the 24-foot excavation.

During the excavation process, PCB field screening tests will be used in accordance with 40 CFR 761.61 and the approval of the NYSDEC construction oversight inspector to verify contamination levels. The goal will be to determine if the remaining soil has PCB levels above cleanup criteria, thus requiring additional excavation, or providing documentation that additional excavation is not necessary if the results indicate that PCB levels are less than the respective clean up goals. A sampling grid will be developed over each remaining soil area for the NYSDEC construction oversight inspector’s approval.

Dewatering may be necessary once depths of 19 feet or more are encountered based on groundwater data in the western area of the site. Means and methods of dewatering will be determined by the contractor’s approach to the site work. E & E assumed the establishment of a temporary water treatment system on site. This will require PCB concentrations to be reduced to levels below groundwater standards and appropriately disposed of on/off site.

Excavated soils will be segregated based on contamination level and stockpiled onsite for characterization in accordance with disposal facility requirements. The first 3 feet of the above-grade PCB cell capping system was assumed to be "clean," and will be reused either as topsoil (top foot) or general backfill (bottom 2 feet). The contractor will be responsible for the characterization sampling, which will be conducted at a New York State Department of Health certified laboratory.

After the results of the characterization sampling are received, the soil will be cleared for disposal by the NYSDEC construction oversight inspector. E & E evaluated the use of roll-offs versus dump trucks for transportation of contaminated material. Based on discussions with CWM, the cost of using roll-offs was 15% higher than dump trucks. Therefore, for this alternative, lined and covered dump trucks were assumed at $44 and $31 per ton for transportation of hazardous and non-hazardous material respectively. Trucks will be weighed with an empty load at a nearby scale (or the contractor may choose to establish one on-site). The soil will be loaded onto the trucks then weighed again to determine the loaded weight of the vehicle. The trucks will then transport the soil to the appropriate disposal facilities.

Table 5-2 summarizes the volume of hazardous and non-hazardous soil to be excavated by depth interval. The soil volumes were calculated using Surfer software as described Section 2.3.3. Hazardous soils will be disposed of at a permitted NYSDEC-approved RCRA landfill. According to the U.S. Army Corps of Engineers Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise Information, eight hazardous waste landfill facilities operating in the United States are permitted to accept these soils. Of those eight, only three of the facilities are located east of the Mississippi River: CWM in Emelle, Alabama, and Model City, New York; and Wayne Disposal, Inc., facility in Belleville, Michigan.

The CWM facility in Model City, Niagara County, New York, is the closest facility to the site, and therefore, the likely destination for the PCB-contaminated soils from the site. Based on discussions with CWM, there is no upper limit for PCB concentrations at this facility. This facility requires PCB samples to be collected every 300 tons. Based on the soil volume calculations presented in Table 5-2, approximately 83,000 BCY (approximately 9,000 BCY surface soil, 24,000 BCY subsurface soil, and 50,000 BCY from the PCB cell) of soil will be excavated and disposed of as hazardous material.

Excavated soils with PCB concentrations less than 50 mg/kg are considered non-hazardous. These soils can be disposed of in a permitted NYSDEC approved non-hazardous/solid waste landfill. A number of disposal locations are available for non-hazardous soils. CWM also accepts soil with PCBs less than 50 mg/kg at a landfill in Fairport, New York. The contractor will be responsible for characterization sampling in accordance with disposal facility requirements. At a minimum, E & E assumed that toxicity characteristic leaching procedure (TCLP), pesticides/PCB, PAH, RCRA ignitability, RCRA corrosivity, and RCRA reactivity analyses will be performed on samples collected every 500 tons. It is estimated that approximately 29,000 BCY (approximately 3,000 BCY surface soil and 26,000 BCY subsurface soil) of soil will be excavated and disposed of as non-hazardous material (see Table 5-2).

Following excavation and removal of designated soil from the site, imported clean fill will be placed and compacted in the excavation area. Clean material from the PCB cell will be used as backfill or topsoil for the site. Sheet piling will be removed as backfill is placed and compacted in lifts. Six inches of topsoil will be placed and graded to the final designed elevation. Once backfill operations are completed, all access roads and other intrusions to the site will be restored to pre-construction conditions and the site will be hydroseeded. The fence that formerly surrounded and the disturbed portion of the access road to the PCB cell will not be replaced.

5.1.3.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment since contaminated surface and subsurface soils will be removed from the site and properly disposed of in an environmentally acceptable facility. The contaminated soil will no longer present an exposure risk or be a source of contamination to the groundwater.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative complies with ARARs since contaminated surface and subsurface soils will be removed from the site and properly disposed in an environmentally acceptable facility. Off-site disposal will comply with all applicable land disposal restrictions and analytical requirements. Excavated soil will be tested prior to disposal to determine whether it will be considered hazardous waste (equal or greater than 50 mg/kg) or non-hazardous waste (less than 50 mg/kg) as per New York State and TSCA requirements.

Long-term Effectiveness and Performance

Removal and off-site disposal is considered to be an adequate and effective remedy in the long-term since the contaminated surface and subsurface soil will no longer represent a human health risk exposure nor will it act as a continuing source of contamination to the groundwater at the site.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not reduce the toxicity, mobility, or volume of contaminated soil through treatment. However, excavation and off-site disposal of contaminated surface and subsurface soils will eliminate concerns associated with toxicity and mobility of the contaminants at the site. Since hazardous and non-hazardous soil will be disposed of in an engineered permitted facility, the mobility of the contaminants will be within acceptable limits and would be practically reduced.

Short-Term Effectiveness

Several short-term impacts to the community and workers may arise during excavation of contaminated soil at the site. These include dust, noise, and potential spills during handling and transportation of contaminants. To minimize short-tem impacts, site access will be restricted during construction and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment, and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels will be set prior to any intrusive activities, and an appropriate correction action will be implemented if these action levels are exceeded.

Off-site transportation of contaminated soil to the disposal facility will be performed by a licensed hauler. While there is a risk of spills due to accidents, this risk will be minimized by using closed and lined containers for transport.

Because this alternative involves removal of the contaminated soil from the site and replacement with clean fill, the preliminary remediation goals will be achieved at the completion of this work. The time to complete this alternative is estimated to be between 14 and 16 months.

Implementability

This alternative is readily implemented using standard construction means and methods. No technical difficulties are anticipated during excavation and removal of contaminated soil. Contaminated soil will be excavated, tested, and segregated for disposal at either a hazardous or non-hazardous waste facility. Several facilities have been identified which can accept the contaminated soil from the site. No capacity or availability problems have been identified. Finally, no delay is anticipated in obtaining the necessary approvals/permits from the state and local agencies for implementation of this alternative.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period and a discount rate of 5% is $27,558,000 (or $28,479,000 adjusted to 2004 costs). The unit costs for transportation and disposal of non-hazardous and hazardous soils are $66 and $120 per ton, respectively. Table 5-3 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. No O & M costs are anticipated with this alternative.

5.1.4 Alternative 4 - Excavation and On-Site Thermal Treatment of Contaminated Soils

5.1.4.1 Description

This alternative involves excavation and on-site thermal treatment of contaminated surface and subsurface soils. Figure 5-4 presents a conceptual process for this alternative. As summarized in Table 2-14 and illustrated in Figure 5-4, a total of approximately 112,000 BCY of soil will be excavated from the southern, western, and PCB cell areas and hauled to an on-site HTTD unit for treatment. Leachate from the PCB cell will be removed and treated prior to excavation activities in this area, as described in Alternative 2. It is assumed that monitoring wells MW-1S/I/D, MW-2S, PCB-W1, PCB-N1, PCB-E1, PCB-S1, and PCB-SE1 will be decommissioned, without replacement, in the excavated areas.

Excavation of contaminated material will be performed using conventional means and methods. As described in Alternative 3, approximately 61,000 BCY of clean material will also be excavated and stockpiled separately on site. This material will not be thermally treated. Along the northern edge of the western area bordering the Glens Falls Landfill, sheet piling was assumed since cutting back the excavation will result in excavation into the landfill. Approximately 6,300 square feet of sheet piling in the western area will be needed to adequately support the 24-foot excavation in that area. Dewatering may be necessary once depths of 19 feet or more are encountered based on groundwater data in the western area of the site. Means and methods of dewatering will be determined by the contractor’s approach to the site work. E & E assumed the establishment of an on-site temporary water treatment system. Treated water will be appropriately discharged off site.

After excavation of contaminated soils, the soils will be hauled and placed in storage piles near the treatment unit. While awaiting treatment, the storage piles will be mixed by mechanical means (typically a front-end loader). Based on the average concentration of PCBs and the variable thermal content of the materials to be treated, the various storage piles will be fed proportionally by a front-end loader to a blender or pug mill to ensure that the feed to the high-temperature thermal desorption unit is relatively homogeneous.

After blending, but before the soils are fed to the HTTD facility, the soils will be screened for removal of foreign objects, oversized rocks and stones. Soil particles and chunks less than 1 inch will be fed directly to the HTTD unit. Stones, rocks, and clay pieces greater than 1 inch will be processed in a grinder to reduce their size, and then returned to the pug mill for blending with the soil.

After being screened, the soils will be placed in a storage pile and fed to the HTTD unit. Based on the preliminary conceptual design (Appendix E), the feed rate was estimated at 40 tons per hour. The HTTD system would be operated continuously (24 hours/day, 365 days/year) in order to reduce the thermal stress on the unit, although some downtime would be required (25%) for regular maintenance and holidays. The HTTD unit will be an inclined rotary dryer. The material will be fed into the end of the dryer opposite the fuel burner. In this type of system (called a “counter-current feed system”), PCB-contaminated soils will be fed “cold” end of the dryer while the treated soils will exit the “hot” end of the dryer. The incline of the unit is such that the hot gases will travel in the opposite direction, exiting the rotary dryer at the soil inlet point. Based on preliminary thermal and mass balance calculations for the HTTD system (see Appendix E), the soils will enter the rotary dryer at 60° F and exit at 900° F. The system combustion gases will exit at 400° F. These combustion gases will enter a pollution control system, where particulate emissions will be removed through the use of a mechanical cyclone and baghouse. Organic contaminants will also be destroyed in a thermal oxidizer or afterburner that raises the temperature of the gases to 2,000° F. The high-temperature gases exiting the afterburner will then be exhausted to the atmosphere. Figures 5-5 and 5-6 illustrate the process of the HTTD system and the thermal mass and energy balance for the system.

Treated soil exiting the HTTD unit will be sprayed with water in an enclosed structure to allow for cooling without wind dispersion. Treated soil and clean material from the PCB cell cap liner will be used for backfilling the excavated areas. Sheet piling will be removed as backfill is placed and compacted in lifts. Six inches of topsoil will be placed and graded to the final design elevation. Once backfill operations are completed all access roads and other intrusions to the site will be restored to pre-construction conditions and the site will be hydroseeded. The fence that formerly surrounded the PCB cell and the disturbed portion of the access road to the PCB cell will not be replaced.

5.1.4.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is considered protective of human health and the environment since contaminated material in the soil will be thermally treated to meet site cleanup levels. Because the contaminants will be treated and destroyed, exposure risks associated with the surface and subsurface soil contamination will be eliminated. In addition, by treating the contaminants, the potential for migration into groundwater will be minimized.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative will meet ARARs since the PCB contamination in the surface and subsurface soil will be effectively treated to meet cleanup levels at the site. Applicable action-specific ARARs including air discharge permits and requirements, noise limitations, and Occupational Safety and Health Administration (OSHA) regulations will be in compliance with during treatment and implementation of the alternative.

Long-term Effectiveness and Performance

This alternative is considered to be an effective remedy in the long term, since contaminants in the surface and subsurface soils will be destroyed using thermal treatment. Treated soil will meet site cleanup criteria, therefore human health and environmental risks will be eliminated. This alternative will also minimize vertical migration of contaminants to the saturated zone.

Reduction in Toxicity, Mobility, or Volume through Treatment

The volume of contamination will be reduced at the site because this alternative actively treats PCB contamination in the surface and subsurface soils. Consequently, the toxicity and mobility of the contaminants will also be reduced.

Short-Term Effectiveness

Several short-term impacts to the community and workers may arise during excavation and treatment of contaminated soil at the site. With this alternative, an increased risk to workers is imposed due to the complex equipment required to treat the soil. Community impacts include dust, and noise from equipment operation. Continuous operation of the HTTD system (24-hour) may increase noise impacts on the surrounding community. These noise impacts can be reduced through engineering controls such as noise barriers and mufflers attached to the HTTD unit. To minimize other short-term impacts, site access will be restricted during construction and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment, and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels for the site and operation of the HTTD unit will be set prior to any intrusive activities, and an appropriate correction action will be implemented if these action levels are exceeded.

This alternative involves treatment of contaminated soil at the site, so the preliminary remediation goals will be achieved at the completion of this work. Excavation and thermal treatment of the contaminated soil is estimated to be complete within 16 to 18 months.

Implementability

This alternative can be readily implemented using standard construction means and methods. A contractor specializing in thermal treatment systems will likely be retained for installation and operation of the thermal treatment system. Although start-up problems may be encountered and frequent downtime due to mechanical complexity, thermal treatment could reliably meet cleanup goals. Due to uncertainty of the PCB concentration and the type of material (i.e., presence of metals, debris etc.) stored in the PCB cell, adjustment in operational parameters maybe required to treat this material. This however should not affect the performance or implementability of the alternative. Monitoring and sampling of the HTTD system will be conducted during the treatment phase to ensure that site cleanup criteria are met, and air discharge standards are not exceeded.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period and a discount rate of 5% is $21,328,000 (or $22,041,000 adjusted to 2004 costs). This total cost is primarily associated with the fixed cost of $4,443,100 for the HTTD system and approximately $58.37 per ton for thermal treatment. Appendix E presents assumptions and supporting documentation for the cost estimate of the HTTD treatment system at this site. Table 5-4 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. No O & M costs are anticipated with this alternative.

5.1.5 Alternative 5 - Excavation and On-Site Soil Washing of Contaminated Soils

5.1.5.1 Description

Because the quantity and type of surfactant used to wash contaminated soils and process parameters are site specific, bench scale tests would be required prior to implementation of this alternative. Upon completion of the bench scale tests, this alternative would involve excavation and on-site washing of contaminated surface and subsurface soils. Figure 5-7 presents a conceptual process for this alternative. As summarized in Table 2-14 and illustrated in Figure 5-7, a total of approximately 112,000 BCY (165,000 tons) of soil will be excavated from the southern, western, and PCB cell areas and hauled to an on-site soil washing unit for treatment. Leachate from the PCB cell will be removed and treated prior to excavation activities in this area, as described in Alternative 2. It is assumed that monitoring wells MW-1S/I/D, MW-2S, PCB-W1, PCB-N1, PCB-E1, PCB-S1, and PCB-SE1 will be decommissioned, without replacement, in the excavated areas.

Excavation of contaminated material will be performed using conventional means and methods. As described in Alternative 3, approximately 61,000 BCY of clean material will also be excavated and stockpiled separately on site. This material will not be treated. Along the northern edge of the western area bordering the Glens Falls Landfill, sheet piling was assumed since cutting back the excavation will result in excavation into the landfill. Approximately 6,300 square feet of sheet piling in the western area will be needed to adequately support the 24-foot excavation in that area. Dewatering may be necessary once depths of 19 feet or more are encountered based on groundwater data in the western area of the site. Means and methods of dewatering will be determined by the contractor's approach to the site work. E & E assumed the establishment of an on-site temporary water treatment system. Treated water will need to be appropriately discharged off site.

The soil washing process and equipment utilized for treatment varies on a site-specific basis. The following presents a general process for soil washing that is expected to be utilized at this site and is illustrated in Figure 5-8. After excavation of contaminated soils, the soils will be hauled and placed in storage piles near the treatment unit. While awaiting treatment, the storage piles will be mixed by mechanical means (typically a front-end loader). Based on the average concentration of PCBs of the materials to be treated, the various storage piles will be fed proportionally by a front-end loader to the washing unit to ensure that the contaminated soil feed to the soil washing unit is relatively homogeneous. Because concentration levels from the PCB cell are expected to be higher than the remaining contaminated on-site soils, soils from the PCB cell may be treated separately to maintain process consistency (i.e., surfactant concentrations or type, number of passes of soil through unit to achieve acceptable levels, etc).

From the stockpile, the contaminated soil will be placed by a front-end loader into a screening unit to remove oversized material. The screened, mixed soil will then travel to a mixing tank where water and surfactant will be added and the mixture will be agitated to encourage contaminant transfer from the soil matrix to the liquid phase. After sufficient agitation has occurred, wash water will then be separated from the mixture, treated, and disposed of appropriately. Based on initial discussions with the local POTW and for costing purposes, it was assumed the wastewater would be discharged to the POTW. The soil mixture will then be subjected to high-pressure aqueous washing that will separate the fines. This step is crucial as PCB contamination in soils is primarily associated with finer-size particles, leaving the larger-size particles uncontaminated. The contaminated fines will be set aside from the remaining treated soil in piles; both soil piles will be analytically tested for PCBs. Based on discussions with vendors, typically 7% of the total treated volume will consist of contaminated fines (approximately 11,000 tons at this site) that will be disposed of as hazardous (PCB concentrations greater than 50 mg/kg) at a permitted disposal facility while the remaining treated soil, in compliance with cleanup goals, will be stockpiled and utilized as backfill on site. Multiple passes through the treatment process may be required for soil to achieve cleanup goals.

This treatment process will be performed as a batch process, with an assumed feed rate of 180 tons per hour (assumes multiple soil washing units), operating 8 hours per day 5 days per week. Based on these assumptions, approximately 600,000 gallons of water per day would be required to effectively operate the treatment system, which is assumed to be supplied through connection to a nearby municipal water line. Daily operating hours and production rates may vary based on design parameters. Regardless of operating variances, it is anticipated that some downtime would be required (approximately 25%) for regular maintenance of the treatment system.

Treated soil and clean material from the PCB cell cap liner will be used for backfilling the excavated areas. Sheet piling will be removed as backfill is placed and compacted in lifts. Six inches of topsoil will be placed and graded to the final design elevation. Once backfill operations are completed, all access roads and other intrusions to the site will be restored to preconstruction conditions and the site will be hydroseeded. The fence that formerly surrounded the PCB cell and the disturbed portion of the access road to the PCB cell will not be replaced.

5.1.5.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is considered protective of human health and the environment since contaminated soils will be treated to meet site cleanup levels and returned to the site. Because the contaminants will be treated, exposure risks associated with the surface and subsurface soil contamination will be eliminated at the site. The contaminated soil will no longer present an exposure risk, or be a source of contamination to the groundwater.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative complies with ARARs since the PCB contamination in the surface and subsurface soil will be effectively treated to meet cleanup levels at the site. Solid process wastes generated during the treatment process will be tested prior to disposal to determine whether they will be considered hazardous waste or non-hazardous waste as per New York State and TSCA requirements. Off-site disposal of this wastestream will comply with all applicable land disposal restrictions and analytical requirements. Liquid wastes will be treated and disposed of appropriately. Applicable action-specific ARARs including air discharge permits and requirements (as required), noise limitations (as required), and Occupational Safety and Health Administration (OSHA) regulations will be in compliance with during treatment and implementation of the alternative.

Long-term Effectiveness and Performance

This alternative is considered to be an effective remedy in the long-term, since contaminants in the surface and subsurface soils will be removed from site soils using soil washing. Treated soil will meet site cleanup criteria; therefore, human health and environmental risks will be eliminated. This alternative will also minimize vertical migration of contaminants to the saturated zone.

Reduction in Toxicity, Mobility, or Volume through Treatment

PCB-contaminated soils will not be reduced through treatment by implementation of this alternative since contaminated soils will remain after the soil washing process. However, the toxicity, mobility, and volume of contaminated soils will be reduced at the site because this alternative will separate the PCB contamination in surface and subsurface soils for disposal off site. Since solid process wastes assumed as hazardous will be disposed of in an engineered permitted facility, the mobility of the contaminants will be within acceptable limits and would be practically reduced.

Short-Term Effectiveness

Several short-term impacts to the community and workers may arise during excavation and treatment of contaminated soil at the site. With this alternative, an increased risk to workers is imposed due to the complex equipment required to treat the soil. Community impacts include dust and noise from equipment operation. Utilizing an existing overhead electrical line opposed to on-site generators for the power source can reduce noise impacts. To minimize other short-term impacts, site access will be restricted during construction and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment, and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels for the site and operation of the soil washing unit will be set prior to any intrusive activities, and an appropriate correction action will be implemented if these action levels are exceeded.

This alternative involves treatment of contaminated soil at the site, so the preliminary remediation goals will be achieved at the completion of this work. Excavation and soil washing of the contaminated soil is estimated to be complete within 10 to 12 months.

Implementability

This alternative can be readily implemented using standard construction means and methods, however, a bench scale test must be performed prior to selection of this alternative. A contractor specializing in the soil washing process will likely be retained for installation and operation of the soil washing system. Although start-up problems may be encountered and frequent downtime due to mechanical complexity, soil washing could reliably meet cleanup goals. Due to uncertainty of the PCB concentration and the type of material (i.e., presence of metals, debris, etc.) stored in the PCB cell, adjustment in operational parameters maybe required to treat this material. This, however should not affect the performance or implementability of the alternative. Monitoring and sampling of the soil washing system will be conducted during the treatment phase to ensure that site cleanup criteria are met, and air and water discharge standards are not exceeded.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period and a discount rate of 5% is $17,388,000 (or $17,969,000 adjusted to 2004 costs). This total cost is primarily associated with the fixed cost of $2,807,000 for the soil washing unit and mobilization/demobilization costs and approximately $44.00 per ton for treatment. Table 5-5 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. No O & M costs are anticipated with this alternative.

5.2 Comparative Evaluation of Soil Alternatives

Overall Protection of Human Health and the Environment

Since Alternative 1 employs no action, contaminated surface and subsurface soil will remain on-site providing no protection for potential future exposure. Alternatives 2, 3, 4, and 5 are more protective of human health and the environment; each at a different level. By capping the contaminated areas of the site in Alternative 2, potential direct human exposure pathways would be eliminated as well as reducing vertical migration of contamination by minimizing rainwater infiltration. Institutional controls must be implemented to maintain protection of human health and the environment. Alternatives 3, 4, and 5 provide a higher level of protection than Alternative 2 because the contaminated surface and subsurface soils will be excavated and either treated or properly disposed of off site.

Compliance with Applicable or Relevant and Appropriate Requirements

PCBs are recalcitrant compounds by nature, and therefore their levels in the surface and subsurface soil are not expected to decrease over time. Alternatives 1 and 2 do not comply with ARARs because the contaminated surface and subsurface soils will remain on site. Alternatives 3, 4, and 5 comply with ARARs since surface and subsurface soil contamination will be either treated or properly disposed of off site.

Long-term Effectiveness and Performance

Since Alternative 1 employs no action, contaminated surface and subsurface soil will remain on site providing no protection for potential future exposure. Alternative 2 is effective in the long term provided proper inspection and routine maintenance is performed. Alternatives 3, 4, and 5 have a higher level of long-term effectiveness and performance than Alternative 2 because contaminated soils will be either treated to eliminate on-site PCB contamination or properly disposed of.

Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction in toxicity, mobility, or volume through treatment will be achieved through thermal treatment in Alternative 4 only. Alternatives 1, 2, 3, and 5 will not treat contaminated soils, therefore reduction in, toxicity, mobility, or volume will not take place. However, Alternative 2, is expected to indirectly reduce mobility of contamination through capping of the site. Similarly, Alternatives 3 and 5 will essentially eliminate concerns of toxicity, mobility, and volume of contaminated soil at the site through off-site disposal at permitted disposal facility(ies).

Short-Term Effectiveness

Alternative 1 is the only alternative with no short-term effectiveness since no remediation activities will take place. Several similar short-term impacts may affect the community during remedial activities for Alternatives 2, 3, 4, and 5 such as dust, noise, and potential spills during hauling and transportation of contaminants. It is anticipated that the remedial construction duration for Alternative 2 will be less than Alternatives 3 and 4 due to the reduction of excavated soil volumes associated with this alternative. Alternative 5 is assumed to be completed in approximately the same amount of time as Alternative 2. Spills of contaminated soils may be possible with Alternative 3 during the off-site transport of soils by trucks. Noise impacts are inherent of excavation activities, therefore affecting Alternatives 2, 3, 4, and 5. Alternative 4 may potentially have an increased noise impact due to the combination of excavation activities and operation of the HTTD system.

Implementability

There are no actions to implement for Alternative 1. Alternatives 2, 3, 4, and 5 are readily implemented using standard construction means and methods. Although initial problems may be encountered during the start-up phase of the

HTTD and soil washing system in Alternatives 4 and 5, technical difficulties are not anticipated once the systems are fully operational.

Cost

Alternative 1 calls for no action, and thus incurs no costs. Alternative 2 has a lower total present worth and O & M cost than Alternatives 3, 4, and 5 because less soil excavation is required for this alternative ($14,552,00 for Alternative 2 versus $28,479,00, $22,041,000, and $17,969,000 for Alternatives 3, 4, and 5 respectively in 2004 costs). Alternative 3 is the most expensive alternative because of transportation and off-site disposal costs associated with the estimated hazardous soil quantity.

Table 5-1 Cost Estimate for Alternative 2 - Source Area Capping and Excavation and Off-Site Disposal of PCB Cell
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	NA	$366,425
Subtotal					$366,425
Site Preparation					
Surveying Crew	2-person crew @ $50/hr, 8hr/day	Day	60	$800.00	$48,000
Site Clearing (western area and PCB cell)	In western area and PCB cell	Acre	7	$395.00	$2,732
Cut and Chip Trees (southern area)	Trees to 6" dia. in southern area	Acre	8	$2,900.00	$22,130
Grub Stumps and Remove (southern area)	In southern area	Acre	8	$1,400.00	$10,683
Remove Existing Fence at PCB Cell	Removal of fence only	LF	1,420	$2.56	$3,635
Install Construction Fence	Chain link fence rental, 6' high	LF	1,580	$7.10	$11,218
Subtotal					$98,398
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$2,000.00	$4,000
Community/Exclusion Zone Air Monitoring	Photoionization detector (Qty 1) & particulate meter rental (Qty 3)	months	11	$4,050.00	$44,550
Site Safety Officer	10 hrs/day, 5days/wk, $75/hr	manweeks	22	$3,750.00	$82,500
Subtotal					$131,050
Consolidation of Contaminated Soil					
Excavation	Hydraulic excavator w/2 CY bucket = 130 CY/hr	BCY	24,960	$1.71	$42,682
Placement of Consolidated Soil	300 Horsepower Front End Loader w/ 150' haul	LCY	27,960	$0.85	$23,766
Grading	Front-end loader w/ 1.5 CY bucket; Based on 53,050 SF (southern area) + 43,350 SF (parking lot area) + 2,600 SF (area south of southwest corner of PCB cell)	SY	11,000	$2.74	$30,140
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	LCY	27,960	$0.33	$9,227
Monitoring Well Decommissioning		Each	9	$500.00	$4,500
PCB Screening	Immunoassay testing	Each	620	$100.00	$62,000
Characterization Sampling	10% samples collected by PCB screening	Each	62	$100.00	$6,200
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	50	$150.00	$7,500
Subtotal					$186,014
Cap Installation					
Geosynthetic Clay Liner (Material only)	CETCO Claymax CL or similar; includes delivery to site; approx 134,150 SF of cap multiplied by 1.05 for effective area of material	SF	140,860	$0.38	$53,527
Installation of Geosynthetic Clay Liner	Front-end loader w/ 1.5 CY bucket and 5 laborers; approx production rate 0.5 acre/day = 21,780 SF/day	Day	10	$2,127.15	$21,272
Drainage Layer (Material only)	TENFLOW Geocomposite or similar price includes delivery to site	SF	134,160	$0.47	$62,384
Installation of Drainage Layer		SF	134,160	$0.15	$20,124
Protection Layer (Material only)	Soil mixture, some cobblestone; based on 134,150 SF surface area/ 1.5' depth of material w/ 12% swell factor before compaction	LCY	8,350	$10.00	$83,500
Placement of Protection Layer	300 Horsepower Front End Loader w/ 150' haul	LCY	8,350	$0.85	$7,098
Compaction of Protection Layer	Vibrating roller, 12" compacted lifts, 4 passes	LCY	8,350	$0.33	$2,756
Topsoil (Material only)	Based on 134,150 SF (capped area) w/ 12% swell factor/ 0.5' depth of material at 1.2ton/BCY	Ton	3,340	$14.00	$46,760
Placement of Topsoil	300 Horsepower Front End Loader/Bulldozer w/ 50' haul	LCY	3,340	$0.53	$1,770
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; based on 332,403 SF (southern area) + 134,150 SF (capped area) + 39,375 SF (additional PCB cell area)	MSF	135	$45.50	$6,143
Excavate Drainage Ditch	Excavate trench 1'-4' deep w/ 3/8 CY tractor/loader/backhoe; Assume 845 LF of drainage ditches 2' deep/6'width	BCY	380	$5.75	$2,185
Gravel for Drainage Ditch	Gravel = 1.8ton/CY	Ton	690	$7.75	$5,348
Cap Installation in Parking Lot Area					
Geosynthetic Clay Liner (Material only)	CETCO Claymax CL or similar; includes delivery to site; approx 43,350 SF of cap multiplied by 1.05 for effective area of material	SF	45,520	$0.38	$17,298
Installation of Geosynthetic Clay Liner	Front-end loader w/ 1.5 CY bucket and 5 laborers; approx production rate 0.5 acre/day=43,560 SF/day	Day	5	$2,127.15	$10,636
Drainage Layer (Material only)	TENFLOW Geocomposite or similar	SF	43,350	$0.47	$20,158
Installation of Drainage Layer		SF	43,350	$0.15	$6,503
Protection Layer (Material only)	Soil mixture, some cobblestone; based on 43,350 SF surface area/ 1.5' depth of material w/ 12% swell factor before compaction	LCY	2,700	$10.00	$27,000
Placement of Protection Layer	300 Horsepower Front End Loader w/ 150' haul	LCY	2,700	$0.85	$2,295
Compaction of Protection Layer	Vibrating roller, 6" compacted lifts, 4 passes	LCY	2,700	$0.46	$1,242
Pavement (6" gravel base, 2" binder, 1"topping)	Based on 43,350 SF parking area	SF	43,350	$1.73	$74,996
Subtotal					$472,991
Excavation and Off-Site Disposal PCB Cell					
Carbon Drum System	4 total carbon drums in parallel; 2 drums in series for each parallel	Each	4	$500.00	$2,000
Prefilter and internal piping	1 bag-type prefilter for each parallel	Each	2	$860.00	$1,720
Postfilter and internal piping	1 bag-type postfilter for each parallel	Each	2	$860.00	$1,720
Carbon Drum Piping Connections	Assume 1 set per treatment train	Each	2	$350.00	$700
Filter Replacement (Labor)	1-person @ $50/hr, 3 hr/day * 20 days/mo = 60 hr/1-month	HR	60	$50.00	$3,000
Monthly Sampling (for Carbon Drum System)	Includes Pesticides/PCB; influent and effluent	Each	4	$100.00	$400
Excavation	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 49,603 BCY haz soil + 8,857 BCY clean soil (PCB cell)	BCY	58,460	$1.71	$99,967
Transport Soil to Stockpile	300 Horsepower Front End Loader w/ 150' haul; based on excavated soi w/ 12% swell factor	LCY	65,480	$0.85	$55,658
Stockpiling	300 Horsepower Bulldozer w/ 50' haul	LCY	65,480	$0.53	$34,704
Loading Trucks/Second Handling of Soil	Hydraulic excavator w/2 CY bucket = 130 CY/hr	LCY	65,480	$1.71	$111,971
Characterization Sampling	Includes Pesticides/PCB; one sample per 300 tons based on 49,603 BCY haz soil (w/ 12% swell factor at 1.52 tons/CY)	Each	280	$100.00	$28,000

Table 5-1 Cost Estimate for Alternative 2 - Source Area Capping and Excavation and Off-Site Disposal of PCB Cell
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Transportation	Dump truck transport from Glens Falls to Model City, NY; includes fuel surcharge; liners included; based on 49,603 BCY haz soil (at 1.52 tons/BCY)	Ton	75,400	$43.92	$3,311,419
Off-Site Disposal (Soil)		Ton	75,400	$76.01	$5,731,303
Subtotal					$9,382,562
Backfilling					
Backfill (Material only)	Soil volume includes 34,858 BCY (below grade PCB cell) - 5,647 BCY (from top 2' of PCB cell below the topsoil) - 24,954 BCY (consolidated soil volume) w/ 12% swell factor	LCY	4,770	$10.00	$47,700
Placement of Backfill	300 Horsepower Front End Loader w/ 50' haul; based on 34,858 BCY (below grade PCB cell) + 24,954 BCY (consolidated soil volume) w/ 12% swell factor	LCY	66,990	$0.53	$35,505
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	LCY	66,990	$0.33	$22,107
Subtotal					$105,311
Site Restoration					
Topsoil (Material only)	Based on 332,403 SF (southern area) + 39,375 SF (additional PCB cell area) w/ 12% swell factor/ 0.5' depth of material at 1.2ton/CY less 3,210 BCY (w/ 12% swell factor) from top 1' of PCB cell	Ton	9,100	$14.00	$127,400
Placement of Topsoil	300 Horsepower Front End Loader/Bulldozer w/ 50' haul; includes 3,210 BCY (w/ 12% swell factor) from top 1' of PCB cell	LCY	11,180	$0.53	$5,925
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; Based on 332,403(southern area) SF + 39,375 SF (additional PCB cell area) of surface area	MSF	380	$45.50	$17,290
Institutional Controls		Each	1	$2,500.00	$2,500
Subtotal					$153,115

Table 5-1 Cost Estimate for Alternative 2 - Source Area Capping and Excavation and Off-Site Disposal of PCB Cell
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
				Capital Cost Subtotal:	$10,895,866
				Adjusted Capital Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$10,111,363
				15% Legal, administrative, engineering fees, construction management:	$1,516,705
				20% Contingencies:	$2,325,614
				Total Capital Cost:	**$13,954,000**
Annual Costs					
2% of Topsoil Replaced	1.2ton/CY	Ton	182	$14.00	$2,548
Mowing	Riding mower 48"-58", once per year	MSF	810	$1.11	$899
Site Monitoring	2-person @ $50/hr, 8hr/day	Day	1	$800.00	$800
Data Summary		HR	8	$50.00	$400
Subtotal					$4,647
				Annual Cost Subtotal:	$4,647
				Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$4,313
				10% Legal, administrative, engineering fees:	$431
				20% Contingencies:	$949
				Annual Cost Total:	**$5,693**
				30-Year Present Worth of Annual Costs:	**$88,000**
5-Year Costs					
10% of Fence Replaced	Chain link barb wire fence, 6' high	LF	158	$21.50	$3,397
Institutional Controls	Maintain/update documentation	Each	1	$2,500.00	$2,500
Subtotal					$5,897
				5-Year Cost Subtotal:	$5,897
				Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$5,472
				15% Legal, administrative, engineering fees:	$821
				20% Contingencies:	$1,259
				5-Year Total:	**$7,552**
				30-Year Present Worth of 5-Year Costs:	**$39,000**
				2002 Total Present Worth Cost:	**$14,081,000**
				2004 Total Present Worth Cost:	**$14,552,000**

Assumptions

1. Perimeter of existing fence = 440' x 270' = 1420 LF.
2. Perimeter of construction fence approximately = 3000 LF.
3. Assume existing fence and gate surrounding PCB cell will be reused for new perimeter fence.
4. Assume reuse of existing fence as permanent fence surrounding the capped area once construction is complete.
5. Verification sampling to be performed on 8 foot grid each 4 foot interval as per 40 CFR 761.265.
6. For hazardous soil: Assume Pesticides/PCB analysis required for every 300 tons of soil.
7. For loose soil assume sandy, dry soil with 12% swell factor (Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).
8. Based on geotechnical data from the RI (E&E, 2002), in-situ bulk density of on-site and PCB cell soils is 1.47 tons/BCY and 1.52 tons/BCY, respectively.
9. Assume top 3' of PCB cell top liner is clean and will be re-used as backfill/topsoil. Approximately 3,210 BCY of topsoil from top 1', and 5,647 BCY of backfill from bottom 2' of PCB cell.
10. Assume approximately 845 LF of drainage ditches surrounding the cap to the east, west, and north.
11. Topsoil density assumed to be 1.2 tons/CY per quote from Jointa Galusha, Glens Falls, NY.
12. 30-year present worth of costs assumes 5% annual interest rate.
13. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:

BCY = Bank cubic yards.
LCY = Loose cubic yards.
SF = Square feet.
MSF = Thousand square feet.
LS = Lump sum.
LF = Linear foot.

Table 5-2 Soil Volumes - Off-site Disposal of Hazardous and Non-Hazardous Soils, Luzerne Road Site

Depth Interval (feet)	Cleanup Level (BCY) < 50 mg/kg	Cleanup Level (BCY) =>50 mg/kg	Total
Surface Soil			
0-1	2,917	9,394	12,311
Subtotal	**2,917**	**9,394**	**12,311**
Subsurface Soil			
0-4	10,698	8,559	19,257
4-8	4,051	5,141	9,192
8-12	3,052	2,109	5,161
12-16	1,343	2,926	4,270
16-20	3,033	2,199	5,232
20-24	3,737	3,140	6,877
Subtotal	**25,914**	**24,075**	**49,989**
Total	**28,831**	**33,469**	**62,300**

Notes:
BCY = bank cubic yard
mg/kg = milligrams per kilograms

1. Surface soil volume estimated by E&E (see Appendix A).
2. Subsurface soil volumes based on SURFER results summarized in Appendix A of this report.

Table 5-3 Cost Estimate for Alternative 3 - Excavation and Off-Site Disposal of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	NA	$723,667
Subtotal					$723,667
Site Preparation					
Surveying Crew	2-person crew @ $50/hr, 8hr/day	Day	80	$800.00	$64,000
Site Clearing (western area and PCB cell)	In western area and PCB cell	Acre	7	$395.00	$2,732
Cut and Chip Trees (southern area)	Trees to 6" dia. in southern area	Acre	8	$2,900.00	$22,130
Grub Stumps and Remove (southern area)	In southern area	Acre	8	$1,400.00	$10,683
Remove Existing Fence at PCB Cell	Removal of fence only	LF	1,420	$2.56	$3,635
Install Construction Fence	Chain link fence rental, 6' high	LF	1,580	$7.10	$11,218
Subtotal					$114,398
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$2,000.00	$4,000
Community/Exclusion Zone Air Monitoring	Photoionization detector (Qty 1) & particulate meter rental (Qty 3)	months	16	$4,050.00	$64,800
Site Safety Officer	10 hrs/day, 5days/wk, $75/hr	manweeks	24	$3,750.00	$90,000
Subtotal					$158,800
Excavation					
Excavation (includes cut back volume)	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 49,989 BCY + 61,432 BCY (haz & non-haz soil including cut back volume) + 12,311 BCY (southern area)	BCY	123,740	$1.71	$211,595
Transport Soil to Stockpile	300 Horsepower Front End Loader w/ 150' haul	LCY	138,589	$0.85	$117,800
Stockpiling	300 Horsepower Bulldozer w/ 50' haul	LCY	138,589	$0.53	$73,452
Loading Trucks/Second Handling of Soil	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 25,914 BCY (non-haz soil) + 24,075 BCY (haz soil) + 12,311 BCY (southern area) w/ 12% swell factor	LCY	69,780	$1.71	$119,324
Sheet Piling, Drive	25' Deep excavation	SF	6,300	$17.85	$112,455
Sheet Piling, Extract & Salvage	25' Deep excavation	SF	6,300	$17.85	$112,455
Dewatering	Four-4" diaphragm pump used for 8 hours	Day	20	$412.00	$8,240
Monitoring Well Decommissioning		Each	9	$500.00	$4,500
PCB Screening	Immunoassay testing	Each	1,730	$100.00	$173,000
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	50	$150.00	$7,500
Subtotal					$940,322
Off-Site Disposal of Non-Hazardous Soil (PCB concentration < 50 mg/kg)					
Characterization Sampling	Includes TCLP, Pesticides/PCB, PAH, RCRA ignitability, RCRA corrosivity, RCRA reactivity analyses; Assume 24-hr turnaround; one sample per 500 tons based on 25,914 BCY subsurface + 2,917 BCY surface soil (w/ 12% swell factor at 1.47 tons/BCY)	Each	95	$1,063.61	$101,043
Transportation	Dump truck transport from Glens Falls to Fairport, NY; include fuel surcharge which varies monthly (Nov 2002 = 0.82%); based on 25,914 BCY subsurface + 2,917 BCY surface soil (at 1.47 tons/BCY)	Ton	42,390	$31.00	$1,314,090
Off-Site Disposal (Soil)		Ton	42,390	$35.00	$1,483,650
Subtotal					$2,898,783
Off-Site Disposal of Hazardous Soil (PCB concentration => 50 mg/kg)					
Characterization Sampling	Includes Pesticides/PCB; one sample per 300 tons based on 24,075 BCY subsurface + 9,394 BCY surface soil (w/ 12% swell factor at 1.47 tons/BCY)	Each	190	$100.00	$19,000
Transportation	Dump truck transport from Glens Falls to Model City, NY; includes fuel surcharge; liners included; based on 24,075 BCY subsurface + 9,394 BCY surface soil (at 1.47 tons/BCY)	Ton	49,200	$43.92	$2,160,767
Off-Site Disposal (Soil)		Ton	49,200	$76.01	$3,739,789
Subtotal					$5,919,556

Table 5-3 Cost Estimate for Alternative 3 - Excavation and Off-Site Disposal of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Excavation and Off-Site Disposal PCB Cell					
Carbon Drum System	4 total carbon drums in parallel; 2 drums in series for each parallel	Each	4	$500.00	$2,000
Prefilter and internal piping	1 bag-type prefilter for each parallel	Each	2	$860.00	$1,720
Postfilter and internal piping	1 bag-type postfilter for each parallel	Each	2	$860.00	$1,720
Carbon Drum Piping Connections	Assume 1 set per treatment train	Each	2	$350.00	$700
Filter Replacement (Labor)	1-person @ $50/hr, 3 hr/day * 20 days/mo = 60 hr/1-month	HR	60	$50.00	$3,000
Monthly Sampling (for Carbon Drum System)	Includes Pesticides/PCB; influent and effluent	Each	4	$100.00	$400
Excavation	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 49,603 BCY haz soil + 8,857 BCY clean soil (PCB cell)	BCY	58,460	$1.71	$99,967
Transport Soil to Stockpile	300 Horsepower Front End Loader w/ 150' haul	LCY	65,480	$0.85	$55,658
Stockpiling	300 Horsepower Bulldozer w/ 50' haul	LCY	65,480	$0.53	$34,704
Loading Trucks/Second Handling of Soil	Hydraulic excavator w/2 CY bucket = 130 CY/hr	LCY	65,480	$1.71	$111,971
Characterization Sampling	Includes Pesticides/PCB; one sample per 300 tons based on 49,603 BCY haz soil (w/ 12% swell factor at 1.52 tons/BCY)	Each	280	$100.00	$28,000
Transportation	Dump truck transport from Glens Falls to Model City, NY; includes fuel surcharge; liners included; based on 49,603 BCY haz soil (at 1.52 tons/BCY)	Ton	75,400	$43.92	$3,311,419
Off-Site Disposal (Soil)		Ton	75,400	$76.01	$5,731,303
Subtotal					$9,382,562
Backfilling					
Backfill (Material only)	Soil volume includes that to be disposed of off-site (49,989 BCY (subsurface) + 12,311 BCY (surface) + 34,858 BCY ((below grade PCB cell) w/ 12%swell factor) - 5,647 BCY (w/12% swell factor) of PCB cell liner (2ft)	LCY	102,500	$10.00	$1,025,000
Placement of Backfill	300 Horsepower Front End Loader w/ 50' haul; includes 5,647 BCY (w/12% swell factor) of PCB cell liner (2ft)	LCY	108,830	$0.53	$57,680
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	LCY	108,830	$0.33	$35,914
Subtotal					$1,118,594
Site Restoration					
Topsoil (Material only)	Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) excavated surface area and 6" of topsoil at 1.2ton/LCY less 3,210 BCY (w/ 12%swell factor) from top 1' of PCB cell and 11,382 SF parking lot area	Ton	11,180	$14.00	$156,520
Placement of Topsoil	300 Horsepower Front End Loader/Bulldozer w/ 50' haul; includes 3,210 BCY (w/12% swell factor) from top 1' of PCB cell	LCY	12,920	$0.53	$6,848
Pavement (6" gravel base, 2" binder, 1"topping)	Based on 43,350 SF parking area	SF	43,350	$1.73	$74,996
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) of excavated surface area - 11,382 SF parking lot area	MSF	520	$45.50	$23,660
Subtotal					$262,023
				Capital Cost Subtotal:	$21,518,705
				Adjusted Capital Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$19,969,358
				15% Legal, administrative, engineering fees, construction management:	$2,995,404
				20% Contingencies:	$4,592,952
				Total Capital Cost:	**$27,558,000**

Table 5-3 Cost Estimate for Alternative 3 - Excavation and Off-Site Disposal of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Annual Costs					
Not Applicable				$0.00	$0
Subtotal					$0
Annual Cost Subtotal:					$0
Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$0
15% Legal, administrative, engineering fees:					$0
20% Contingencies:					$0
Annual Cost Total:					**$0**
30-Year Present Worth of Annual Costs:					**$0**
2002 Total Present Worth Cost:					**$27,558,000**
2004 Total Present Worth Cost:					**$28,479,000**

Assumptions

1. Perimeter of existing fence = 440' x 270' = 1420 LF.
2. Perimeter of construction fence approximately = 3000 LF.
3. Assume existing fence and gate will be reused for new perimeter fence.
4. Verification sampling to be performed as per 40 CFR 761.265 (one sample on 8 foot grid each 4 foot interval).
5. For non-hazardous soil: Assume 1 full set of analyses required for every 500 tons soil.
6. For hazardous soil: Assume Pesticides/PCB analysis required for every 300 tons of soil.
7. For loose soil assume sandy, dry soil with 12% swell factor (Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).
8. Based on geotechnical data from the RI (E&E, 2002), in-situ bulk density of on-site and PCB cell soils is 1.47 tons/BCY and 1.52 tons/BCY, respectively.
9. Assume top 3' of PCB cell top liner is clean and will be re-used as backfill/topsoil. Approximately 3,210 BCY of topsoil from top 1', and 5,647 BCY of backfill from bottom 2' of PCB cell.
10. Topsoil density assumed to be 1.2 tons/CY per quote from Jointa Galusha, Glens Falls, NY.
11. 30-year present worth of costs assumes 5% annual interest rate.
12. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:

BCY = Bank cubic yards.
LCY = Loose cubic yards.
SF = Square feet.
MSF = Thousand square feet.
LS = Lump sum.
LF = Linear foot.

Table 5-4 Cost Estimate for Alternative 4 - Excavation and On-Site Thermal Treatment of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	NA	$560,057
Subtotal					$560,057
Site Preparation					
Surveying Crew	2-person crew @ $50/hr, 8hr/day	Day	80	$800.00	$64,000
Site Clearing (western area and PCB cell)	In western area and PCB cell	Acre	7	$395.00	$2,732
Cut and Chip Trees (southern area)	Trees to 6" dia. in southern area	Acre	8	$2,900.00	$22,130
Grub Stumps and Remove (southern area)	In southern area	Acre	8	$1,400.00	$10,683
Remove Existing Fence at PCB Cell	Removal of fence only	LF	1,420	$2.56	$3,635
Install Construction Fence	Chain link fence rental, 6' high	LF	1,580	$7.10	$11,218
Subtotal					$114,398
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$2,000.00	$4,000
Community/Exclusion Zone Air Monitoring	Photoionization detector (Qty 1) & particulate meter rental (Qty 3)	months	18	$4,050.00	$72,900
Site Safety Officer	10 hrs/day, 5days/wk, $75/hr	manweeks	24	$3,750.00	$90,000
Subtotal					$166,900
Excavation					
Excavation	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 49,989 BCY + 61,432 BCY (haz & non-haz soil including cut-back volume) + 12,311 BCY (southern area) + 58,460 BCY (PCB cell clean and contaminated soil)	BCY	182,200	$1.71	$311,562
Transport Soil to Stockpile	300 Horsepower Front End Loader w/ 150' haul	LCY	204,070	$0.85	$173,460
Stockpiling	300 Horsepower Bulldozer w/ 50' haul	LCY	204,070	$0.53	$108,157
Sheet Piling, Drive	25' Deep excavation	SF	6,300	$17.85	$112,455
Sheet Piling, Extract & Salvage	25' Deep excavation	SF	6,300	$17.85	$112,455
Dewatering	Four-4" diaphragm pump used for 8 hours	Day	20	$412.00	$8,240
Monitoring Well Decommissioning		Each	9	$500.00	$4,500
PCB Screening	Immunoassay testing	Each	1,730	$100.00	$173,000
Characterization Sampling	10% samples collected by PCB screening	Each	173	$100.00	$17,300
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	50	$150.00	$7,500
Subtotal					$1,028,629
High-Temperature Thermal Desorption (HTTD) System					
HTTD (Fixed Costs)	Includes equipment, mob/demob costs	LS	1	$4,443,100.00	$4,443,100
HTTD (Treatment)	Includes labor, maintenance, utilities, and fuel costs; based on 49,989 BCY (subsurface at 1.47 tons/BCY) + 12,311 BCY (surface at 1.47 tons/BCY) + 49,603 BCY (PCB cell at 1.52 tons/BCY)	Ton	166,980	$58.37	$9,746,153
Soil Mixing	300 Horsepower Front End Loader w/ 150' haul; based on 49,989 BCY (subsurface) + 12,311 BCY (surface) + 49,603 BCY (PCB cell) w/ 12% swell factor	LCY	125,340	$0.85	$106,539
Loading Soil to HTTD Unit	Front End Loader, 2-1/2 to 3-1/2 CY, 130 horsepower	months	9	$3,800.00	$34,200
Unloading Soils from HTTD Unit	Front End Loader, 2-1/2 to 3-1/2 CY, 130 horsepower	months	9	$3,800.00	$34,200
Subtotal					$14,364,192
Removal of PCB Cell Leachate					
Carbon Drum System	4 total carbon drums in parallel; 2 drums in series for each parallel	Each	4	$500.00	$2,000
Prefilter and internal piping	1 bag-type prefilter for each parallel	Each	2	$860.00	$1,720
Postfilter and internal piping	1 bag-type postfilter for each parallel	Each	2	$860.00	$1,720
Carbon Drum Piping Connections	Assume 1 set per treatment train	Each	2	$350.00	$700
Filter Replacement (Labor)	1-person @ $50/hr, 3 hr/day * 20 days/mo = 60 hr/1-month	HR	60	$50.00	$3,000
Monthly Sampling (for Carbon Drum System)	Includes Pesticides/PCB; influent and effluent	Each	4	$100.00	$400
Subtotal					$9,540

Table 5-4 Cost Estimate for Alternative 4 - Excavation and On-Site Thermal Treatment of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Backfilling					
Placement of Backfill	300 Horsepower Front End Loader w/ 150' hau	LCY	125,340	$0.85	$106,539
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	LCY	125,340	$0.33	$41,362
Subtotal					$147,901
Site Restoration					
Topsoil (Material only)	Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) excavated surface area and 6" of topsoil at 1.2ton/LCY - 3,210 BCY (w/ 12%swell factor) from top 1' of PCB cell - 11,382 SF parking lot area	Ton	11,180	$14.00	$156,520
Placement of Topsoil	300 Horsepower Front End Loader/Bulldozer w/ 50' haul; includes 3,210 BCY (w/ 12% swell factor) from top 1' of PCB cell	LCY	12,920	$0.53	$6,848
Pavement (6" gravel base, 2" binder, 1"topping)	Based on 43,350 SF parking area	SF	43,350	$1.73	$74,996
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) of excavated surface area - 11,382 SF parking lot area	MSF	520	$45.50	$23,660
Subtotal					$262,023
				Capital Cost Subtotal:	$16,653,640
				Adjusted Capital Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$15,454,578
				15% Legal, administrative, engineering fees, construction management:	$2,318,187
				20% Contingencies:	$3,554,553
				Total Capital Cost:	**$21,328,000**
Annual Costs					
Not Applicable				$0.00	$0
Subtotal					$0
				Annual Cost Subtotal:	$0
				Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$0
				15% Legal, administrative, engineering fees:	$0
				20% Contingencies:	$0
				Annual Cost Total:	**$0**
				30-Year Present Worth of Annual Costs:	**$0**
				2002 Total Present Worth Cost:	**$21,328,000**
				2004 Total Present Worth Cost:	**$22,041,000**

Assumptions

1. Perimeter of existing fence = 440' x 270' = 1420 LF.
2. Perimeter of construction fence approximately = 3000 LF.
3. Assume existing fence and gate will be reused for new perimeter fence.
4. Verification sampling to be performed as per 40 CFR 761.265 (one sample on 8 foot grid each 4 foot interval).
5. For treated soil: Assume Pesticides/PCB analysis required for every 500 tons of soil.
6. For loose soil assume sandy, dry soil with 12% swell factor (Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).
7. Based on geotechnical data from the RI (E&E, 2002), in-situ bulk density of on-site and PCB cell soils is 1.47 tons/BCY and 1.52 tons/BCY, respectively.
8. Assume top 3' of PCB cell top liner is clean and will be re-used as backfill/topsoil. Approximately 3,210 BCY of topsoil from top 1', and 5,647 BCY of backfill from bottom 2' of PCB cell.
9. Topsoil density assumed to be 1.2 tons/CY per quote from Jointa Galusha, Glens Falls, NY.
10. 30-year present worth of costs assumes 5% annual interest rate.
11. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:

BCY = bank cubic yards.
LCY = loose cubic yards.
SF = square feet.
MSF = thousand square feet.
LS = lump sum.
LF = linear foot.

Table 5-5 Cost Estimate for Alternative 5 - Excavation and On-Site Soil Washing of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	NA	$454,076
Bench Scale Study	Includes process testing and report	LS	1	NA	$75,000
Subtotal					$529,076
Site Preparation					
Surveying Crew	2-person crew @ $50/hr, 8hr/day	Day	80	$800.00	$64,000
Site Clearing (western area and PCB cell)	In western area and PCB cell	Acre	7	$395.00	$2,732
Cut and Chip Trees (southern area)	Trees to 6" dia. in southern area	Acre	8	$2,900.00	$22,130
Grub Stumps and Remove (southern area)	In southern area	Acre	8	$1,400.00	$10,683
Remove Existing Fence at PCB Cell	Removal of fence only	LF	1,420	$2.56	$3,635
Install Construction Fence	Chain link fence rental, 6' high	LF	1,580	$7.10	$11,218
Install Equipment Staging Area (Paving)	Asphaltic concrete 6" base, 2" binder, 1" topping; 150' x 250'	SF	37,500	$1.72	$64,500
Subtotal					$178,898
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$2,000.00	$4,000
Community/Exclusion Zone Air Monitoring	Photoionization detector (Qty 1) & particulate meter rental (Qty 3)	months	12	$4,050.00	$48,600
Site Safety Officer	10 hrs/day, 5days/wk, $75/hr	manweeks	24	$3,750.00	$90,000
Subtotal					$142,600
Excavation					
Excavation	Hydraulic excavator w/2 CY bucket = 130 CY/hr; based on 49,989 BCY + 61,432 BCY (haz & non-haz soil including cut-back volume) + 12,311 BCY (southern area) + 58,460 BCY (PCB cell clean and contaminated soil)	BCY	182,200	$1.71	$311,562
Transport Soil to Stockpile	300 Horsepower Front End Loader w/ 150' haul	LCY	204,070	$0.85	$173,460
Stockpiling	300 Horsepower Bulldozer w/ 50' haul	LCY	204,070	$0.53	$108,157
Sheet Piling, Drive	25' Deep excavation	SF	6,300	$17.85	$112,455
Sheet Piling, Extract & Salvage	25' Deep excavation	SF	6,300	$17.85	$112,455
Dewatering	Four-4" diaphragm pump used for 8 hours	Day	20	$412.00	$8,240
Monitoring Well Decommissioning		Each	9	$500.00	$4,500
PCB Screening	Immunoassay testing	Each	1,730	$100.00	$173,000
Characterization Sampling	10% samples collected by PCB screening	Each	173	$100.00	$17,300
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	50	$150.00	$7,500
Subtotal					$1,028,629
Soil Washing System and Treatment					
Soil Washing (Fixed Costs)	Includes permitting (if applicable), equipment, mob/demob costs	LS	1	$2,807,000.00	$2,807,000
Soil Washing (Treatment)	Includes labor, maintenance, utility, analytical, and soild waste disposal costs; based on 49,989 BCY (subsurface at 1.47 tons/BCY) + 12,311 BCY (surface at 1.47 tons/BCY) + 49,603 BCY (PCB cell at 1.52 tons/BCY)	Ton	166,980	$44.00	$7,347,120
Soil Mixing	300 Horsepower Front End Loader w/ 150' haul; based on 49,989 BCY (subsurface) + 12,311 BCY (surface) + 49,603 BCY (PCB cell) w/ 12% swell factor	LCY	125,340	$0.85	$106,539
Water Connection Fee and Meter	Assume water source is municipal water line along Luzerne Rd	LS	1	NA	$5,000
Piping (Water; Material only)	6" dia PVC pipe	LF	300	$7.32	$2,195
Electrical & Telephone Connection Fee and Meter	Assume power source is overhead electric from Luzerne Road	LS	1	NA	$1,500
Underground Water, Electrical & Telephone Distribution	Excavate trench 1'-4' deep w/ 3/8 CY tractor/ loader/backhoe; Assume 1,400 LF (1,100 LF for electrical and 300 LF for water) of trenching/4' deep/2'width	BCY	420	$5.75	$2,415
Conduit and Tubing (Electrical & Telephone)	Assume 2" dia rigid galvanized steel	LF	1,100	$8.35	$9,185
Panel Board (Electrical)		Each	1	$2,000.00	$2,000
Gravel (Water, Electrical , & Telephone; Material only)	Gravel = 1.8ton/CY	Ton	756	$7.75	$5,859
Subtotal					$10,288,813

Table 5-5 Cost Estimate for Alternative 5 - Excavation and On-Site Soil Washing of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Wastewater Discharge					
Wastewater Pumping Station	Capacity 1,000 gallons per minute	Each	1	$119,500.00	$119,500
Discharge Pipe Trenching (from soil washing unit to sanitary sewer)	Excavate trench 1'-4' deep w/ 3/8 CY tractor/loader/backhoe; Assume maximum 2,000 LF of trenching/4' deep/2'width	BCY	600	$5.75	$3,450
Gravel (Material only)	Gravel = 1.8ton/CY	Ton	1,054	$7.75	$8,167
Piping (Material only)	6" dia PVC pipe	LF	2,000	$7.32	$14,630
Installation of Discharge Pipe (Labor)	2-man crew @ $50/hr, 8hr/day, 5 days	HR	40	$100.00	$4,000
Wastewater Discharge Fee	Assume 600,000 gallons per day for 140 days	kGal	84,000	$10.00	$840,000
Subtotal					$989,747
Removal of PCB Cell Leachate					
Carbon Drum System	4 total carbon drums in parallel; 2 drums in series for each parallel	Each	4	$500.00	$2,000
Prefilter and internal piping	1 bag-type prefilter for each parallel	Each	2	$860.00	$1,720
Postfilter and internal piping	1 bag-type postfilter for each parallel	Each	2	$860.00	$1,720
Carbon Drum Piping Connections	Assume 1 set per treatment train	Each	2	$350.00	$700
Filter Replacement (Labor)	1-person @ $50/hr, 3 hr/day * 20 days/mo = 60 hr/1-month	HR	60	$50.00	$3,000
Monthly Sampling (for Carbon Drum System)	Includes Pesticides/PCB; influent and effluent	Each	4	$100.00	$400
Subtotal					$9,540
Backfilling					
Placement of Backfill	300 Horsepower Front End Loader w/ 150' haul	LCY	125,340	$0.85	$106,539
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	LCY	125,340	$0.33	$41,362
Subtotal					$147,901
Site Restoration					
Topsoil (Material only)	Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) excavated surface area and 6" of topsoil at 1.2ton/LCY - 3,210 BCY (w/ 12%swell factor) from top 1' of PCB cell - 11,382 SF parking lot area	Ton	11,180	$14.00	$156,520
Placement of Topsoil	300 Horsepower Front End Loader/Bulldozer w/ 50' haul; includes 3,210 BCY (w/ 12% swell factor) from top 1' of PCB cell	LCY	12,920	$0.53	$6,848
Pavement (6" gravel base, 2" binder, 1"topping)	Based on 43,350 SF parking area	SF	43,350	$1.73	$74,996
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; Based on 332,403 SF (southern area) + 189,450 SF (western area) + 111,800 SF (PCB cell area) of excavated surface area - 11,382 SF parking lot area	MSF	520	$45.50	$23,660
Subtotal					$262,023
				Capital Cost Subtotal:	$13,577,227
				Adjusted Capital Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$12,599,667
				15% Legal, administrative, engineering fees, construction management:	$1,889,950
				20% Contingencies:	$2,897,923
				Total Capital Cost:	**$17,388,000**
<u>**Annual Costs**</u>					
Not Applicable				$0.00	$0
Subtotal					$0
				Annual Cost Subtotal:	$0
				Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):	$0
				15% Legal, administrative, engineering fees:	$0
				20% Contingencies:	$0
				Annual Cost Total:	**$0**
				30-Year Present Worth of Annual Costs:	**$0**
				2002 Total Present Worth Cost:	**$17,388,000**
				2004 Total Present Worth Cost:	**$17,969,000**

Table 5-5 Cost Estimate for Alternative 5 - Excavation and On-Site Soil Washing of Contaminated Soils
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost

Assumptions

1. Perimeter of existing fence = 440' x 270' = 1420 LF.
2. Perimeter of construction fence approximately = 3000 LF.
3. Assume existing fence and gate will be reused for new perimeter fence.
4. Verification sampling to be performed as per 40 CFR 761.265 (one sample on 8 foot grid each 4 foot interval).
5. For treated soil: Assume Pesticides/PCB analysis required for every 500 tons of soil.
6. For loose soil assume sandy, dry soil with 12% swell factor (Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).
7. Based on geotechnical data from the RI (E&E, 2002), in-situ bulk density of on-site and PCB cell soils is 1.47 tons/BCY and 1.52 tons/BCY, respectively.
8. Assume top 3' of PCB cell top liner is clean and will be re-used as backfill/topsoil. Approximately 3,210 BCY of topsoil from top 1', and 5,647 BCY of backfill from bottom 2' of PCB cell.
9. Topsoil density assumed to be 1.2 tons/CY per quote from Jointa Galusha, Glens Falls, NY.
10. 30-year present worth of costs assumes 5% annual interest rate.
11. Fixed and treatement costs for soil washing supplied by vendor, Biogenesis May 2004. Costs presented for these line items were adjusted to 2002 costs for consistency with cost estimate using RS Means Historical Cost Index.
12. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:

BCY = bank cubic yards
LCY = loose cubic yards
SF = square feet
MSF = thousand square feet
LS = lump sum
LF = linear foot
kGal = 1,000 gallons

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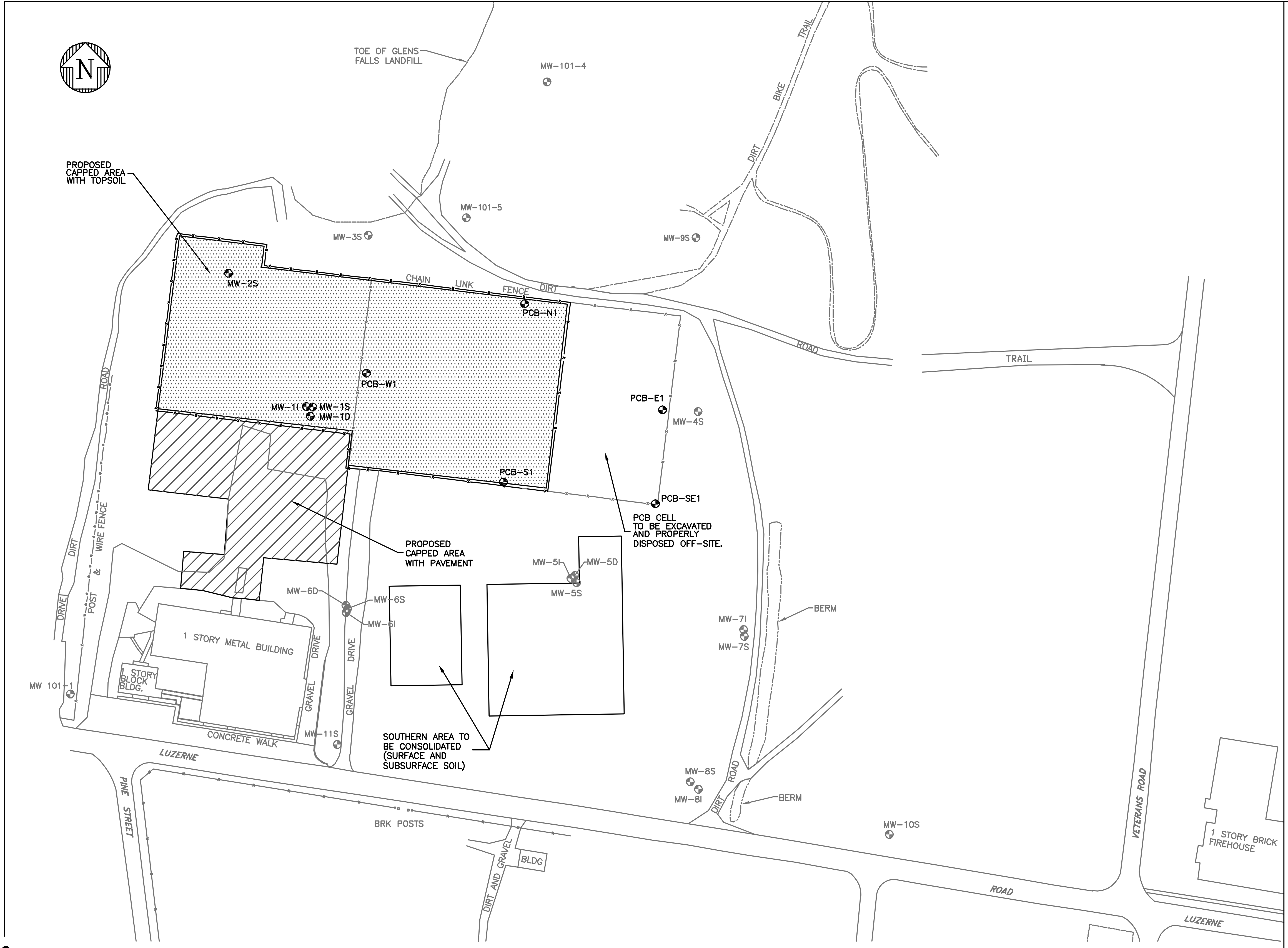

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NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. PCB CELL TO BE EXCAVATED PRIOR TO SOIL CONSOLIDATION.
5. SURFACE AND SUBSURFACE SOIL FROM SOUTHERN AREA AND PARKING LOT TO BE CONSOLIDATED AND PLACED INTO FOOTPRINT OF FORMER PCB CELL.

LEGEND

—x—x—	EXISTING CHAIN LINK FENCE
—•—•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
——	EXISTING CONCRETE CURB
▒	PROPOSED CAPPED AREA (WITH TOPSOIL SURFACE)
▨	PROPOSED CAPPED AREA (WITH PAVEMENT SURFACE)
—x—x—	PROPOSED CHAIN LINK FENCE
● PCB-W1	PROPOSED MONITORING WELL TO BE DECOMMISSIONED
○ MW-7I	EXISTING MONITORING WELL

SCALE IN FEET

0 150 300 450

FIGURE 5-1 ALTERNATIVE 2 –
SOURCE AREA CAPPING &
EXCAVATION & OFF-SITE
DISPOSAL OF PCB CELL
LUZERNE ROAD SITE
QUEENSBURY, NEW YORK

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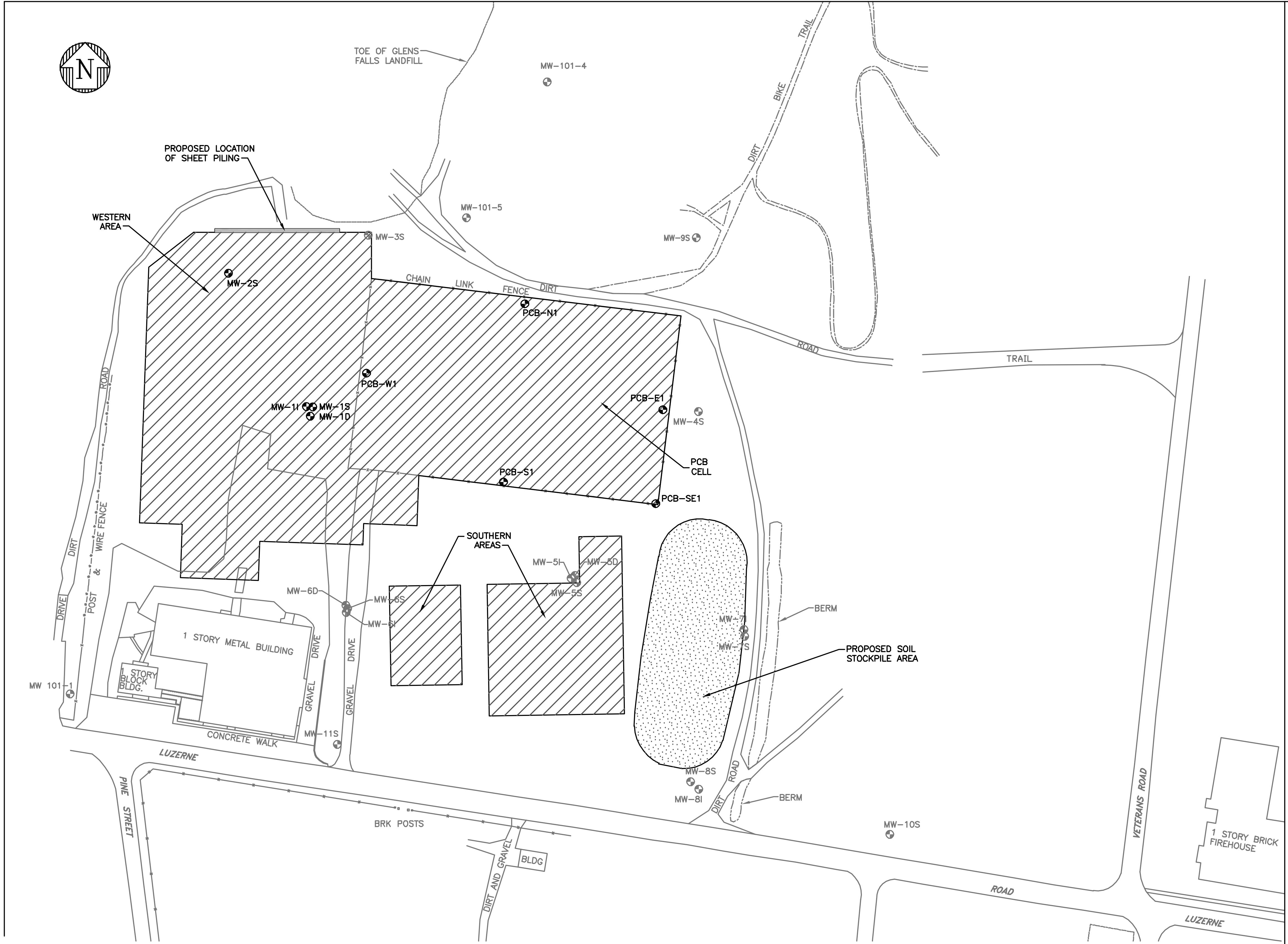

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NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. SURFACE SOIL TO BE EXCAVATED IN THE SOUTHERN AREA FROM 0 TO 1 FOOT.
5. LIMITS OF EXCAVATION ARE SHOWN AT GRADE (i.e. INCLUDING REQUIRED CUTBACK). FOR SUBSURFACE SOILS, DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM 4 FEET BGS IN SOUTHERN AREA AND 24 FEET BGS IN WESTERN AREA.
6. DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM AT 15 FEET BGS IN PCB CELL AREA.

LEGEND

—x——x—	EXISTING CHAIN LINK FENCE
—•——•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
═══	EXISTING CONCRETE CURB
▨	PROPOSED AREAS TO BE EXCAVATED AND DISPOSED ON-SITE
░	PROPOSED SOIL STOCKPILE AREA
● PCB-W1	PROPOSED MONITORING WELL TO BE DECOMMISSIONED
○ MW-7I	EXISTING MONITORING WELL

SCALE IN FEET

0 150 300 450

FIGURE 5-3 ALTERNATIVE 3 – EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SOILS
LUZERNE ROAD SITE
QUEENSBURY, NEW YORK

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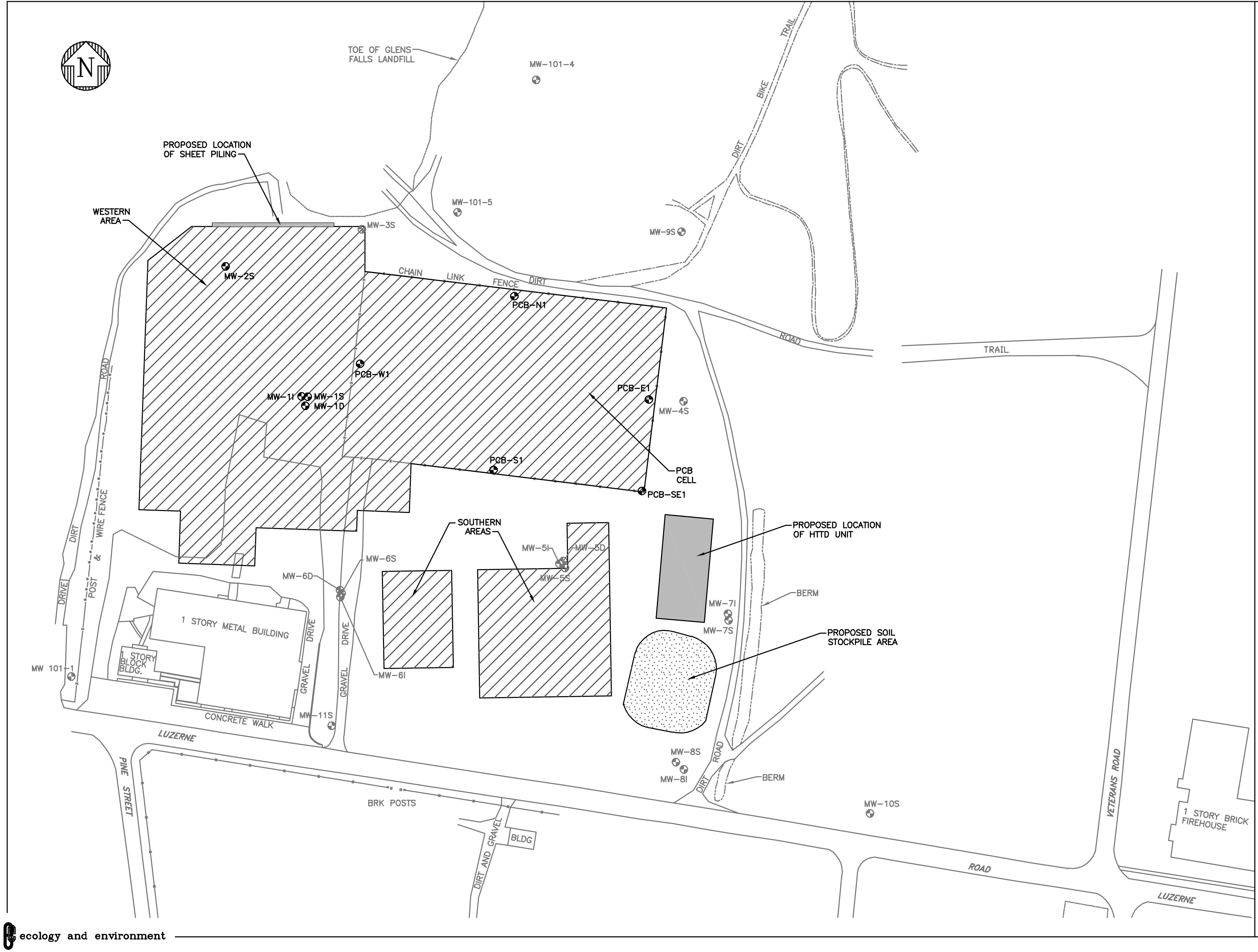

NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. SURFACE SOIL TO BE EXCAVATED IN THE SOUTHERN AREA FROM 0 TO 1 FOOT.
5. LIMITS OF EXCAVATION ARE SHOWN AT GRADE (i.e. INCLUDING REQUIRED CUTBACK). FOR SUBSURFACE SOILS, DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM 4 FEET BGS IN SOUTHERN AREA AND 24 FEET BGS IN WESTERN AREA.
6. DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM AT 15 FEET BGS IN PCB CELL AREA.

LEGEND

—x—x—	EXISTING CHAIN LINK FENCE
—•—•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
——	EXISTING CONCRETE CURB
▨	PROPOSED AREAS TO BE EXCAVATED AND TREATED ON-SITE
░	PROPOSED SOIL STOCKPILE AREA
● PCB-W1	PROPOSED MONITORING WELL TO BE DECOMMISSIONED
● MW-7I	EXISTING MONITORING WELL

SCALE IN FEET

0 150 300 450

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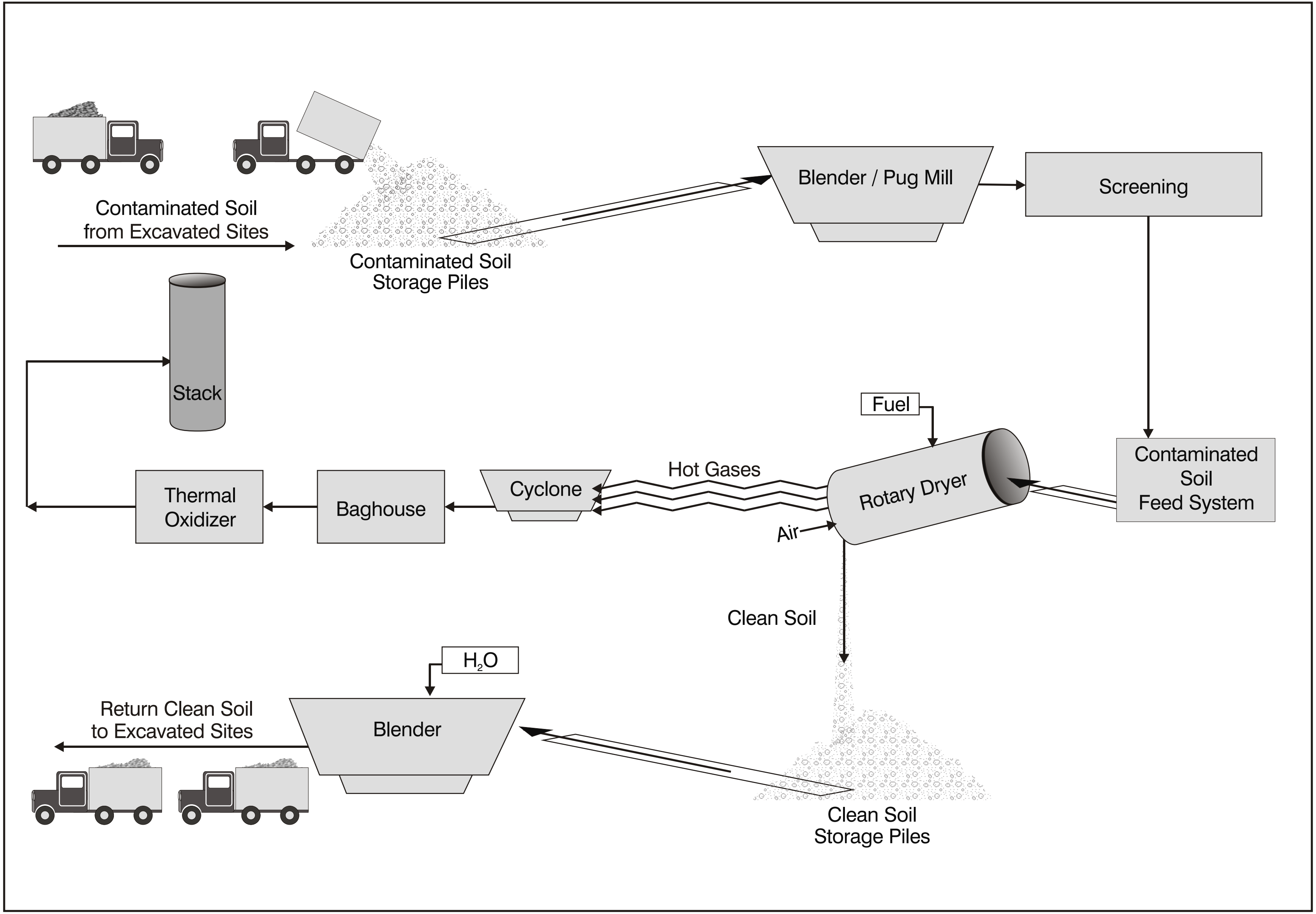
FIGURE 5-4 ALTERNATIVE 4 – EXCAVATION & ON-SITE THERMAL TREATMENT OF CONTAMINATED SOILS LUZERNE ROAD SITE QUEENSBURY, NEW YORK

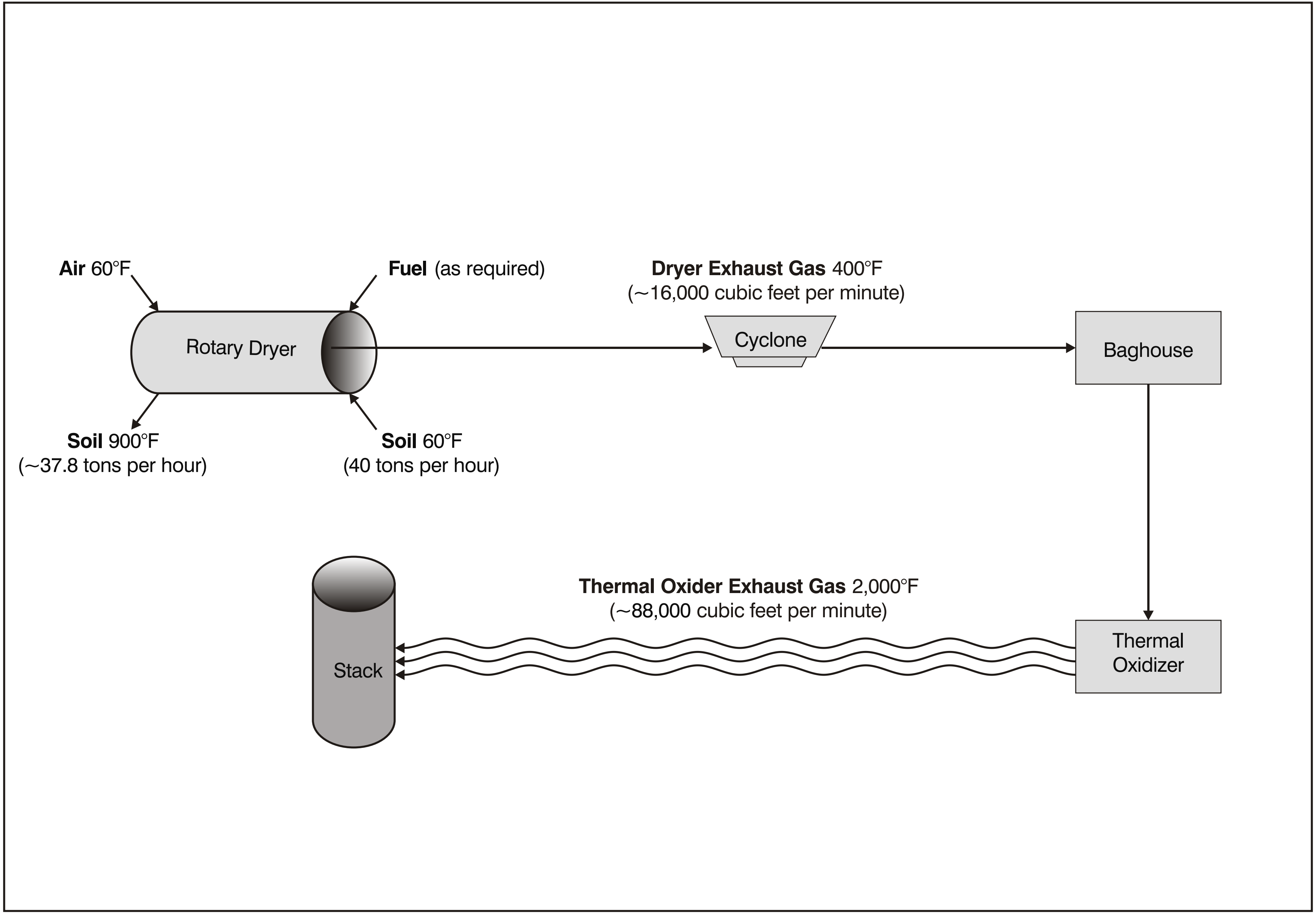
02:000699_QQ08_00_05
Fig5-5.CDR-12/9/02-GRA



SOURCE: Ecology and Environment, Inc. 2002

Figure 5-5 **High-temperature Thermal Desorption Process**
Luzerne Road Site

02:000699_QQ08_00_05
Fig5-6.CDR-12/9/02-GRA



SOURCE: Ecology and Environment, Inc. 2002

Figure 5-6 **High-temperature Thermal Mass and Energy Balance Luzerne Road Site**

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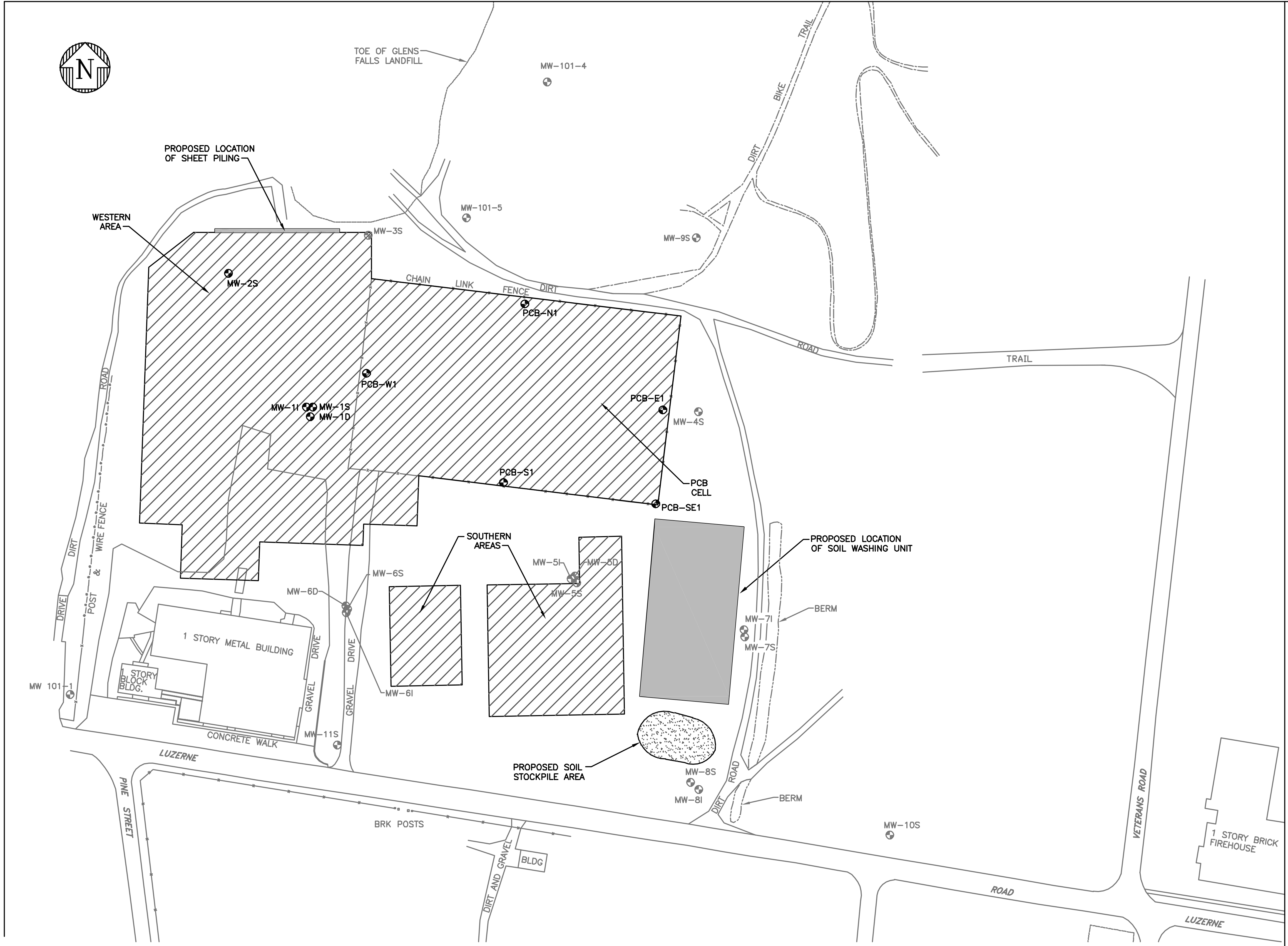


NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. SURFACE SOIL TO BE EXCAVATED IN THE SOUTHERN AREA FROM 0 TO 1 FOOT.
5. LIMITS OF EXCAVATION ARE SHOWN AT GRADE (i.e. INCLUDING REQUIRED CUTBACK). FOR SUBSURFACE SOILS, DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM 4 FEET BGS IN SOUTHERN AREA AND 24 FEET BGS IN WESTERN AREA.
6. DEPTH OF EXCAVATION IS ASSUMED TO BE MAXIMUM AT 15 FEET BGS IN PCB CELL AREA.

LEGEND

—x—x—	EXISTING CHAIN LINK FENCE
—•—•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
——	EXISTING CONCRETE CURB
▨	PROPOSED AREAS TO BE EXCAVATED AND TREATED ON-SITE
░	PROPOSED SOIL STOCKPILE AREA
● PCB-W1	PROPOSED MONITORING WELL TO BE DECOMMISSIONED
○ MW-71	EXISTING MONITORING WELL

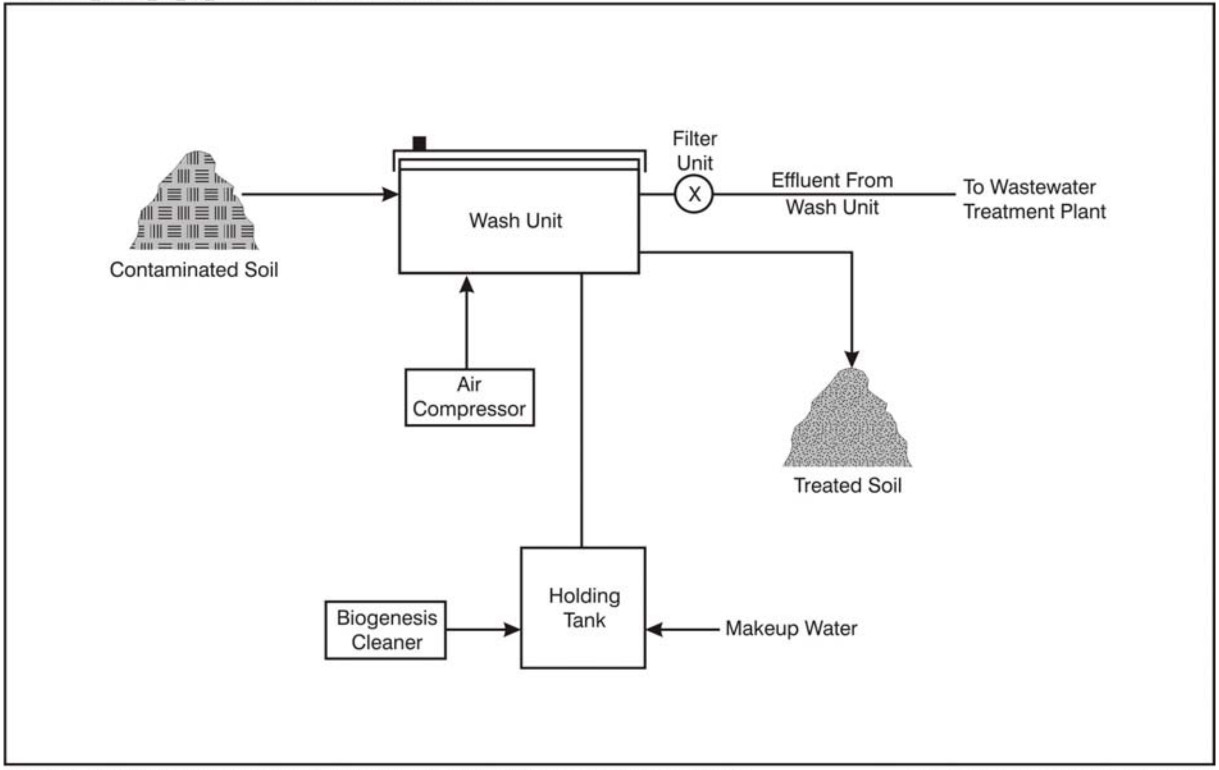
SCALE IN FEET

0 150 300 450

ecology and environment

FIGURE 5-7 ALTERNATIVE 5 – EXCAVATION & ON-SITE SOIL WASHING OF CONTAMINATED SOILS LUZERNE ROAD SITE QUEENSBURY, NEW YORK

02:000699_QQ08_00_05_00-B1090\Fig5-8.CDR-5/18/04-GRA



SOURCE: EPA/540/R-93/510, Biogenesis™ Soil Washing Technology, Innovative Technology Evaluation Report, September 1993

Figure 5-8 Conceptual Soil Washing Process, Luzerne Road Site

6 Detailed Analysis of Groundwater Alternatives

6.1 Analysis of Individual Alternatives

6.1.1 Alternative 1 - No Action

6.1.1.1 Description

The no-action alternative is presented in accordance with the NCP as a baseline for comparison with other alternatives. This alternative does not include remedial action, institutional or engineering controls, and long-term monitoring.

6.1.1.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is not protective of human health and the environment. Groundwater contamination exceeding target risk levels and regulatory standards will remain in place and be available for potential future exposure.

Compliance with Applicable or Relevant and Appropriate Requirements

This alternative does not comply with ARARs for the COC.

Long-term Effectiveness and Performance

Because this alternative does not involve the removal or treatment of contaminated groundwater, contamination, risks associated with potential groundwater use, and the migration of contaminants in groundwater will remain essentially the same. This alternative is therefore not effective in the long-term.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not involve removal or treatment of contaminated groundwater, and therefore the toxicity, mobility, and volume of contamination will not be reduced.

Short-Term Effectiveness

No short-term impacts are anticipated during implementation of this alternative, since no groundwater removal or treatment activities are involved with the alternative.

Implementability

There are no actions to implement under this alternative.

Cost

There is no cost associated with this alternative.

6.1.2 Alternative 2 - Long-Term Monitoring

6.1.2.1 Description

This alternative involves long-term monitoring of groundwater at the site, and placing institutional controls to minimize potential exposure to contaminated groundwater. Institutional controls would place restrictions on groundwater use and limit/prohibit future excavations at the site to minimize potential exposure to the PCB contamination. According to the Phase II Investigation of the Glens Falls Landfill (Recra Environmental, Inc. 1987), local residents are serviced by the Town of Queensbury and the City of Glens Falls municipal water departments. Therefore, modifications to the municipal water supply to local residents would not be necessary.

The long-term groundwater monitoring program will consist of annual sampling events from the following 13 existing on-site monitoring wells: MW-3S, MW-4S, MW-5S/I/D, MW-6S/I/D, MW-7S/I, MW-8S/I, MW-10S (see Figure 6-1). However, depending on soil alternative selected MW-3S may be decommissioned. Although groundwater contamination was not observed in the deep wells during the RI (E & E 2002), deep wells are included in the long-term monitoring program to assess the potential for future vertical migration of contaminants into this zone. All 13 wells would be sampled and analyzed for TCL PCBs (EPA Method 8082) at an off-site laboratory. Groundwater levels will be collected for all monitoring wells in conjunction with the groundwater sampling. The analytical data from the monitoring program will be combined with historical groundwater data to monitor the extent of migration.

6.1.2.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

Because this alternative includes placement of institutional controls that would restrict and prevent future uses of contaminated groundwater, it is protective of human health. There are currently no on-site human or environmental receptors impacted by the contamination. Nearby residential areas are serviced by the municipal water supply system.

Compliance with Applicable or Relevant and Appropriate Requirements

Although institutional controls will be placed and monitoring conducted, groundwater standards are not expected to be reached. Therefore, this alternative does not comply with ARARs for the COC.

Long-term Effectiveness and Performance

Although groundwater contamination will remain on site, institutional controls, if properly maintained, are an effective mechanism to prevent future exposure to contaminated groundwater. With the continual use of the municipal water supply for local residents and businesses, this alternative would be effective in the long term.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not involve removal or treatment of contaminated groundwater, and therefore the toxicity, mobility, and volume of contamination will not be reduced.

Short-Term Effectiveness

No short-term impacts are anticipated during implementation of this alternative, since no groundwater removal or treatment activities are involved with the alternative. In addition, no new monitoring wells will be installed to implement the long-term monitoring program.

Implementability

This alternative is readily implemented using standard groundwater monitoring methods. Furthermore, all proposed wells to be monitored exist on site.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period at a discount rate of 5% is $207,000 (or $214,000 adjusted to 2004 costs). Table 6-1 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Annual groundwater monitoring costs and renewal of institutional controls are assumed with this alternative.

6.1.3 Alternative 3 - Groundwater Extraction and Treatment, and Long-Term Monitoring

6.1.3.1 Description

This alternative involves extraction and treatment of groundwater by carbon adsorption, in addition to long-term monitoring of groundwater. The treated groundwater will be appropriately discharged. Institutional controls will also be placed to minimize future exposure to groundwater contamination.

Based on the RI groundwater results (E & E 2002), the highest PCB concentration in groundwater of 151 µg/L was detected in monitoring well PCB-E1, just east of the PCB cell. This well is considered to be a shallow well as it extends to approximately 30 feet BGS. With the exception of this well, on-site groundwater concentrations were generally less than 1 µg/L. Similarly, groundwater PCB concentrations from off-site monitoring wells in residential areas (downgradient of the PCB cell) collected during the RI (E & E 2002) were also generally less than 1 µg/L. The RI groundwater results also indicated that PCB contamination was primarily detected in the shallow groundwater zone (approximately 20 feet to 35 feet BGS), although PCBs were detected in some of the intermediate wells. Based on this information, this alternative was developed to target the shallow groundwater zone where the highest PCB concentration is suspected. Since an aquifer (pump) test was not performed during the RI, E & E completed a preliminary groundwater analysis to estimate the capture zone and pumping rate of a typical extraction well and develop a preliminary scheme for the pump and treat system. Note that the objective of this simplified analysis was to develop a preliminary scheme for the extraction system, size the carbon treatment system components, and develop a cost estimate for the alternative. Further refining of this analysis using numerical modeling tools and/or aquifer and pilot test, would be required to optimize well spacing and pumping rate if this alternative is selected.

Because the intent of this alternative is to target the shallow zone, and not the entire extent of the saturated zone where PCB contamination was detected, E & E initially assumed three extraction wells installed perpendicular to the groundwater flow and approximately 120, 375, and 600 feet southeast (downgradient) of monitoring well PCB-E1. Based on an average hydraulic conductivity of $3.82x10^{-2}$ cm/s ($1.25\ x10^{-3}$ ft/s) for the shallow and intermediate zones, and an average hydraulic gradient of 0.0096 ft/ft, and assuming a porosity of 25%, the groundwater velocity was estimated using Darcy's law at $4.8x10^{-5}$ ft/s (see Appendix F). Assuming a capture width of 100 feet per well, and a saturated aquifer thickness of 70 feet, the groundwater volumetric flow rate is estimated at $8x10^{-2}$ cubic feet per second (ft^3/s) per well. Capturing this flow would require pumping at a rate of approximately 40 gallons per minute (gpm) for each well (see Appendix F), or 120 gpm total. Note that based on the actual capture zone of the well, the pumping rate could reach up to 100 gpm per well. As stated earlier, aquifer tests or numerical modeling would be needed to optimize the extraction rate for the limited area of concern.

The extracted water would be pumped to a carbon adsorption system located near the extraction well closest to monitoring well PCB-E1 as shown in Figure 6-2. The carbon treatment system will consist of pre- and post-filters connected to three sets in parallel of two high-pressure activated carbon water purification system units (1,000 pounds of carbon per drum) in series. The second in-series carbon unit will provide redundancy in the system if breakthrough occurs in the first unit. The system will be housed in a prefabricated protective and insulated enclosure. Temperature control of the enclosure will prevent freezing of system components. A flow meter will be installed at the influent and effluent sides to monitor flow through the system. Any external exposed piping will be heat traced.

The estimated lifetime of the carbon within the unit prior to requiring replacement is estimated at 12 months based on the anticipated pumping rate of 40 gpm and a maximum PCB concentration of 151 µg/L. Spent carbon will be removed, properly disposed of, and replaced with new carbon. Long-term maintenance of the system will also require replacing filters on a weekly basis and monthly sampling of the influent and effluent PCB concentrations. Treated groundwater from the system will be appropriately discharged.

Long-term monitoring of groundwater and performance evaluation will consist of annual sampling events from the following 13 on-site wells: MW-3S, MW-4S, MW-5S/I/D, MW-6S/I/D, MW-7S/I, MW-8S/I, MW-10S (see Figure 6-2). However, depending on soil alternative selected, MW-3S may be decommissioned. Although groundwater contamination was not observed in the deep wells during the RI (E & E 2002), deep wells are included in the long-term monitoring program to assess the potential for future vertical migration of contaminants into this zone. All 13 wells would be sampled and analyzed for TCL PCBs (EPA Method 8082) at an off-site laboratory. Groundwater levels will be collected for all monitoring wells in conjunction with the groundwater sampling. The analytical data from the monitoring program will be combined with historical groundwater data to monitor the extent of migration.

6.1.3.2 Evaluation of Criteria

Overall Protection of Human Health and the Environment

Because this alternative includes placement of institutional controls that would restrict future use of contaminated groundwater, it is protective of human health. There are currently no human environmental receptors impacted by the contaminated groundwater. Extraction and treatment of the relatively highest groundwater contamination would provide additional protection of human health and environment.

Compliance with Applicable or Relevant and Appropriate Requirements

Implementation of this alternative will treat the majority of site-contaminated groundwater to levels in compliance with ARARs. However, since this alternative involves extraction and treatment of contaminated groundwater in the shallow groundwater zone only, this alternative will not comply fully with chemical-specific ARARs.

Long-term Effectiveness and Performance

Because this alternative includes placement of institutional controls that would restrict future uses of contaminated groundwater, it is protective of human health. There are currently no on-site human or environmental receptors impacted by the contamination. Nearby residential areas are serviced by the municipal water supply system. In addition, this alternative is considered to be effective because the extraction and treatment of groundwater from a location downgradient from where the highest PCB concentration was detected will reduce contamination on site and minimize off-site migration.

Reduction in Toxicity, Mobility, or Volume through Treatment

Because this alternative involves extraction and treatment of contaminated groundwater, the volume of contamination will be practically reduced at the site. Consequently, the toxicity, and mobility, of contamination will be reduced.

Short-Term Effectiveness

Minimal short-term impacts are anticipated during implementation of this alternative. The installation of three extraction wells, a treatment building, and discharge pipeline would require the clearing of some vegetation, yet not enough to make a substantial impact on the environment. In addition, no new monitoring wells will be installed to implement the long-term monitoring program.

Implementability

Based on a preliminary groundwater analysis, this alternative is readily implemented using standard groundwater construction and monitoring methods. However, further refining of this analysis using numerical modeling tools and/or aquifer and pilot tests, would be required prior to selection of this alternative.

Cost

The 2002 total present worth cost of this alternative based on a 30-year period at a discount rate of 5% is $1,162,000 (or $1,201,000 adjusted to 2004 costs). Table 6-2 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Considerable O & M activities associated with the extraction well and carbon treatment system are anticipated with this alternative resulting in significant annual costs. Annual groundwater monitoring costs and renewal of institutional controls were also assumed with this alternative.

6.2 Comparative Evaluation of Groundwater Alternatives

Overall Protection of Human Health and the Environment

There are currently no human or environmental receptors impacted by the contaminated groundwater. Although there are no receptors of contamination, Alternative 1 will not prevent possible future exposures. Alternative 2 includes institutional controls and a monitoring program to minimize potential future exposures to contaminants. Although no efforts would be made to eliminate the existing groundwater contamination, the current and future use of the site for commercial/light industrial would permit this alternative to be protective of human health and the environment. Alternative 3 employs active treatment to eliminate the groundwater contamination with the highest PCB concentrations and institutional controls, providing the highest level of protection.

Compliance with Applicable or Relevant and Appropriate Requirements

Groundwater standards comprise the chemical-specific ARARs for groundwater contamination at this site. Alternatives 1, 2, and 3 do not comply with ARARs. Although Alternative 3 provides active treatment to eliminate contamination, the extraction and treatment of groundwater will target the shallow groundwater zone only, which is where the highest PCB concentrations have been detected.

Long-term Effectiveness and Performance

Because Alternatives 1 and 2 do not involve the removal or treatment of contaminated groundwater, contamination will remain essentially the same. However, institutional controls combined with long-term monitoring in Alternative 2 provide an effective long-term mechanism to protect human health and the environment. Also, removal actions taken under the soil alternatives will help decrease the PCB concentrations in the groundwater. Alternative 3 targets groundwater contamination and provides an established technology to extract and treat the contaminated groundwater, which is known to control groundwater migration, and thus increases protectiveness.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternatives 1 and 2 do not involve removal or treatment of contaminated groundwater, and therefore the toxicity, mobility, and volume of contamination will not be reduced. Alternative 3 will reduce some of the volume of contaminated groundwater based on the actual capture zone of the well, thus reducing the mobility and volume of contamination.

Short-Term Effectiveness

No short-term impacts are anticipated during implementation of Alternatives 1 and 2. Alternative 2 involves long-term monitoring from existing on-site wells. Alternative 3 will result in minimal impacts associated with installation of the extraction wells and treatment system. Without further analysis and investigation, the ability and timeframe of the pump and treat system to effectively reach the cleanup goals is somewhat uncertain.

Implementability

There are no actions to implement under Alternative 1. Alternative 2 is readily implemented. Alternative 3 is implementable, but would require some additional time compared to the other two alternatives. The necessity for further groundwater investigations hinders Alternative 3 for immediate implementation. Pump tests, and/or groundwater analysis, would be required prior to finalizing the extraction scheme for this alternative.

Cost

Alternative 1 calls for no action, and thus incurs no costs. Alternative 2 is less expensive than Alternative 3 at an estimated present worth cost of $214,000 (in 2004 costs) for a 30-year long-term monitoring program at the site. Alternative 3 has an estimated present worth cost of $1,201,000 (in 2004 costs), most of which is associated with the operation and maintenance of the treatment system.

Table 6-1 Cost Estimate for Alternative 2 - Long-Term Monitoring
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Work Plan		LS	1	NA	$15,000
Institutional Controls	Maintain/update documentation	Each	1	$2,500.00	$2,500
Subtotal					$17,500
Capital Cost Subtotal:					$17,500
Adjusted Capital Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$16,240
15% Legal, administrative, engineering fees, construction management:					$2,436
20% Contingencies:					$3,735
Total Capital Cost:					**$23,000**
Annual Costs					
Groundwater Monitoring					
Groundwater Sampling (Labor)	2-person @ $50/hr, 8hr/day; 13 total wells - assume 3 wells per day	Day	5	$800.00	$4,000
Parameter Analyses	Includes Pesticides/PCB	Each	13	$100.00	$1,300
Data Evaluation and Reporting		HR	32	$90.00	$2,880
Subtotal					$8,180
Annual Cost Subtotal:					$8,180
Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$7,591
15% Legal, administrative, engineering fees:					$1,139
20% Contingencies:					$1,746
Annual Cost Total:					**$10,476**
30-Year Present Worth of Annual Costs:					**$161,000**
5-Year Costs					
Institutional Controls	Maintain/update documentation	Each	1	$2,500.00	$2,500
Monitoring Well Maintenance		Each	1	$1,000.00	$1,000
Subtotal					$3,500
5-Year Cost Subtotal:					$3,500
Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$3,248
15% Legal, administrative, engineering fees:					$487
20% Contingencies:					$747
5-Year Total:					**$4,482**
30-Year Present Worth of 5-Year Costs:					**$23,000**
2002 Total Present Worth Cost:					**$207,000**
2004 Total Present Worth Cost:					**$214,000**

Assumptions
1. 30-year present worth of costs assumes 5% annual interest rate.
2. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:
HR = Hour.

Table 6-2 Cost Estimate for Alternative 3 - Groundwater Extraction and Treatment, and Long-Term Monitoring
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	NA	$9,010
Institutional Controls		Each	1	$2,500.00	$2,500
Subtotal					$11,510
Site Preparation					
Site Clearing	Based on 8,325 SF of area along south edge of PCB cell fenceline and eastern area of site	Day	1	$788.00	$394
Cut and Chip Trees (southern area)	Trees to 6" dia. in southern area	Acre	1	$2,900.00	$1,450
Grub Stumps and Remove (southern area)	In southern area	Acre	1	$1,400.00	$700
Subtotal					$2,544
Extraction and Treatment System					
Pre-Design Investigation	Includes additional investigation	LS	1	NA	$75,000
6" ID Extraction Well, includes well construction; no split spoon sampling; to 75' deep		Each	3	$13,400.00	$40,200
Pump and Controls	Submersible pump 33-55 gpm w/ controls	Each	3	$5,740.00	$17,220
Carbon Adsorption System	Assumes CARBTROL HP-1000 Water Purification Adsorber Unit and 1,000 pounds of carbon	LS	6	$4,300.00	$25,800
Prefilter and Internal Piping	Bag prefilter type	Each	3	$1,000.00	$3,000
Postfilter and Internal Piping	Bag postfilter type	Each	3	$1,000.00	$3,000
Delivery of Carbon System		LS	1	NA	$4,000
Pre-Fabricated Enclosure (Approx 400 SF)	Includes installation, insulation, piping, etc.	LS	1	NA	$40,000
Connection Piping (from well to carbon units)	Assume 850' of 2"dia PVC pipe; assumes material cost with 10% profit	LF	850	$0.98	$832
Installation of Carbon System and Piping	3-man crew @ $50/hr, 8hr/day, 10 days	HR	100	$150.00	$15,000
Subtotal					$224,052
Discharge Pipe					
Discharge Pipe Trenching (from extraction well to carbon adsorption system to catch basin)	Excavate trench 1'-4' deep w/ 3/8 CY tractor/loader/backhoe; Assume 1,000 LF of trenching/4' deep/2'width	BCY	300	$5.75	$1,725
Gravel (Material only)	Gravel = 1.8ton/CY	Ton	527	$7.75	$4,084
Piping (Material only)	6" dia PVC pipe	LF	1,000	$7.32	$7,315
Subtotal					$13,124
Electrical Distribution					
Underground Electrical & Telephone Distribution	Excavate trench 1'-4' deep w/ 3/8 CY tractor/ loader/backhoe; Assume 1,100 LF of trenching/4' deep/2'width	BCY	330	$5.75	$1,898
Conduit and Tubing	Assume 2" dia rigid galvanized steel	LF	1,100	$8.35	$9,185
Panel Board		Each	1	$2,000.00	$2,000
Electrical & Telephone Connection Fee and Meter	Assume power source is overhead electric from Luzerne Road	LS	1	NA	$1,500
Gravel (Material only)	Gravel = 1.8ton/CY	Ton	594	$7.75	$4,604
Subtotal					$19,186
Construction Cost Subtotal:					$270,416
Adjusted Construction Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$250,946
15% Legal, administrative, engineering fees, construction management:					$37,642
20% Contingencies:					$57,718
Total Capital Cost:					**$347,000**
Annual Costs					
Operation and Maintenance					
Filter Replacement (Material)	6 filters changed once per week = 312 filters/yr	Each	312	$5.00	$1,560
Filter Replacement (Labor)	1-person @ $50/hr, 4 hr/week = 208 hr/yr	HR	208	$50.00	$10,400
Pump and Motor Maintenance	Assume 1 per year per well	Each	3	$450.00	$1,350
Monthly System Sampling	Includes Pesticides/PCB; influent and effluent	Each	24	$100.00	$2,400
Electricity Charge		LS	1	NA	$4,000
Telephone Charge	Assume $50/mo	LS	1	NA	$600
Carbon Replacement	Assume replacement of carbon in 3 units once per 12 months; Includes removal of spent carbon and refill of new	LB	3,000	$2.00	$6,000

Table 6-2 Cost Estimate for Alternative 3 - Groundwater Extraction and Treatment, and Long-Term Monitoring
Luzerne Road Site

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Monitoring					
Groundwater Sampling (Labor)	2-person @ $50/hr, 8hr/day; 13 total wells - assume 3 wells per day	Day	5	$800.00	$4,000
Parameter Analyses	Includes Pesticides/PCB	Each	13	$100.00	$1,300
Data Evaluation and Reporting	8hr/mo	HR	96	$90.00	$8,640
Subtotal					$40,250
Annual Cost Subtotal:					$40,250
Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$37,352
15% Legal, administrative, engineering fees:					$5,603
20% Contingencies:					$8,591
Annual Cost Total:					**$51,546**
30-Year Present Worth of Annual Costs:					**$792,000**
5-Year Costs					
Institutional Controls	Maintain/update documentation	Each	1	$2,500.00	$2,500
Monitoring Well Maintenance		Each	1	$1,000.00	$1,000
Subtotal					$3,500
5-Year Cost Subtotal:					$3,500
Adjusted Annual Cost Subtotal for Glens Falls, New York Location Factor (0.928):					$3,248
15% Legal, administrative, engineering fees:					$487
20% Contingencies:					$747
5-Year Costs Total:					**$4,482**
30-Year Present Worth of 5-Year Costs:					**$23,000**
2002 Total Present Worth Cost:					**$1,162,000**
2004 Total Present Worth Cost:					**$1,201,000**

Assumptions
1. 30-year present worth of costs assumes 5% annual interest rate.
2. 2002 Total Present Worth Costs adjusted to 2004 costs using RS Means Historical Cost Index.

Abbreviations:
HR = Hour.
LF = Linear feet.
KWH = Kilowatt hour.
LB = Pound.

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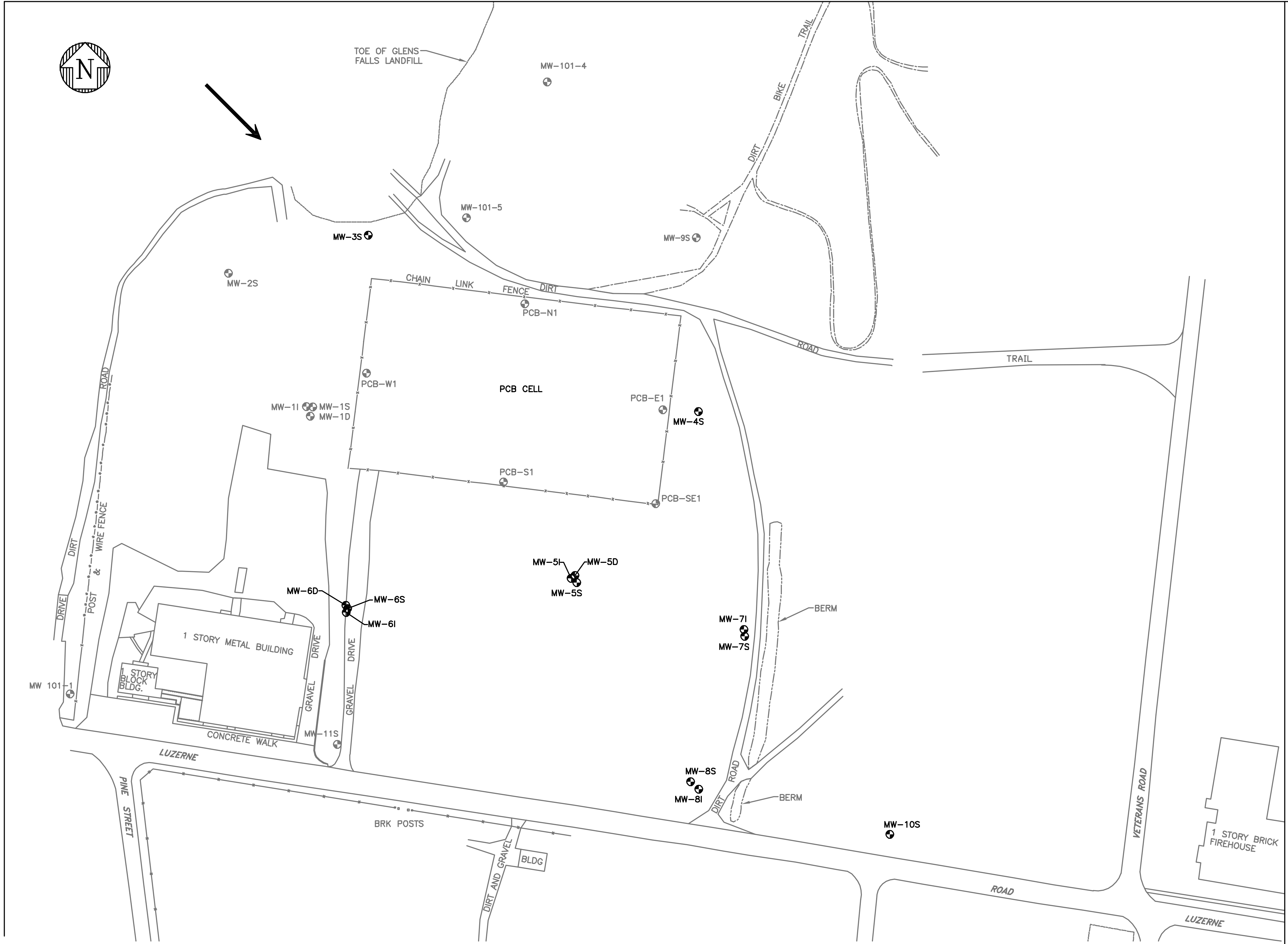


NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. APPROXIMATE GROUNDWATER FLOW BASED ON WATER LEVEL READINGS TAKEN ON 9/00 (E&E, RI 2002)

LEGEND

—x—x—	EXISTING CHAIN LINK FENCE
—•—•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
——	EXISTING CONCRETE CURB
● MW-4S	EXISTING MONITORING WELL TO BE SAMPLED DURING LTM PROGRAM
○ MW-11S	EXISTING MONITORING WELL
→	APPROXIMATE GROUNDWATER FLOW

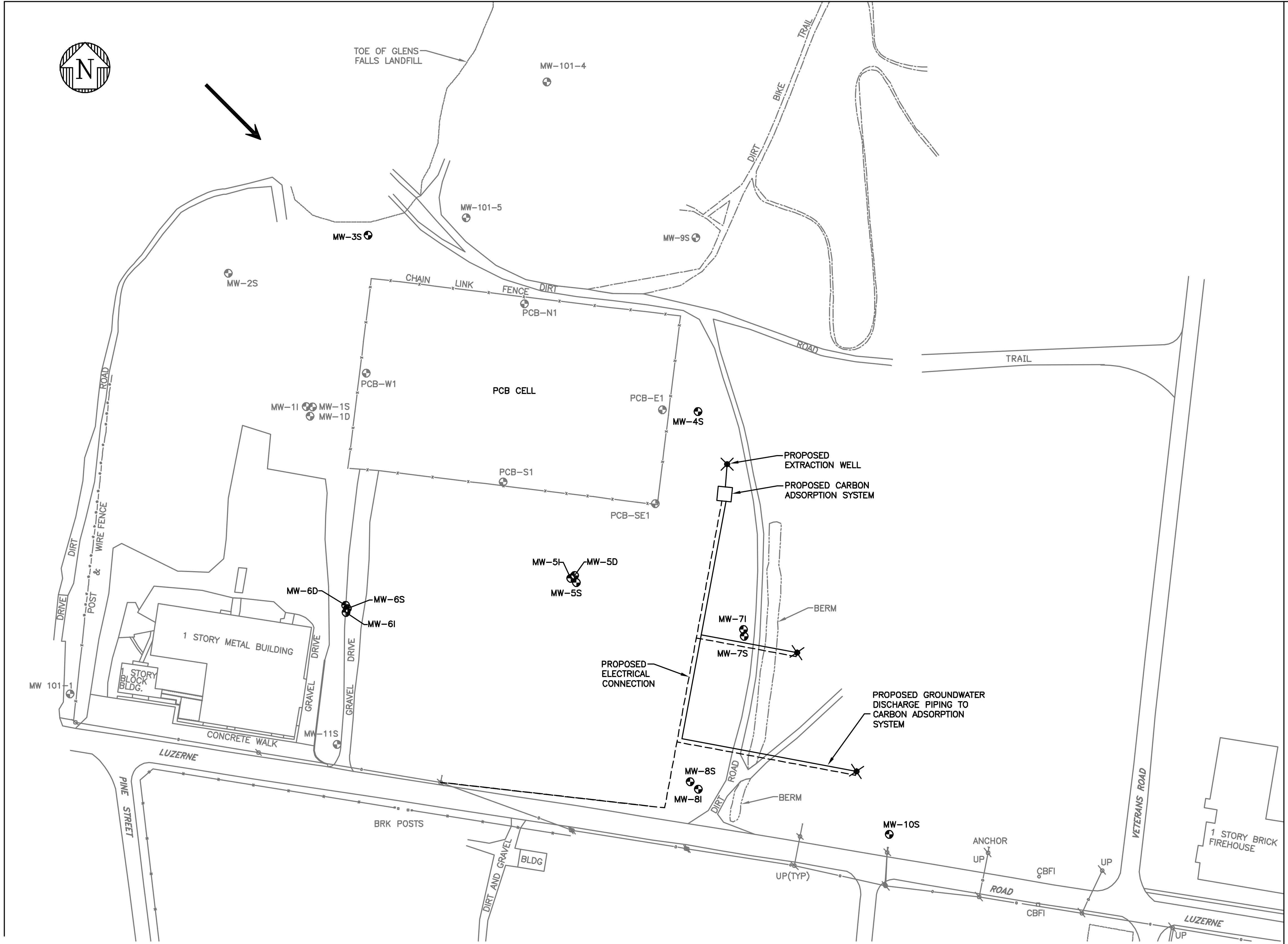
SCALE IN FEET

0 150 300 450

ecology and environment

FIGURE 6-1 ALTERNATIVE 2 –
LONG TERM MONITORING
LUZERNE ROAD SITE
QUEENSBURY, NEW YORK

F:\qq8000\Final RI\5-19-04\FIG 6-2.dwg



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NOTES:

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZERNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.
4. APPROXIMATE GROUNDWATER FLOW BASED ON WATER LEVEL READINGS TAKEN ON 9/00 (E&E, RI 2002)

LEGEND

-----	PROPOSED UNDERGROUND ELECTRICAL CONDUIT
—x—x—	EXISTING CHAIN LINK FENCE
—•—•—	EXISTING POST AND WIRE FENCE
——	EXISTING CONCRETE WALL
═══	EXISTING CONCRETE CURB
⊗	EXISTING UTILITY POLE
CBFI □ ○	EXISTING CATCH BASIN FIELD INLET
◉ MW-4S	EXISTING MONITORING WELL TO BE SAMPLED DURING LTM PROGRAM
◉ MW-11S	EXISTING MONITORING WELL
✕	PROPOSED EXTRACTION WELL
→	APPROXIMATE GROUNDWATER FLOW

SCALE IN FEET

0 150 300 450

FIGURE 6-2 ALTERNATIVE 3 – GROUNDWATER EXTRACTION & TREATMENT, & LONG TERM MONITORING
LUZERNE ROAD SITE
QUEENSBURY, NEW YORK

7 References

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A

Soil Volume Calculations – Surface and Subsurface Soils

F0350793

ecology and environment, inc.

General Computation Sheet

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 1 of 3 Project No.

Rev.	Completed By	Checked By
	Initials: KMP 11/25/02	Initials: / /
	Initials: / /	Initials: / /

Name of Project LUZERNE RD FS System

Subject SURFER(TM) CHECK

OBJECTIVES: VERIFY SURFER(TM) RESULTS ARE REASONABLE AND VALID

ASSUMPTIONS: 1. PERFORM CHECK ON 4-8' INTERVAL AND ASSUME SIMILAR RESULTS FOR REMAINING INTERVALS AND CONTAMINATION LEVELS.

CHECK:

AREAS BASED ON CONTAMINATION $\geq$ 10 ppm (SEE ATTACHED FIGURE FOR REFERENCE)

$A_1 = (200' \times 100') = 20,000 ft^2$

$A_2 = \frac{1}{2}(150' \times 50') = 3,750 ft^2$

$A_3 = (200' \times 100') = 20,000 ft^2$

$A_4 = (150' \times 100') = 15,000 ft^2$

$A_5 = (50' \times 65') = 3,250 ft^2$

$$A_T = \sum_{n=1}^{5} A_n$$

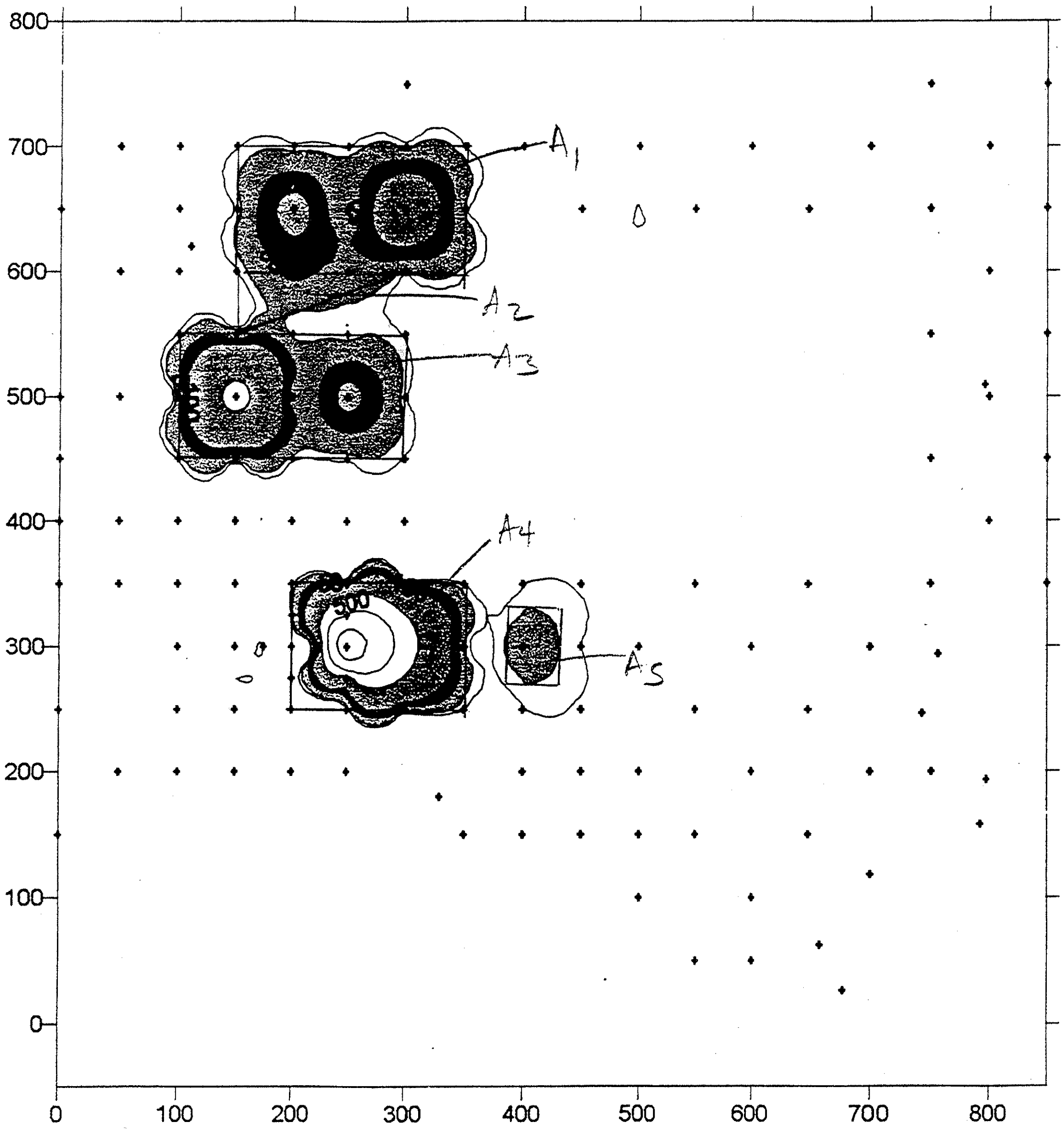
$$= 20,000 ft^2 + 3750 ft^2 + 20,000 ft^2 + 15,000 ft^2 + 3,250 ft^2$$

$$= 62,000 ft^2$$

SURFER(TM) RESULT VALUE FOR CONTAMINATION $\geq$ 10 ppm in 4-8' INTERVAL = 62,048 ft^2

∴ SURFER RESULT VALUES APPEAR TO BE REASONABLE AND VALID FOR ALL INTERVALS AND CONTAMINATION LEVELS

4 - 8 FEET



LUZERNE RD FS

PAGE 2 OF 3

F0350793

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General Computation Sheet

Name of Project LUZERNE RD F S System ____

Subject SOIL VOLUME CALCS - Haz & Non Haz Surface Soil

Calculation Set No.		
Preliminary	☐	
Final	☐	
Void	☐	
Sheet 1 of 2	Project No.	
Rev.	Completed By	Checked By
	Initials: KMP 12/13/02	Initials: / /
	Initials: WJK 12/18/02	Initials: / /

OBJECTIVE: DETERMINE SURFACE SOIL VOLUME TO BE CONSIDERED HAZARDOUS AND NON-HAZARDOUS IN THE SOUTHERN AREA.

ASSUMPTIONS:

1. BASED ON SURFER ESTIMATIONS, CONTAMINATED SURFACE SOIL AREA IN SOUTHERN AREA IS 332,403 ft²

2. HAZARDOUS SOIL = PCB CONCENTRATION ≥ 50 mg/kg
NON-HAZARDOUS SOIL = PCB CONCENTRATION < 50 mg/kg

CALCULATIONS:

BASED ON ATTACHED FIGURE, NON-HAZARDOUS SOIL ESTIMATED BY A_1

$$A_1 = 450\text{ ft} \times 175\text{ ft} = 78{,}750\text{ ft}^2$$

HAZARDOUS SOIL ESTIMATED BY REMAINING SOIL VOLUME:

$$A_2 = 332{,}403\text{ ft}^2 - 78{,}750\text{ ft}^2$$
$$A_2 = 253{,}653\text{ ft}^2$$

ASSUMING 1' DEPTH OF SURFACE SOIL, SOIL VOLUMES ESTIMATED TO BE:

NON HAZARDOUS $V = A_1 D = 78750\text{ ft}^2(1\text{ ft})\left(\frac{1\text{CY}}{27\text{ ft}^3}\right) = 2{,}917\text{CY}$

HAZARDOUS $V = A_2 D = 253{,}653\text{ ft}^2(1\text{ ft})\left(\frac{1\text{CY}}{27\text{ ft}^3}\right) = 9394\text{CY}$

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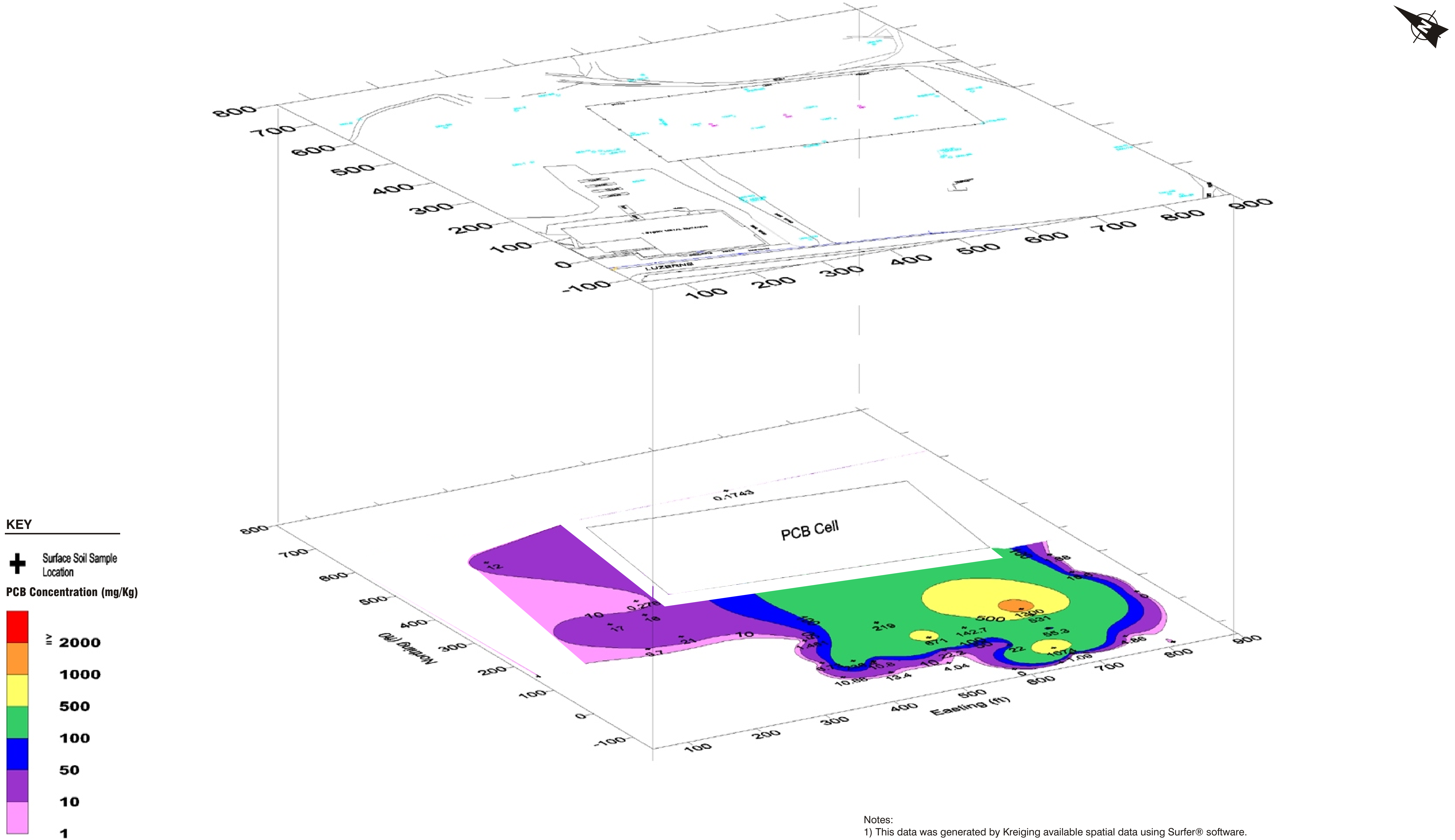
Fig5-1.CDR-12/12/02-GRA



Notes:
1) This data was generated by Kreiging available spatial data using Surfer® software.
2) The detection limit for data presented in this plot is 1 mg/Kg. Concentrations below this detection limit are not accurately presented.

SOURCE: Ecology and Environment, Inc., 2001

Figure 5-1 TOTAL PCB CONCENTRATION DISTRIBUTION IN SITE SURFACE SOILS LUZERNE ROAD LANDFILL SITE QUEENSBURY, NEW YORK

B

Soil Volume Calculations – PCB Cell

F0350793

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General Computation Sheet

Calculation Set No.

Preliminary ☐

Final ☐

Void ☐

Sheet 1 of 9 Project No.

Rev.	Completed By	Checked By
	Initials: WK 11 18 02	Initials: / /
	Initials: KMP 11/11/02	Initials: / /

Name of Project Luzerne Rd. FS System

Subject Estimate Waste Volume Stored in PCB Cell.

OBJECTIVE: Estimate volume of contaminated soil in PCB cell, and volume of base and cover liner material

ASSUMPTIONS

1) Based on data collected by NYSDEC during leachate monitoring (attached), and E&E's borehole log for the two points in the cell (CGP2), it appears that the cell is excavated into ground to some depth. The NYSDEC data indicates that the depth of the cell is approximately 23.5 feet from top of cell to the top of base liner.

E&E's boring log indicates that approximately 4 ft of cap material (2' Topsoil, 1' sand, 1' clay + sand). is placed on top of waste material. This is consistent with cross-section provided by NYSDEC for cap improvement in 1986 (attached).

Assume manhole sticks up 1.5' above ground

$\Rightarrow$ Depth of fill $\simeq$ 23.5' - 4' - 1.5'

$\simeq$ 18 feet.

if top of cell elevation is assumed to be 392' and toe of slope (base of cell) or grade elevation is 380' (Based on survey), then

- Depth of Soil Waste above ground $\simeq$ 8 ft
- Depth of Soil Waste below ground $\simeq$ 10 ft.

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General Computation Sheet

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 2 of 9 Project No.

Name of Project Luzerne RD FS System
Subject

Rev.	Completed By	Checked By
	Initials: WIK 11/18/02	Initials: / /
	Initials: / /	Initials: / /

2) Thickness of base liner material is unknown. Thickness was assumed 5 ft based on cross-sectio of cell provided by NYSDEC (Dated 1987).

3) For cap-material, the first 3 foot of the capping system (2' Topsoil, 1' sand) was assumed clean and could be used for clean fill. Only the bottom 1 foot of capping system was assumed contaminated. ⇒ Depth of waste aboveground = 8+1 ≃ 9

4) Base Liner system was assumed to be contaminated and would require disposal or treatment.

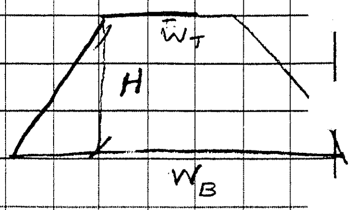
5) Slope of PCB cell was estimated on average to be 6 H : 1 V ; for aboveground pit. For below ground pit,, slope was assumed to be 3 H : 1 V based on cross-section provided by NYSDEC (dated 1987)

ANALYSIS

The truncated Pyramid equation was used to estimate volume of material within cell, and cap and base liner mate

$$\text{Volume} = \frac{H}{3}\left(A_{Top} + \sqrt{A_{Top} \cdot A_{Bott}} + A_{Bott}\right)$$

A_{Top} = Area at Top = $W_T \times L_T$
A_{Bott} = Area at Bottom = $W_B \times L_B$



Analysis was compiled for above grade and buried portions of PCB cell

W_B: Base width
W_T: Top width

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General Computation Sheet

Name of Project Luzerne Rd FS System

Subject

Calculation Set No.

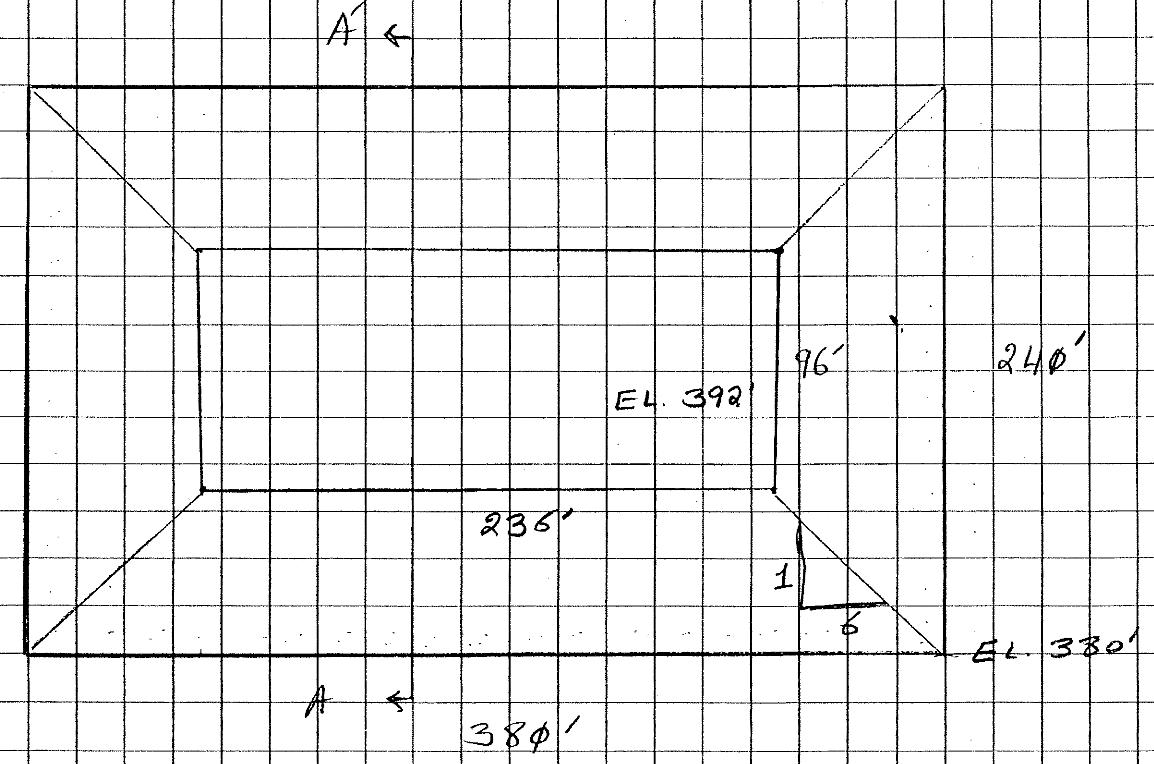
Preliminary ☐

Final ☐

Void ☐

Sheet 3 of 9 Project No.

Rev.	Completed By	Checked By
☒	Initials: WK 11/13/02	Initials: / /
	Initials: / /	Initials: / /



PCB Cell Plan.

Notes- PCB Footprint was scaled off from site topogicphical map. Footprint shows edge of cover Material

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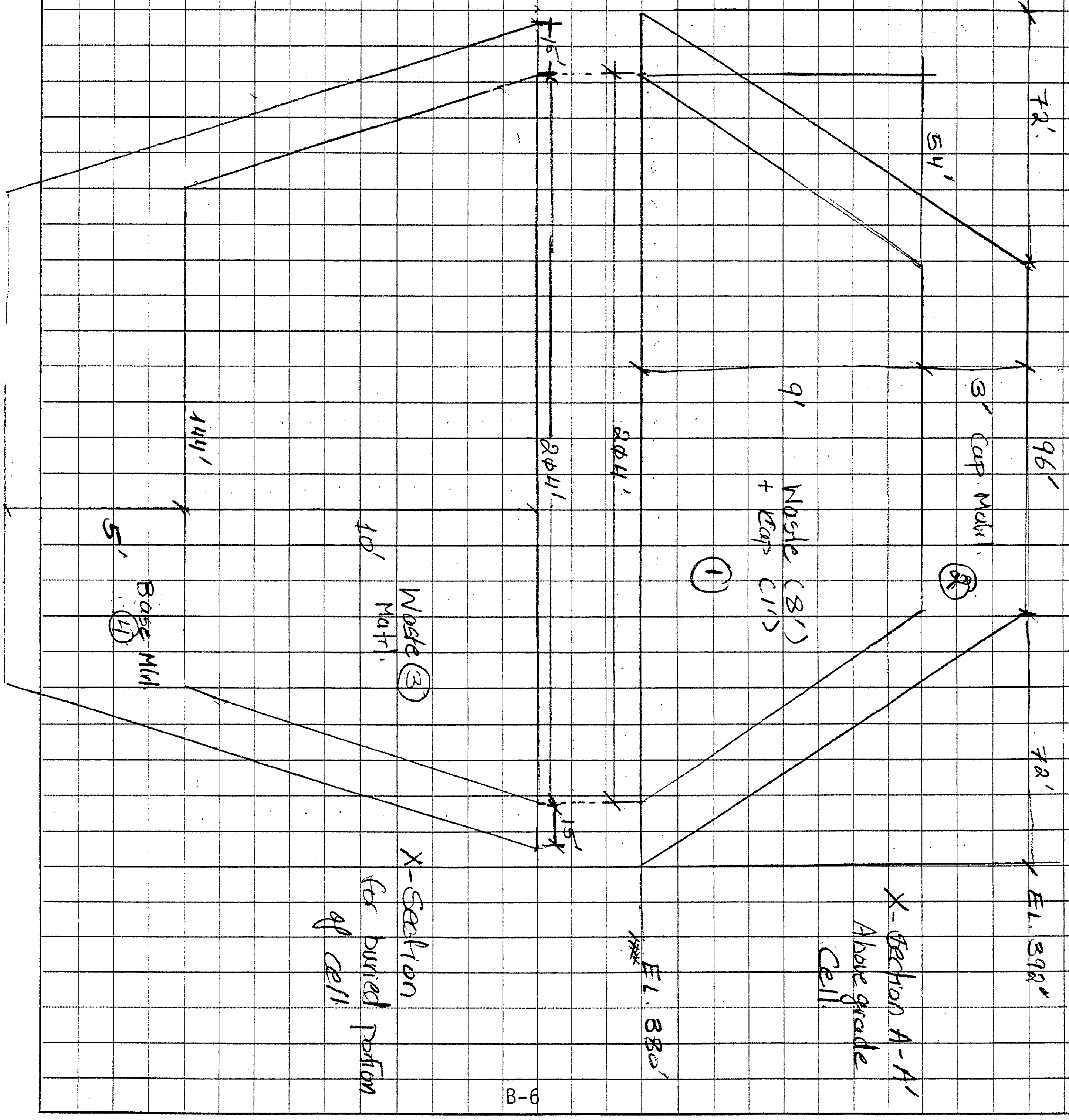
General Computation Sheet

Name of Project Luzerne Rd FS System

Subject

Calculation Set No.		
Preliminary ☐		
Final ☐		
Void ☐		
Sheet 4 of 9	Project No.	
Rev.	Completed By	Checked By
☒	Initials: WJK 11/18/02	Initials: / /
	Initials: / /	Initials: / /



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General Computation Sheet

Name of Project Luzerne Rd FS System

Subject

Calculation Set No.

Preliminary ☐

Final ☐

Void ☐

Sheet 5 of 9 Project No.

Rev.	Completed By	Checked By
☒	Initials: WJK 11/13/02	Initials: / /
	Initials: / /	Initials: / /

A) Estimate Volume of Contaminated Soil + Clean Cap Material for aboveground Cell.

(i) Volume of Contaminated Soil (Area 1) $= \frac{H}{3}\left(A_{Top} + \sqrt{A_{Top} \cdot A_{Bott}} + A_{Bott}\right)$

$A_{Top} = L_{Top} \times W_{Top}$

$= 236' \times 96' \Rightarrow A_{Top} = 22,656\ ft^2$

$A_{Bott} = L_{Bott} \times W_{Bott}$ $\left[L_{Bott} = 380' - (3' \times 6' \times 2) = 344'\right]$

$= 344' \times 204'$

$= 70,176\ ft^2$

$H = 9'$ (include 1' from cap material)

Volume of Contaminated Soil $= \frac{9}{3}\left(22,656\ ft^2 + \sqrt{22,656 \times 70,176} + 70,176\ ft^2\right)$

$= 398,117\ ft^3$

$\approx \underline{\underline{14,745\ CY}}$

(ii) Volume of Contaminated + Cap Material (Area 2)

$H = 12'$

$A_{Top} = 236' \times 96'$

$= 22,656\ ft^2$

$A_{Bott} = 380' \times 240'$

$= 91,200\ ft^2$

⇒ Vol of Contaminated Soil + Cap Mtrl $= \frac{12}{3}\left(22,656 + \sqrt{22,656 \times 91,200} + 91,200\right)$

$= 637,247\ ft^3$

$= \underline{23,602\ CY}$

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General Computation Sheet

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 6 of 9 Project No.

Rev.	Completed By	Checked By
	Initials: WJK 11/18/02	Initials: / /
	Initials: / /	Initials: / /

Name of Project Luzerne Rd FS System

Subject

⇒ Volume of Cap Material $= Vol_{(Area 2)} - Vol_{(Area 1)}$

$= 23,602 \text{ CY} - 14,745 \text{ CY}$

$= \underline{\underline{8,857 \text{ CY}}}$

B) Estimate Volume of Contaminated Soil + Base Liner Material for Below ground Cell.

(i) Vol. of Contaminated Soil (Area 3) $= \frac{H}{3}\left(A_{Top} + \sqrt{A_{Top} \times A_{Bott}} + A_{Bott}\right)$

$H = 10'$

$A_{Top} = L_{Top} \times W_{Top}$

$= 344' \times 204'$

$= 70,176 \text{ ft}^2$

$A_{Bott} = 284' \times 144'$

$= 40,896 \text{ ft}^2$

$\left[L_{Bott} = 344' - (10' \times 3' \times 2) \right.$

$\left. L_{Bott} = 284' \right]$

Vol. of Contaminated Soil $= \frac{10}{3}\left(70,176 \text{ ft}^2 + \sqrt{70,176 \times 40,396} + 40,896\right.$

$= 548,812 \text{ ft}^3$

$= \underline{\underline{20,326 \text{ CY}}}$

(ii) Vol. of Contaminated Soil + Base Material (Area 4)

$H = 15'$

$A_{Top} = L_{Top} \times W_{Top}$

$= 374' \times 234' = 87,516 \text{ ft}^2$

$A_{Bott} = 284' \times 144'$

$= 40,896 \text{ ft}^2$

Vol. of Contaminated Soil + Base Mat'l $= \frac{15}{3}\left(87,516 + \sqrt{87,516 \times 40,896} + 40,896\right)$

$= 941,186 \text{ ft}^3$

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General Computation Sheet

Name of Project Luzerne Rd FS System

Subject

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 7 of 9 Project No.

Rev.	Completed By	Checked By
☒	Initials: NRK 11/18/02	Initials: / /
	Initials: / /	Initials: / /

Volume of Base Material = Vol (Area 4) – Vol (Area 5)

$= 941,186 \text{ ft}^3 - 548.812 \text{ ft}^3$

$= 392,374 \text{ ft}^3$

$\simeq$ 14,532 CY

Summary of Volumes

	Vol. of Contaminated Soil (CY)	Vol. of Clean Soil (CY)
Abovegrade Portion of Cell	14,745	8,857
Buried Portion of Cell – Fill	20,326	
Base Liner	14,532	
TOTAL	49,603 CY (Hazardous soil)	8,857 CY

New York State Department of Environmental C

new cont
ASAP
8/11/95 TJ

MEMORANDUM

TO: Gerald Rider, Jr., Chief, Operations, Maintenance & Support Section, BHSC
FROM: Thomas Vickerson, Chief, Field Support Unit, BCS Thomas Vickerson
SUBJECT: Site No. 5-57-010, Luzerne Road, Queensbury (T), Warren County

DATE: AUG 0 8 1995

RECEIVED
AUG 8 1995
BUREAU OF HAZARDOUS SITE CONTROL
DIVISION OF HAZARDOUS WASTE REMEDIATION

We have completed pumping leachate at the referenced site. The schedule was as follows:

Date	Dept. to Liquid	Liquid Depth	Amount Pumped
6/28/95	16.6 ft	6.9 ft	8,000 gal
6/29/95			4,000 gal
7/5/95	17.7 ft	5.8 ft	5,400 gal
7/10/95	18.1 ft	5.4 ft	5,600 gal
7/17/95	18.5 ft	5.0 ft	5,800 gal
7/23/95	18.8 ft	4.7 ft	5,700 gal
8/1/95	19.0 ft	4.5 ft	5,650 gal
8/10/95	19.5	4.0	40,1[illegible] gal Center MH
9/14/95	18.9 2.4 ft	4.6	
12/8/95	19.0	4.5'	left manhole
2/23/96	18'9.5" 18.8	4.7	left manhole
[illegible]/18/96	19.0	4.5	left manhole
[illegible]/17/96	19.0	4.5'	[illegible] Center MH
7/24/96	19.0	4.5' 10:30am	Center MH
8/22/96	19.0	4.5'	Center MH
6/12/97	19'0.5"	Down ½ inch.	center MH
10/16/97	19'3"	Down 2.5 inches. removed.	40,150 gal

[illegible] 34,500 gal had [illegible] and the

[illegible] recent rain

Bottom Chamber
Depth is 23.2'.

Shipped
[illegible] Road

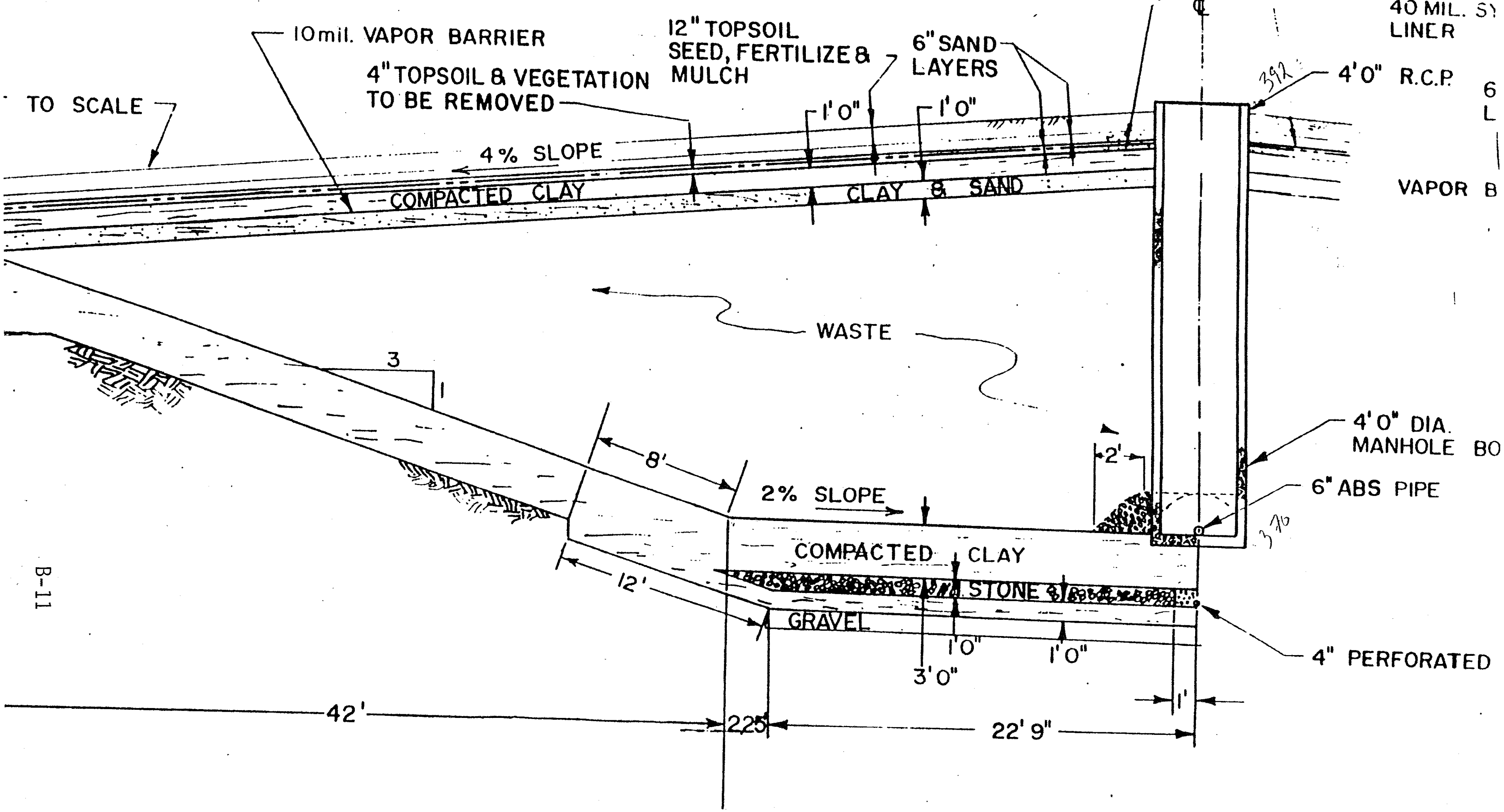
[illegible]s, Non-RCRA.

Possibly 50,000 gallons
remaining.

8 of 9

E. CH DE AIL

TTAC ENT



B-11

SECTION "B-B"

SCALE: 1" = 6'0"

VII-32

AS BUILT
3/2/87 E

9 of 9

C

Soil Volume Calculation – Cutbacks

F0350793

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General Computation Sheet

Name of Project LUZERNE RD FS System ______

Subject SOIL VOLUME CALCS - CUT BACKS - EXCAV. ALT.

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 1 of 12 Project No.

Rev.	Completed By	Checked By
	Initials: KMP 11 18 02	Initials: MMM 11 18 02
	Initials: / /	Initials: / /

OBJECTIVE: ESTIMATE VOLUME OF SOIL ON-SITE TO BE EXCAVATED INCLUDING CUT BACK SOIL.

ASSUMPTIONS: 1. ASSUME 3H:1V CUT BACK SLOPE FOR ALL EXCAVATIONS (IE SOUTHERN AREA, WESTERN AREA)

2. CUT BACK PERIMETER WAS TRANSPOSED ONTO FIGURES (INCLUDED ON PAGES 6-12) BASED ON A MAXIMUM 24' DEPTH EXCAVATION IN 4' INTERVALS. VOLUMES WERE CALCULATED BASED ON THESE FIGURES.

3. ASSUME APPROXIMATELY 175' OF SHEET PILING TO BE INSTALLED ON NORTHERN SECTION OF EXCAVATION THA BORDERS THE GLENS FALLS LANDFILL. ON THE GRID PRESENTED IN FIGURES ATTACHED (PAGES 6-12) THE SHEETING WOULD BE LOCATED BETWEEN APPROXIMATELY (150, 700) TO (325, 700). SHEET PILING CALCULATIONS ARE INCLUDEDON PAGE 5

ecology and environment, inc.

General Computation Sheet

Calculation Set No.
Preliminary ☐
Final ☐
Void ☐
Sheet 2 of 12 Project No.

Rev.	Completed By	Checked By
	Initials: / /	Initials: /
	Initials: / /	Initials: / /

Name of Project LUZERNE RD FS System

Subject

0-4' INTERVAL

DEPTH = D = 4'

SOUTHERN AREA

$A_S = (100' \times 140') + (190' \times 85') + (60' \times 65') = 53,050 \text{ ft}^2$

WESTERN AREA

$A_1 = (110' \times 55') = 6,050 \text{ ft}^2$
$A_2 = (255' \times 30') = 7,650 \text{ ft}^2$
$A_3 = (320' \times 480') = 153,000 \text{ ft}^2$
$A_4 = (75' \times 220') = 16,500 \text{ ft}^2$
$A_5 = (55' \times 70') = 3,850 \text{ ft}^2$
$A_6 = (20' \times 90') = 1,800 \text{ ft}^2$

$A_W = A_1 + A_2 + A_3 + A_4 + A_5 + A_6$
$= 6050 \text{ ft}^2 + 7650 \text{ ft}^2 + 153,000 \text{ ft}^2 + 16500 \text{ ft}^2 + 3850 \text{ ft}^2$
$+ 1800 \text{ ft}^2$
$= 189,450 \text{ ft}^2$

$V_{0-4} = (A_S + A_W) D$
$= (53,050 + 189,450) 4'$
$= (242,500 \text{ ft}^2) 4'$
$= 970,000 \text{ ft}^3 \left(\frac{1 \text{ CY}}{27 \text{ ft}^3} \right) = \underline{\underline{35,925 \text{ CY}}}$

4-8' INTERVAL

D = 4'

WESTERN AREA

$A_1 = (255' \times 150') = 38,250 \text{ ft}^2$
$A_2 = (300' \times 85') = 25,500 \text{ ft}^2$
$A_3 = (275' \times 230') \ 63,250 \text{ ft}^2$

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General Computation Sheet

Calculation Set No.
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	Initials: / /	Initials: / /

Name of Project LUZERNE RD FS System

Subject

$A_4 = (175' \times 30') = 5,250\ ft^2$
$A_5 = (60' \times 40') = 2,400\ ft^2$

$A_W = A_1 + A_2 + A_3 + A_4 + A_5$
$= 38,250\ ft^2 + 25,500\ ft^2 + 63250\ ft^2 + 5250\ ft^2 + 2400\ ft^2$
$= 134,650\ ft^2$

$V_{4-8} = A_W D$
$= (134,650\ ft^2)\ 4'$
$= 538,600\ ft^3$
$= \underline{\underline{19,948\ CY}}$

8-12' INTERVAL

D = 4'

WESTERN AREA

$A_W = (115' \times 30') + (225' \times 230') + (275' \times 45')$
$+ (230' \times 190') = 118,175\ ft^2$

$V_{8-12} = A_W D$
$= (118,175\ ft^2)\ 4'$
$= 472,700\ ft^3$
$= \underline{\underline{17,507\ CY}}$

12-16' INTERVAL

D = 4'

WESTERN AREA

$A_W = (235' \times 230') + (250' \times 25') + (210' \times 200')$
$= 102,300\ ft^2$

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☒	Initials: / /	Initials: /
	Initials: / /	Initials: / /

Name of Project LUZERNE RD FS System

Subject

$V_{12-16} = A_W D$
$= (102,300\ ft^2)4'$
$= 409,200\ ft^3$
$= \underline{15,156\ CY}$

16-20' INTERVAL

D=4'

WESTERN AREA

$A_W = (210' \times 210') + (130' \times 25') + (190' \times 210') = 87,250\ ft^2$

$V_{16-20} = A_W D$
$= (87,250\ ft^2)4'$
$= 349,000\ ft^3$
$= \underline{12,926\ CY}$

20-24' INTERVAL

D=4'

WESTERN AREA

$A_W = (185' \times 185') + (165' \times 200') = 67,225\ ft^2$

$V_{20-24} = A_W D$
$= (67,225\ ft^2)4'$
$= 268,900\ ft^3$
$= \underline{9959\ CY}$

TOTAL SOIL VOLUME TO BE EXCAVATED (HAZ AND NON-HAZ) DUE TO CUTBACK CONSIDERATIONS

DEPTH INTERVAL	0-4	4-8	8-12	12-16	16-20	20-24	TOTAL
SOIL VOLUME (CY)	35,925	19,978	17,507	15,156	12,926	9,959	111,42

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Computation Sheet

Project No.
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Final ☐
Void ☐
Sheet 5 of 12

Rev.	Completed By: K.M.P	Checked By:
☒	Initials: 11/8/02	Initials: / /
	Initials: / /	Initials: / /

Project Name LUZERNE RD FEASIBILITY STUDY
Subject SHEET PILING CALCULATION

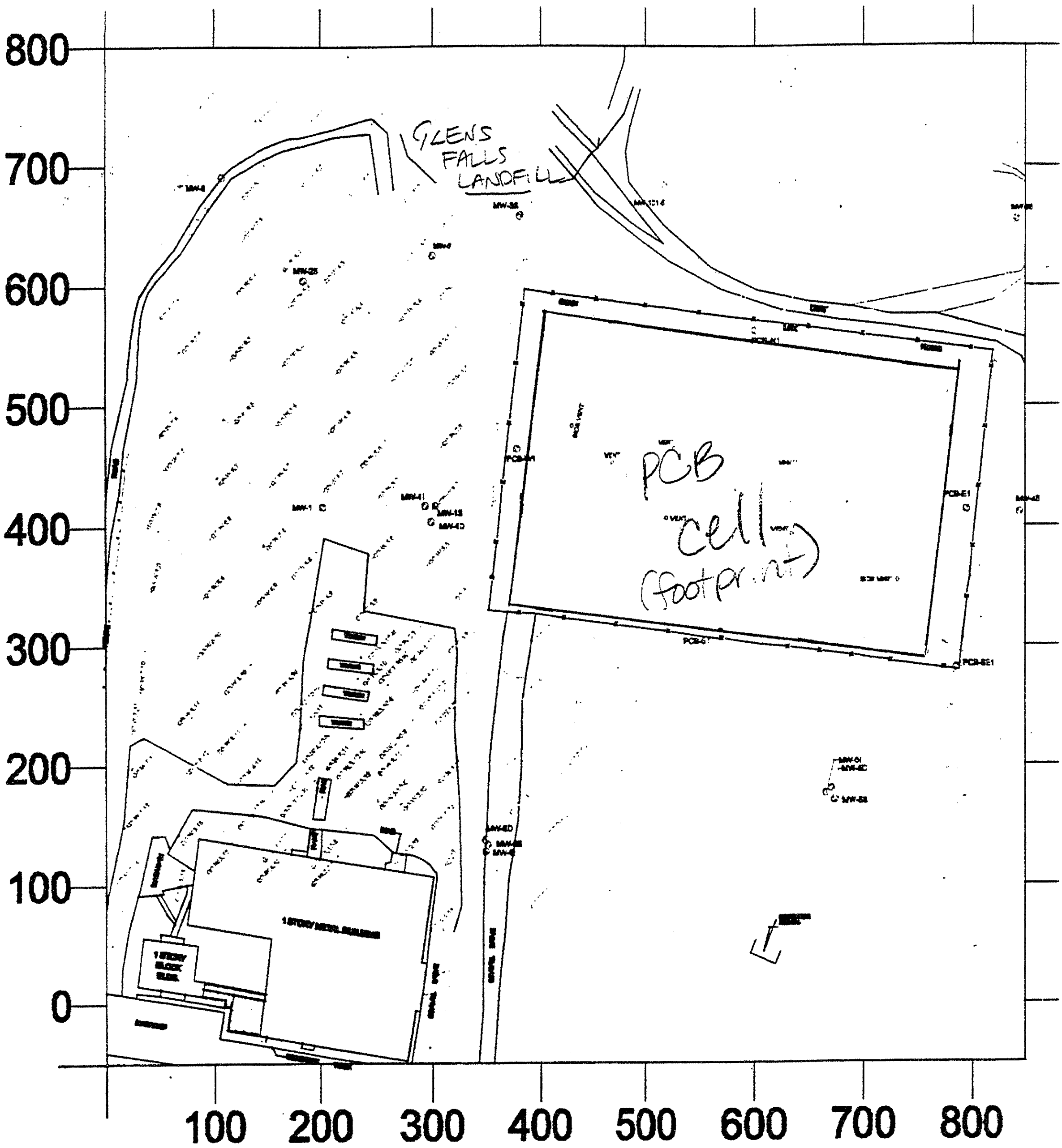
APPROX DEPTH OF EXCAVATION = 24'

APPROX. WIDTH OF EXCAVATION = 175'

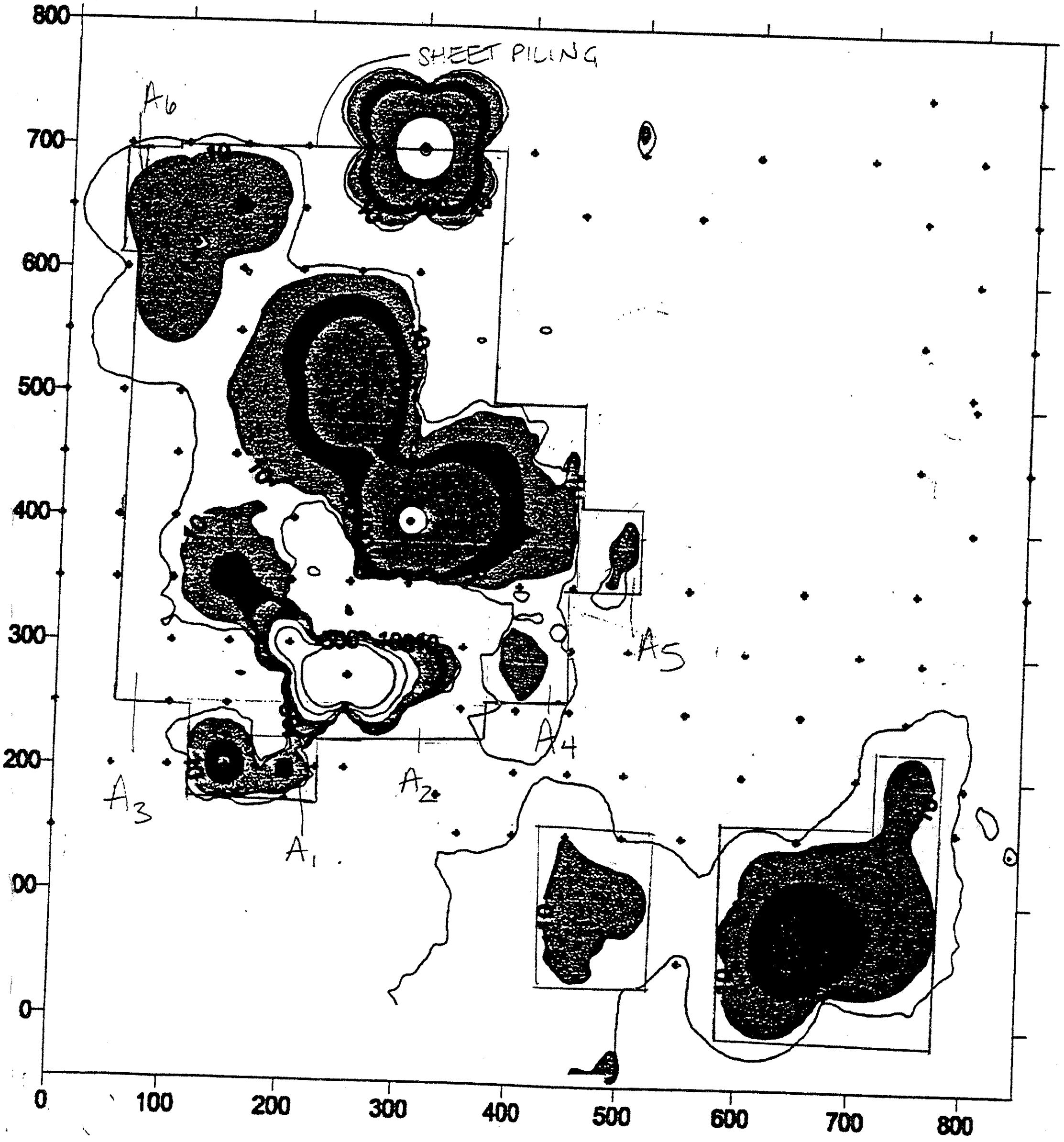
RULE OF THUMB: 1/3 OF ENTIRE PILING LENGTH IS IMBEDDED IN THE GROUND LEAVING 2/3 TO BE THE DEPTH OF EXCAVATION, THEREFORE:

2/3 ENTIRE PILING LENGTH = 24'
ENTIRE PILING LENGTH = $\frac{3}{2}(24') = \underline{\underline{36'}}$

THEREFORE TOTAL AREA OF SHEET PILING NEEDED:
$A = 36' \times 175'$
$A = 6{,}300 ft^2$


800
700
600
500
400
300
200
100
0
GLENS FALLS LANDFILL
PCB cell (footprint)
MW-25
MW-1
MW-41
MW-43
MW-6D
PCB-W1
PCB-S1
PCB-E1
PCB-SE1
1 STORY METAL BUILDING
1 STORY BLOCK BLDG.
100
200
300
400
500
600
700
800

0 - 4 FEET


SHEET PILING
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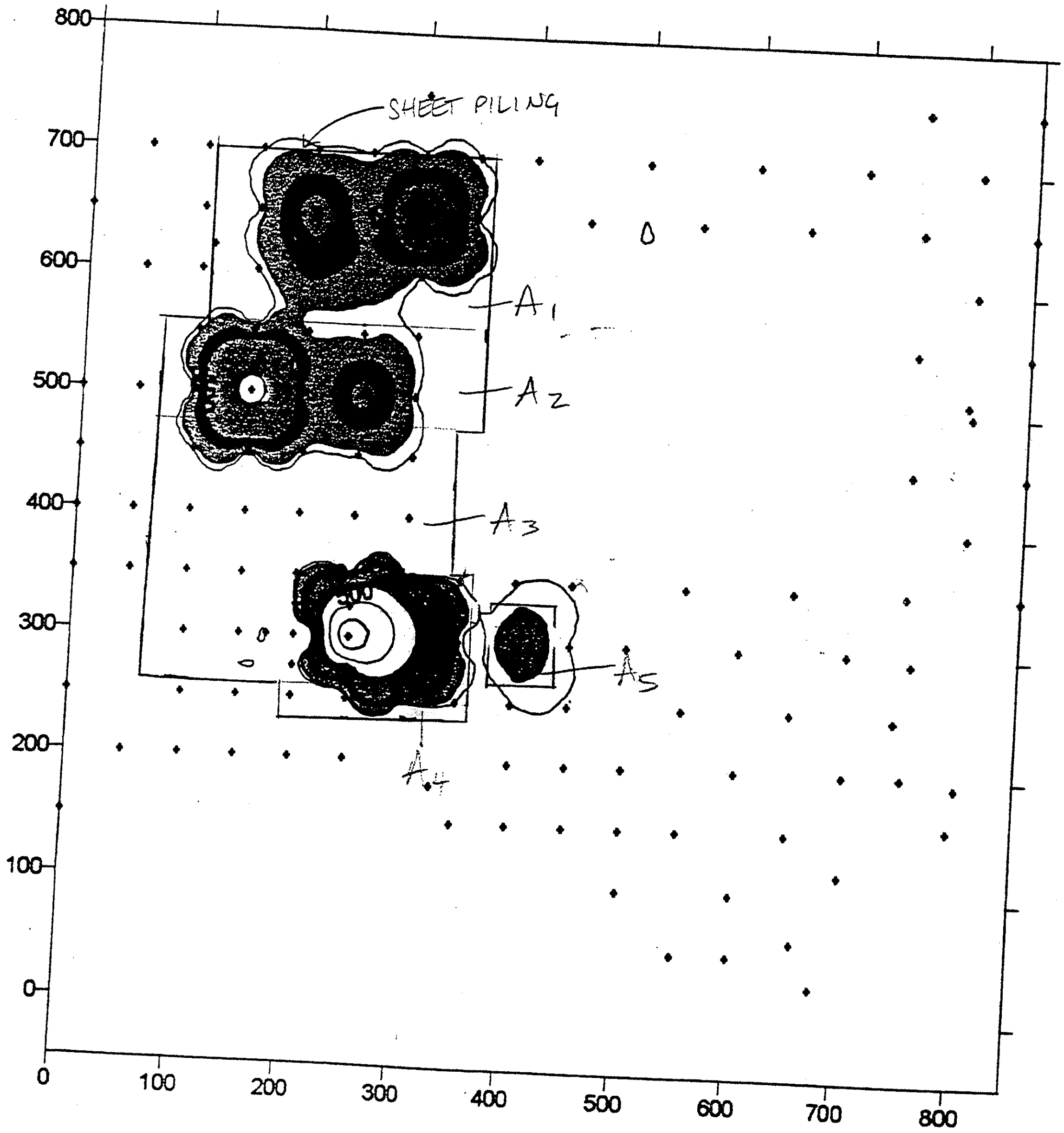
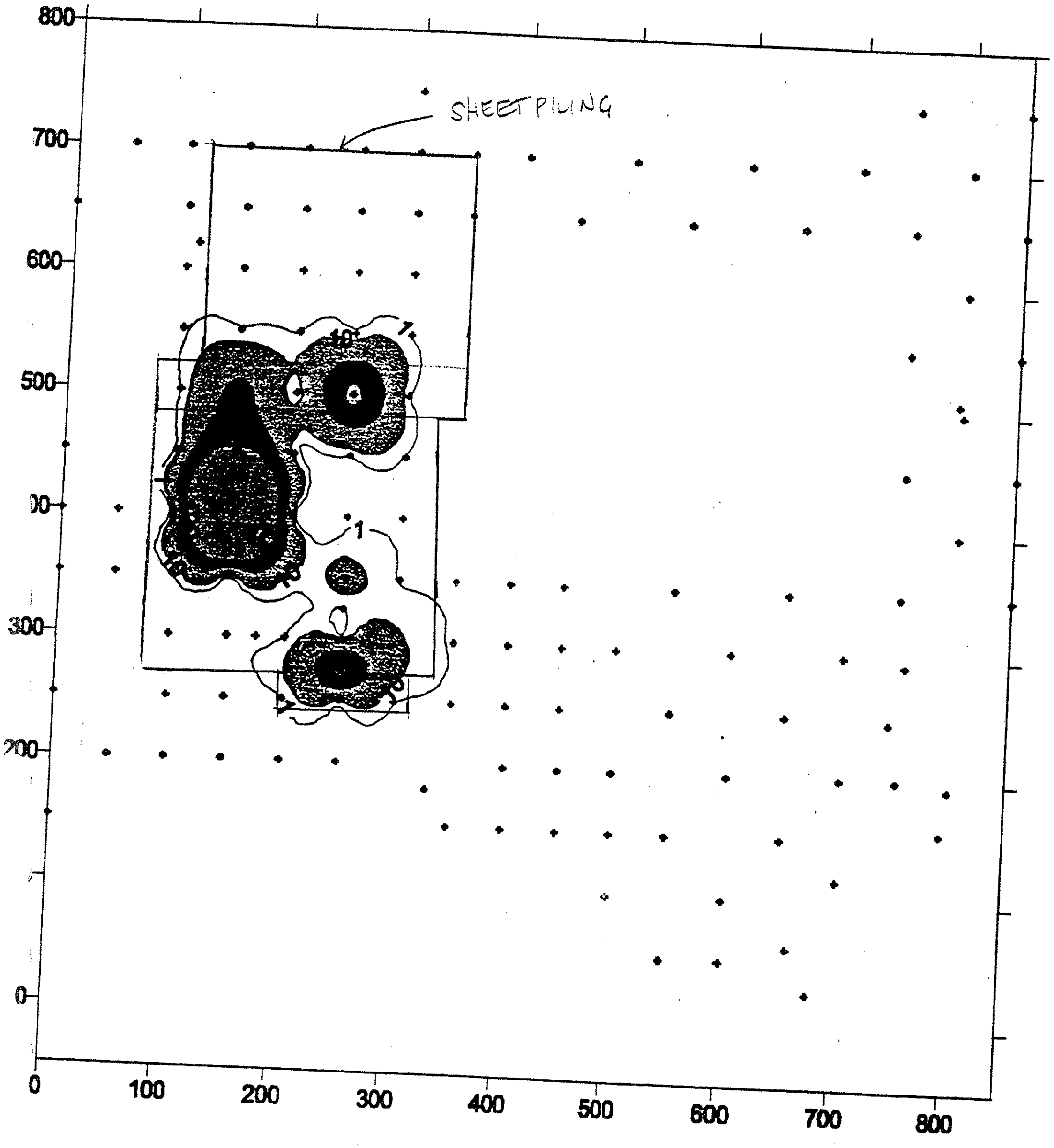
4 - 8 FEET



8 - 12 FEET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800
700
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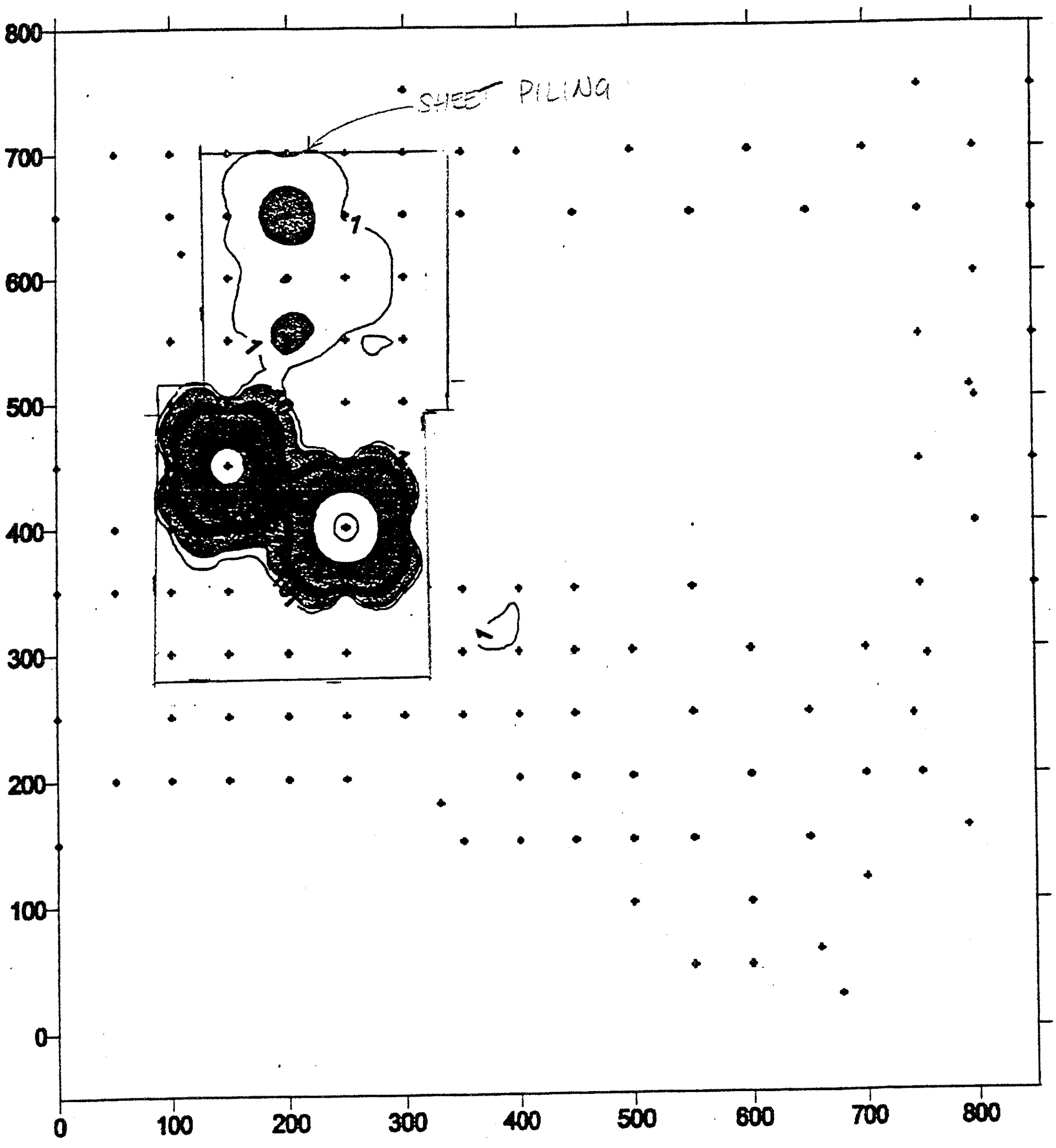
10
7
10

12 - 16 FEET



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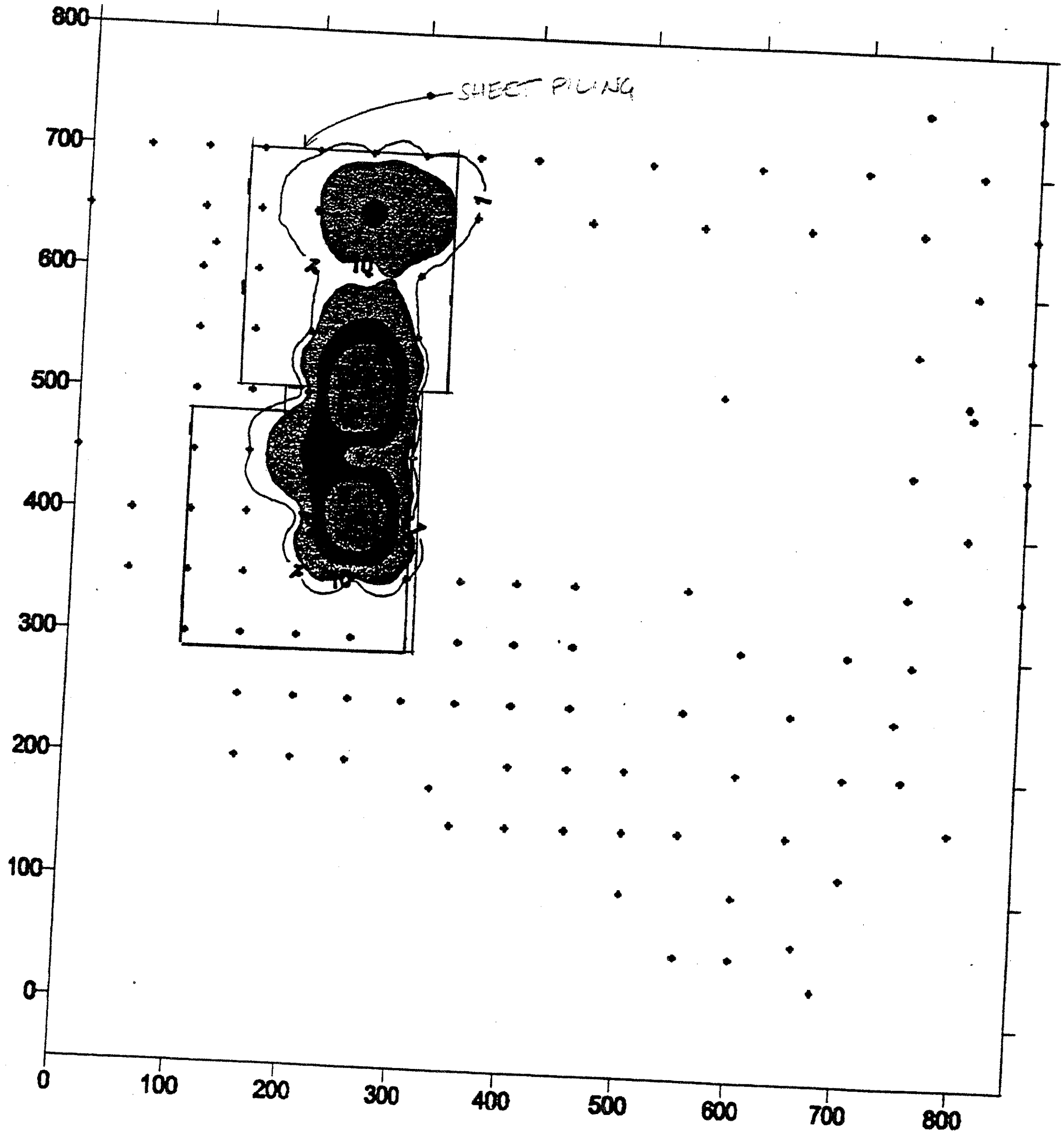
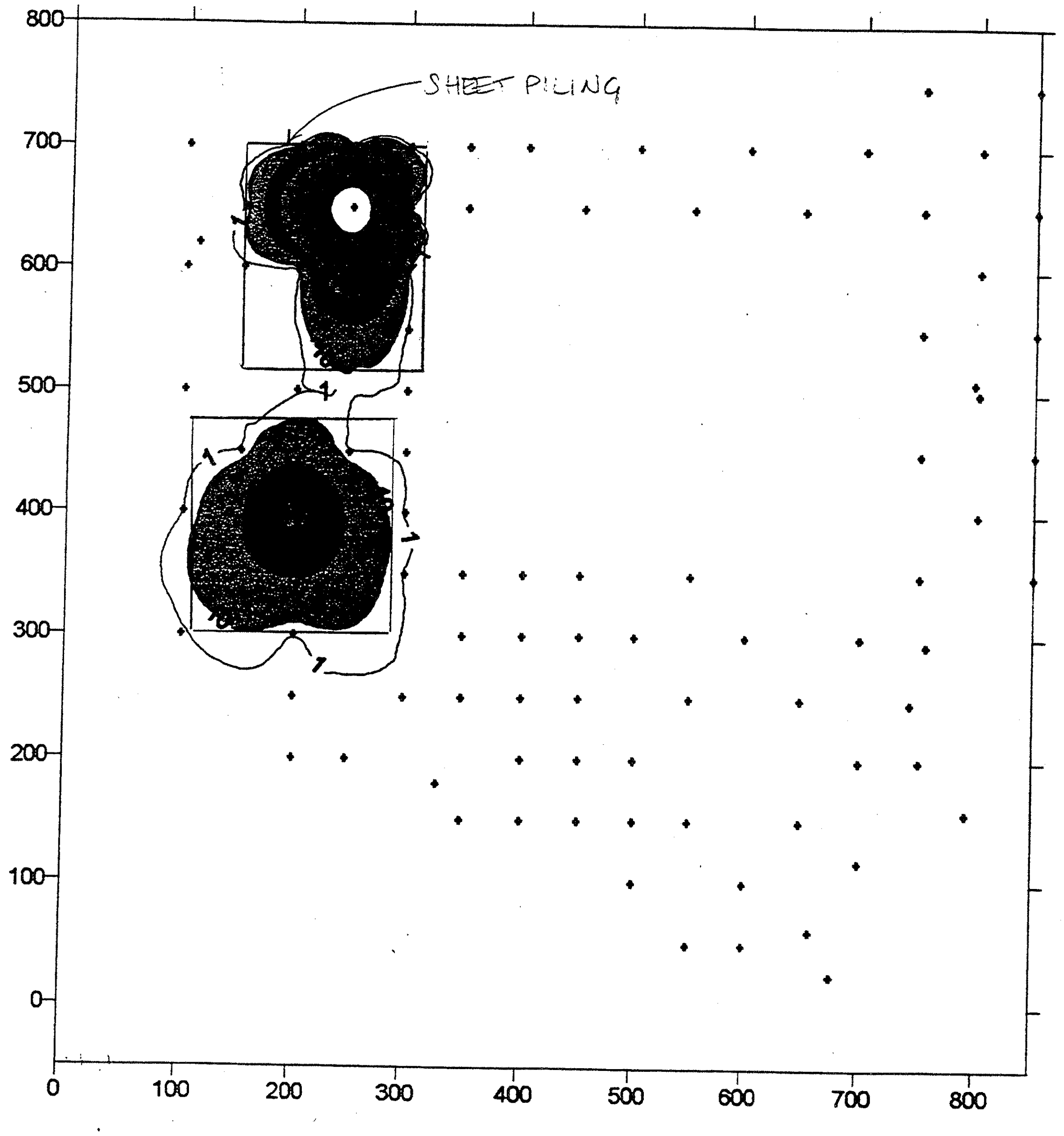
LUZERNE ROAD FS

16 - 20 FEET



LUZERNE ROAD FS

20 - 24 FEET



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LUZERNE ROAD FS

D

Soil Volume Calculations – Consolidated Soil

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General Computation Sheet

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Void	☐		
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	Initials: / /		Initials: / /

Name of Project LUZERNE RD FS System

Subject SOIL VOLUME TO BE CONSOLIDATED - CAPPING ALT.

OBJECTIVE: TO CALCULATE THE SOIL VOLUME TO BE CONSOLIDATED UNDER THE CAP FOR THE CAPPING ALTERNATIVE.

ASSUMPTIONS: 1. SOIL TO BE CONSOLIDATED FROM SOUTHERN AREA AND A PORTION OF THE EXISTING GRAVEL PARKING LOT BEHIND THE EXISTING BUILDING IN THE SOUTHWEST CORNER OF THE SITE.

2. THE SOIL VOLUME FROM THE SOUTHERN AREA IS CALCULATED TO BE:

SURFACE SOIL[1]: 12,311 CY

SUBSURFACE SOIL[2]: $(53{,}050\,ft^2)\,4'$

$$= 212200\,ft^3 \left(\frac{1\,CY}{27\,ft^3}\right)$$

$$V = 7{,}859\ CY$$

$$V_{STOTAL} = 12{,}311\ CY + 7859\ CY = \underline{\underline{20{,}170\ CY}}$$

[1] - SURFACE SOIL VALUE CALCULATED BASED ON FIGURE 5-1 FROM THE RI (E&E AUG. 2002) AND USING SURFER SOFTWARE

[2] - SUBSURFACE SOIL VALUE CALCULATED BASED ON "SOIL VOLUME CALCULATIONS-CUT-BACKS" PAGE 2 (E&E, NOV. 2002) WHICH IS ATTACHED

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General Computation Sheet

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Void ☐
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	Initials: / /	Initials: / /

Name of Project ________ System ________

Subject ________

CALCULATIONS:

→ PARKING LOT AREA

$A_1 = (255' \times 110') = 28{,}050\ ft^2$

$A_2 = (140' \times 70') = 9{,}800\ ft^2$

$A_3 = (100' \times 55') = 5{,}500\ ft^2$

AREA TO BE EXCAVATED TO 2.5' IN ORDER TO REPLACE WITH CAP. ∴ DEPTH = 2.5'

$$
\begin{aligned}
V_{pkg\ lot} &= (A_1 + A_2 + A_3)D \\
&= (28050\ ft^2 + 9800\ ft^2 + 5500\ ft^2)\,2.5' \\
&= (43350\ ft^2)\,2.5' \\
&= 108375\ ft^3 \left(\frac{1\ CY}{27\ ft^3}\right) = \underline{\underline{4{,}014\ CY}}
\end{aligned}
$$

→ AREA SOUTH OF SOUTHWEST CORNER OF PCB CELL

$A = (40' \times 65') = 2600\ ft^2$

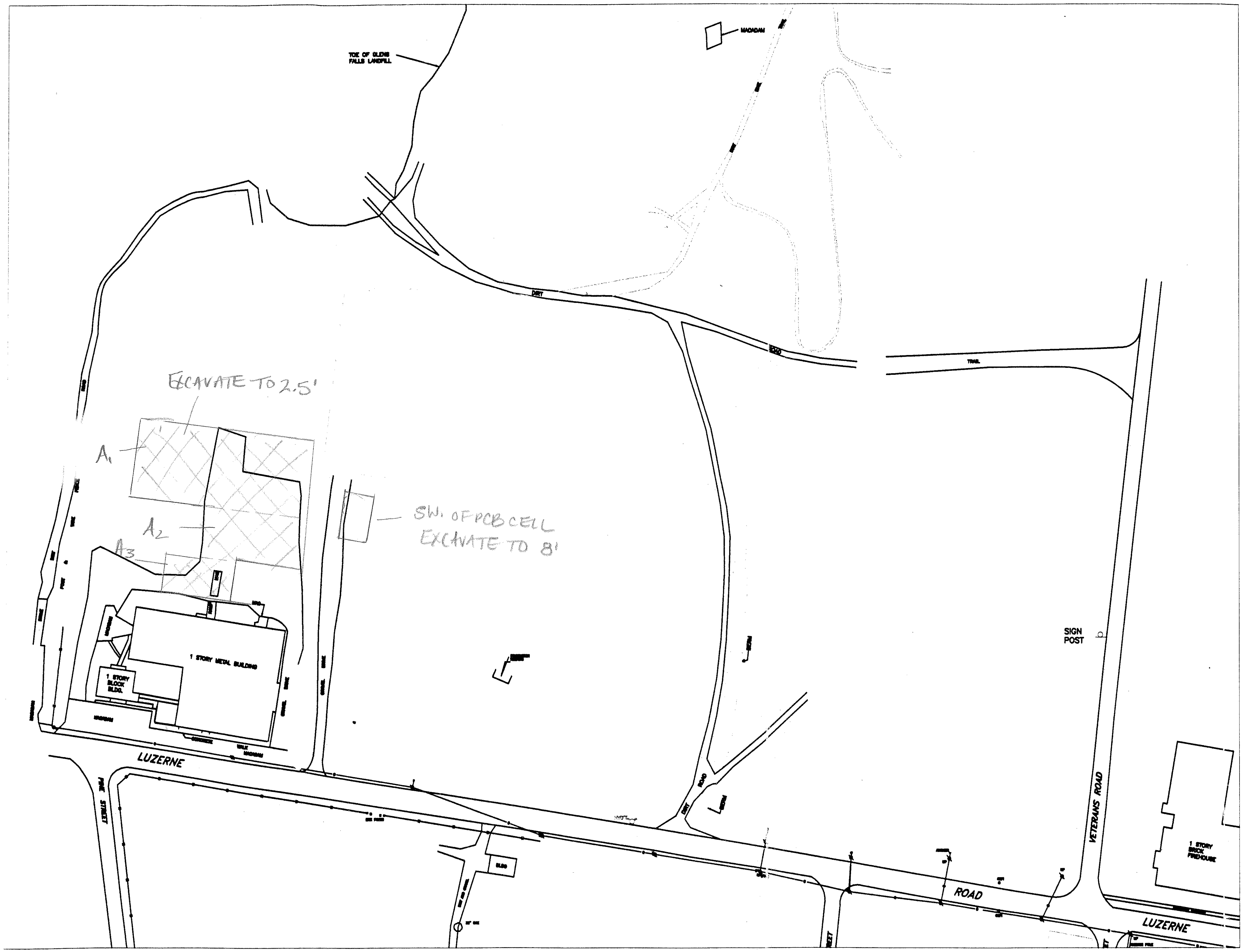
SUBSURFACE SOIL CONTAMINATION ≥ 10 ppm EXISTS TO MAXIMUM OF 8'. ∴ DEPTH = 8'

$$
\begin{aligned}
V_{SWCELL} &= (A)D \\
&= (2600\ ft^2)\,8' \\
&= 20800\ ft^3 \\
&= \underline{\underline{770\ CY}}
\end{aligned}
$$

TOTAL VOLUME OF SOIL TO BE CONSOLIDATED

$V_T = V_{STOTAL} + V_{PKG\ LOT} + V_{SWCELL}$

$= 20{,}170\ CY + 4{,}014\ CY + 770\ CY = \underline{\underline{24954\ CY}}$



NOTES

1. BACKGROUND DATA FOR THIS FIGURE, TAKEN FROM YEC INC. LUZURNE ROAD SURVEY DATED AUGUST 13, 1999, SEPTEMBER 27, 1999, NOVEMBER 6, 2000, AND MARCH 28, 2001.
2. HORIZONTAL DATUM: ASSUMED
3. VERTICAL DATUM: FROM PREVIOUS SURVEY INFORMATION SUPPLIED BY ECOLOGY AND ENVIRONMENT, INC.

LEGEND

	STRATIGRAPHIC CROSS SECTION LOCATION
—x——x—	CHAIN LINK FENCE
— — —	POST AND WIRE FENCE
———	CONCRETE WALL
	CONCRETE CURB
	UTILITY POLE
——o——	OVERHEAD WIRE
CBFI □ ○	CATCH BASIN FIELD INLET
	MANHOLE
HYD'T	FIRE HYDRANT
	GROUNDWATER MONITORING WELL
MAC	MACADAM
	GEOPROBE GROUNDWATER COLLECTION POINT

SCALE IN FEET

0 150 300 450

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment

DESIGNED BY
J. NICKERSON

CHECKED BY
J. NICKERSON

DRAWN BY
JJ KOHLER/KEVIN KRAJEWSKI

APPROVED BY
J. NICKERSON

LUZERNE ROAD

GLENS FALLS NEW YORK

FIGURE 3-1 - CROSS SECTION LOCATIONS, LUZERN
ROAD LANDFILL SITE, QUEENSBURY, NEW YORK

SCALE	DATE ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=150'-0"	9/01	11x17FIGS.DWG	FIG - 3-1	

LUZERNE RD FS

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General Computation Sheet

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	Initials: / /	Initials: / /

Name of Project LUZERNE RD FS System

Subject

0-4' INTERVAL

DEPTH : D = 4'

EASTERN AREA

$A_E = (100' \times 140') + (190' \times 85') + (60' \times 65') = 53,050\ ft^2$

WESTERN AREA

$A_1 = 110' \times 55') = 6,050\ ft^2$

$A_2 = 255' \times 30') = 7,650\ ft^2$

$A_3 = (320' \times 480') = 153,000\ ft^2$

$A_4\ (75' \times 220') = 16,500\ ft^2$

$A_5\ (55' \times 70') = 3,850\ ft^2$

$A_6 = (20' \times 90') = 1,800\ ft^2$

$A_W = A_1 + A_2 + A_3 + A_4 + A_5 + A_6$

$= 6050\ ft^2 + 7650\ ft^2 + 153,600\ ft^2 + 16500\ ft^2 + 3850\ ft^2$

$+ 1800\ ft^2$

$= 189,450\ ft^2$

$V_{0-4} = (A_E + A_W)\ D$

$= (53,050 + 189,450)\ 4'$

$= (242,500\ ft^2)\ 4'$

$= 970,000\ ft^3 \left(\frac{1\ CY}{27\ ft^3}\right) = \underline{\underline{35,925\ CY}}$

4-8' INTERVAL

D = 4'

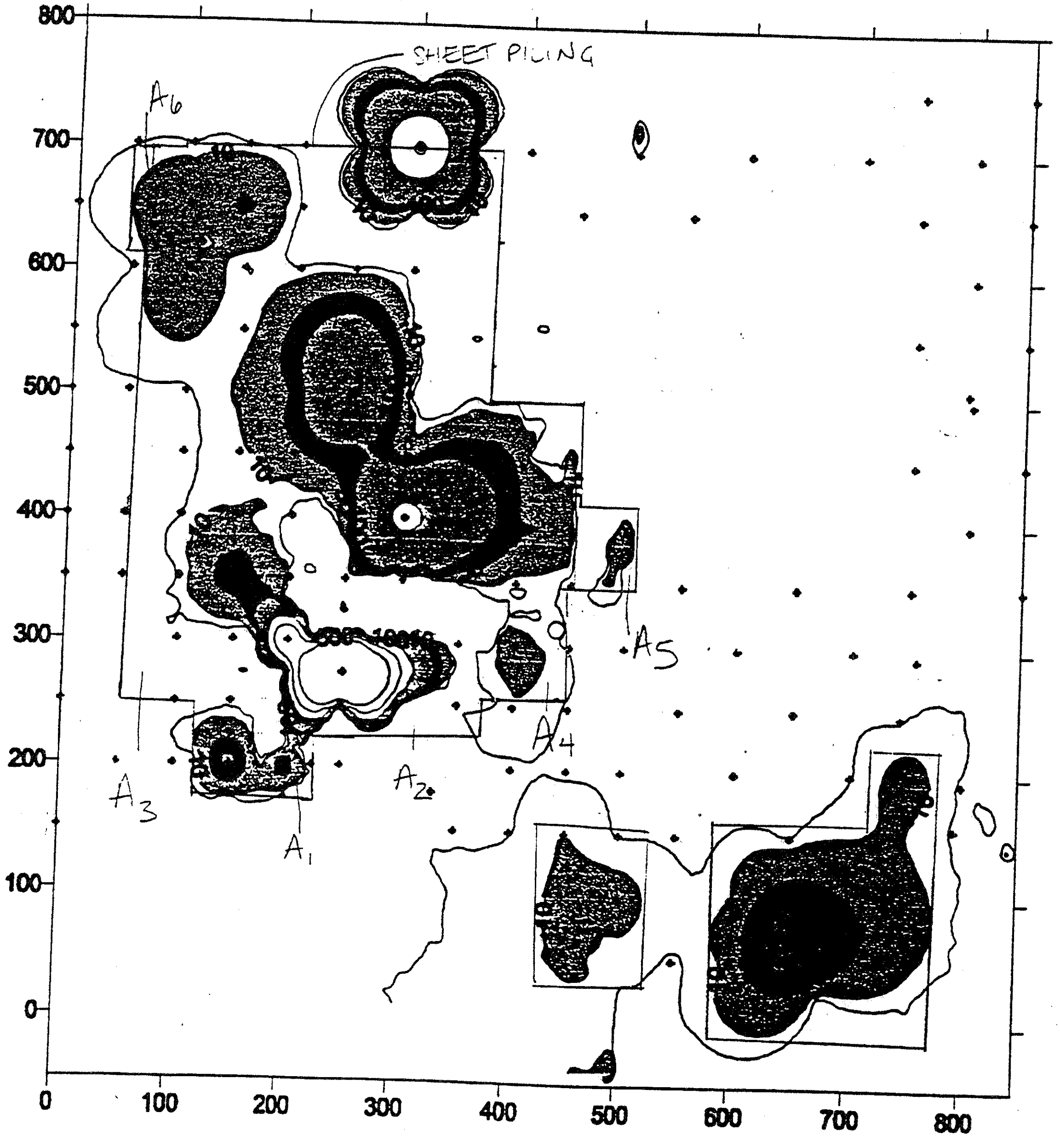
WESTERN AREA

$A_1 = (255' \times 150') = 38,250\ ft^2$

$A_2 = (300' \times 85') = 25,500\ ft^2$

$A_3 = (275' \times 230')\ 63,250\ ft^2$

0 - 4 FEET


SHEET PILING
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E High-Temperature Thermal Desorption Conceptual Design Calculations

High-Temperature Thermal Desorption (HTTD) Conceptual Design
Luzerne Road Site

This appendix is supplemental to Section 5.1.4, Alternative 4 - Excavation and On-site Thermal Treatment of Contaminated Soils. E&E completed a conceptual design for a representative HTTD system at the Luzerne Road Site to size system components, establish preliminary operating parameters, and costs. This conceptual design is based on the use of a theoretical mass and thermal balance to define overall system quantities, followed by proven empirical design criteria to establish system layout and performance. The conceptual design was based on maximum PCB concentrations for surface and subsurface soils and the PCB cell. If higher PCB concentrations are encountered in the field, the system is designed to allow flexibility in operation, such as feed rate and retention time, to achieve site cleanup goals. However, this will impact the cleanup time estimated for the site.

Design Parameters

The design parameters used in the conceptual design process are as follows:

(1) Mass and Thermal Balance:

- Maximum PCB Concentration for:
  - Surface Soil = 2,984 mg/kg
  - Subsurface Soil = 17,200 mg/kg
  - PCB Cell = 12,150 mg/kg

  (based on analytical data (E&E, 2002)).

- Soil Feed Rate = 40 tons per hour

- Soil Moisture Content = The soil moisture content is assumed to be 7 percent (based on geotechnical data (E&E, 2002)).

- Soil Energy Content = Negligible energy content in soil.

- Cleanup Criteria = 1.0 mg/kg surface soil; 10 mg/kg subsurface soil.

- System Temperatures
  - Soil Inlet Temperature = 60° Fahrenheit
  - Soil Exit Temperature = 900° Fahrenheit
  - Air Inlet Temperature = 60° Fahrenheit
  - Rotary Dry Exhaust Gas Temperature = 400° Fahrenheit
  - Thermal Oxidizer Inlet Temperature = 350° Fahrenheit
  - Thermal Oxidizer Exhaust Gas Temperature = 2,000° Fahrenheit
  - Heat Loss from System = 10 percent

- System Losses
  - 10 percent Heat Loss from Rotary Dryer and Thermal Oxidizer
  - 20 percent Air Leakage in Rotary Dryer
  - Negligible heat loss from thermal oxidizer

- Fuel
  - Number 2 Diesel Fuel at 25 percent Excess Air

(2) Equipment Design Assumptions:

- Rotary Dryer
  - Soil Retention Time = 30 to 40 minutes
  - Length to Diameter Ratio = 4.0 to 6.0
  - Rotary Dryer Fuel = Number 2 (diesel)
  - Rotary Dryer Excess Air = 25 percent
  - Dryer Gas Flow Velocity <500 feet per minute
  - Maximum Soil Temperature = 900° Fahrenheit
  - Rotary Dryer Leakage = 20 percent

- Thermal Oxidizer
  - Gas Flow Retention Time >2.0 seconds
  - Length to Diameter Ratio = 3.0 to 4.0
  - Gas Flow Velocity >10.0 feet per second
  - Thermal Oxidizer Excess Air = 10 percent

- Mechanical Cyclone
  - High-Temperature Stainless Steel
  - Removal Efficiency = More than 75 percent for particles more than 10 microns

- Baghouse
  - Nomex Bags with Temperature Capability of 450° Fahrenheit
  - Air to Cloth Ratio = 4.0 to 6.0

Based on these conditions, a theoretical mass and energy balance was conducted, and the results are presented in the following tables and Figure 5-6 of this FS. Using the gas flows and energy requirements defined by this mass and energy balance, and the design parameters as previously presented, an empirical design was conducted for each system component presented in Figure 5-5 of this FS.

Cost Estimate

Based on the conceptual design and operating parameters described above, E & E developed a cost estimate for thermal treatment of contaminated soils. The cost estimate was separated into fixed costs and per-ton unit treatment cost. Fixed costs include equipment and installation cost, start-up cost, and demobilization cost. Equipment cost was obtained from Tarmak Inc., a leading vendor specializing in thermal treatment equipment supply. Additional fixed costs and (piping, instrumentation, foundations) and operating costs were estimated based on the value of major purchased equipment cost, using guidance published by the United States Environmental Protection Agency ("Engineering Handbook for Hazardous Waste Incineration" Chapter 6 "Estimating Incineration Costs"). The following basic parameters were established, for the purpose of developing the cost estimate:

- Thermal desorption unit will have a capacity to process 40 tons of contaminated soil at a moisture content of 7 percent or less;

- Each unit will operate 24 hours per day, seven days per week;

- Each unit will be off-line 25 percent of the total time, due to maintenance and holidays;

Additional assumptions for developing the cost estimate are presented in the cost tables. The table below presents a description of the tables used to develop the revised high-temperature thermal desorption cost estimate.

Table	Description
Table E-1	Cost for High-Temperature Thermal Desorption Treatment: Summary
Table E-2	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Production Calculation
Table E-3	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Labor Cost Calculation
Table E-4	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Maintenance Cost Calculation
Table E-5	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Utility Cost Calculation
Table E-6	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Capital Cost Calculation
Table E-7	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Startup Cost Calculation
Table E-8	Cost for High-Temperature Thermal Desorption Treatment of Contaminated Soils: Fuel Cost Calculation

References

Brunner, Calvin R., P.E., 1988, Incineration Systems: Selection and Design, Incineration Consultants, Inc., Reston, Virginia.

Rock Talk Manual, 3rd Revised Printing, 1982, Wichita, Kansas.

Troxler, Bill L., P.E., 1987, Letter and attached to Mr. Joseph L. Tessitore.

Table E-1: Lump Sum and Unit Costs for High Temperature Thermal Desorption Treatment

Production Rate Summary		
	Reference	
Production Rate (tons/hr)	Table E-2	40
Total throughput (annual) tons/yr	Table E-2	262,080

Cost per Ton of Contaminated Soil				
Item	**Reference**	**Unit Cost ($) per Ton**	**Unit Cost Subtotals**	**Lump Sum Cost ($)**
Labor	Table E-3	$21.70		
Maintenance	Table E-4	$3.27		
Utility	Table E-5	$1.73		
Captial Cost	Table E-6			$1,788,609
Interest Cost	Table E-6	$1.97		
Startup	Table E-7			$1,320,803
Fuel	Table E-8	$23.37		
Subtotal			$52.03	
Soil Pretreatment	Note 1	$1.60		
Monitoring, Sampling, Analysis	Note 2	$0.40		
Subtotal			$2.00	
Generated Waste	Note 3	$1.00		
Demobilization	Note 4			$929,723
Subtotal			$1.00	
Subtotal of the above items			$55.03	$4,039,135
Mark Up (excluding labor)	10%		$3.33	$403,913
Total			**$58.37**	**$4,443,048**

Notes:

1. Cost was based on 1996 vendor survey estimate of $0.80 per US ton. Because of potential varying soil concentrations from PCB cell and subsurface soils, requiring sufficient blending and screening, a soil pretreatment cost of $1.60 per ton was assumed
2. Based on the 1996 vendor survey of $0.40 per ton and adjusted for variation in on-site PCB concentrations.
3. Based on the 1996 vendor survey cost of $1.00 per ton
4. Demobilization cost was assumed equal to cost of equipment, piping, and building installation cost.

Table E-2 : Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Production Calculation

	Unit	Quantity
Throughput	tons/hour	**40**
Online System Avalability	%	75%
Hours Offline/Year	hours	2,184
Annual Production	tons/year	**262,080**

Table E-3: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Labor Cost Calculation

Labor Classification	Quantity	Hourly Rate ($/hour)	Quantity Costed	Total ($)
Site Manager/Project Director	1	$114.48	0.33	$37.78
Resident Engineer	1	$71.00	1	$71.00
Assistant Resident Engineer	1	$71.00	1	$71.00
Project Engineer (O&M)	1	$56.58	1	$56.58
Safety Engineer	4	$56.58	0.33	$74.69
Skilled Laborer				
Mechanical	1	$48.35	1	$48.35
Electrical	1	$52.90	1	$52.90
Common Laborer	2	$36.50	1	$73.00
Equipment Operators	3			
Control Panel	1	$47.15	1	$47.15
Front End Loader	2	$47.15	1	$94.30
Administrative	1	$35.83	0.33	$11.82
Clerk	1	$31.93	0.33	$10.54
Total Hourly Labor Cost ($)				$649.10
Total Annual Working Hours	8,760			
Total Annual Labor Cost				$5,686,158
Per Ton Cost (annual)	262,080			**$21.70**

References:

1. RS Means 2002 Environmental Remediation Cost Data- Assemblies 8th Annual Edition, Kingston, Ma (Rates include 2.5 multiplier for overhead and profit)
2. RS Means 2002 Heavy Construction Data, 16th Annual Edition, Kingston Ma. (Rates include overhead and profit)

Table E-4: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Maintenance Cost Calculation

Cost per Ton ($)	Factor	Source
$1.50		1991 ThermoTech System Corporation
$1.64	1.09	Escalation factor for 2002 vs. 1991 (138.2/126.7)
$3.27	2.0	Engineer's Estimate

Notes:
ThermoTech Systems Corporation, *Operating Cost and Commercial Aspects of Contracting* , Remediation America 1991 Seminar.

Table E-5: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Utility Cost Calculation

HTTD Utility Costs			
Moisture to be added to treated soil	5%		Added for Dust Control
Production Rate	40	tons/hour	E & E Estimate and Tarmack Inc., 2002
Water Usage for Soil Additive	500	gal/hr	
Factor for loss to overspray and evaporation	2.50		Engineer's Estimate
Subtotal	1,250	gal/hr	
Plant Use	1000	gal/hr	ThermTec, 2002
Total Water Use	2,250	gal/hr	
Contingency - 100%	4,500	gal/hr	
Total Annual Water Usage	39,420,000	gal/yr	
Unit Cost of water	0.0015	$/gallon	
Annual Cost of Water	59,130	$/year	
Total Water Cost	***$0.23***	$/ton	
Plant Electricity Usage	800	KWH	
Yearly Electricity Usage (w/ 25% contingency)	6,570,000		Engineer's Estimate
Unit Cost of Electricity	$0.06	$/KWH	
Annual Cost of Electricity	$394,200	$/year	
Electricity Cost	***$1.50***	$/ton	
Total Utility Cost	**$1.73**	$/ton	

Table E-6: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Capital and Interest Cost Calculation

Cost Item Description	Capital Cost Factor*	Factor of	Total Cost ($)
Purchased Equipment Cost (PEI)			$3,541,800.00
Installed Equipment Cost (IEC)	0.15	PEI	$531,270.00
Cost of Piping	0.4	IEC	$212,508.00
Buildings, Tanks, Structures, and Foundations	0.35	IEC	$185,944.50
Total Physical Plant Cost (TPPC)			$4,471,522.50
Engineering, Permitting	0.1	TPPC	$447,152.25
Total Capital Cost (TCC)			$4,918,675
Assume HTTD equipment has lifetime of 5 yrs, and will be on-site for 1.5 yr, =>Equivalent TCC**			**$1,788,609**
Total tons treated	2,358,720	tons	
Interest/Year	7.0%	TCC	$344,307
Assume HTTD Unit On-Site for 1.5 yr			**$516,461**
Tons Treated per Year	262,080	tons/year	
Interest Cost per Ton of Production			**$1.97**

Notes:

*Cost factors were based on USEPA "Engineering Handbook for Hazardous Waste Incineration" Chapter 6 "Estimating Incineration Costs" September, 1981

** Equivalent TCC is the cost that would be charged to the job for the time HTTD units is actually on-site

Purchased Equipment Cost (PEI)

Description	Cost ($)	Reference
In Feed Hopper/Weigh Scale	$95,000	Tarmack, Inc
Infeed Belt Conveyor	$35,000	Tarmack, Inc
Rotary Dryer	$1,150,000	Tarmack, Inc
Soil Conditioner	$65,000	Tarmack, Inc
Stacking Conveyor	$50,000	Tarmack, Inc
Cyclone Collectors	$60,000	Tarmack, Inc
Baghouse	$175,000	Tarmack, Inc
Baghouse ID Fan	$41,000	Tarmack, Inc
Thermal Oxidizer	$325,000	Tarmack, Inc
Draft Stack	$52,000	Tarmack, Inc
Collection Auger	$75,000	Tarmack, Inc
Transfer Duct Work	$75,000	Tarmack, Inc
Compressor/Tank	$65,000	Tarmack, Inc
Control House/Controls and Motor Control Center	$147,000	Tarmack, Inc
1000 KW Generator Set	$255,000	Caterpillar
Subtotal	*$2,665,000*	
Onsite Equipment Prep	$350,000	ThermTec, Inc
Electrical and Instrumentation	$400,000	ThermTec, Inc
System Total	***$3,415,000***	
Auxiliary Equipment		
Soil Blending System (Pug Mill with Hopper and Screen)	$126,800	ThermTec, Inc
Total Auxiliary Equipment	*$126,800*	
Total w/ Auxiliary Equipment	**$3,541,800**	

Notes:

1. Capital costs were obtained from indicated vendors in August, 2002

Table E-7: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Startup Cost Calculation

Startup Time	25	days
	600	hours

Description	Cost per US Ton ($)	Startup Factor[1]	Startup Cost Per US Ton ($)
Labor	$21.70	1	$21.70
Fuel	$23.37	1	$23.37
Utility	$1.73	1	$1.73
Maintenance	$3.27	1	$3.27
Interest	$1.97	1	$1.97
Soil Pretreatment[1]	$1.60	1	$1.60
Monitoring[2]	$0.40	1	$0.40
Generated Waste[3]	$1.00	1	$1.00
Total			$55.03
Total Hourly Cost (40 tons/hr)			$2,201.34
Total Startup Cost			$1,320,803.17
Cost per Ton ($)			**$0.56**

Notes:
1. Refer to Table E-1 for cost per ton.
2. Refer to Table E-1 for cost per ton.
3. Refer to Table E-1 for cost per ton.

Table E-8: Cost for High Temperature Thermal Desorption Treatment of Contaminated Soils: Fuel Cost Calculation

Fuel Cost Summary		
Item	**Quantity**	**Units**
High Temperature Thermal Desorption	3,433,248	gal/yr
Material Handling	550,368	gal/yr
Standby Generator	72,000	gal/yr
Total Yearly Fuel Consumption	4.06E+06	gal/yr
Gallons per Ton (40 ton/hr)	15.47	gal/ton
Fuel Cost per Gallon	$1.51	
Cost Fuel per Ton	**$23.37**	

High Temperature Thermal Desorption Fuel Consumption

Production Rate	40	tons/hr
Moisture Content	5%	
Mean BTU Content of Soil (In Situ)	0	Btu/lb

Energy Consumption of HTTD

Based on mass and energy balances, total HTTD fuel consumption is 524 gal/hr

This assumes no energy content in soil and 5% moisture content.

Total Fuel Consumption	524	gal/hr
Annual Fuel Consumption	**3,433,248**	gal/yr

Material Handling Fuel Consumption

From Caterpillar Performance Handbook;		
Front End Loader Fuel Usage	42	gal/hr
For 2 Front End Loaders		
Annual Fuel Consumption	**550,368**	gal/yr

Standby Generator 1000 KW Fuel Consumption

From Caterpillar Performance Handbook;		
Hourly Fuel Usage	72	gal/hr
Assume Generator Use	1000	hrs/yr
Annual Fuel Consumption	**72,000**	gal/yr

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Computation Sheet

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	Initials: WK 12/04/02	Initials: / /

Project Name Luzerne Rd Feasibility Study
Subject HTTD Design

Calculation of Soil Retention Time

Soil Characteristics

PCB Concentrations:

- Max Surface Concentration - 2984 ppm
- Max Subsurface Concentration - 17,200 ppm
- PCB Cell Concentration - 12,150 ppm

Soil Properties

Subsurface Soil: Moisture Content = 7% Avg
Dry Density = 101 lb/ft^3 Avg

PCB Cell Soil: Moisture Content = 5.5% Avg
Dry Density = 107 lb/ft^3 Avg

Soil Quantities

Surface Soil - ~~6,900 Bcy~~ 12,311 BCY WK
Subsurface Soil - ~~56,000 Bcy~~ 49,989 BCY WK
PCB Cell - ~~54,000 Bcy~~ 119,603 BCY WK

Cleanup Criteria

1 ppm for surface soils

10 ppm for subsurface soils

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Project Name Luzerne Rd. Feasibility Study
Subject HTTO Design

<u>Surface Soil</u>

(See attached drawing)

$$\frac{1 \text{ ppm}}{2{,}984 \text{ ppm}} = 3.35 \times 10^{-4}$$

$\Rightarrow$ Retention Time $\simeq$ 35 minutes

<u>Subsurface Soil</u>

(See attached drawing)

$$\frac{10 \text{ ppm}}{17{,}200 \text{ ppm}} = 0.6 \times 10^{-4}$$

$\Rightarrow$ Retention Time $\simeq$ 30 minutes

<u>For Surface Soil</u>

T = 35 minutes

$$T = \frac{a\left(\frac{d^2 \times \pi}{4}\right) \times L \times R}{C} \quad \text{(minutes)}$$

$$C\,(\text{lbs/min}) = \frac{a\left(\frac{d^2 \times \pi}{4}\right) \times L \times R}{T}$$

$$= \frac{(0.10)\left[\frac{(9.5)^2 \times \pi}{4}\right] \times 52 \times 101}{(35)}$$

$$= 1063.6 \text{ lbs/min} = 63{,}818 \frac{\text{lbs}}{\text{hr}} = \underline{32\ t/hr}$$

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General Computation Sheet

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Name of Project Luzerne Rd FS System

Subject Thermal treatment Alternative.

For Subsurface Soil Cell Soil

$T =$ 30 minutes
C (lbs/min) = 74,454 lbs/hr = 37 tons/hr

Calculation of Cleanup Time

(1) Surface Soil

$\gamma_d = 101$ lb/ft³ (in-situ)
$w = 7\%$

$\Rightarrow$ In-Situ Bulk Density $(\gamma) = 101$ lb/ft³ $\times (1+.07)$
$= 108$ lb/ft³

$$\Rightarrow 12{,}311 \text{ yd}^3 \times 27 \frac{\text{ft}^3}{\text{yd}^3} \times 108 \text{ lb/ft}^3 \times \frac{\text{ton}}{2000 \text{ lb}}$$

$= 17{,}949$ tons

Assuming feed rate of 32 ton/hr

$$\text{Time to treat Surface Soil} = \frac{17{,}949 \text{ tons}}{32 \text{ ton/hr}}$$

$= 561$ hrs

(2) Subsurface Soil

$$\Rightarrow 49{,}989 \text{ yd}^3 \times 27 \frac{\text{ft}^3}{\text{yd}^3} \times 108 \text{ lb/ft}^3 \times \text{ton}/2000 \text{ lb}$$

$= 72{,}884$ ton

Assuming 37 ton/hr

$$\text{Time to treat Subsurface Soil} = \frac{72{,}884 \text{ ton}}{37 \text{ ton/hr}}$$

$= 1970$ hrs

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General Computation Sheet

Name of Project ______ System ______

Subject ______

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(3) PCB Cell

In-Situ Dry Density (γ_d) = 107 lb/ft^3
Moisture Content = 5.5%

⇒ Bulk Density γ = 113 lb/ft^3.

$49,603\ yd^3 \times 27\ \frac{ft^3}{yd^3} \times 113\ \frac{lb}{ft^3} \times \frac{lb}{2000\ ton}$

= 75,669 tons

Time to Clean PCB Cell Soil = $\frac{75,669\ tons}{37\ ton/hr}$

= 2045 hr

Total Cleanup time = 561 hrs + 1970 hrs + 2045 hrs

= 4,576 hrs

Assume HTTD is 75% on-line, 24-7 operation

⇒ No. of hrs HTTD unit available for treatment = 365 d x 24 hr/d x 0.7
= 6,570 hr/yr

⇒ Cleanup Time = $\frac{4,576\ hrs}{6,570\ hrs/yr}$

≃ 0.7 yrs OR 8.5 months

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Computation Sheet

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Checked By: Initials: / / Initials: / /

Project Name Luzerne Rd Feasibility Study
Subject HTTD Mass and Thermal Balance

Calculation of Mass and Thermal Balance

Assumptions:

Soil Temperature = 900 °F

Fuel Oil Burners (25% excess air)

Soil Moisture Content = 7 %

Rotary Dryer Discharge Temperature = 400 °F

Soil Inlet Temperature = 60 °F

Air Inlet Temperature = 60 °F

Soil Feed Rate = 40 tons/hour

Rotary Dryer Soil Retention Time = 30 minutes

Heat Loss From Rotary Dryer = 10 %

Air Leakage in Rotary Dryer = 20 %

Rotary Drum Mass and Thermal Balance

Enery Balance

Soil Energy Requirement

$$\Delta BTU/hr = 40 \frac{ton}{hr} \times 2000\ lb/ton \times (900 - 60)\ °F$$

$$\times\ 0.22\ \frac{BTU}{lb\ °F} = \underline{14.78 \times 10^6\ BTU/hr}$$

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Project Name

Subject

Moisture Energy Requirement

lb H_2O in Soil $= 40 \frac{\text{ton}}{\text{hr}} \times 2000 \frac{\text{lb}}{\text{ton}} \times (0.07)$

$= 5600$ lb/hr

Δ BTU $= 5600 \frac{\text{lb}}{\text{hr}} \times (1211.82)$ Δ enthalpy $_{60°F \to 400°F}$ $\frac{\text{BTU}}{\text{lb}}$

$= \underline{6.78 \times 10^6}$ BTU/hr

Total Energy Required $= (14.78 + 6.78)\, 10^6$ BTU/hr.

$= \underline{21.56 \times 10^6}$ BTU/hr

Fuel Oil Required

Assume that 25% excess air plus 20% leakages yields ≈ 50% excess air.

At excess air ratio = 1.5

lb Dry gas/gal = 156.8

lb H_2O/gal = 9.16

Heat Available = 115,716 BTU/gal

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$$\text{Fuel Oil Required} = \frac{21.56 \times 10^6 \ \text{BTU/hr}}{(115,716)\ \text{BTU/gal}}$$

$$= 186\ \text{gal/hr}$$

For 10% heat loss ⇒ $186 \times (1.10) = \underline{205\ \text{gallon/hr}}$

<u>Rotary Drum Mass Balance</u>

$$\text{Rotary Drum Dry Gas} = 205\ \frac{\text{gal}}{\text{hr}} \times 156.8\ \text{lb}\ \frac{\text{dry gas}}{\text{gal}}$$

$$= \underline{32,144}\ \text{lb/hr}$$

$$\text{Rotary Drum Wet Gas} = 205\ \frac{\text{gal}}{\text{hr}} \times 9.157\ \text{lb}\ \frac{\text{wet gas}\ (H_2O)}{\text{gal}}$$

$$+ 5600\ \text{lb/hr}$$

$$= \underbrace{1877\ \text{lb/hr}}_{H_2O\ \text{Fuel Combustion}} + \underbrace{5600\ \frac{\text{lb}}{\text{hr}}}_{H_2O\ \text{soil moisture}} = \underline{7477}\ \text{lb/hr}$$

<u>Rotary Dryer Gas Volume @ 400°F</u>

$$\text{Dry Gas Volume} = 32,144\ \text{lb/hr} \times 21.7\ \frac{\text{ft}^3}{\text{lb}} \times \frac{1\ \text{hr}}{60\ \text{minutes}}$$

$$= \underline{11,625}\ \text{ft}^3/\text{min}\ (\text{acfm @ } 400°\text{F})$$

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Project Name

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$$\text{Wet Gas Volume} = 7477 \ \frac{lb}{hr} \times 34.9 \ \frac{ft^3}{lb} \times \frac{hr}{60 \text{ minutes}}$$

$$= \underline{4349} \ \frac{ft^3}{min} \ (\text{acfm @ } 400°F)$$

$$\text{Total Rotary Dryer Gas Flow} = 11{,}625 + 4349$$

$$= \underline{15{,}974} \ \text{acfm @ } 400°F$$

Thermal Oxidizer Energy Balance

Assume 10% excess air

Assume 5% heat loss

Assume 2000°F exit temperature

$$\underset{\text{Dry Gas}}{\Delta BTU} = \underbrace{32{,}144}_{\text{dry gas}} \ lb/hr \times (510.07 - 82.19) \ \underset{400°F \rightarrow 2000°F}{\Delta \text{ enthalpy } \frac{BTU}{lb}}$$

$$= \underline{13.75} \times 10^6 \ BTU/hr$$

$$\underset{H_2O}{\Delta BTU} = \underbrace{7477}_{\text{wet gas}} \ \frac{lb}{hr} \times (2067.42 - 1211.82) \ \underset{400°F \rightarrow 2000°F}{\Delta \text{ enthalpy } \frac{BTU}{lb}}$$

$$= \underline{6.40 \times 10^6} \ BTU/hr$$

$$= \underline{20.15 \times 10^6} \ BTU/hr$$

Thermal Oxidizer Fuel Requirement

Fuel Oil @ 10% excess air

lb Dry Gas/gal = 115.115   lb H_2O/gal = 8.615

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Heat Available = 63,175 BTU/gal

Fuel Oil Required = $\frac{20.15 \times 10^6}{(63,175)\ \text{BTU/gal}} \frac{\text{BTU}}{\text{hr}} = \underline{319}\ \frac{\text{gal}}{\text{hr}}$

Thermal Oxidizer Mass Balance

Thermal Oxidizer Dry Gas = $319\ \frac{\text{gal}}{\text{hr}} \times (115.115)\ \text{lb}\ \frac{\text{dry gas}}{\text{gal}}$

$= \underline{36,717}\ \frac{\text{lb}}{\text{hr}}$

Thermal Oxidizer Wet Gas = $319\ \frac{\text{gal}}{\text{hr}} \times (8.615)\ \text{lb}\ \frac{H_2O\ \text{gas}}{\text{gal}}$

$= \underline{2748}\ \text{lb/hr}$

Total Dry Gas = 32,144 lb/hr + 36,717 = $\underline{68,861}\ \frac{\text{lb}}{\text{hr}}$

Total Wet Gas = 7477 lb/hr + 2748 lb/hr = $\underline{10,225}$ lb/hr

Thermal Oxidizer Exhaust Gas Volume

Gas Volume = $68,861\ \frac{\text{lb}}{\text{hr}}\ (61.9)\ \text{ft}^3/\text{lb} + 10,225\ \text{lb/hr}$

$\times (99.7)\ \frac{\text{ft}^3}{\text{lb}} = (4.26 \times 10^6 + 1.019 \times 10^6)\ \frac{\text{ft}^3}{\text{hr}}$

$= 5.279 \times 10^6\ \frac{\text{ft}^3}{\text{hr}} = \underline{87,983}\ \text{ft}^3/\text{min}$

@ 2000°F

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Project Name Luzerne Rd. Feasibility Study

Subject HTTO Design

Rotary Dryer Gas Velocity

9.5' diameter

Assume ≈ 9.25' inside diameter

$$\text{Area} = \pi\left(\frac{9.25}{2}\right)^2 = 67.2 \text{ ft}^2$$

Gasflow = 15,974 acfm @ 400°F

$$15,974 \ \frac{\text{ft}^3}{\text{min}} \times \frac{1}{67.2 \text{ ft}^2} = 237.7 \text{ ft/min}$$

Thermal Oxidizer Gas Velocity + Retention Time

Internal Volume = 8,850 ft³

Gasflow = 87,983 ft³/min @ 2000°F

$$\frac{8,850 \text{ ft}^3}{87,983 \text{ ft}^3/\text{min}} = 0.10058 \text{ min} = 6.03 \text{ seconds}$$

TECHNOLOGY
CORPORATION

W. L. Troxler, P.E.
Project Manager

Regional Office
312 Directors Drive • Knoxville, Tennessee 37923
615-690-3211

**INTERNATIONAL
TECHNOLOGY
CORPORATION**

September 28, 1987

Mr. Joseph L. Tessitore
Cross/Tessitore & Associates, P.A.
4759 South Conway Road, Unit D
Orlando, Florida 32812

Dear Joe:

I enjoyed seeing you at the incineration conference last week in Washington, D.C. Overall, I thought it was an excellent conference.

Per our discussion, I am enclosing a diagram demonstrating a time/temperature relationship for volatilizing PCBs from soil at a temperature of 450° C. The data was generated by IT in a lab-scale thermal separation system. We have not yet published this information and would appreciate it if you would treat it as confidential at this time.

Please feel free to call me if you have any questions or need additional information.

Sincerely,

Bill Troxler

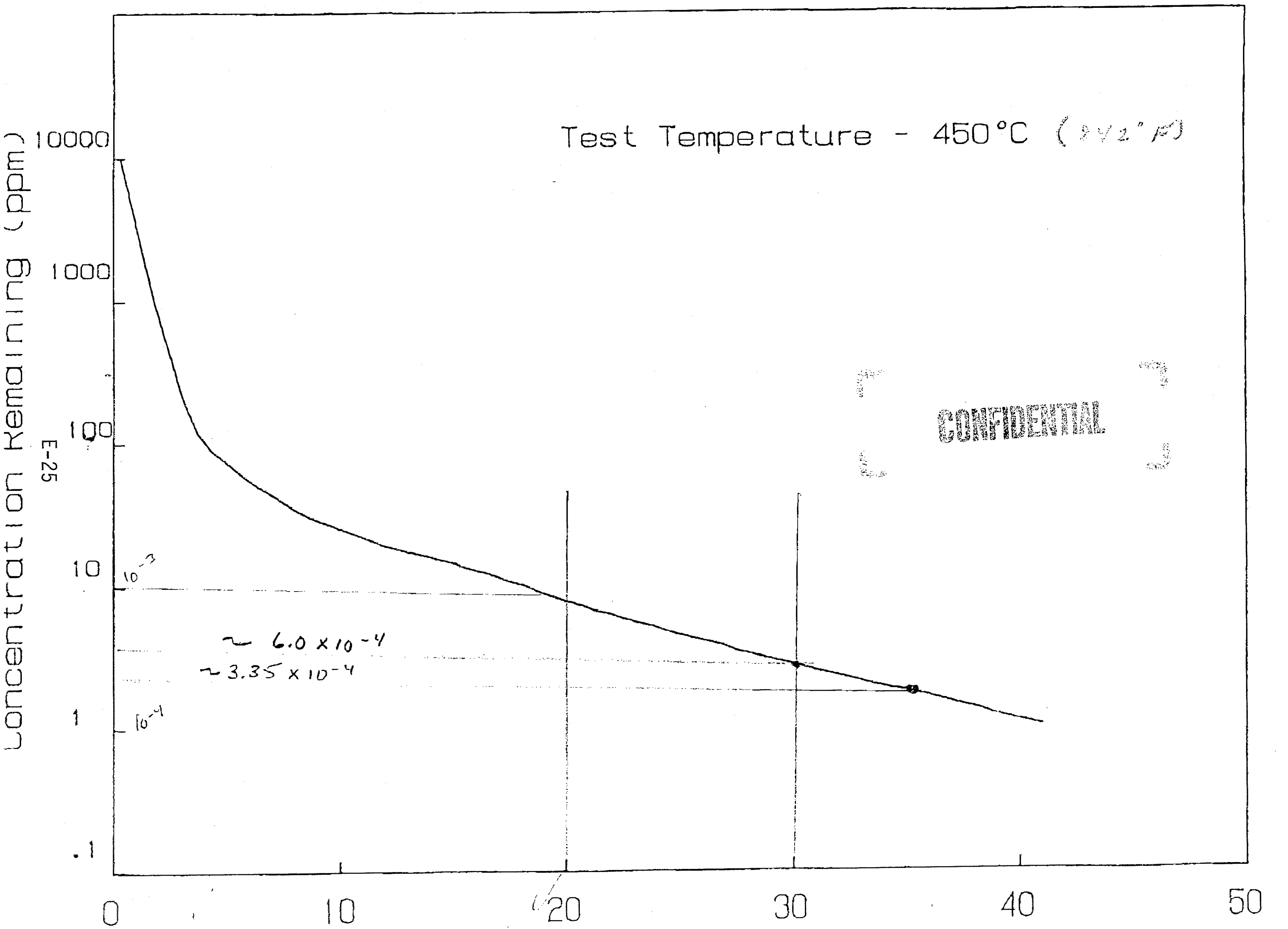
Bill Troxler

RECEIVED OCT 01 1987

WLT/fcb

Enclosure

Regional Office
312 Directors Drive • Knoxville, Tennessee 37923 • 615-690-3211



Time/Temperature Relationship for PCBs (Arachlor 1242 and 1260)

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E-25

ROCK TALK MANUAL

E-26

3rd Revised Printing 1982

Price in U.S.A. $5.00

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Wichita, Kansas

KVS
a member of
THE McNally GROUP

K1082

ROCK TALK MANUAL

This manual is published by Kennedy Van Saun Corporation for use by mineral preparation engineers, plant operators and people in general who have use for practical data.

The information in this manual was collected from many sources and if not properly acknowledged we would like to express here our appreciation for the collaboration and contributions by various individuals within our company and outside.

NOTE:
It is intended to update this manual periodically and make it more useful by including new information and improving the quality of data included. Your suggestions will be very much appreciated; please write to

Editor
Rock Talk Manual
Kennedy Van Saun Corporation
Danville, PA 17821-0500

f) consider size distribution and handling characteristics of material: filter cake, sticky material does not shower well → more retention time (longer drying) required.

g) specific evaporation rate (lbs. of water evaporated per hour per cubic foot of dryer volume) ranges from 1.8 to 7.5 lbs./hr./ft.^{3}. Lower range to be used for sticky materials, low gas temperatures, low percent H_2O removed.

h) dryer loading can vary between 3-15% (Space occupied by material in dryer compared to the total dryer volume); usually 8 to 12% loading is normal.

i) retention times vary from 5 to 25 minutes; the normal range is 7 to 15 minutes.

note: calculate retention time (T) from.

R	material bulk/density (lbs./ft.^{3})
a	% loading (as fraction: 10%=.10)
C	dryer capacity (lbs./minute)
	dryer dimensions (diameter, length in feet)
l	length
d	diameter

$$T = \frac{a \times \frac{d^2 \times \pi}{4} \times l \times R}{C} \quad \text{(time in minutes)}$$

j) length to diameter ratios vary from 4-10, usually are 6-8. This ratio can be used to determine dryer diameter from total lbs./hr. of H_2O evaporated and specific evaporation rate. Use Tables E-2 through E-5, *pages 108-111*, as follows:

given: Wet feed rate 100 TPH or 200,000 lbs./hr.
feed H_2O 10% (wet basis) or 20,000 lbs./hr. to be evaporated

from Table E-2 *(p. 108)* read vertically from 20,000 lbs./hr. on abscissa to line 4 (for average specific evaporation rate) then horizontally to dryer volume (read 5,000 ft.^{3} dryer volume).

On Table E-4 *(p. 110)* read from abscissa 5,000 ft.^{3} dryer volume to L/D ratio 8, then horizontally to dryer diameter of 9.7 feet; use 10 feet diameter by 80 feet long.

k) To cross check size use dryer loading or retention time as determined under h) and i):

5,000 ft.^{3} dryer volume operating with 10% loading or 500 ft.^{3} material in dryer; with bulk density of 100 lbs./ft.^{3} this loading equals holdup of 50,000 lbs. material in dryer.

Dryer feed rate is 200,000 lbs./hr. hence retention time equals holdup divided by feed rate or $\frac{50,000}{200,000} = .25$ hrs. = 15 minutes.

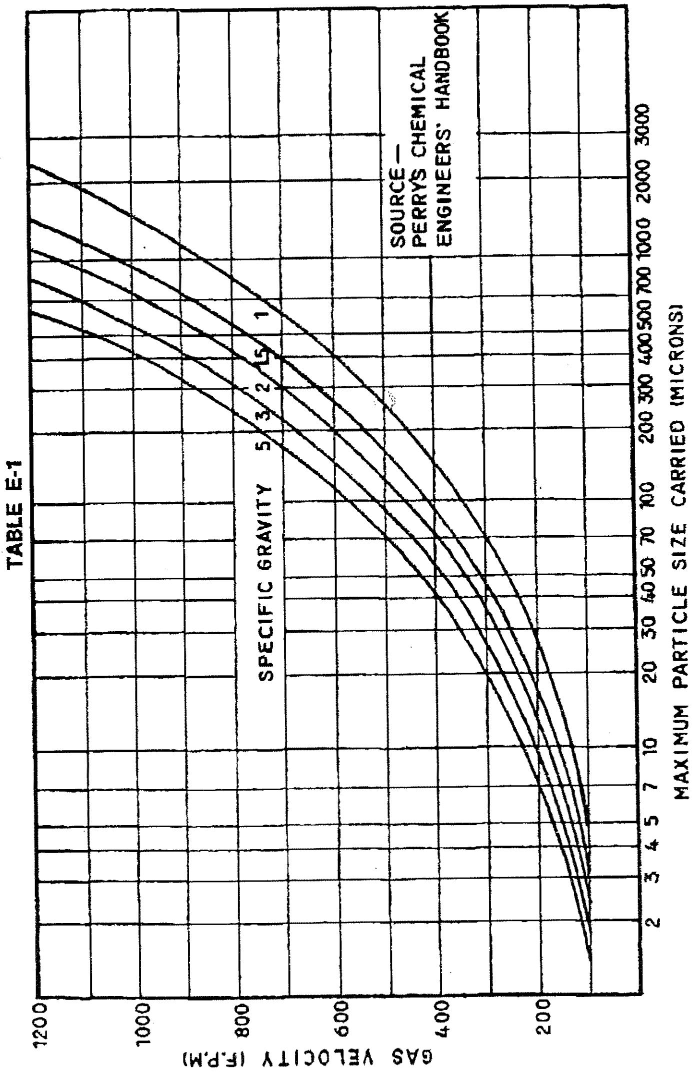
Note: this retention time is on high side therefore dryer speed and slope should be adjusted to give shorter retention time (hence use lower dryer loading).

l) To estimate burner capacity use 1600 to 2200 B.T.U. per lb. of water evaporated. This represents inefficiency of 600-1200 B.T.U./lb.; sources for inefficiency are high exit gas temperature, low inlet gas temperature, radiation losses etc.

m) To estimate ID fan capacity by rule of thumb (for bunker C fuel oil @ 1600°F inlet temperature and 1600-2200 B.T.U./lb. of H_2O evaporated) use 1.4 to 1.75 SCFM per lb./hr. evaporated. For more exact calculation of exit gas volumes use section on general combustion data.

TABLE E-1

SIZE OF LARGEST PARTICLE CARRIED BY HORIZONTAL FLOW VS. GAS VELOCITY FOR VARIOUS SPECIFIC GRAVITIES



18,381

Table 9-4. No. 2 Fuel Oil, 139,703 BTU/gal, 7.6 lb/gal.

Total Air:	1.1	1.2	1.3
lb air/gal	114.640	125.062	135.483
lb dry gas/gal	115.115	125.537	135.958
lb H_2O/gal	8.615	8.751	8.886
Temp., °F	Heat Available, BTU/gal		
200	126,210	125,707	125,206
300	123,016	122,255	121,495
400	119,802	118,780	117,760
500	116,562	115,277	113,995
600	113,283	111,732	110,184
700	109,965	108,146	106,328
800	106,029	103,885	101,742
900	103,197	100,829	98,463
1,000	99,747	97,099	99,747
1,100	96,255	93,325	90,397
1,200	92,721	89,505	86,291
1,300	89,147	85,643	82,140
1,400	85,535	81,738	77,943
1,500	81,887	77,796	73,707
1,600	78,205	73,817	69,431
1,700	74,487	69,799	65,115
1,800	70,746	65,757	60,771
1,832	69,538	64,452	59,369
1,900	66,971	61,679	56,389
2,000	63,175	57,578	51,984
2,100	59,341	53,445	59,349
2,192	55,813	49,628	44,385
2,200	55,507	49,294	43,084
2,300	41,637	45,114	38,594
2,400	47,750	40,916	34,085
2,500	43,852	36,706	29,562
2,600	39,914	32,453	24,995
2,700	35,938	28,162	20,388

7,303 BTU/lb

The moisture flow rate from combustion of fuel oil is 8.75 lbs H_2O/gal fuel oil X 37.51 gal fuel oil/hr = 328 lb/hr.

DG W/FO is the total quantity of dry gas exiting the system. It is equal to the dry gas produced from combustion of the waste plus the dry gas produced from fuel combustion 66303 lb/hr + 4709 lb/hr = 71012 lb/hr dry gas.

H_2O W/FO is the total quantity of moisture exiting the system, that calculated in the mass flow sheet plus the contribution from combustion of supplementary fuel, 4568 lb/hr + 328 lb/hr = 4896 lb/hr.

Air W/FO is the total amount of air entering the incinerator, calculated from

F

Groundwater Extraction and Treatment Calculations

Groundwater Calculations for Alternative 3 - Groundwater Extraction, Treatment, and Long-Term Monitoring
Luzerne Road Site

k =	6.20E-02	cm/s	shallow
	2.03E-03	ft/s	shallow
	1.43E-02	cm/s	intermediate
	4.69E-04	ft/s	intermediate
	3.82E-02	cm/s	average
	1.25E-03	ft/s	average
i =	0.0096	ft/ft	average of shallow and intermediate
L =	100	ft	
B =	70	ft	
A =	7000	ft2	
n =	0.25		
ho =	70	ft	
hw =	68.7	ft	
ro =	1000	ft	
rw =	0.25	ft	
k(avg) =	1.25E-03	ft/s	
	1.3	=drawdown= ho-hw	

Groundwater Flow Rate

q=	8.37E-02	ft3/s
	37.6	gal/min

$$q = kiA$$

Groundwater Velocity

U=	4.79E-05	ft/s

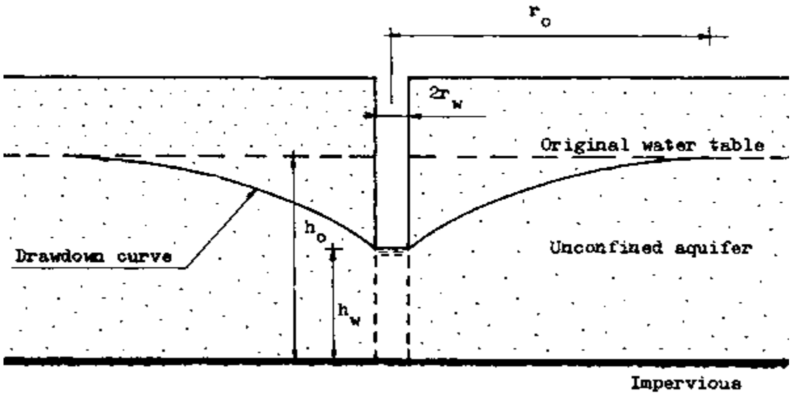
$$U = \frac{ki}{n}$$

Pumping Flow Rate

Assume 6" ID extraction well

Q=	0.09	ft3/s
Q=	38	gal/min

$$Q = \frac{\pi k(h_o^2 - h_w^2)}{\ln\left(\frac{r_o}{r_w}\right)}$$



Notes

q = groundwater flow rate

k = hydraulic conductivity

i = horizontal hydraulic gradient

L = length

B = aquifer thickness

A = area

U = groundwater velocity

n = effective porosity

ho = height of groundwater at observation well an assumed 1000 feet from extraction well

hw = height of groundwater at extraction well

ro = distance between extraction well and observation well

rw = radius of extraction well

1. Hydraulic conductivity values taken from *Remedial Investigation Report of the Luzerne Road Site* (E&E 2002).
2. Average horizontal hydraulic gradient calculated by E&E based on 2001 groundwater elevation data (E&E, 2002).
3. Saturated aquifer thickness assumed to be 70' as per *Remedial Investigation Report of the Luzerne Road Site* (E&E 2002).
4. Effective porosity assumed to be 0.25 (*Remedial Investigation Report of the Luzerne Road Site*, (E&E 2002)).
5. Groundwater flow rate calculated by on Darcy's Law.
6. Groundwater velocity is assumed as Darcy's velocity.
7. Pumping flow rate calculated by Thiem equation for an unconfined aquifer.