Focused Feasibility Study Report

Lake Calumet Cluster Site
Chicago, Cook County, Illinois

Illinois EPA ID: 0316555084-Cook County

Illinois EPA Contract No.: HWA-1309
Amendment No.: 17

June 2006

Prepared for:

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
Bureau of Land
Federal Sites Remediation Section
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

ecology and environment engineering, inc.
International Specialists in the Environment

33 N. Dearborn Street, Suite 501 Chicago, IL 60602
Tel: 312/578-9243, Fax: 312/578-9345

Table of Contents

Section **Page**

Table of Contents (Cont.)

Table of Contents (Cont.)

List of Tables

List of Tables (Cont.)

Table **Page**

List of Figures

List of Acronyms

ARARs	applicable or relevant and appropriate requirements
BERA	baseline ecological risk assessment
BGS	below ground surface
Clayton	Clayton Group Services, Inc.
cm/sec	centimeters per second
COPC	contaminant of potential concern
CPECs	contaminants of potential ecological concern
CSM	conceptual site model
CWA	Federal Clean Water Act
DOT	U.S. Department of Transportation NPDES requirements (40 CFR 122),
EcoTox	ecological and toxicological
E & E	Ecology and Environment, Inc.
EEEI	Ecology and Environment Engineering, Inc.
ELCR	excess lifetime cancer risk
EPA	United States Environmental Protection Agency
EPCs	exposure point concentrations
ERT	Environmental Response Team
ESA	Federal Endangered Species Act
ET	evapotranspiration
FFS	Focused Feasibility Study
FML	flexible membrane liner
FWS	U.S. Fish and Wildlife Service
HDPE	high-density polyethylene
HEAST	Health Effects Assessment Summary Table
HHRA	human health risk assessment
HI	hazard indices

List of Acronyms (Cont.)

IAC	Illinois Administrative Code
IGA	intergovernmental agreement
Illinois EPA	Illinois Environmental Protection Agency
IRIS	Integrated Risk Information System
IROD	Interim Remedial Action Record of Decision
LCC	Lake Calumet Cluster
LFG	landfill gas
MWH	Montgomery Watson Harza
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OU1	Operable Unit 1
OU2	Operable Unit 2
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PRG	preliminary remediation goal
RAIS	Risk Assessment Information System
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RfDs	reference doses
ROs	Remediation Objectives
SFs	slope factors
SIC	Standard Industrial Classification
SLERA	screening-level ecological risk assessment
START	Superfund Technical Assessment and Response Team
SVOCs	semivolatile organic compounds
T&E	threatened and endangered

List of Acronyms (Cont.)

TACO	Tiered Approach to Corrective Action Objectives
TBCs	to be considered
TCLP	toxicity characteristic leaching procedure
TSCA	Toxic Substances Control Act
UCL	upper confidence limit
VOCs	volatile organic compounds
XRF	X-ray fluorescence

1 Introduction

This document was prepared for the Illinois Environmental Protection Agency (Illinois EPA) under Professional Services Agreement Number HWA-1309, Amendment No. 17, dated February 18, 2006 between Illinois EPA and Ecology and Environment, Inc. (E & E).

Under this work order, E & E was tasked to develop a Focused Feasibility Study (FFS) Report for the Lake Calumet Cluster (LCC) site located in Chicago, Cook County, Illinois (see Figure 1-1). This FFS was prepared to identify potential remedial options that may be implemented as part of a proposed interim remedial action, which is intended to address buried and exposed waste on the site, as well as site surface water runoff that enters Indian Ridge Marsh.

Ecology and Environment Engineering, Inc. (EEEI), E & E's wholly owned, Illinois-licensed engineering subsidiary, developed this document. Additionally, the Illinois EPA is the lead agency, and the United States Environmental Protection Agency (EPA) is the support agency for this site.

1.1 Purpose and Organization of Report

This FFS Report was developed in accordance with applicable EPA guidance documents, including:

- EPA's *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA/540/P-91-001); and
- EPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA 540-F-93-035).

This report is divided into six sections. Section 1 provides background information and summarizes the findings of previous LCC site investigations and reports. Section 2 screens potential remedial technologies, Section 3 develops comprehensive site alternatives, and Section 4 provides a detailed analysis of the alternatives using EPA evaluation criteria. Section 5 provides a summary of the findings of the FFS, and Section 6 lists the references used in this document.

1.2 Background Information

1.2.1 Site Description

The LCC site is a group of several land and waste storage/disposal facilities located in southeastern Chicago, Cook County, Illinois (latitude 41°41’15.0” North and longitude 87°34’35.0” West at the Paxton II area). The site is approximately 87 acres in size and is bordered by the Paxton I Landfill to the north, Land and Lakes #3 Landfill to the west, the Norfolk Southern Railroad right-of-way to the east, and 122nd Street to the south. The LCC site consists of the following individual areas: Paxton Avenue Lagoons, Alburn Incinerator, U.S. Drum II, and an unnamed parcel. A site location map is presented in Figure 1-1, and an aerial photograph of the site with area features is presented as Figure 1-2. From 1900 to the 1970s, nearby industries deposited slag and other waste that raised the surface area to an elevation just above the water table. From 1940 to 1992, much of the area was used for unpermitted waste disposal. The contaminated runoff in the area impacts wetland soils and hydrology.

Current topography around the LCC Site is relatively flat, with the notable exceptions of Land and Lakes #3 Landfill and Paxton II Landfill. The flat terrain includes interspersed areas of slag, open waters and wetlands. The composition of the fill varies considerably, as evidenced by the uneven growth of vegetation and the fact that much of the area is inundated a significant portion of the year. There are limited surface drainage ditches, and no stormwater lines. The uppermost 15 to 20 feet contains an unconfined, contaminated aquifer.

1.2.2 Site History

More than a century ago, the Calumet region was the largest wetland complex in the Great Lakes area, but by the 1900s it became the heart of heavy industry for the upper Midwest. Currently, a combination of natural, industrial, and residential areas typifies the contrast found around Lake Calumet. Abundant wildlife (including many state and federally endangered species) live in remnants of a once-vast wet prairie system scattered among industrial facilities. Much of the wetland area that was not converted into active industrial or residential use was used for municipal, industrial, and chemical waste disposal. The economic decline of the steel industry during the last decades of the 20th Century left the Calumet area economically and ecologically degraded. Today, remnant wetlands and other natural areas remain, but they are interspersed among active and abandoned industries, slag piles generated by nearby steel manufacturers, and chemical waste disposal sites and landfills.

Prior to 1949, aerial photographs did not show any indications of activities at what is now the LCC site (E & E 1999). The site was mostly wetlands, characterized by marsh-type vegetation and some open water. Activities up to the 1970s consisted primarily of a combination of what are described as “extraction” activities, which evidently refer to excavation and removal of soil materials from the site, and filling activities. The filling activities were first noted in the northwest quadrant of the site, and were described as the dumping of both solid and liquid wastes in this area. Drainage was noted to flow toward the eastern half of the site, which at the time was still a wetlands area.

Extraction and filling continued on the site through the early 1970s, at which time the entire site was disturbed, and fill occupied the full site north to south and over half the site from west to east. Liquids were noted to be draining in all directions, and standing pools of liquids were noted in the pit areas, which had been excavated and as yet unfilled.

Several investigations have been performed at the LCC site since the early 1980s. These investigations, which have identified soil, sediment, and groundwater contamination at the site, are discussed in more detail in Sections 1.3 and 1.4. A brief description of each of the LCC sites is presented below.

1.2.2.1 Alburn Incinerator

The former Alburn Incinerator (Alburn) site is located 0.5 miles east of Lake Calumet, 1 mile west of the Calumet River, and 1.25 miles north of the Little Calumet River. The Alburn Incinerator parcel encompasses approximately 35 acres. The Alburn site operated as a landfill from 1967 through 1977, and historic records suggest that the property received a large amount of slag material that raised the ground height above the existing surface water level. No details are available concerning the types and quantities of wastes buried during this period. In 1977, Alburn initiated hazardous waste incineration and hazardous waste storage and transfer operations. In 1979, the EPA issued a Resource Conservation and Recovery Act (RCRA) permit to Alburn for the operation of the incinerator. Alburn incinerated/stored hazardous wastes and sludge, including paints, thinners, varnishes, chlorinated solvents, styrene, ink, adhesives, waste oils, antifreeze, petroleum, naphtha, coal tar, and waste solvents. Site storage and disposal methods included landfilling, incineration, operation of a surface impoundment, and bulk liquid waste storage.

In 1982, Alburn had their permit revoked due to several RCRA violations. Alburn continued to accept bulk waste until January 1983. On July 5, 1983, two on-site drums exploded from heat expansion and a subsequent chemical reaction. EPA ordered an immediate removal action to remove all visible sources of hazardous materials from the site, including bulk storage tanks, drums, 5-gallon pails, and lagoon sludge. In addition, the top 6 inches of soil, assumed to be the most contaminated, was excavated, and the site received a partial cover. Illinois EPA conducted a follow-up soil sampling investigation in 1988 and 1989.

1.2.2.2 Unnamed Parcel

The Unnamed Parcel is approximately 38 acres in size and is located south and west of Alburn; the Unnamed Parcel is classified as an unpermitted landfill. It is believed that this area received various municipal, industrial, and chemical waste materials from approximately the 1940s through the 1960s. Now, much of the Unnamed Parcel area has little or no soil cap and is covered with perennial grasses, weeds, and wetland vegetation.

1.2.2.3 U.S. Drum II

The U.S. Drum II area is an unfenced, undeveloped area covering about 2.5 acres. Historic records suggest that as early as the 1940s, U.S. Drum II and the adjacent areas had been used as dumping grounds for industrial and municipal wastes. Currently, the surface level of the U.S. Drum II property is raised approximately 10 feet above the original natural ground level, due to the unauthorized land disposal. During the mid-1970s the site was used as a hazardous waste transfer and petroleum recovery facility until a fire occurred in July 1975. Operations at the facility were abandoned temporarily in 1976. In 1979, a waste drum temporary storage and transfer facility operated at the site. The waste transfer facility was shut down in 1979.

The Illinois EPA became aware of the site in the 1970s, when the property was used as a solvent recovery and waste transfer facility. In April 1979, a temporary restraining order was issued and operations ceased due to the discovery of 6,000 55-gallon drums, four open-dump lagoons of sludge and various wastes, 25 semi-trailers, and three bulk liquid trucks. The site ceased operations shortly thereafter.

Between October and December 1979, an estimated 34,100 gallons of liquid and semisolid wastes were removed from the property, and an estimated 1,750 drums were left on site inside earth berms. An EPA removal action occurred at the site from December 1984 through July 1985. During construction of a new access road, an additional 1,500 buried drums were discovered. The ends of the drums had been cut off or the drums had been punctured to allow the contents to drain into the ground prior to or at the time of burial. All observable drums, 435 cubic yards of contaminated soil, and 62,000 gallons of standing water were removed during the EPA action.

1.2.2.4 Paxton Avenue Lagoons

The Paxton Avenue Lagoons are located north of 122nd Street, southwest of the Alburn Incinerator and west of the Unnamed Parcel. Lake Calumet is located approximately 1 mile to the west. The Paxton Avenue Lagoons consisted of three lagoons, a berm composed of soil and crushed drums, and an area of oily soil. The lagoons were reportedly active during the 1940s, and a variety of chemical wastes from nearby steel mills were allegedly brought to the site. A large number of drums are also alleged to have been buried. Illinois EPA samples collected in 1985 indicated significant levels of volatiles, semivolatiles, polychlorinated biphenyls (PCBs), and heavy metals. In 1990, Illinois EPA conducted an immediate removal action at the site of 60 drums of hazardous materials and 2,200 cubic yards of acidic soil. The lagoon area was capped with clay. The lagoons have been closed and fenced since October 1993.

1.3 Nature and Extent of Contamination

For this FFS, data obtained from the four most recent investigations has been used to define the nature and extent of soil contamination at the LCC site, which has been defined as Operable Unit 1 (OU1). It should be noted that addressing groundwater contamination as a remedial action is beyond the scope of this FFS and will not be addressed in this report. Groundwater, which for the LLC site is defined as OU2, will be addressed under a separate action. Groundwater monitoring is included as a component of each of the alternatives for OU1.

The four investigative reports used in the development of this section are:

- E & E, March 10, 1999a, *Results of Phase I Sampling Activities for the Lake Calumet Site*;

- E & E, November 30, 1999b, *The Nature and Extent of Contamination at the Lake Calumet Cluster Site*;

- Harza Engineering Company, May 2001, *Comprehensive Site Investigation Report, Lake Calumet Cluster Site: Alburn, U.S. Drum, and Unnamed Parcel Areas*; and

- Clayton Group Services, Inc. September 27, 2002, *Remedial Options Report, Southeast Chicago Cluster Site*.

Since 1998, a total of 123 surface soil samples and 19 subsurface soil samples have been collected and submitted for various analyses. Additionally, a total of 145 test pit excavations have been performed with a minimum of two soil samples collected from each pit.

In addition to the soil and test pit investigations, groundwater was also investigated by E & E. A total of 18 groundwater monitoring wells were sampled for VOCs, SVOCs, and metals. Based on the detected contaminant concentrations, iron, manganese, benzene, and benzo(a)pyrene exceeded the human health threshold for drinking water. Groundwater contamination for these contaminants of potential concern (COPCs) extends across most of the site with the two areas of highest contamination being located on the Alburn site in an area between the Paxton I Landfill and Big Marsh. Additionally, within the Paxton I area, a significant tetrachloroethene and trichloroethene plume was identified. While this information shows that groundwater has been adversely affected by previous site use, groundwater will be addressed under a separate action and will not be further discussed in this FFS.

1.3.1 Surface and Subsurface Soil Sampling Results

Between August 1998 and June 1999, and under contract to the EPA, E & E's Superfund Technical Assessment and Response Team (START) collected surface and subsurface soil samples and provided for laboratory analysis of approximately 135 compounds. Based on the detected concentrations in these samples, the following COPCs were identified:

- Metals – Arsenic, barium, chromium, lead, and mercury;
- PCBs and Pesticides – Aroclor 1254, beta-BHC, and Dieldrin;
- Volatile organic compounds (VOCs) – Naphthalene; and
- Polynuclear aromatic hydrocarbons (PAHs) - Benzo(a)pyrene, benzo(a)anthracene, and dibenz(a,h)anthracene.

The area of the former Alburn incinerator was the most consistently contaminated parcel of the LCC site. Two other areas that consistently showed contamination were the southwestern area of the Unnamed Parcel and the area immediately south of the Alburn parcel.

For metals, arsenic was the most frequently detected analyte that exceeded human health risk criteria. Barium, chromium, lead, and mercury were detected at concentrations that most frequently exceeded ecological risk criteria. Tables 1-1, 1-2, and 1-3 provide a summary of the analytical results.

1.3.2 Sediment and Surface Water Sampling Results

In addition to surface and subsurface soil sampling, E & E's START collected sediment and surface water samples from the LCC site and Indian Ridge Marsh for laboratory analysis. Based on the detected contaminant concentrations, the following sediment and surface water COPCs were identified:

Sediment:

- Metals –Arsenic, barium, cadmium, chromium, lead, manganese, mercury, and nickel; and
- PAHs –Anthracene, benzo(a)anthracene, benzo(a)pyrene, and chrysene.

Surface Water:

- Metals –Barium, iron, lead, and manganese; and
- Pesticides –Heptachlor and 4, 4'-DDD

The most highly contaminated sediment samples collected at the LCC site were collected from the Alburn area. Toxicity characteristic leaching procedure (TCLP) analysis was also performed for metals. No detectable TCLP concentrations were reported for any analyte. Table 1-4 provides a summary of the analytical results for the COPCs.

In all of the collected samples, barium concentrations were detected at concentrations above the threshold screening value of 0.004 milligrams per liter. As with the sediment sample results, the most contaminated surface water samples were collected in the vicinity of the Alburn parcel. Water quality across the LCC site varies from north to south with the northern section having the highest detected contaminant concentrations and the southeastern section having the lowest detected concentrations. Table 1-5 provides a summary of the analytical results for the COPCs.

1.3.3 Test Pits

In 2000, the Illinois EPA, with assistance from the EPA and the City of Chicago, performed 134 test pit excavations. At each excavation, a minimum of two samples were submitted for laboratory analysis. The first sample in each test pit was collected from a depth of 0.5 to 5 feet below ground surface (BGS), and the second sample was collected in the range of 5 feet to 30 feet BGS. The samples were analyzed for total metals, VOCs, semivolatile organic compounds (SVOCs), pesticides, PCBs, and at certain locations, dioxins.

In 2001, 11 additional test pits were excavated with the samples being submitted for TCLP analysis in addition to the previously listed parameters. A summary of the findings associated with soil analytical data as well as observations about the waste contents is provided below.

Soil Impact

At all of the test pit locations, several contaminants were detected at concentrations exceeding their respective Tiered Approach to Corrective Action Objectives (TACO) Tier 1 Soil Remediation Objectives. Analytical results for the soil samples collected from the test pits indicated a total of 21 VOCs, 23 SVOCs, eight PCBs and pesticides, and six metals at concentrations that exceeded at least one of their TACO Tier 1 criteria. A summary of the contaminants that were detected at concentrations above the Tier 1 criteria is presented in Table 1-6.

Solid Waste

With the exception of one test pit, solid waste was encountered at all of the excavation locations. In general, at each excavation pit with solid waste, there was 1 foot to 3 feet of soil covering the waste material. The excavation depths ranged from 4 feet to 30 feet BGS, and the types of wastes encountered varied greatly, ranging from household waste to syringes to drums labeled trichloroethene. Based on the varying depths of buried waste and the fact that the excavations apparently did not reach the bottom of the waste, the vertical extent of contamination (i.e., total depth/thickness of waste) was not be defined in the previous site investigations.

1.3.4 TCLP Soil Results

As part of the multiple investigations performed at the LCC site, limited TCLP testing was performed on a finite number of samples. As part of the E & E investigation, a total of 68 samples underwent TCLP metals analysis. A total of 3 samples detected lead at a concentration above its TCLP limit. No other metals were detected above their regulatory limits.

During the test pit investigations, 1 soil sample was submitted for TCLP SVOC analysis, 2 soil samples were submitted for TCLP pesticide analysis, 3 soil samples were submitted for TCLP metals analysis, and 4 soil samples were submitted TCLP VOC analysis. In one sample, trichloroethene was detected above its regulatory limit. No other compounds were detected above their regulatory limits in any of the samples.

Since records of waste shipments and disposal locations are not available, it can only be assumed that on-site hazardous waste determination can only be made based on analytical results. While there was limited sampling and analysis for TCLP parameters, based on the analytical results, isolated areas of site soil would be classified as a characteristic hazardous waste.

1.4 Human Health Risk Assessment Summary

This section summarizes the *Human Health Risk Assessment (HHRA) Report for the LCC Site: Alburn, U.S. Drum II, and Unnamed Parcel Areas – Final Report,* previously prepared for the City of Chicago Department of Environment by Montgomery Watson Harza and dated February 2002 (MWH 2002). The complete report is included as Appendix A to this FFS and a summary of the calculated risks is provided in Table 1-7.

1.4.1 Data Evaluation and Selection of Contaminants of Potential Concern

All laboratory-generated analytical data were compiled and used in the risk assessment. Field analytical data, including X-ray fluorescence (XRF) metals data and Geoprobe groundwater samples collected during the Phase I Investigation conducted by E & E (1999a), were considered screening data and were not used. Data were evaluated and COPCs were selected for each area of interest as follows.

1.4.1.1 Soil

Soil data were compared to Illinois TACO background concentrations and Tier 1 Soil Remediation Objectives (ROs) for the receptors listed in Subsection 1.4.2.1 of this report. Chemicals that exceeded both criteria were selected as COPCs.

1.4.1.2 Sediments

Sediment data were compared to Ontario Ministry of the Environment guidelines for protection of aquatic sediment quality (Persaud et al. 1993). Chemicals that exceeded these guideline concentrations were selected as COPCs.

1.4.1.3 Surface Water

Surface water data were compared to ecological and toxicological (EcoTox) thresholds (EPA 1996). Chemicals that exceeded the thresholds were selected as COPCs.

1.4.1.4 Groundwater

Groundwater data were compared to Illinois TACO Class I Groundwater ROs. Chemicals that exceeded these criteria were selected as COPCs.

1.4.1.5 Essential Nutrients

Calcium, potassium, magnesium, iron, and sodium are natural constituents, and were detected in all media. These chemicals are essential human nutrients and EPA has not established maximum allowable daily intakes or reference doses (RfDs) for these chemicals. Therefore, these chemicals were not selected as COPCs.

COPCs selected for soil and sediment for the Alburn, U.S. Drum II, and the Unnamed Parcel of the Lake Calumet Cluster site are listed in Table 1-7 of this FFS report. Approximately 25 to 35 COPCs were identified in each of the areas. A greater number of COPCs were found in soil and groundwater; fewer were found in surface water and sediment. The largest numbers of COPCs were metals or PAHs, but VOCs, SVOCs, pesticides, and PCBs also were represented.

1.4.2 Exposure Assessment

No significant use of the LCC site was occurring when the HHRA was prepared. A possible future use considered by the HHRA was as a solar-powered generating station. Therefore, potential receptors and exposures associated with such a use were used as the basis of the HHRA.

1.4.2.1 Receptors

Five categories of on-site workers were considered:

- A solar panels maintenance worker;
- A mower;
- A landscape maintenance worker;

- A construction worker; and
- A general industrial/commercial maintenance worker.

1.4.2.2 Exposure Pathways

Potential exposure pathways considered for various worker categories included:

- Dermal contact with surface water, groundwater, sediment, and surface and subsurface soils;
- Ingestion and inhalation of contaminants in surface and subsurface soils; and
- Inhalation of volatile groundwater contaminants.

A conceptual site model (CSM) that details which receptor/exposure pathway combinations were judged likely to be complete is included as Figure 3 of the HHRA report.

1.4.2.3 Exposure Point Concentrations

The 95% upper confidence limit (UCL) on the arithmetic average concentrations, assuming a lognormal distribution, was used as the exposure point concentration (EPC) unless the UCL exceeded the maximum detected concentration, in which case the maximum detected concentration was used as the EPC. Ninety-five percent (95%) UCLs were calculated in accordance with EPA guidance (EPA 1992b). When a COPC was reported as not detected in a sample, one-half of the sample quantitation limit was used as a surrogate value.

For groundwater, each well represents a possible exposure point. Therefore, the highest concentration of each COPC in groundwater was used as the EPC.

1.4.2.4 Quantification of Exposure

Exposure estimates were calculated using standard EPA exposure estimation equations. The exposure factor and physical chemical property values used to estimate exposures, along with the sources of the values, are summarized in Tables 4-1 through 4-6 of the HHRA. Most exposure factor and physical chemical values were obtained from EPA or Illinois EPA guidance documents.

1.4.3 Toxicity Assessment

RfDs and cancer slope factors (SFs) for all of the COPCs were compiled from various sources and presented in Table 5-1 of the HHRA report. Most of the values were obtained from EPA’s Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST). A few values that were not available in IRIS or HEAST were obtained from EPA Region 9’s 2001 Preliminary Remediation Goal (PRG) Table, Oak Ridge National Laboratory’s (ORNL) Risk Assessment Information System (RAIS), or through personal communications with EPA personnel. The tissues or organs affected by the carcinogenic COPCs are summarized in Table 5-2 of the HHRA report. The critical noncarcinogenic effects and target organs of the systemic toxicants are summarized in Table 5-3 of the HHRA report.

1.4.4 Risk Characterization

Risk characterization procedures and calculations are described in the Human Health Risk Assessment report (Appendix A) for carcinogens and noncarcinogens. The human health risks estimated for all three areas are summarized in Table 1-7.

1.4.4.1 Alburn Area

Cancer risk and noncancer hazard estimates for the Alburn area are presented in HHRA Table 6-1. Soil COPCs were estimated to pose an excess lifetime cancer risk (ELCR) ranging from 2 x 10^{-6} for construction and landscape workers to 2 x 10^{-5} for general industrial/commercial workers. The total estimated hazard indices (HIs) for soil were less than 1 for all workers except construction workers for whom the HI was 3. For groundwater, surface water, and sediment, estimated ELCRs were less than 1 x 10^{-6} and the total HI was less than 0.1 for all workers.

The estimated ELCRs from soil COPCs fall within the 10^{-4} to 10^{-6} range generally considered acceptable by EPA. The estimated ELCRs for other media were less than 10^{-6} and would be considered minimal and acceptable. The COPCs that contributed significantly to the estimated ELCR included arsenic, benzene, benzo(a)pyrene, PCBs, and vinyl chloride.

The estimated HI of 3 for construction workers exceeds 1, the value below which adverse noncarcinogenic effects would not be expected. An HI above 1 does not necessarily mean that adverse effects would be manifested, but as the value increases above 1 the risk of adverse effects also increases. The elevated noncancer hazard was due primarily to toluene.

1.4.4.2 U.S. Drum II

Cancer risk and noncancer hazard estimates for the U.S. Drum II area are presented in HHRA Table 6-3. Soil COPCs were estimated to pose an ELCR ranging from 5 x 10^{-6} for construction workers to 5 x 10^{-5} for general industrial/ commercial workers. The total estimated HIs for soil were less than 1 for all workers, although the HI approached 1 (0.9) for construction workers. For groundwater and surface water estimated ELCRs were less than 1 x 10^{-6}, and the total HI was less than 0.1 for all workers. No COPCs were identified for sediment in this area. The COPCs that contributed significantly to the estimated ELCR included arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, and PCBs.

1.4.4.3 Unnamed Parcel

Cancer risk and noncancer hazard estimates for the Unnamed Parcel are presented in HHRA Table 6-5. Soil COPCs were estimated to pose an ELCR ranging from

1×10^{-6} for construction and landscape workers to 2×10^{-5} for general industrial/ commercial workers. The total estimated HIs for soil were less than 1 for all workers. For groundwater, estimated ELCRs were less than 1×10^{-6}, and the total HI was less than 0.001 for all workers. No COPCs were identified for surface water or sediment in this area. The COPCs that contributed significantly to the estimated ELCR included arsenic and benzo(a)pyrene.

1.4.5 Uncertainties

There are a number of uncertainties that affect all aspects of the risk assessment process. Specific areas of uncertainty are related to data evaluation, exposure assessment, toxicity assessment, and risk characterization. Various uncertainties are identified that affect each of these areas. Most uncertainties arise from conservative (health-protective) assumptions or procedures. Therefore, the cumulative effect of all of the uncertainties is that risks are more likely to be overestimated than underestimated.

1.4.6 Conclusions

The conclusions of the HHRA report reiterate the risk characterization findings.

The estimated ELCRs in all three areas are within or less than the 10^{-4} to 10^{-6} range generally considered acceptable by EPA. Remedial action is usually not required for risks in this range; however, this general rule is subject to modification based on site-specific factors.

The estimated HI of 3 for construction workers in the Alburn area exceeds 1, the value below which adverse noncarcinogenic effects would not be expected. An HI above 1 does not necessarily mean that adverse effects would be expected, but as the value increases above 1 the risk of adverse effects also increases. The elevated noncancer hazard was due primarily to toluene. The oral RfD for toluene includes an uncertainty factor of 1,000 and the inhalation reference concentration (RfC) includes an uncertainty factor of 300. Given the magnitude of these uncertainty, or “safety” factors, coupled with the conservative exposure assumptions used, construction workers are probably not likely to experience adverse noncancer effects from exposure to toluene at a level that gives an estimated HI of 3.

An important limitation of the HHRA report is that it only considers worker exposure. Workers, as a group, are generally adults and are generally healthy. Therefore, they may be less sensitive to potential adverse effects of exposure to environmental toxicants than other segments of the population such as the young, the old, and the infirm. If the site is ultimately used for a purpose such as a recreational or general commercial facility, exposure of more sensitive segments of the population could become a significant concern.

1.5 Habitat-Based Risk Evaluation

A baseline ecological risk assessment (BERA) was prepared by the EPA Environmental Response Team (ERT 2001) for the LCC site, which followed guidance issued by the EPA. The complete BERA is presented in Appendix B of this report. The BERA was conducted as a follow-up to a screening-level ecological risk assessment (SLERA) for the site, which identified over 100 COPCs, including metals, VOCs, SVOCs, PAHs, pesticides, and PCBs.

Assessment endpoints are explicit expressions of the actual ecological resources that are to be protected. Ecological resources include those without which ecosystem function would be significantly impaired, or those providing critical components (i.e., habitats). A review of the habitat of the LCC site and its associated wetlands provided information for the selection of assessment endpoints. In general, endpoints are aimed at the viability of terrestrial and aquatic populations.

The BERA evaluated risk to the following assessment endpoints:

1. Wetland structure and function;
2. Fish recruitment and nursery function;
3. Benthic community viability and function;
4. Amphibian population viability and function;
5. Insectivorous bird viability and recruitment;
6. Omnivorous waterfowl viability and recruitment;
7. Herbivorous bird viability and recruitment;
8. Piscivorous bird viability;
9. Omnivorous mammal viability;
10. Carnivorous mammal viability;
11. Soil-invertebrate community function; and
12. Plant community viability.

Field sampling to support the BERA was conducted in 2001 and included: (1) collecting water, sediment, soil, fish, and crayfish for chemical analysis; (2) collecting water and sediment for toxicity testing with laboratory-reared fish (*Pimephales promelas*, fathead minnow) and benthic invertebrates (*Hyalella azteca*, amphipod), respectively; and (3) collecting soil for toxicity and bioaccumulation testing with earthworms (*Eisenia foetida*) and ryegrass (*Lolium perenne*).

For assessment endpoints 1, 2, 3, 11, and 12, multiple measures of exposure and effects were evaluated and a weight-of-evidence approach was used to infer the presence or absence of risk. For endpoints 4 to 10, which pertain to wildlife, a food-chain exposure model was used to estimate a daily chemical dose from food for comparison with toxicity reference values from the literature. Nearly all assessment endpoints were found to be at risk. A summary of the individual assessment endpoint findings is provided below:

1. Wetland structure and function were predicted to be at risk based on adverse effects on fish, benthos, and nearly all wildlife functional groups from a variety of chemicals in water, sediment, and biota.
2. Fish recruitment and nursery function were predicted to be at risk for two reasons: (1) reduced survival of fathead minnows in toxicity tests with surface water from pond LHL-1 and the southeast ponds, and (2) exceedances of surface water screening criteria for metals (aluminum, chromium, copper, lead, vanadium, and zinc) and PCBs in the southeast ponds.
3. Benthic community viability and function were predicted to be at risk for three reasons: (1) low diversity and abundance of benthos in on-site ponds and nearby wetlands, (2) reduced survival of amphipods in toxicity tests with sediment from pond LHL-1 and the southeast ponds, and (3) exceedances of sediment benchmarks for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc), DDT breakdown products, and PCBs in sediment from on-site ponds.
4. Amphibian populations were predicted to be at risk based on reduced survival of amphipods in toxicity tests with sediment from pond LHL-1 and the southeast ponds. Amphipods were considered to be a suitable surrogate for amphibians because both amphipods and amphibians have intimate contact with sediment in ponds and wetlands.
5. Insectivorous bird viability and recruitment were predicted to be at risk from PCBs, aluminum, cadmium, chromium, copper, lead, mercury, selenium, and zinc based on food-chain modeling.
6. Omnivorous waterfowl were predicted to be at risk from PCBs and selenium based on food-chain modeling.
7. Herbivorous bird viability and recruitment could not be evaluated due to insufficient data. The plan for evaluating herbivorous birds was to grow ryegrass in soil samples from the site, analyze the ryegrass for chemicals of concern, and use the resulting data as input for a food-chain exposure model. However, because of poor growth of ryegrass in site soil, there was insufficient plant biomass for chemical analysis.
8. Piscivorous bird viability was predicted to be at risk from PCBs and selenium and perhaps also from chromium and lead based on food-chain modeling.
9. Omnivorous mammal viability was predicted to be at risk from PCBs, numerous SVOCs, antimony, and barium based on food-chain modeling.
10. Carnivorous mammal viability was predicted to be at risk from PCBs and numerous metals (aluminum, arsenic, antimony, barium, cadmium, iron, lead, mercury, selenium, vanadium, and zinc) based on food-chain modeling.
11. The soil-invertebrate community at the site was predicted to be at risk for two reasons: (1) reduced survival of earthworms in toxicity tests with site

soil samples from some sampling locations, and (2) exceedances of soil screening levels for chromium, iron, and lead at all sampling locations and for SVOCs at selected locations.

12. Plant community viability was predicted to be at risk for two reasons: (1) reduced ryegrass survival, shoot length and weight, and root length and weight in toxicity tests with site soil samples, and (2) exceedances of one or more soil screening benchmarks for metals (aluminum, chromium, lead, and silver) and pesticides (Aldrin, DDD, DDE, and chlordane) at most sampling locations.

The BERA concludes that there is a risk to the aquatic and terrestrial communities at and in the vicinity of the LCC site. The calculated risks used only contaminant exposure from food sources. Contaminant concentrations in water, sediment, and soil were excluded from the calculations. Therefore, the risk to receptor organisms living on the site is likely underestimated, and there is likely risk to off-site communities preying on organisms that use the site.

Table 1-1 Summary of Surface Soil Analytical Results for Contaminants of Potential Concern
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Compound	Frequency of Detection	Minimum Detection	Average Detection	Maximum Detection	Region 3 Human Health RBC[a]	Number of Samples Exceeding RBC	RCRA EDQL[b]	Number of Samples Exceeding RCRA EDQL
Metals (micrograms per kilogram)								
Arsenic	83/120	0.800	7.761	26	4	74/120	5.700	59/120
Barium	120/120	21.300	143.388	1,200	14,000	0/120	1.040	120/120
Chromium	120/120	9.550	244.963	2,200	NP	NP	0.400	120/120
Lead	112/120	10.700	185.862	1,170	NP	NP	0.451	112/120
Mercury	116/120	0.012	0.364	13	61	0/120	0.008	116/120
Volatile Organic Compounds (milligrams per kilogram)								
Naphthalene	66/121	0.022	0.888	41	41000	0/121	0.10	39/121
Semivolatile Organic Compounds (milligrams per kilogram)								
Benzo(a)pyrene	112/121	0.034	1.035	6.8	0.78	45/121	1.52	23/121
Benzo(a)anthracene	116/121	0.029	1.022	9	7.8	1/121	5.21	3/121
Dibenz(a,h)anthracene	99/121	0.038	0.341	2.2	0.78	11/121	18.4	0/121
PCBs/Pesticides (milligrams per kilogram)								
Aroclor 1254	68/120	0.007	1.484	68.8	2.9	2/120	NP	NP
beta-BHC	58/120	0.001	0.009	0.075	3.2	0/120	0.004	33/120
Dieldrin	61/120	0.001	0.056	1.8	0.36	3/120	0.002	37/120

Note: Data summarized from *The Nature and Extent of Contamination at the Lake Calumet Site* (E & E 1999b).

Key
RBC = Risk-based concentration.
NP = Information not provided or calculated.

Source:
[a] EPA Region 3 human health risk-based screening concentrations for soil for commercial or industrial use (October 1998).
[b] EPA Region 5 Resource Conservation and Recovery Act Division's Ecological Data Quality Levels (April 1998).

Table 1-2 Summary of Surface Soil Analytical Results (2 to 3 Feet Below Ground Surface) for Contaminants of Potential Concern
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Compound	Frequency of Detection	Minimum Detection	Average Detection	Maximum Detection	Region 3 Human Health RBC^a	Number of Samples Exceeding RBC	RCRA EDQL^b	Number of Samples Exceeding RCRA EDQL
Metals (micrograms per kilogram)								
Arsenic	3/15	8.8000	35.967	63.5	3.8	3/15	5.70	3/15
Barium	15/15	40.500	117.913	266	14,000	0/15	1.04	15/15
Chromium	15/15	13.400	172.127	1,260	NP	NP	0.4	15/15
Lead	15/15	23.000	280.087	812	NP	NP	0.45	15/15
Mercury	14/15	0.046	5.496	73.5	1610	1/15	0.008	14/15
Volatile Organic Compounds (milligrams per kilogram)								
Naphthalene	14/15	0.036	9.657	90	4,100	0/15	0.10	10/15
Semivolatile Organic Compounds (milligrams per kilogram)								
Benzo(a)pyrene	15/15	0.071	1.002	4.8	0.78	6/15	1.52	3/15
Benzo(a)anthracene	15/15	0.079	0.986	4.6	7.8	0/15	5.21	0/15
Dibenz(a,h)anthracene	14/15	0.033	0.337	1.8	0.78	1/15	18.4	0/15
PCBs/Pesticides (milligrams per kilogram)								
Aroclor 1254	6/16	0.016	1.281	2.972	2.9	1/16	NP	NP
beta-BHC	2/16	0.017	0.018	0.018	3.20	0/16	0.004	2/6
Dieldrin	10/16	0.027	0.106	0.420	0.36	1/16	0.002	10/16

Note: Data summarized from *The Nature and Extent of Contamination at the Lake Calumet Cluster Site* (E & E 1999b).

Key:

RBC = Risk-based concentration.
FoE = Frequency of exceedance.
NP = Information not provided or calculated.

Source:

[a] U.S. EPA Region 3 human health risk-based screening concentrations for soil for commercial or industrial use (October 1998).

[b] U.S. EPA Region 5 Resource Conservation and Recovery Act Division’s Ecological Data Quality Levels (April 1998).

Table 1-3 Summary of Subsurface Soil Analytical Results (4 to 6 Feet Below Ground Surface) for Contaminants of Potential Concern

Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Compound	Frequency of Detection	Minimum Detection	Average Detection	Maximum Detection	Region 3 Human Health RBC[a]	Number of Samples Exceeding RBC	RCRA EDQL[b]	Number of Samples Exceeding RCRA EDQL
Metals (micrograms per kilogram)								
Arsenic	1/15	17.100	17.100	17.100	3.8	1/15	5.70	1/15
Barium	15/15	16.800	107.087	275.000	14,000	0/15	1.04	15/15
Chromium	15/15	3.960	51.017	336.000	NP	NP	0.4	15/15
Lead	15/15	7.730	427.062	2,950.000	NP	NP	0.45	15/15
Mercury	13/15	0.029	0.645	3.820	610	0/15	0.008	13/15
Volatile Organic Compounds (milligrams per kilogram)								
Naphthalene	14/14	0.250	9.020	44.000	4,100	0/14	0.10	14/14
Semivolatile Organic Compounds (milligrams per kilogram)								
Benzo(a)pyrene	13/14	0.070	2.354	11.000	0.78	8/14	1.52	5/14
Benzo(a)anthracene	14/14	0.060	2.149	12.000	7.80	1/14	5.21	1/14
Dibenz(a,h)anthracene	12/14	0.029	0.752	2.000	0.78	4/14	18.4	0/14
PCBs/Pesticides (milligrams per kilogram)								
Aroclor 1254	5/14	0.263	1.299	3.552	2.90	1/14	NP	NP
beta-BHC	5/14	0.007	0.087	0.380	3.2	0/14	0.004	5/14
Dieldrin	9/14	0.005	0.051	0.160	0.36	0/14	0.002	9/14

Note: Data summarized from *The Nature and Extent of Contamination at the Lake Calumet Cluster Site* (E & E 1999).

Key

RBC = Risk-based concentration.
NP = Information not provided or calculated.

Source:

[a] U.S. EPA Region 3 human health risk-based screening concentrations for soil for commercial or industrial use (October 1998).

[b] U.S. EPA Region 5 Resource Conservation and Recovery Act Division's Ecological Data Quality Levels (April 1998).

Table 1-4 Summary of Sediment Sample Analytical Results for Contaminants of Potential Concern Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Compound	Frequency of Detection	Minimum Detection	Average Detection	Maximum Detection	RCRA EDQL[a]	Number of Samples Exceeding RCRA EDQL
Metals (milligrams per kilogram)						
Arsenic	26/27	4.900	17.015	104	5.9	24/27
Barium	27/27	42.400	156.822	582	NP	NP
Cadmium	24/27	0.200	2.813	8.9	0.596	21/27
Chromium	27/27	20.000	96.737	537	26	26/27
Lead	27/27	23.500	184.374	725	31	26/27
Manganese	20/20	419.000	915.850	1,670	NP	NP
Mercury	13/27	0.098	0.369	0.90	0.174	11/27
Nickel	20/20	24.3	35.385	49.4	16	20/20
Semivolatile Organics (milligrams per kilogram)						
Anthracene	26/27	0.190	0.557	1.3	0.03	26/27
Benzo(a)pyrene	26/27	0.160	0.611	1.5	0.03	26/27
Benzo(a)anthracene	26/27	0.190	0.557	1.3	0.03	26/27
Chrysene	26/27	0.230	0.688	1.7	0.06	26/27

Note: Data summarized from *The Nature and Extent of Contamination at the Lake Calumet Cluster Site* (E & E 1999b).

Key:
NP = Information not provided or calculated.

Source:
[a] EPA Region 5 Resource Conservation and Recovery Act Division's Ecological Data Quality Levels (April 1998).

Table 1-5 Summary of Surface Water Sample Analytical Results for Contaminants of Potential Concern Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Compound	Frequency of Detection	Minimum Detection	Average Detection	Maximum Detection	OSWER[a] EcoTox	Number of Samples Exceeding OSWER Ecotox	RCRA[b] EDQL	Number of Samples Exceeding RCRA EDQL
Metals (milligrams per kilogram)								
Barium, dissolved	4/4	0.036	0.148	0.285	0.004	4/4	5	0/4
Barium, total	25/25	0.049	0.108	0.358	0.004	25/25	5	0/25
Iron, dissolved	4/4	0.054	0.195	0.523	1	0/4	NP	NP
Iron, total	25/25	0.084	0.909	6.580	1	7/25	NP	NP
Lead, total	7/25	0.003	0.022	0.107	0.002	7/25	0.001	7/25
Manganese, dissolved	4/4	34.7	56.000	75.8	NP	NP	NP	NP
Manganese, total	25/25	35.3	52.004	73.9	NP	NP	NP	NP
Pesticides (milligrams per kilogram)								
4,4'-DDD	2/25	0.00001	0.00002	0.00003	NP	NP	1.1E-6	2/25
Heptachlor	3/25	0.00001	0.0001	0.0003	6.9E-6	3/25	3.9E-7	3/25

Note: Data summarized from *The Nature and Extent of Contamination at the Lake Calumet Cluster Site* (E & E 1999b).

Key:

NP = Information not provided or calculated.

Source:

[a] EPA Region 5 Resource Conservation and Recovery Act Division's Ecological Data Quality Levels (April 1998).

[b] EPA Office of Solid Waste and Emergency Response ecological and toxicological thresholds (January 1996).

Table 1-6 Comparison of Test Pit Soil Analytical Data to TACO Cleanup Objectives Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Parcel	Alburn Incinerator				U.S. Drum II				Unnamed Parcel			
Compound	**Maximum Detected Concentration**	**a**	**b**	**c**	**Maximum Detected Concentration**	**a**	**b**	**c**	**Maximum Detected Concentration**	**a**	**b**	**c**
Inorganics (milligrams per kilogram)												
Antimony	1,020	X		X	218	X		X	Not Detected			
Arsenic	151	X		X	82.5	X		X	99.9	X		X
Beryllium	8.4	X		X	2.5	X			3.0	X		
Chromium (Total)	1,730	X		X	1,070	X			1,620	X		
Lead	6,730	X		X	5,090	X			5,710	X		
Manganese	40,500	X		X	30,600	X			13,000	X		
Volatile Organic Compounds (milligrams per kilogram)												
1,1,1-Trichloroethane	ND				ND				52,000		X	X
1,1-Dichloroethane	ND				ND				440		X	X
1,2-Dibromo-3-chloropropane	ND				ND				470		X	X
1,2-Dichloroethane	ND				14	X		X	720		X	X
Benzene	92		X	X	20	X		X	ND			
Carbon disulfide	14		X	X	ND				ND			
Chlorobenzene	47		X	X	120	X		X	180		X	X
Chloroform	ND				6	X		X	ND			
Ethylbenzene	5,000		X	X	260	X		X	1,800		X	X
Methylene chloride	400		X	X	ND				470		X	X
Tetrachloroethene	360		X	X	28	X		X	ND			
Toluene	3,700		X	X	730	X		X	8,900		X	X
Trichloroethene	370		X	X	ND				460		X	X
Vinyl chloride	0.26		X	X	0.23	X		X	ND			
Xylenes	25,000		X	X	950	X		X	56,000		X	X
Semivolatile Organic Compounds (milligrams per kilogram)												
Benzo(a)anthracene	67	X		X	100	X		X	310	X		X
Benzo(a)pyrene	37	X		X	55	X		X	250	X		X
Benzo(b)fluoranthene	72	X		X	71	X		X	350	X		X
Benzo(k)fluoranthene	ND				ND				150	X		X

Table 1-6 Comparison of Test Pit Soil Analytical Data to TACO Cleanup Objectives
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Parcel	Alburn Incinerator				U.S. Drum II				Unnamed Parcel			
Compound	**Maximum Detected Concentration**	**a**	**b**	**c**	**Maximum Detected Concentration**	**a**	**b**	**c**	**Maximum Detected Concentration**	**a**	**b**	**c**
bis(2-Chloroethyl) Ether	0.68	X		X	ND				ND			
bis(2-Ethylhexyl) phthalate	ND				480	X		X	ND			
Dibenz(a,h)anthracene	11	X		X	9.1	X		X	59	X		X
Indeno(1,2,3-cd)pyrene	24	X		X	22	X		X	140	X		X
Pesticides/Herbicides (milligrams per kilogram)												
alpha-BHC	ND				ND				1.7	X		X
Heptachlor	ND				ND				2.8	X		X

Note: Data summarized from *Comprehensive Site Investigation Report, Lake Calumet Cluster Site: Alburn, U.S. Drum, and Unnamed Parcel Areas* (Harza Engineering Company, May 2001).

[a] TACO Tier 1 Soil Remediation Objective for Industrial-Commercial Ingestion Exposure Route.
[b] TACO Tier 1 Soil Remediation Objective for Industrial-Commercial Inhalation Route.
[c] TACO Tier 1 Soil Remediation Objective for the Soil Component of the Class I Groundwater Ingestion Exposure Route.

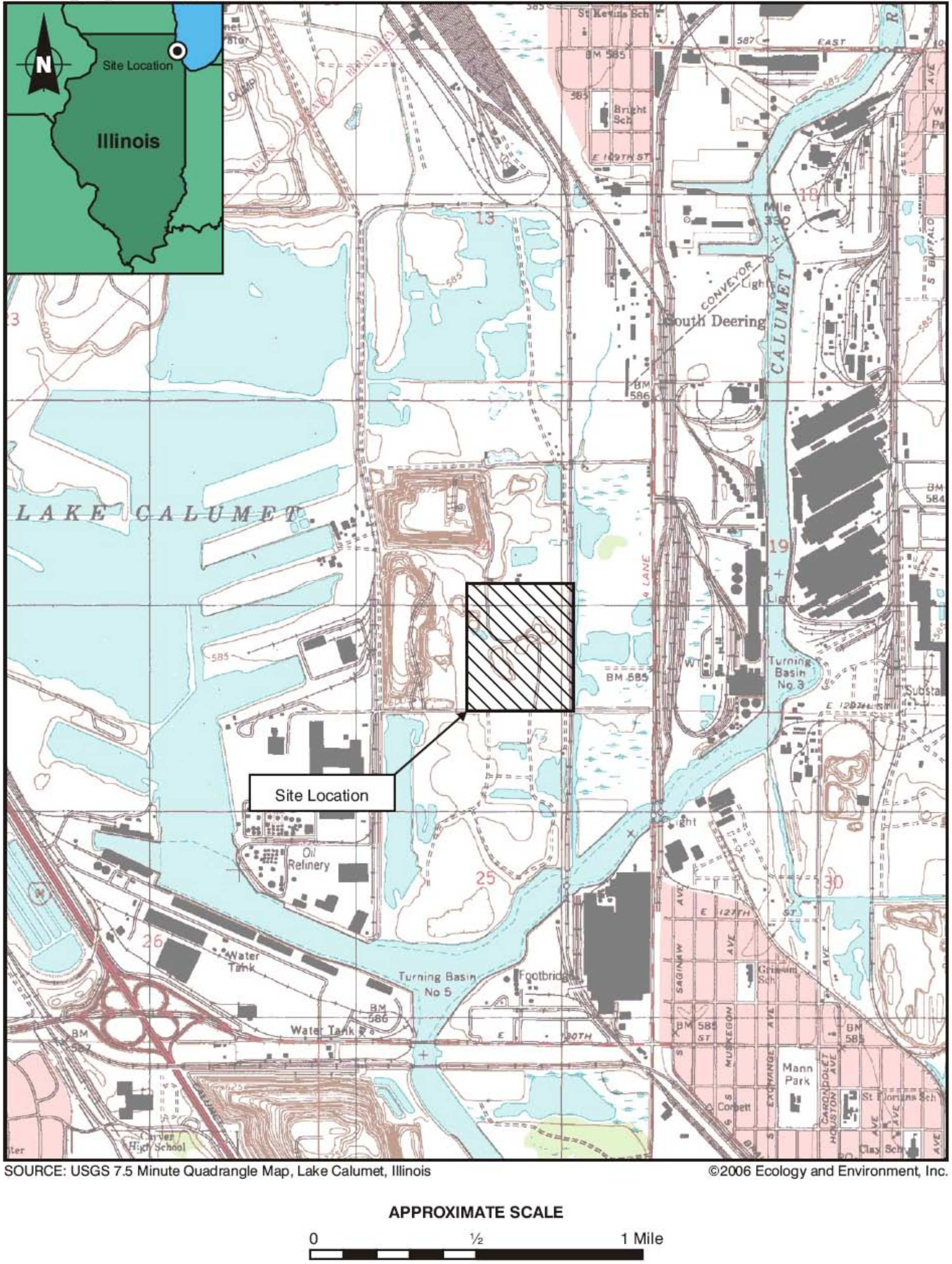
Key:

TACO = Tiered Approach to Corrective Action Objectives.
ND = Not detected at a concentration above the TACO Industrial-Commercial Ingestion or Exposure Route Objective.
X = Exceeds Soil Remediation Objective for exposure pathway indicated.

Table 1-7 Summary of Human Health Risk Estimates

Environmental Medium	On-Site Worker	Construction Worker	Industrial/ Commercial Worker	Mower	Landscape Worker	Risk Drivers
Alburn Area						
Total Excess Lifetime Cancer Risks						
Soil	**5E-6**	**2E-6**	**2E-5**	**1E-5**	**2E-6**	Arsenic, benzene, benzo(a)pyrene, total PCBs, vinyl chloride
Groundwater	8E-7	3E-8	8E-7	NA	NA	
Surface Water	3E-9	1E-10	3E-9	NA	NA	
Sediment	2E-7	9E-9	2E-7	NA	NA	
Total Noncancer Hazard Index						
Soil	2E-2	**3E+0**	2E-1	4E-2	8E-1	Toluene
Groundwater	1E-2	1E-1	1E-2	NA	NA	
Surface Water	4E-5	4E-4	4E-5	NA	NA	
Sediment	1E-3	1E-2	1E-3	NA	NA	
U.S. Drum Area						
Total Excess Lifetime Cancer Risks						
Soil	**1E-5**	**3E-6**	**5E-5**	**3E-5**	**4E-6**	Arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, total PCBs
Groundwater	4E-7	1E-8	4E-7	NA	NA	
Surface Water	9E-10	4E-11	9E-10	NA	NA	
Total Noncancer Hazard Index						
Soil	1E-2	9E-1	6E-2	3E-2	2E-1	None
Groundwater	3E-3	4E-2	5E-4	NA	NA	
Surface Water	2E-5	3E-4	4E-6	NA	NA	
Unnamed Parcel						
Total Excess Lifetime Cancer Risks						
Soil	**3E-6**	1E-6	**2E-5**	**1E-5**	1E-6	Arsenic, benzo(a)pyrene
Groundwater	2E-7	9E-9	2E-7	NA	NA	
Total Noncancer Hazard Index						
Soil	1E-2	6E-1	5E-2	2E-2	1E-1	None
Groundwater	4E-4	4E-3	4E-4	NA	NA	

02:001200_IL13_02-Brown\Fig1-1.cdr-03/08/06-GRA



SOURCE: USGS 7.5 Minute Quadrangle Map, Lake Calumet, Illinois

©2006 Ecology and Environment, Inc.

Figure 1-1 SITE LOCATION MAP
LAKE CALUMET CLUSTER SITE
CHICAGO, ILLINOIS

SOURCE: Ecology and Environment, Inc., 2006.

Figure 1-2 AERIAL SITE VIEW
LAKE CALUMET CLUSTER SITE
CHICAGO, ILLINOIS

2

Identification and Screening of Technologies

2.1 Introduction

This section presents the first phase of the FFS process for the Lake Calumet Cluster site. The first step in developing remedial alternatives is to establish remedial action objectives (RAOs). Thus, for each medium of interest at the site, RAOs that will protect both human health and the environment are established. These objectives are typically based on COPCs and contaminants of potential ecological concern (CPECs), applicable or relevant and appropriate requirements (ARARs), and the findings of the human health and ecological risk evaluations. General response actions describing measures that will satisfy the remedial action objectives are then developed. This includes estimating the areas or volumes to which the response actions may be applied. Finally, remedial technologies applicable to each action are identified and discussed with respect to their effectiveness and implementability. The applicable technologies are then assembled into medium-specific remedial alternatives in Section 3.

2.2 Remedial Action Objectives

2.2.1 Development of Remedial Action Objectives

Based on the Human Health Risk Evaluation, Ecological Risk Evaluation, and potentially complete exposure pathways, the following list of RAOs was developed for protection of human health and the environment:

1. Prevent direct and dermal contact with, and ingestion of, contaminated soil/landfill contents;
2. Prevent inhalation of dust;
3. Minimize or eliminate contaminant leaching to groundwater aquifers;
4. Prevent ingestion, adsorption, and bioconcentration of on-site surface water and sediment;
5. Provide groundwater monitoring of the contaminant plume;
6. Prevent explosions from accumulations of LFG; and
7. Prevent inhalation of COPCs present in the LFG in excess of benchmark concentrations.

Selected RAOs are consistent with those presented in *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA/540/P-91/001). Groundwater remedies and development of groundwater RAOs are not included as part of this FFS.

2.2.2 ARARs and Other Policies and Guidance "To Be Considered"

Prior to implementing a remedial action, the federal, state, and local regulatory requirements that may be pertinent to such an action must be identified. Such requirements may guide or impact the selection of a remedial approach. In the course of conducting the FFS for the LCC site, EEEI identified ARARs as well as other “To Be Considered” criteria (TBCs) from policy or guidance documents that may be pertinent to evaluating and implementing remedial options.

Requirements typically fall into three categories: chemical-specific, location-specific, and action-specific ARARs. Chemical-specific ARARs set health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances. During the planning process, these requirements are used to establish site cleanup levels or to provide a basis for calculating cleanup levels for the media of interest. They are also used to define an acceptable level of discharge, for sites where discharge is necessary, which will determine the treatment and disposal requirements, and to assess the effectiveness of the remedial alternatives. During implementation of a remedial action, chemical-specific ARARs are used to define acceptable exposure levels.

Location-specific requirements set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on Federal and State siting laws for hazardous waste facilities, proximity to wetlands or floodplains, or proximity to manmade features such as existing landfills, disposal areas, and historic buildings.

Action-specific requirements are triggered by the particular remedial activities that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs that specify performance levels, actions, or technologies, as well as specific levels for discharge of residual chemicals, provide a basis for assessing the feasibility and effectiveness of the remedies.

2.2.2.1 Chemical-Specific ARARs and TBCs

A list of potential chemical-specific ARARs and TBCs for the LCC site are provided in Table 2-1, accompanied by a brief discussion of applicability to the site. For the LCC site, the anticipated interim remedial actions may include consolidation of waste and capping. For areas where waste will be removed, chemical-specific ARARs would include those that pertain to cleanup goals to determine that sufficient material has been removed and remaining soils do not pose significant risks to the environment. Chemical-specific ARARs for the LCC site also include solid waste management regulations, Clean Water Act regulations, air regulations for flaring of landfill gas, and the Toxic Substances Control Act for establishing PCB cleanup goals. Those ARARs are summarized in Table 2-1.

2.2.2.2 Location-Specific ARARs and TBCs

A list of potential location-specific ARARs and TBCs for the LCC site is provided in Table 2-2. Location-specific ARARs include the Federal Endangered Species Act, as well as State of Illinois surface water, floodplain, and wetlands requirements.

The Federal Endangered Species Act (ESA) requires action to avoid jeopardizing the continued existence of listed threatened and endangered (T&E) species, or destroying or adversely modifying critical habitat. The ESA requires federal agencies to consult or confer with other agencies such as the U.S. Fish and Wildlife Service (FWS), the National Oceanic and Atmospheric Administration (NOAA), and the National Marine Fisheries Service. State requirements also require consultation with the Illinois Department of Natural Resources. Although no T&E species have been identified at the site, there are T&E species in nearby water bodies, and any remedial action taken at the LCC site must minimize any negative impacts to those habitats from site activities.

Section 303.441 of Title 35 of the Illinois Administrative Code (IAC) designates the Little Calumet River, the Grand Calumet River, and Lake Calumet as secondary contact and indigenous aquatic life waters (as opposed to drinking water sources). Therefore, the water quality standards that apply to these water bodies are specified in Part 302 Subpart D, including standards for pH, dissolved oxygen, chemical constituents, and toxic substances. These requirements may be applicable to wastewater discharges generated in the course of the remedial action.

The site is located adjacent to wetland areas, and the Illinois wetland ARARs typically apply to the siting of new facilities. However, based on reviews of the Federal Emergency Management Association’s National Flood Insurance Program Flood Insurance Rate Map, the LCC site does not lie within the boundaries of the 100-year floodplain. Therefore, the LCC site is not subject to 35 IAC 703.184, 724.118, 811.102, and 811.302, and these codes are not considered as ARARs for the site.

2.2.2.3 Action-Specific ARARs and TBCs

A list of potential action-specific ARARs and TBCs for the LCC site is provided in Table 2-3. Action-specific ARARs include final cover requirements, U.S. Department of Transportation (DOT) shipping regulations, Occupational Safety and Health Administration (OSHA) regulations, NPDES requirements (40 CFR 122), Discharge of Stormwater Runoff (40 CFR 122.26), and RCRA Subtitle C requirements for hazardous waste landfills (e.g., requires cap permeability of 10^{-7} centimeters per second [cm/sec]). Title 35, Illinois Administrative Code, Part 212, Subpart K is relevant and appropriate for control of air emissions (fugitive particulate and visible emission standards for excavation of soil and staging in piles), and requires that standards of care be used during implementation (e.g., control of fugitive dust through spraying of water).

Chapter 11-4 of the Municipal Code of the City of Chicago pertains to Environmental Protection and Control. Specific sections regarding waste management, hazardous waste management, visible air emissions, and noise are “ to be considered” for the planned remedial actions. Landfill operations require a city permit; waste handling and the disposal of wastes generated in the course of a remedial action must comply with waste management requirements. Likewise, air emissions, including visible emissions, must be controlled during the remedial action. Municipal codes also restrict noise levels and hours of operation for heavy equipment.

Illinois Pollution Control Board Cover Requirements

The state of Illinois has three distinct sets of requirements for the design of cover systems for landfills. They are 35 IAC 811, 817, and 724. Major components of each cover system are described below.

35 IAC 811

Title 35 IAC 811 contains the standards for all new landfills, with Subpart C containing standards for landfills receiving chemical and putrescible wastes. Subpart C also contains the requirements for the final cover.

Under 35 IAC 811.314 (Final Cover System), the landfill must be covered by a final cover consisting of a low-permeability layer overlain by a final protective layer.

The technical standards for the low-permeability layer are:

- The low-permeability layer must cover the entire unit and connect with the liner system.

- The low-permeability layer must consist of one of the following:

1. A compacted earth layer constructed to a minimum allowable thickness of 3 feet, and the layer must be compacted to achieve a permeability of 1×10^{-7} cm/sec and must minimize void spaces.

2. A geomembrane, which must provide performance equal or superior to the compacted earth layer described above. The geomembrane must have the strength to withstand the normal stresses imposed by the waste stabilization process and be placed over a prepared base free from sharp objects and other materials that may cause damage.
3. Any other low-permeability layer construction techniques or materials, provided that they provide equivalent or superior performance to the requirements of the earthen system.

The technical standards for the final protective layer are:

- The final protective layer must cover the entire low-permeability layer.
- The thickness of the final protective layer must be sufficient to protect the low-permeability layer from freezing and minimize root penetration of the low-permeability layer, but must not be less than 3 feet.
- The final protective layer must consist of soil material capable of supporting vegetation.
- The final protective layer must be placed as soon as possible after placement of the low-permeability layer to prevent desiccation, cracking, freezing, or other damage to the low-permeability layer.

Finally, the cover must be protective of human health and the environment.

While the LCC site is not a new landfill, various sections of the site have received chemical wastes in addition to municipal wastes. Therefore, 35 IAC 811 has been included as an ARAR.

35 IAC 817

Title 35 IAC 817 contains the standards that apply exclusively to the non-putrescible wastes produced by the steel and foundry processes covered by various Standard Industrial Classification (SIC) Codes.

The State of Illinois may approve the use of iron- and steel-making slags and foundry sands for land reclamation purposes upon a demonstration by the owner or operator that such use will not cause an exceedance of the applicable groundwater quality standards specified in 35 IAC 620.

Under 35 IAC 817, there are two standards for a final cover. The first (35 IAC 817.303) is for steel slags and sands, which may have a reuse value, and the second (35 IAC 817.410) is for low-risk wastes. For the purposes of this FFS, the more stringent cover design (35 IAC 817.410) will be used.

The requirements set forth under 35 IAC 817.410 are same as those set forth under 35 IAC 811.314 with the following exceptions:

- The low-permeability layer, if constructed of earthen material, shall be a minimum of 2 feet thick.

- The protective layer shall have a minimum thickness of 1.5 feet.

Given that slag may be imported from local steel mills to be used as part of a gas collection system, the requirements of 35 IAC 817 are considered to be relevant.

35 IAC 724

This standard is for owners and operators of hazardous waste treatment, storage, and disposal facilities. Its purpose to establish minimum standards that define the acceptable management of hazardous waste.

Section 724.410 (Closure and Post-Closure Care) defines the minimum requirements for landfill covers, which are:

- Provide long-term minimization of migration of liquids through the closed landfill;

- Function with minimum maintenance;

- Promote drainage and minimize erosion or abrasion of the cover;

- Accommodate settling and subsidence so that the cover's integrity is maintained; and

- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

At the LCC site, there is no manmade or installed liner system. Waste material was placed at and/or beneath the water table, with the aquifer soil consisting primarily of fine silty sand. Located approximately beneath the aquifer is a clay lens, which acts as an aquitard. The characteristics of this clay layer across the site are poorly defined. Given that waste material is in direct contact with groundwater and the clay layer is not clearly defined, a standard hydraulic permeability cannot readily be established for this regulation.

While 35 IAC 724 was established to address hazardous waste treatment, storage, and disposal facilities, the EPA issued a technical guidance document, *Final*

Covers on Hazardous Waste Landfills and Surface Impoundments (EPA 1989), which can be used to establish the criteria for meeting the intent of 35 IAC 724.

The cover system presented in the EPA guidance document is a multilayer design consisting of a vegetated top layer, drainage layer, and low-permeability layer. It should be noted that within the document, it is stated that the recommendations for the proposed cover design are guidance only and not regulations.

The guidance document recommends the following cap design:

- A top layer of at least 60 centimeters of soil either vegetated or armored at the surface;
- At a minimum, a 12-inch-thick granular or geosynthetic drainage layer with a hydraulic transmissivity of not less than 3 x 10^{-5} square centimeters per second (cm^2/sec); and
- A two-component low-permeability layer composed of a 20-millimeter-thick flexible membrane liner (FML) installed directly on a 24-inch-thick compacted soil layer having a hydraulic conductivity no greater than 1 x 10^{-7} cm^2/sec.

It also states that optional layers may be needed (i.e., biotic barrier, gas vent layer, etc.).

As stated above, the guidance document recommends the low-permeability layer to be a two-part system, which consists of an FML and a compacted soil layer. While a two-part low-permeability layer is recommended, it is not required. To further support a single, low-permeability layer system, the State of Illinois's 92nd General Assembly directed the Illinois EPA to study the merits and effectiveness of multiple liner systems at Illinois landfills and provide a recommendation on the advisability of requiring multiple liner systems. The report, *A Study of the Merits and Effectiveness of Alternate Liner Systems at Illinois Landfills*, recommends against modifying the Illinois regulations to change the minimum liner design requirement from a single liner to a double-composite liner. Finally, 35 IAC 724 does not require a multicomponent low-permeability layer.

By using recommendations of the EPA guidance document, the minimum Federal standards for a hazardous waste cover can be stated as:

- Provide long-term minimization of migration of liquids through the closed landfill;

- Function with minimum maintenance;
- Promote drainage and minimize erosion or abrasion of the cover;
- Accommodate settling and subsidence so that the cover's integrity is maintained;
- At a minimum, use a 12-inch-thick granular or geosynthetic drainage layer with a hydraulic transmissivity of not less than 3×10^{-5} cm^2/sec; and
- The low-permeability layer shall be composed of not less than a 24-inch-thick compacted soil layer having a hydraulic conductivity not greater than 1×10^{-7} cm^2/sec.

Since isolated areas of LCC site soils are classified as characteristic hazardous waste based on previous TCLP analysis of site soils, and since the site has a history of waste products being brought to the site for disposal, 35 IAC 724 and 811 are considered to be relevant and appropriate.

In addition to the ARARs associated with the cap construction, there are ARARs associated with post-closure care. For a cap placed on a hazardous waste landfill, 35 IAC 724.410 would be considered an ARAR, and, for a non-hazardous waste landfill, 35 IAC 811.110, 811.111, and 811.314 would be considered ARARs. Post-closure care includes scheduled inspections and repairs (if necessary) to ensure the cap integrity is maintained; groundwater monitoring of the contaminant plume; and placement of deed restrictions.

While the LCC site does not readily fit into a single category with regard to landfill covers and/or post-closure requirements, all three regulations have requirements that are relevant to the final presumptive remedy of capping. In evaluating the various alternatives in Section 4, the discussion will focus on the ability of individual alternatives to meet these regulations.

RCRA and Waste Management

RCRA provides guidelines for the control of hazardous waste from generation through transportation, treatment, storage, and disposal. The Illinois Administrative Code adopts the Federal regulations. RCRA guidelines pertain to the identification of hazardous waste (40 CFR 261). If all waste at the LCC site is incorporated into a capped unit, and no waste is transported off site, these requirements will not apply. However, if residual wastes are generated in the course of the remedial action (e.g., rinsate from decontamination of heavy equipment that comes in contact with hazardous waste), and such waste must be transported off site for disposal, these requirements would apply. While consolidation will be kept to a minimum and the majority of excavation spoils will remain on site, there may be some materials that require off-site disposal that will need to be characterized for proper treatment/disposal. Those wastes that contain a RCRA-listed constituent or exhibit hazardous characteristics would have to be managed, treated, and disposed of as hazardous waste. Activities involving hazardous waste must comply with Illinois requirements listed in Table 2-3. Activities involving wastes determined to be non-hazardous must comply with Illinois requirements for solid waste management.

Clean Water Act

The Federal Clean Water Act (CWA), adopted under Illinois water pollution laws, regulates the discharge of pollutants to surface waters of the State and may be applicable to remedial activities because of the proximity of the site to Lake Calumet and the Calumet River and the potential discharge of surface runoff during the remedial action. Any discharge from the site that could impact surface water bodies would need to comply with chemical-specific discharge limits (as discussed above).

As noted previously, Section 303.441 of Title 35 of the Illinois Administrative Code designates the Little Calumet River, the Grand Calumet River, and Lake Calumet as secondary contact and indigenous aquatic life waters (as opposed to drinking water sources). Therefore, the standards that apply to these water bodies are specified in Part 302 Subpart D, including standards for pH, dissolved oxygen, chemical constituents, and toxic substances. For a remedial action to meet this ARAR, it must limit any surface runoff of contamination from the site that would lead to an exceedance of the water quality criteria for these water bodies.

Subpart A of 35 IAC Section 304 establishes general effluent standards. Section 304.141 requires that any discharge of wastewater comply with effluent limits stipulated in a facility’s NPDES permit, and forbids discharge of any pollutant for which a facility does not have permit-established effluent standards that would cause violation of water quality standards in a receiving water body. These requirements would be applicable to the discharge of any wastewater to surface waters during the course of the remedial action or after completion of the remedial action.

Clean Air Act

The Federal Clean Air Act (CAA), adopted under Illinois law, regulates the discharge of pollutants to the air of the State. The CAA may be applicable to remedial activities because landfill gas will be collected at the LCC site with the vacuum and subsequent treatment provided by the Paxton II Landfill flare system, which is located to the immediate north of the site.

Therefore, 35 IAC 811.311 (Landfill Gas Management System) outlines the actual construction and performance requirements associated with the gas extraction system. Treatment, discharge and the associated permits for emitting combusted landfill gas to the atmosphere would be covered under 35 IAC 811.312 (Landfill Gas Processing and Disposal System). Given that the flare system at Paxton will be used, and no additional equipment outside of the collection header piping and valves would be installed at the LCC site, an air permit for the LCC site would not be required. However, 35 IAC 811.312 is still considered to be relevant because a permit modification may have to be obtained to add the LCC site landfill gas to the influent gas generated at Paxton II.

Additionally, 35 IAC 811.312 further references that the discharge permit from a flare system must include the six criteria air pollutants and the hazardous air pollutants subject to regulation under the Clean Air Act (42 U.S. C. 7401 et seq.). Finally, the air discharge permit must also meet the requirements of 35 IAC 200 through 245.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) addresses the manufacture, handling, and disposal of specific toxic substances, including PCBs. Because PCBs have been detected at significant concentrations at the LCC site, TSCA requirements apply to actions addressing PCB-containing materials.

The ARARs and TBCs identified in Tables 2-1, 2-2, and 2-3 enter into the evaluation of remedial alternatives, discussed in Section 4 of this report. The list of ARARs and TBCs will be refined as a preferred alternative is selected, and final ARARs will be presented in the Interim Remedial Action Record of Decision (IROD).

2.2.3 Cleanup Goals

The final step required for the development of RAOs is to establish cleanup goals based on chemical-specific ARARs, TBCs, and COPCs and CPECs. The aim of remedial action objectives is to meet ARARs and eliminate exposure to contaminants of concern such that human health and the environment are adequately protected. This can be achieved by eliminating exposure pathways (which is discussed in the upcoming Section 2.3, Identification of General Response Actions) or reducing contaminant concentrations to levels that are accepted to be adequately protective of human health and the environment.

This FFS follows the presumptive remedy for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) municipal landfill sites and focuses on capping to eliminate exposure pathways. Therefore, establishing cleanup concentrations by review of state and federal laws, regulations, and guidance documents, and identification of any chemical-specific ARARs or TBCs, is not necessary. Furthermore, no chemical-specific cleanup goals will be established for LFG in this FFS since a collection system will be proposed that will also limit any exposure pathways.

2.3 Identification of General Response Actions

Based on the information derived from previous investigations, general response actions are identified for each medium of interest. General response actions can be considered conceptual alternatives for each medium of interest that will satisfy the remedial action objectives. The “no-action” alternative is included as a general response action for each medium of interest to serve as a basis for comparison with other potential response actions.

2.3.1 Soil and Waste

The general response actions for soil identified in this section address the pathways of direct contact (e.g., inhalation, dermal adsorption, and ingestion) and leaching. Containment (capping) would prevent direct contact with potential receptors and reduce leachate production resulting from surface water infiltration. Excavation, treatment, and disposal would remove, immobilize, or destroy waste material and soil contaminants, as well as remove the source of contamination. Excavation, treatment, and disposal would eliminate the potential for direct contact with the wastes, and leaching of contaminants into groundwater. The no-action alternative would leave the soils and wastes in their present condition, but may include institutional controls (e.g., fencing or deed restrictions), which would limit site access, thereby reducing the potential for exposure to contaminants.

2.3.2 Groundwater

Groundwater response actions are not being considered in this document. However, groundwater monitoring will be a component of the operations and maintenance for the selected remedy.

2.3.3 Leachate

Leachate response actions are not being considered in this document other than preventing/reducing the amount of leachate generation.

2.3.4 Landfill Gas

General response actions for LFG include gas collection and/or treatment, institutional actions, and no action. Except for the no-action response, these response actions would reduce exposure of the public to emissions exceeding benchmark concentrations for the COPCs. The no-action alternative would allow for continued dissipation of LFG. Under this FFS, response actions are only considered when necessary to protect capping systems or to prevent off-site lateral migration.

2.3.5 Surface Area and Volume Estimation of Contaminated Media

Land Disposal Areas and Volumes

The surface area of the site was obtained using the boundaries established in a 1999 aerial photograph obtained from Patrick Engineering Inc. Based on this aerial photograph and adding to the north boundary to tie into the Paxton I landfill cap, it is estimated that the site encompasses an area of approximately 90 acres. Total fill volumes were obtained from estimates in Clayton Group Services, Inc.'s (Clayton's) *Remedial Options Report for the Southeast Chicago Cluster Site*, Volume 1 of 2. Reported fill areas are estimated to be up to 30 feet in depth; based on this value and using a site area of 76 acres, Clayton estimated a total fill volume in excess of 4.75 million cubic yards (Clayton 2002).

Gas Production Rates

Methane gas production in landfills can be associated with the anaerobic decomposition of organic materials in the landfill and depends on the moisture content of the waste. (The highest generation rates occur between 60% and 80% saturation.) Since significant concentrations of organic vapors were documented during the test pit excavations, for the purposes of this FFS it has been assumed that methane is being generated and that a gas collection system will be required. It should also be noted that a methane survey may be performed at the site as part of the engineering design effort.

2.4 Identification of Applicable Remedial Technologies

Applicable remedial technologies are identified below for each general response action. The section has been refined by retaining only those remedial technologies appropriate for the LCC site, taking into account the following:

- Site conditions and characteristics that may affect implementability of the technology;
- Physical and chemical characteristics of contaminants that determine the effectiveness of various technologies; and
- Performance and operating reliability of the technology.

2.4.1 Soil and Waste

Existing site information was reviewed to determine future probable property use. As indicated by the site history and analytical results from site investigations, the site consists of multiple disposal areas generally extending to a depth of 30 feet. The agglomeration of disposal areas makes up what could be considered a non-permitted landfill. The most likely future use of the property is as open space. This evaluation assumes that the site would not be accessible to people with the exception of periodic on-site operations and maintenance (O&M) work.

The first step in the development of remedial alternatives was to screen available, viable remedial technologies that could be applied to the site. The list of potential remedial technologies was quickly narrowed because VOCs, SVOCs, and metals were all present above acceptable risk levels at the site. Most technologies currently available are not able to address both organics and inorganic contamination. Additionally, the various organics present in at the site are generally remediated by different methods (i.e., anaerobic degradation for tetrachloroethene (PCE) and aerobic degradation for benzene). The immense volume of waste present at the site (in excess of 4.75 million cubic yards assuming a total depth of 30 feet [Clayton 2002]) makes any option focused on removal or treatment of the total volume economically infeasible. Technologies that were considered but eliminated during the initial screening include:

1. Bioremediation;
2. Chemical destruction/detoxification (oxidation/reduction, dehalogenation, neutralization);
3. Thermal treatment (incineration, in situ vitrification, pyrolysis);
4. Chemical/physical extraction (soil vapor extraction, soil flushing, soil washing);
5. Thermal desorption (low temperature thermal desorption, steam stripping);
6. Immobilization (stabilization/solidification, fixation); and
7. Soil aeration.

Although not technically a landfill, the LCC site has the same characteristics as a non-permitted abandoned landfill. The permeable cover allows substantial infiltration of water through the waste, contaminated shallow groundwater is present possibly due to this infiltration, regional shallow groundwater flow is present, and contaminant types (i.e., organics, metals, pesticides, etc.) are not specific to a particular area due to widespread dumping of various wastes. Because of the uncertainty about specific site contents and their location, it is impossible to fully characterize, excavate, and/or treat independent source areas. Characterization of landfill contents is not necessary for selecting a remedial option, but existing data are used to determine whether the containment presumption is appropriate. Based on the similarities, the site is a prime candidate for evaluating the presumptive remedies developed by the EPA for abandoned or inactive landfills. The EPA, in its guidance document entitled *Presumptive Remedy for CERCLA Municipal Landfill Sites* (1993), has indicated that the presumptive remedies for source containment at a landfill site include:

1. Landfill cap;
2. Source area groundwater control to contain the plume;
3. Leachate collection and treatment;
4. Landfill gas collection and treatment; and/or
5. Institutional controls to supplement engineering controls.

The screening process was completed by concluding that the remedial alternatives to be evaluated for the site would focus on the presumptive remedies for an inactive landfill. This FFS concentrates on landfill cover systems to prevent surficial migration and surface water infiltration. Horizontal and vertical barriers for controlling groundwater migration are beyond the scope of this document.

Alternatives for the site include a combination of approaches, all of which involve an engineered cover. Cover designs not considered include asphalt-, concrete-, and chemical-based covers. Soil covers, clay caps, and multi-layer caps are considered. A number of different variations of these elements are technically feasible; however, alternatives that include wide-spread excavation or consolidation of wastes are not evaluated. The alternatives evaluated include:

1. No Action;
2. Capping of existing wastes with a permeable soil cover;
3. Capping of existing wastes with an evapotranspiration (ET) cap;
4. Capping of existing wastes with a low-permeability 35 IAC Part 724 clay cap; and
5. Capping of existing wastes with a low-permeability 35 IAC Part 811 clay cap.

2.4.2 Landfill Gas

Remedial technologies for LFG are used to collect, remove, or treat gases generated by landfills. Disposal of LFG is accomplished by venting the treated or untreated LFG to the atmosphere. Applicable technologies include passive systems, active systems, thermal treatment, and physical treatment. Because an on-site flare that has the capacity to accept LFG from the LCC site is currently present on the Paxton II landfill, it will be assumed that an active gas collection system will be a component for all of the interim remedial action alternatives that have a low-permeability component.

2.4.3 Leachate

Leachate collection is not part of OU1 and is not discussed within this FFS.

2.4.4 Surface Water

Run-on and run-off management and collection systems are used to remove excess surface water from the cap and prevent infiltration through the low-permeability layers. Any remedy selected will be required to address surface water. Because of the large area to be drained, it is assumed that the water will need to be collected at several low points in catch basins. The catch basins would feed a system of underground piping that would drain to the low area at the northeast corner of the site. The surface water would then be combined with surface water from the Paxton I and Paxton II sites before flowing off the northwest corner of the Paxton II site to Lake Calumet. The option to discharge surface waters to Indian Ridge Marsh will also be explored during the design phase of the project.

2.4.5 Groundwater

Groundwater remediation is not part of OU1; however, groundwater monitoring will be a component of the operations and maintenance for any selected remedy.

2.4.6 Construction Quality Assurance Program

The CQA program ensures the structural stability and integrity of all components, proper construction of all components, and conformity of all materials used with design or other material specifications. A construction quality assurance (CQA) program is required in accordance with 35 IAC 724.119.

Table 2-1 Chemical-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
State Chemical-Specific ARARs and TBCs					
Illinois Environmental Protection Act, Pollution Control Board	Risk Based Cleanup Objectives	Title 35 IAC, Subtitle G, Chapter I, Subchapter f	Part 740 - Site Remediation Program Part 742 – Tiered Approach to Corrective Action Objectives	TBC	In areas where waste is removed, pertinent for establishing cleanup goals for remaining soils and engineered barriers
Federal Chemical-Specific ARARs and TBCs					
Clean Water Act 33 USC 1313	Federal Total Maximum Daily Loads (TMDLs)	40 CFR Part 130.7	Requires states to identify impaired waters and to establish TMDLs to ensure that water quality standards can be attained	Potentially Relevant	
Clean Air Act 33 USC 7401	Air Quality Standards	40 CFR Part	Establish Federal standards for various pollutants from both stationary and mobile sources	Potentially Applicable	
EPA Directive #9355.4-12, July 1994	Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites		Guides establishment of cleanup standards for lead	TBC	May be pertinent for lead in areas where waste will be removed for consolidation
RCRA Subtitle C	Groundwater Protection Standards	40 CFR 264.92-264.101	Sets standards for groundwater at RCRA facilities.	Not Applicable for this action	Cleanup of groundwater is not a goal of this interim action;
Toxic Substances Control Act	Rules for Cleanup of PCBs	40 CFR 761.125	Provides guidance on cleanup of PCB-contaminated materials	Potentially Applicable	Relevant for establishing cleanup goals for PCBs in areas where waste will be removed

Note: Some chemical-specific ARARs listed above are also discussed as action-specific ARARs. Some requirements can serve to establish remedial objectives as well as impact the actual implementation of a given remedial alternative.

Table 2-2 Location-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
State Location-Specific ARARs and TBCs					
Illinois Environmental Protection Act, Pollution Control Board	Secondary Contact Waters	Title 35 IAC, Section 303.441	Designates Lake Calumet and Calumet River as secondary contact and indigenous aquatic life waters	Potentially Relevant	For this category of surface waters, different water quality standards apply; pertinent for any wastewater discharges in the course of the remedial action
Illinois Endangered Species Protection Act, Illinois Department of Natural Resources	Endangered Species	Title 17 IAC, Part 1075	Requires consultation with DNR by other state/local agencies prior to acts that may affect T & E species	Potentially Applicable	Relevant if T&E species in vicinity of site
Illinois Interagency Wetlands Policy Act	Wetlands Protection	Title 17 IAC, Part 1090	Requires DNR review of any state-funded action that may impact wetlands	Potentially Relevant	
Illinois Department of Natural Resources	Floodplain Construction	Title 17 IAC, Part 3706	Restricts construction activities in floodplain	Not Applicable	
Federal Location-Specific ARARs and TBCs					
Executive Order No. 11990	Wetlands Protection	40 CFR § 6.302(a) and Appendix A	Minimizes impacts to wetlands.	Potentially Applicable	
Executive Order No. 11988	Floodplain Management	40 CFR § 6.302 and Appendix A	Regulates construction in floodplains.	Potentially Applicable	
Wild and Scenic Rivers Act	Waterway Protection	16 USC §§ 1271-1287 40 CFR § 6.302(e) 36 CFR Part 297	Establishes requirements to protect wild, scenic, or recreational rivers.	Not Applicable	No regulated rivers impacted
Wilderness Act	Wilderness Protection	16 USC 1311, 16 USC 668 50 CFR 53, 50 CFR 27	Limits activities within areas designated as wilderness or National Wildlife Refuge.	Not Applicable	Not a wilderness area

Table 2-2 Location-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Fish and Wildlife Coordination Act	Wildlife Protection	16 USC § 661 et seq. 40 CFR § 6.302(g)	Requires coordination with Federal and State agencies to provide protection of fish and wildlife.	Potentially Applicable	
Endangered Species Act	Species and Habitat Protection	16 USC §§ 1531-1543 50 CFR Parts 17, 402 40 CFR § 6.302(b)	Regulates the protection of threatened or endangered species.	Potentially Applicable	Relevant if T&E species are present in vicinity of site
Section 404, Clean Water Act	Dredging/Fill	33 USC 1251 et seq. 33 CFR Part 330	Regulates discharge of dredging or fill materials into waters of the United States	Not Applicable	
Migratory Bird Treaty Act	Migratory Birds	16 USC § 703-12	Requirement for agencies to examine proposed actions by the government relative to habitat impacts and impacts to individual organisms	Potentially Applicable	
Executive Order No. 12962	Recreational Fisheries	16 USC § 742a-d and e-j; 16 USC § 661-666c; 42 USC § 4321; and 16 USC § 1801-1882	Requirement that Federal agencies improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities	Potentially Applicable	

Note: Location-specific ARARs and TBCs apply to sites that contain features such as wetlands, floodplains, sensitive ecosystems, or historic buildings that are located on or close to the site. Because of the presence of wetlands, floodplains, and sensitive ecosystems close to the site, location-specific ARARs and TBCs may be pertinent for the remedial action.

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Local Action-Specific ARARs and TBCs					
Chicago Municipal Code	Waste-Water Management	Chapter 11-4 (Utilities and Environmental Protection), Article VI	Standards for the discharge of waste-water	TBC	Relevant to construction-related activities or waste-water treatment.
	Solid and Liquid Waste Control	Chapter 11-4 (Utilities and Environmental Protection), Article IX	Standards for treating or disposing of solid or liquid waste	TBC	Relevant to waste streams generated in the course of remedial action
	Air Pollution Control	Chapter 11-4 (Utilities and Environmental Protection), Article II	Emission standards for smoke, visible emissions, carbon monoxide and nitrogen	TBC	General limits for emissions – may be relevant to dust emissions generated in the course of remedial action
	Reprocessable Construction/Demolition Material	Chapter 11-4 (Utilities and Environmental Protection), Article XIV	Requirements for recycling construction/demolition waste	TBC	
	Noise and Vibration Control	Chapter 11-4 (Utilities and Environmental Protection) Article VII	Establishes general noise limits	TBC	General restriction on ‘excessive noise’
Cook County Environmental Control Ordinance	Emission Standards and Limitations for Stationary Sources	Article VI	Emission standards for smoke, visible emissions, particulates, sulfur, organic material, carbon monoxide, nitrogen oxides	TBC	Limitations for emissions from capped landfills, including flare for landfill gas

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Cook County Environmental Control Ordinance (Cont.)		Article 6.12	Materials Subject to Becoming Windborne	TBC	Requires control of windborne emissions during consolidation of waste, prior to capping
	Noxious, Odorous, and Toxic Matter	Article VIII	General prohibition of emissions of substances that threaten public health, comfort, or welfare	TBC	
	Noise and Vibration Control	Article 9.6	Restricts hours of operation of construction equipment if in proximity to buildings	Not applicable	No residential or hospital buildings within 600 feet
		Articles 9.7, 9.9-9.13	Restricts idling of vehicles and vehicle noise levels	TBC	
	Solid Waste Management	Article XI	Coordination of municipal efforts to manage solid wastes	Not Applicable	Has no bearing on actual waste management practices
	New Pollution Control Facility Siting Ordinance	Article XII	Application and Approval Process for New Facility Siting	Not Applicable	Only for new facilities in unincorporated areas of Cook County
State Action-Specific ARARs and TBCs					
Illinois Environmental Protection Act, Pollution Control Board	Emission Standards and Limitations for Stationary Sources	35 IAC 212.301, 212.315, 212.316(c)	Emission standards for visible emissions, vehicle covers, and roadway emissions	Potentially Applicable	Relevant to emissions during construction operations
	Non-methane Organic Compounds	35 IAC 220 Subpart B	Landfill gas collection and flare systems	Potentially Applicable	Relevant to emissions from landfill gas flare
	Toxic Air Contaminants	35 IAC 232	Emission restrictions for toxic contaminants	Potentially Applicable	Relevant to emissions from landfill gas flare
	Water Quality	35 IAC 302 Subpart D	Water quality standards for secondary contact waters	Potentially Applicable	Relevant to surface runoff during and after remedial action
	Permits	35 IAC 703.121 and 703.207	RCRA permit program and waste stream authorization	Potentially Relevant and Appropriate	While RCRA permits are typically not required for Superfund Remedial Actions, the requirements of such permits are often relevant
	Hazardous Waste Operating Requirements	35 IAC 721 and 723	Identification, transportation, and disposal of hazardous wastes	Potentially Applicable	Relevant to off-site transport of remediation derived wastes

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Illinois Environmental Protection Act, Pollution Control Board (Cont.)	Illinois Superfund Program	35 IAC 750	Establishes procedures for assessing and remediating Illinois State Superfund sites	Applicable	See text
	Solid Waste and Special Waste Hauling	Subtitle G, Chapter I, Subchapter i	Regulates classification, transport, and disposal of solid and special waste	Potentially Applicable	Relevant to transport and disposal of non-hazardous remediation-derived waste; landfill requirements may be relevant and appropriate for capped area (refer to federal requirements)
	Noise	Subtitle H	Sound emission standards and limitations	Potentially Applicable	For construction equipment during remedial action; because of surrounding land use, may not be relevant
	Hazardous Waste Cover Systems	35 IAC 724, Subpart N	Standards for hazardous waste landfill cover systems	Potentially Applicable	
	Closure and Post-Closure Care	35 IAC 724.410	Closure and post-closure requirements for hazardous waste landfills	Potentially Applicable	
	Leachate Collection	35 IAC 724.401(c)(2)	Liner requirements and collection and removal standards	Not Applicable to OU1	Not relevant to this phase of the project
	Run-on and Run-off Management and Collection Systems	35 IAC 724.401(g), (h), and (i)	Establish requirements for run-on prevention, run-off design storm, and holding facilities	Potentially Applicable	
	Groundwater Monitoring	35 IAC 724 Subpart F	Groundwater protection standards, point of compliance, and detection monitoring programs	Potentially Applicable	A component of operations and maintenance
	Construction Quality Assurance Plan	35 IAC 724.119	CQA written plan components and contents of program, inspection and sampling requirements	Potentially Applicable	Relevant and appropriate for landfills
	Non-hazardous Waste Cover Systems	35 IAC 811, Subpart C	Standards for putrescible and chemical waste landfill cover systems	Potentially Applicable	

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Illinois Environmental Protection Act, Pollution Control Board (Cont.)	Closure and Post-Closure Care	35 IAC 811.110, 811.111, 811.314	Closure and post-closure requirements for non-hazardous waste landfills	Potentially Applicable	
	Landfill Gas Management	35 IAC 811.311	Establish minimum requirements for gas venting and collection systems	Potentially relevant	
	Landfill Gas Processing and Disposal System	35 IAC 811.312	Establishes treatment, discharge and permitting requirements for combusted landfill gas	Potentially relevant	
	Steel and Foundry Industry Wastes	35 IAC 817	Standards for management of beneficially usable wastes	Potentially Applicable	
Federal Action-Specific ARARs and TBCs					
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986 (SARA)	National Contingency Plan	40 CFR 300, Subpart E	Outlines procedures for remedial actions and for planning and implementing off-site removal actions.	Potentially Applicable	
Occupational Safety and Health Act	Worker Protection	29 CFR 1904, 1910, and 1926	Specifies minimum requirements to maintain worker health and safety during hazardous waste operations. Includes training requirements and construction safety requirements.	Potentially Applicable	Under 40 CFR 300.38, requirements of OSHA apply to all activities that fall under jurisdiction of the National Contingency Plan.
Executive Order	Delegation of Authority	Executive Order 12316 and Coordination with Other Agencies	Delegates authority over remedial actions to federal agencies	Potentially Applicable	

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Clean Water Act	National Pollutant Discharge Elimination System (NPDES)	40 CFR 122 and 125	Issues permits for discharge into navigable waters. Establishes criteria and standards for imposing treatment requirements on permits.	Potentially Applicable	Relevant for any wastewater discharges in the course of the remedial action
Clean Air Act	National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes emission limits for six pollutants (SO_2, PM_{10}, CO, O_3, NO_2, and Pb).	Potentially Applicable	Potentially relevant for landfill gas flare emissions
	National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for 8 contaminants. Identifies 25 additional contaminants as having serious health effects but does not provide emission standards for these contaminants.	Potentially Applicable	Potentially relevant for landfill gas flare emissions
Toxic Substances Control Act	Rules for Controlling PCBs	40 CFR 761	Provides guidance on storage and disposal of PCB-contaminated materials	Potentially Applicable	Relevant for transport of any PCB-containing materials, if any such materials generated in the course of the remedial action is removed from the site
Resource Conservation and Recovery Act	Criteria for Municipal Solid Waste Landfills	40 CFR 258	Establishes minimum national criteria for management of non-hazardous waste.	Potentially Applicable	Applicable to remedial alternatives that involve generation of non-hazardous waste. Non-hazardous waste must be hauled and disposed of in accordance with RCRA.
	Hazardous Waste Management System - General	40 CFR 260	Provides definition of terms and general standards applicable to 40 CFR 260 - 265, 268.	Potentially Applicable	Applicable to remedial alternatives that involve generation of a hazardous waste (*e.g.*, contaminated remediation-derived waste). Hazardous waste must be handled and disposed of in accordance with RCRA.
	Identification and Listing of Hazardous Waste	40 CFR 261	Identifies solid wastes that are subject to regulation as hazardous wastes.	Potentially Applicable	

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Resource Conservation and Recovery Act (Cont.)	Standards Applicable to Generators of Hazardous Waste	40 CFR 262	Establishes requirements (e.g., EPA ID numbers and manifests) for generators of hazardous waste.	Potentially Applicable	
	Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Establishes standards that apply to persons transporting manifested hazardous waste within the United States.	Potentially Applicable	
	Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities	40 CFR 264	Establishes the minimum national standards that define acceptable management of hazardous waste.	Potentially Applicable	Applicable to construction of site cap and to any off-site treatment/disposal of remedial-action generated waste
	Standards for owners of hazardous waste facilities	40 CFR 265	Establishes interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities.	Potentially Applicable	
	Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes that are restricted from land disposal.	Potentially Applicable	
	Hazardous Waste Permit Program	40 CFR 270, 124	USEPA administers hazardous waste permit program for CERCLA/Superfund Sites. Covers basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Potentially Applicable	
EPA Publication	Design and Construction of RCRA/CERCLA Final Covers	EPA/625/4-91/025	Describes design and construction of caps for CERCLA Landfills	TBC	
	Design and Construction of Covers for Solid Waste Landfills	EPA/6002-79/165	Describes design and construction of caps for landfill caps	TBC	

Table 2-3 Action-Specific ARARs and TBCs, Lake Calumet Cluster Site

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
EPA Publication (Cont.)	Standardized Procedures for Planting Vegetation on Competed Sanitary Landfills	EPA/600/2-83/055	Describes planting procedures for vegetative layers	TBC	
	Covers for Uncontrolled Hazardous Waste Landfills and Surface Impoundments	EPA/530/SW-89/047	Describes design and construction of caps for uncontrolled waste sites	TBC	
	Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide	EPA/540/F-95/009			

3

Development of Remedial Alternatives

Currently, the LCC site is covered with soil, slag, cinders, and various other construction debris with depths generally ranging from 0 to 3 feet. Test pit excavations found fill thicknesses ranging from 0 to greater than 30 feet BGS. Based on the results of the soil investigation, contamination was detected in surface soils, and there are several locations were little to no soil cover exists and contact with waste material is possible. Additionally, the bulk of waste located on site is beneath the water table, allowing contaminants to leach directly into the groundwater.

Under an intergovernmental agreement (IGA) with the Illinois EPA, the Illinois Department of Transportation (IDOT) has been exporting excess native soils from their Dan Ryan Expressway Reconstruction Project to the LCC site. This soil varies from sand to clay with the majority of the material being silty-clay to clay. The material imported to the LCC site is tested by IDOT prior to shipment to the site to ensure that the standards of the IGA are met. The IGA requires all soils to meet the TACO Tier 1 Soil Remediation Objectives for Residential Properties (35 IAC 742, Appendix B, Table A). The IAG also requires the soils to not contain any contaminants that are not listed on the Target Compound List found in 35 IAC 740, Appendix A, to contain only native soils, to be visually inspected, and not to have been used as fill material.

In addition to the Tier 1 requirements, the IGA establishes acceptable levels for PAHs, which are based on background concentrations for the City of Chicago, Metro, and Non-Metro areas.

Whenever IDOT imported soils are referenced within this document, it should be assumed that these soils meet the IGA standard. There are approximately 300,000 cubic yards of material currently on site, and it is estimated that the total volume of imported soils may reach as much as 1 million cubic yards. Once the soil reaches the site, it is sorted into piles based on a visual inspection.

Given the amount of the soil that will be required as part of the action alternatives, it has been assumed, wherever possible, that the IDOT material will be incorporated as part of the alternative. It should be noted that this use is dependent upon the material's properties. For the purposes of alternatives development, it has been assumed that once the clay material is compacted, it will achieve a hydraulic conductivity of 1 x 10^{-7} centimeters per second.

The alternatives have been developed to mitigate potential threats posed by LCC site contaminants. These alternatives were also developed based on Federal and Illinois State guidance as described below.

Using the presumptive remedy of a cover across the LCC site, five cover/cap alternatives, including the No Action alternative, have been developed and are presented in this section. In Section 4, the alternatives are evaluated individually and comparatively using the criteria established by the EPA.

3.1 Alternative 1: No Action

Under this alternative, no action would be taken to remove, treat, or contain contaminated soils, wastes, and groundwater at the site. Because contaminated media would remain in place, the potential for continued migration of contaminants would not be mitigated. Additionally, no institutional controls would be implemented to prevent intrusive activities into the waste materials. The No Action alternative has been included as a requirement of the National Contingency Plan (NCP) and to provide a basis for the comparison for the remaining alternatives.

This alternative does not improve on the minimal protection already provided by the existing cover soils, nor is it considered a permanent remedy because it does not reduce the toxicity, volume, or mobility of the hazardous waste on the site. The resultant risks associated with the No Action alternative would be the same as those identified in the human health and ecological risk evaluations.

3.2 Alternative 2: Capping of Existing Wastes with a Permeable Soil Cover

Description of Remedial Alternative

Alternative 2 involves construction of a permeable soil cover over the existing wastes including creation of an appropriate grade for stormwater retention. Activities comprising this alternative include site preparation/grading, placement of the cover material, and planting of a vegetative cover, which would consist of native plants and prairie grasses. Groundwater monitoring is included as a component of the operations and maintenance for this alternative.

Site Preparation

Site preparation would be performed before any disturbance of the existing surface is initiated. The purpose of site preparation is to remove on-site structures and vegetation that would affect the cover construction, and to control and collect runoff during construction. Three small structures will be demolished and disposed of off site following assessments for asbestos-containing materials and lead. Site runoff can potentially be contaminated by contact with the waste and sediment from exposed soils. Temporary collection ponds would be built, and silt fencing or straw bales located along downstream perimeters will prevent sediment-laden water from flowing off site. Following implementation of these measures, clearing, grubbing, and removal of the existing vegetation on site is necessary to facilitate further operations. Woody and brushy material can be chipped for volume reduction, and may be reusable as mulch elsewhere. The vegetation removal would be done in phases preceding earthwork operations to minimize erosion impacts.

The TCLP results obtained from previous investigations indicate that there are four sampling locations that contained wastes characteristically hazardous for either metals or VOCs (Clayton 2002). The Illinois EPA will need to evaluate whether any of these wastes would be regulated as hazardous waste under this alternative, and require removal and off-site disposal.

Access restrictions will also be enacted, in the form of deed restrictions and fencing (groundwater restrictions already exist within the limits of Cook County, Illinois). Deed restrictions would be placed on the use of land within the site boundaries. A clause prohibiting future development or excavation of the contaminated areas would be added to the property deed or deeds that include the site. Additionally, fencing will be constructed around the perimeter of the entire site to limit access.

Soil Cover and Vegetation

Following completion of site preparation, a grading layer would be constructed on the site to attain the final site contour followed by a 2.5-foot-thick permeable soil cover. Perimeter waste may need to be excavated and consolidated on site to move it away from the site property edges. As necessary, additional fill will be imported and placed to develop an acceptable slope for proper drainage. The soil cover will consist of an uncompacted, medium-permeability soil, such a loam or sandy loam. The site will be contoured in such a way that all precipitation will be held on site and allowed to infiltrate. Biosolids will be incorporated into the top 6 inches of soil cover to provide a vegetative layer. Figure 3-1 shows a plan view of the site following remedial action. Figure 3-2 illustrates the proposed cross section for this alternative. Native short-rooted prairie grasses would be used for vegetation of the site based on their low maintenance requirements and compatibility with the end use for the site.

Effectiveness and Cost

The principal "functional" element of this alternative is the permeable soil cover. The soil cover will not prevent precipitation from pooling and infiltrating into the waste; therefore, the volume and rate of flow of surface water into the fill will not diminish. The alternative also fails to address the collection and destruction of generated LFG. This alternative does not provide a great deal of flexibility with respect to future land uses, since any excavation or drilling would be prohibited from disturbing the soil cover, although almost any "surface only" land use could be accommodated. Since wastes are being left virtually undisturbed under this alternative, except for possible consolidation of perimeter waste, the general surface elevation of the site will be raised, which would necessitate the construction of perimeter berms to collect and control stormwater runoff and prevent it from flowing off site.

The cost to construct Alternative 2 is estimated to be $10,999,000, and yearly operations and maintenance (O&M) will cost approximately $65,000. Assuming 30 years of O&M will be required and an inflation rate of 5%, the net present worth of this alternative is estimated to be $11,900,000. Table 3-1 summarizes the cost estimates for Alternative 2. Detailed cost estimate tables for each alternative are included in Appendix C.

3.3 Alternative 3: Capping of Existing Wastes with an Evapotranspiration (ET) Cap

Description of Remedial Alternative

Alternative 3 involves construction of an ET soil cap over the existing wastes and creation of an appropriate grade for stormwater retention. This alternative involves construction of a permeable soil cover, grading for stormwater collection over the entire site, and vegetation of the entire site. The vegetative cover would be designed to promote transpiration and limit erosion. Potential vegetation includes a mixture of warm- and cool-season native grasses, shrubs, and trees. As with the previous alternative, groundwater monitoring is a component of the O&M for Alternative 3.

ET cover systems use water balance components to minimize the downward migration of water from the cover to the waste (percolation), unlike conventional cover system designs that use materials with low hydraulic permeability (barrier layers) to minimize percolation. ET cover systems rely on the properties of soil to store water until it is either transpired through vegetation or evaporated from the soil surface. The ET cover system design would be based on water balance components specific to the site such as the water storage capacity of the soil, precipitation, surface runoff, evapotranspiration, and infiltration. For example, with greater storage capacity and evapotranspiration properties of the existing soil at the site, there would be a lower potential for percolation through the cover system. Therefore, ET cover systems tend to highlight the following properties:

1. Fine-grained soils, such as silts and clayey silts, that have a relatively high water storage capacity;
2. Native vegetation to increase evapotranspiration; and
3. Locally available soils to streamline construction and provide cost savings.

Two general types of ET cover systems are monolithic barriers and capillary barriers. Monolithic covers use a single vegetated soil layer to retain water until it is transpired through vegetation or evaporated through the soil surface. A capillary barrier system consists of a finer-grained soil layer overlying a coarser-grained material layer, usually sand or gravel.

ET cover systems are increasingly being considered for use at municipal solid waste and hazardous waste landfills when equivalent performance to conventional final cover systems can be demonstrated. ET covers are generally less costly to construct and have the potential to provide equal or superior performance compared to conventional cover systems, especially in arid or semi-arid environments. The limitations of ET systems include the following:

1. Generally considered applicable only in arid or semi-arid climates;
2. Storage capacity must be relied on for large precipitation events occurring during dormant periods;
3. Production of landfill gases may limit plant growth;
4. Landfill gases are not normally captured and vented with ET cover systems;
5. Limited performance data are available; and
6. Models do not effectively predict performance of ET cover systems.

Site Preparation

Site preparation would be the same as detailed in Alternative 2.

Soil Cover and Vegetation

Following completion of site preparation, a grading layer would be constructed on the site using the IDOT material to attain the final site contour, demarcation fabric would be installed across the entire site, and a 4-foot-thick ET soil cap would be constructed. Perimeter waste may need to be excavated and consolidated on site to move it away from the site edges. As necessary, additional fill will be imported and placed to develop an acceptable degree of slope for proper drainage. The ET soil cap would consist of an uncompacted, medium-permeability soil, such a loam or sandy loam. Given the soil properties needed to facilitate proper root growth and permeability, the IDOT material could not be used. Therefore, materials associated with the construction of the ET soil layer would have to be purchased and imported to the site.

The site would be contoured in such a way that all precipitation would be held on site and allowed to infiltrate. Biosolids would be incorporated into the top 6 inches of soil cover to provide a vegetative layer. Figure 3-1 shows a plan view of the site following remedial action, and Figure 3-3 illustrates the proposed cross section for this alternative. A mixture of warm- and cool-season native grasses, shrubs, and trees would be used for vegetation of the site based on their root depth penetration, evapotranspiration rates, growth rates, low maintenance requirements, and compatibility with the end use for the site.

Effectiveness and Cost

The principal "functional" element of this alternative is the ET soil cap. The ET soil cover will minimize infiltration into the waste; therefore, the volume and rate of flow of contaminated groundwater will diminish somewhat. The alternative fails to address the collection and destruction of generated LFG. This alternative does not provide a great deal of flexibility with respect to future land uses, since any excavation or drilling would be prohibited from disturbing the soil cover. Most "surface only" land use would not be available because of ET cap vegetation.

The cost to construct Alternative 3 is estimated to be $18,700,000, and yearly O&M will cost approximately $65,000. Assuming 30 years of O&M will be required and an inflation rate of 5%, the net present worth of this alternative is estimated to be $19,700,000. Table 3-2 summarizes the cost estimates for Alternative 3. Detailed cost estimate tables for each alternative are included in Appendix C.

3.4 Alternative 4: Capping of Existing Wastes with a Low-Permeability, 35 IAC Part 724 Clay Cap

Description of Remedial Alternative

Alternative 4 involves construction of a low-permeability clay cap over the existing wastes and the creation of an appropriate cap grade for stormwater runoff. This alternative involves construction of a low-permeability clay cap meeting the requirements of Title 35 IAC Part 724, grading for stormwater containment and collection over the entire site, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, installation of a gas collection system, and vegetation of the entire site with native plants and prairie grasses. As with the previous alternatives, groundwater monitoring is a component of the O&M for this alternative.

Site Preparation

Site preparation would be the same as detailed in Alternative 2.

Gas Collection

To control LFG generation, a gas collection system would be installed across the entire site. The system would consist of horizontal collection pipes placed in excavated trenches. The trenches will be excavated into the existing soil cover to the top of the underlying waste layer. It has been estimated that trenching for the gas collection system would be completed at an average depth of 4 feet across the site based on data collected and observations made during trenching for previous site investigations. All trenched material would be disposed of by consolidation on site. It is anticipated that the trenches will be backfilled around perforated collection piping using a slag material imported to site. A geotextile would be placed between the slag and subsequent soil layers to prevent silt from entering the system.

Clay Cap and Vegetation

Following completion of the gas collection layer, a grading layer would be constructed on the site to attain the final site contour, and a low-permeability clay cap meeting the requirements of Title 35 IAC Part 724, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, would be constructed. Perimeter waste may need to be excavated and consolidated on site to move it away from the site edges. As necessary, the IDOT material would be re-excavated and placed to develop an acceptable degree of slope for proper drainage across the entire site. The clay cap would consist of the IDOT material compacted to a thickness of 3 feet with a permeability of 1 x 10^{-7} cm/sec, overlain by a 1.5-foot uncompacted protective soil layer. A drainage collection and conveyance layer would be installed above the low-permeability layer consisting of a 200-mil geocomposite geonet, a 6-inch sand drainage layer, an 8-inch cobble drain biotic layer, and a geotextile filter fabric. The drainage layer would collect water that infiltrates through the protective cover soil, remove it from the surface of the low-permeability layer, and convey it to the stormwater drainage system.

Biosolids would be incorporated into the top 6 inches of the protective layer to provide a vegetative layer. Figure 3-1 shows a plan view of the site following remedial action, and Figure 3-4 illustrates the proposed cross section for this alternative. This remedial alternative results in steeper slopes on the site and lower-permeability surfaces. Runoff from precipitation events would be greater in total volume following low-permeability cap construction and would accumulate more rapidly than on the existing, poorly drained site.

In terms of water quality, the runoff from the cap will be considered uncontaminated, since it will not contact waste materials or contaminated media. To collect, and regulate the discharge rate of, stormwater from the site, a detention pond would be constructed. Runoff would flow overland as sheet flow toward the detention pond, with shallow swales along the site perimeter aiding in collecting and transporting the flow to the pond. The pond area would be built above the soil cover and lined with a flexible membrane liner (FML, or 60-mil high-density polyethylene [HDPE]) with riprap protection at the waterline to protect the liner from ultraviolet exposure and to protect soil above the FML. A weir structure to regulate overflow and a discharge channel will also be included.

From the discharge, water would flow through the discharge channel to the Paxton I Landfill stormwater collection system. Water could be easily routed from the overflow weir to Indian Ridge Marsh, which presently receives LCC site runoff. A new culvert would be jacked or directionally bored under the Norfolk Southern railroad tracks for this purpose if the existing culverts prove unsuitable for this use. Native short-rooted prairie grasses would be used for vegetation of the site based on their low maintenance requirements and compatibility with the end use of the site.

Effectiveness and Cost

The four principal "functional" elements of this alternative are the compacted low-permeability clay cap, gas collection layer, drainage layer, and stormwater management system. The clay cap would substantially reduce precipitation infiltration into the waste (because of the improved slope for more rapid, positive drainage). The volume and rate of flow of contaminated groundwater would diminish. Disadvantages of the stormwater management system are related to the relatively shallow depth to the remaining waste on site, reduced flexibility for future use, and the relatively large volumes of fill soils required from off-site sources to shape and contour the site for proper drainage. The top of the cover would be a minimum of 5 feet 8 inches above the remaining waste, with the average depth greater over most of the site area. This separation from the waste provides reduced contact potential with the remaining waste materials. It does not provide a great deal of flexibility with respect to future land uses, since any excavation or drilling activities would be prohibited from disturbing the soil cover. Almost any "surface only" land use could be accommodated under this alternative.

As with all the capping alternatives, stormwater runoff will increase with a low-permeability cap with a positive degree of slope. However, the stormwater would also be clean and free of contamination since it would not be in contact with the waste materials. Modeling and calculating the flow volumes would be an integral part of designing the soil cover. The general surface elevation of the site would be raised by construction, which necessitates the creation of berms around the perimeters to collect and control stormwater runoff and prevent it from flowing off site.

The cost to construct Alternative 4 is estimated to be $17,700,000, and yearly O&M will cost approximately $83,000. Assuming 30 years of O&M will be required and an inflation rate of 5%, the net present worth of this alternative is estimated to be $18,900,000. Table 3-3 summarizes the cost estimate for Alternative 4. Detailed cost estimate tables for each alternative are included in Appendix C.

3.5 Alternative 5: Capping of Existing Wastes with a Low-Permeability 35 IAC Part 811 Clay Cap

Description of Remedial Alternative

Alternative 5 involves construction of a low-permeability clay cap over the existing wastes and creation of an appropriate grade for stormwater runoff from the cap. This alternative involves construction of a low-permeability clay cap meeting the requirements of Title 35 IAC Part 811, grading for stormwater containment and collection over the entire site, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, and vegetation of the entire site with native plants and prairie grasses. As with all of the previous remedial action alternatives, O&M for Alternative 5 includes groundwater monitoring.

Site Preparation

Site preparation would be the same as detailed in Alternative 2.

Gas Collection

Gas collection would be the same as detailed in Alternative 4.

Clay Cap and Vegetation

Following installation of the gas collection layer, a grading layer would be constructed on the site to attain the final site contour, and a low-permeability clay cap meeting the requirements of Title 35 IAC Part 811, *Standards for New Solid Waste Landfills*, would be built. Perimeter waste may need to be excavated and consolidated on site to move it away from the site boundaries. As necessary, IDOT material will be re-excavated and placed atop the grading to develop an acceptable degree of slope for proper drainage across the entire site. Using IDOT soils, the cap will consist of compacted clay, 3 feet thick, having a permeability of 1×10^{-7} cm/sec, overlain by a 3-foot uncompacted protective soil layer. Biosolids will be incorporated into the top 6 inches of the protective layer to provide a vegetative layer. Figure 3-1 shows a plan view of the site following remedial action. Figure 3-5 illustrates the proposed cross section for this alternative.

This remedial alternative results in steeper slopes on the site and lower-permeability surfaces. Runoff from precipitation events would be greater in total volume following low-permeability cap construction and will accumulate more rapidly than on the existing site. In terms of water quality, the runoff from the cap will be considered uncontaminated, since it will not contact waste materials or contaminated media.

To collect and regulate the discharge rate of stormwater from the site, a detention pond would be constructed. Runoff would flow overland as sheet flow toward the detention pond, with shallow swales along the site perimeters aiding in collecting and transporting the flow to the pond. The pond area would be built above the soil cover and have an FML (60-mil HDPE) with riprap protection at the waterline to protect the liner from ultraviolet exposure and to protect soil above the FML. A weir structure to regulate overflow and a discharge channel would also be included.

From the discharge, water would flow through the discharge channel to the Paxton I Landfill stormwater collection system. Water could be easily routed from the overflow weir to Indian Ridge Marsh, which presently receives LCC site runoff. A new culvert would be jacked or directionally bored under the Norfolk Southern railroad tracks for this purpose if the existing culverts prove unsuitable for use. Native short-rooted prairie grasses would be used for vegetation of the site based on their low maintenance requirements and compatibility with the end use for the site.

Effectiveness and Cost

The three principal "functional" elements of this alternative are the compacted low-permeability clay cap, gas collection layer, and the stormwater management system. The clay cap will substantially reduce precipitation infiltration into the waste (because of the improved slope for more rapid, positive drainage). The volume and rate of flow of contaminated groundwater will decrease. Disadvantages of the stormwater management system are related to the relatively shallow depth to remaining waste on site, reduced flexibility for future site use, and the relatively large volumes of fill soils required from off-site sources to shape and contour the site for proper drainage.

The cost to construct Alternative 5 is estimated to be $15,900,000, and yearly O&M will cost approximately $83,000. Assuming 30 years of O&M will be required and an inflation rate of 5%, the net present worth of this alternative is estimated to be $17,200,000. Table 3-4 summarizes the cost estimates for the remedial alternatives. Detailed cost estimate tables for each alternative are included in Appendix C.

Table 3-1 Preliminary Construction Cost Estimate, Alternative 2 - Capping of Existing Wastes with a Permeable Soil Cover Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Item	Description	Quantity	Unit	Cost
Direct Capital Costs				
C1a	Field Overhead and Oversight	0.5	LS	$ 737,100
C1b	Submittals and Testing	0.75	LS	$ 75,000
C1c.1	Pre-Construction Surveying	1	LS	$ 22,000
C1c.2	Construction Surveying	0.5	LS	$ 254,800
C1c.3	Post-Construction Surveying	1	LS	$ 22,000
C2a	Clearing and Grubbing	1	LS	$ 18,100
C2b	Demolition	1	LS	$ 50,000
C2c	Relocate Utilities	1	LS	$ 100,000
C4a	Grading Layer (~2.5' thick)	346,000	CY	$ 2,322,200
C4b	Permeable Soil Layer (2' Thick)	290,667	CY	$ 5,051,900
C5b	Biosolids, tilled 6" deep into cover	3,920	MSF	$ 11,200
C5c	Seeding	90	Acre	$ 126,000
C5d	Fence	7,200	LF	$ 95,990
Total Direct Capital Costs (Rounded to Nearest $1,000)				*$ 8,886,000*
Indirect Capital Costs				
	Engineering and Design	5%		$ 399,870
	Legal Fees and License/Permit Costs	3%		$ 222,150
	Construction Oversight	5%		$ 399,870
Total Indirect Capital Costs (Rounded to Nearest $1,000)				*$ 1,022,000*
Total Capital Costs				
	Subtotal Capital Costs			*$ 9,908,000*
	Contingency Allowance	10%		$ 990,800
Total Capital Cost (Rounded to Nearest $1,000)				**$ 10,899,000**
Item	**Description**	**Quantity**	**Unit**	**Cost**
Annual Direct O&M Costs				
O2a	Annual Groundwater Monitoring	16	Each	$ 15,700
O3a	Cover Inspection	1	LS	$ 4,400
O3b	Cover Maintenance	1	LS	$ 10,500
O3d	Access Road Maintenance	1	LS	$ 15,000
O3e	Annual Summary Report	1	LS	$ 2,600
Total Annual Direct O&M Costs (Rounded to Nearest $1,000)				*$ 48,000*
Annual Indirect O&M Costs				
	Administration	5%		$ 2,400
	Insurance, Taxes, Licenses	3%		$ 1,200
Total Annual Indirect O&M Costs (Rounded to Nearest $1,000)				*$ 4,000*
Total Annual O&M Costs				
	Subtotal Annual O&M Costs			*$ 52,000*
	Contingency Allowance	25%		$ 13,000
Total Annual O&M Cost (Rounded to Nearest $1,000)				**$ 65,000**

30 Year Cost Projection (Assume discount Rate per year: 5%)	
Total Capital Costs	$ 10,899,000
Present Worth of 30 Years O&M (Rounded to Nearest $1,000)	$ 999,000
Total Cost: Alternative 2 (Rounded to nearest $10,000)	**$ 11,900,000**

Key:

LS = Lump sum.
O & M = Operations and maintenance.
CY = Cubic Yard.
MSF = Million square feet.

Table 3-2 Preliminary Construction Cost Estimate, Alternative 3 - Capping of Existing Wastes with an Evapotranspiration (ET) Cap Focused Feasibility Study, Lake Calumet Cluster Site Chicago, Cook County, Illinois

Item	Description	Quantity	Unit	Cost
Direct Capital Costs				
C1a	Field Overhead and Oversight	1	LS	$ 1,474,200
C1b	Submittals and Testing	1	LS	$ 100,000
C1c	Surveying	1	LS	$ 553,600
C2a	Clearing and Grubbing	1	Acre	$ 18,100
C2b	Demolition	1	LS	$ 50,000
C2c	Relocate Utilities	1	LS	$ 100,000
C4a	Grading Layer (~2.5' thick)	346,000	CY	$ 2,322,200
C4h	Demarcation Fabric Installation	436,000	SY	$ 270,300
C4j	Soil (Silty Loam) Layer (4' thick)	581,333	CY	$ 9,600,000
C4k	ET Vegetation	90	Acre	$ 674,700
C5b	Biosolids, tilled 6" deep into cover	3,920	MSF	$ 11,200
C5d	Fence	7,200	LF	$ 95,990
Total Direct Capital Costs (Rounded to Nearest $1,000)				*$ 15,270,000*
Indirect Capital Costs				
	Engineering and Design	5%		$ 687,150
	Legal Fees and License/Permit Costs	3%		$ 381,750
	Construction Oversight	5%		$ 687,150
Total Indirect Capital Costs (Rounded to Nearest $1,000)				*$ 1,756,000*
Total Capital Costs				
	Subtotal Capital Costs			*$ 17,026,000*
	Contingency Allowance	10%		$ 1,702,600
Total Capital Cost (Rounded to Nearest $1,000)				**$ 18,729,000**
Annual Direct O&M Costs				
Item	**Description**	**Quantity**	**Unit**	**Cost**
O2a	Annual Groundwater Monitoring	16	Each	$ 15,700
O3a	Cover Inspection	1	LS	$ 4,400
O3b	Cover Maintenance	1	LS	$ 10,500
O3d	Access Road Maintenance	1	LS	$ 15,000
O3e	Annual Summary Report	1	LS	$ 2,600
Total Annual Direct O&M Costs (Rounded to Nearest $1,000)				*$ 48,000*
Annual Indirect O&M Costs				
	Administration	5%		$ 2,400
	Insurance, Taxes, Licenses	3%		$ 1,200
Total Annual Indirect O&M Costs (Rounded to Nearest $1,000)				*$ 4,000*
Total Annual O&M Costs				
	Subtotal Annual O&M Costs			*$ 52,000*
	Contingency Allowance	25%		$ 13,000
Total Annual O&M Cost (Rounded to Nearest $1,000)				**$ 65,000**

30 Year Cost Projection (Assume discount Rate per year: 5%)	
Total Capital Costs	$ 18,729,000
Present Worth of 30 Years O&M (Rounded to Nearest $1,000)	$ 999,000
Total Cost: Alternative 3 (Rounded to nearest $10,000)	**$ 19,730,000**

Key:

LS = Lump sum.
MSF = Million square feet.
O & M = Operations and maintenance.
SY = Square Yard.
CY = Cubic Yard.

Table 3-3 Preliminary Construction Cost Estimate, Alternative 4 - Capping of Existing Wastes with a Low-Permeability 35 IAC 724 Clay Clap Focused Feasibility Study, Lake Calumet Cluster Site Chicago, Cook County, Illinois

Item	Description	Quantity	Unit	Cost
Direct Capital Costs				
C1a	Field Overhead and Oversight	1	LS	$ 1,474,200
C1b	Submittals and Testing	1	LS	$ 100,000
C1c	Surveying	1	LS	$ 553,600
C2a	Clearing and Grubbing	1	Acre	$ 18,100
C2b	Demolition	1	LS	$ 50,000
C2c	Relocate Utilities	1	LS	$ 100,000
C3a	Trenching (4' Depth)	42,000	CY	$ 224,206
C3b	Collection Pipe	94,000	LF	$ 645,337
C3c	Trench Infill	42,000	CY	$ 76,987
C3d	Geotextile	52,000	SY	$ 98,203
C4a	Grading Layer	346,000	CY	$ 2,322,200
C4c	Impervious Layer (3' Thick)	436,000	CY	$ 3,054,900
C4d	Geonet	3,924,000	SF	$ 1,569,600
C4e	Sand Drainage Layer (6" Thick)	73,000	CY	$ 1,057,500
C4f	Cobble Drain-Biotic Layer (8" Thick)	97,000	CY	$ 405,500
C4g	Geotextile	436,000	SY	$ 392,400
C4i	Cover Layer (1.5' Thick)	218,000	CY	$ 1,717,600
C5a	Drain Layer Collection/Conveyance	Job	LS	$ 335,000
C5b	Biosolids, tilled 6" deep into cover	3,920	MSF	$ 11,200
C5c	Seeding	90	Acre	$ 126,000
C5d	Fence	7,200	LF	$ 95,990
Total Direct Capital Costs (Rounded to Nearest $1,000)				*$ 14,429,000*
Indirect Capital Costs				
	Engineering and Design	5%		$ 649,305
	Legal Fees and License/Permit Costs	3%		$ 360,725
	Construction Oversight	5%		$ 649,305
Total Indirect Capital Costs (Rounded to Nearest $1,000)				*$ 1,659,000*
Total Capital Costs				
	Subtotal Capital Costs			*$ 16,088,000*
	Contingency Allowance	10%		$ 1,608,800
Total Capital Cost (Rounded to Nearest $1,000)				**$ 17,697,000**
Item	**Description**	**Quantity**	**Unit**	**Cost**
Annual Direct O&M Costs				
O1a	Gas Collection Condensate Disposal	16	Hour	$ 1,900
O2a	Annual Groundwater Monitoring	16	Each	$ 15,700
O3a	Cover Inspection	1	LS	$ 4,400
O3b	Cover Maintenance	1	LS	$ 10,500
O3c	Vent System Monitoring and Maintenance	1	LS	$ 11,300
O3d	Access Road Maintenance	1	LS	$ 15,000
O3e	Annual Summary Report	1	LS	$ 2,600
Total Annual Direct O&M Costs (Rounded to Nearest $1,000)				*$ 61,000*
Annual Indirect O&M Costs				
	Administration	5%		$ 3,050
	Insurance, Taxes, Licenses	3%		$ 1,525
Total Annual Indirect O&M Costs (Rounded to Nearest $1,000)				*$ 5,000*
Total Annual O&M Costs				
	Subtotal Annual O&M Costs			*$ 66,000*
	Contingency Allowance	25%		$ 16,500
Total Annual O&M Cost (Rounded to Nearest $1,000)				**$ 83,000**

30 Year Cost Projection (Assume discount Rate per year: 5%)	
Total Capital Costs	$ 17,697,000
Present Worth of 30 Years O&M (Rounded to Nearest $1,000)	$ 1,276,000
Total Cost: Alternative 4 (Rounded to nearest $10,000)	**$ 18,970,000**

Key:

LS = Lump sum.
CY = Cubic Yard.
MSF = Million square feet.
O & M = Operations and maintenance.
LF = Linear foot.
SF = Square foot.

Table 3-4 Preliminary Construction Cost Estimate, Alternative 5 - Capping of Existing Wastes with a Low-Permeability 35 IAC 811 Clay Clap Focused Feasibility Study, Lake Calumet Cluster Site Chicago, Cook County, Illinois

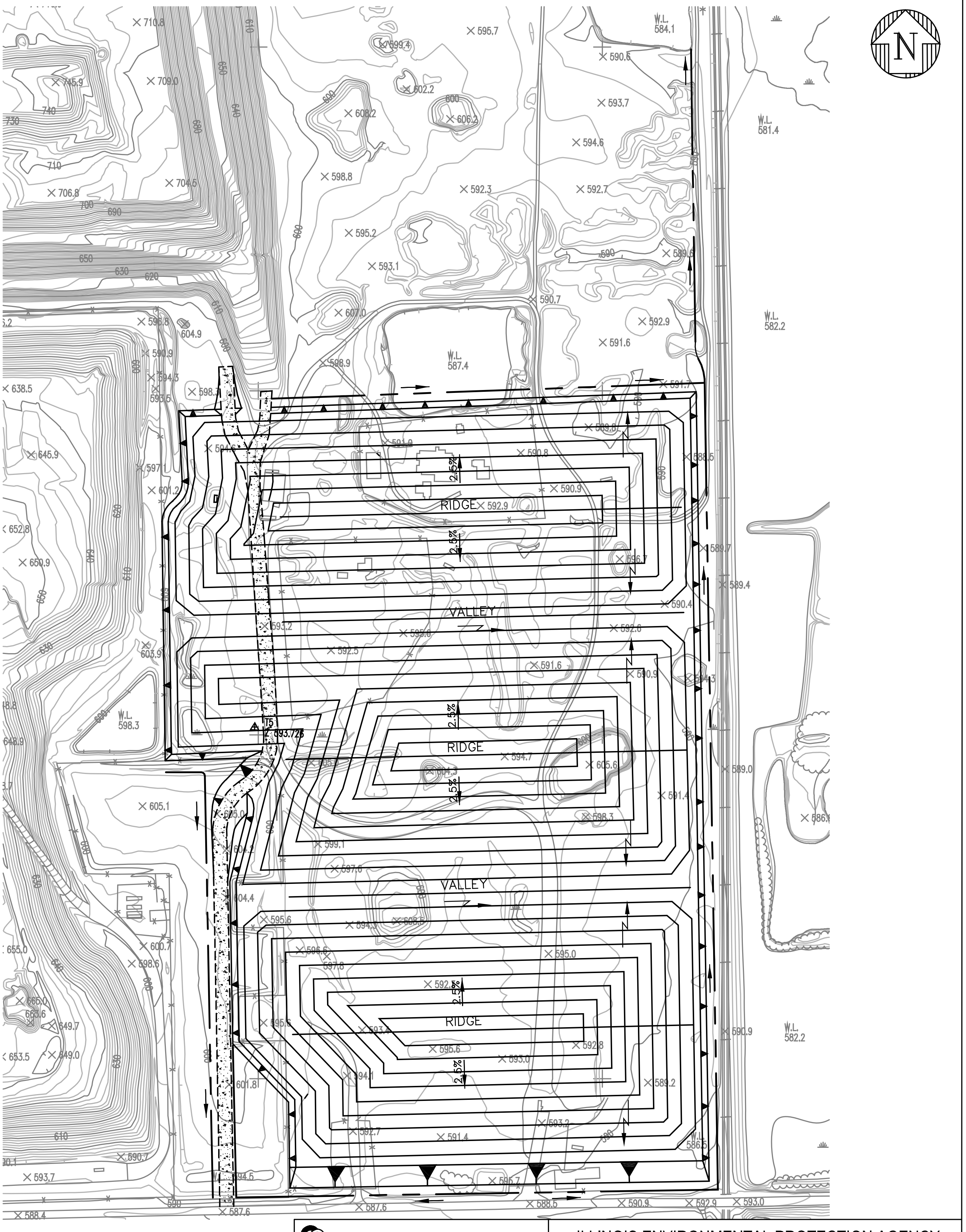
Item	Description	Quantity	Unit	Cost
Direct Capital Costs				
C1a	Field Overhead and Oversight	1	LS	$ 1,474,200
C1b	Submittals and Testing	1	LS	$ 100,000
C1c	Surveying	1	LS	$ 553,600
C2a	Clearing and Grubbing	1	Acre	$ 18,100
C2b	Demolition	1	LS	$ 50,000
C2c	Relocate Utilities	1	LS	$ 100,000
C3a	Trenching (4' Depth)	42,000	CY	$ 224,206
C3b	Collection Pipe	94,000	LF	$ 645,337
C3c	Trench Infill	42,000	CY	$ 645,337
C3d	Geotextile	52,000	SY	$ 98,203
C4a	Grading Layer (~2.5' thick)	346,000	CY	$ 2,322,200
C4c	Impervious Layer (3' thick)	436,000	CY	$ 3,054,900
C4i	Cover Layer (3' Thick)	436,000	CY	$ 3,435,200
C5b	Biosolids, tilled 6" deep into cover	3,920	MSF	$ 11,200
C5c	Seeding	90	Acre	$ 126,000
C5d	Fence	7,200	LF	$ 95,990
Total Direct Capital Costs (Rounded to Nearest $1,000)				*$ 12,954,000*
Indirect Capital Costs				
	Engineering and Design	5%		$ 582,930
	Legal Fees and License/Permit Costs	3%		$ 323,850
	Construction Oversight	5%		$ 582,930
Total Indirect Capital Costs (Rounded to Nearest $1,000)				*$ 1,490,000*
Total Capital Costs				
	Subtotal Capital Costs			*$ 14,444,000*
	Contingency Allowance	10%		$ 1,444,400
Total Capital Cost (Rounded to Nearest $1,000)				**$ 15,888,000**
Item	**Description**	**Quantity**	**Unit**	**Cost**
Annual Direct O&M Costs				
O1a	Gas Collection Condensate Disposal	0	0	$ 1,900
O2a	Annual Groundwater Monitoring	16	Each	$ 15,700
O3a	Cover Inspection	1	LS	$ 4,400
O3b	Cover Maintenance	1	LS	$ 10,500
O3c	Vent System Monitoring and Maintenance	1	LS	$ 11,300
O3d	Access Road Maintenance	1	LS	$ 15,000
O3e	Annual Summary Report	1	LS	$ 2,600
Total Annual Direct O&M Costs (Rounded to Nearest $1,000)				*$ 61,000*
Annual Indirect O&M Costs				
	Administration	5%		$ 3,050
	Insurance, Taxes, Licenses	3%		$ 1,525
Total Annual Indirect O&M Costs (Rounded to Nearest $1,000)				*$ 5,000*
Total Annual O&M Costs				
	Subtotal Annual O&M Costs			*$ 66,000*
	Contingency Allowance	25%		$ 16,500
Total Annual O&M Cost (Rounded to Nearest $1,000)				**$ 83,000**

30 Year Cost Projection (Assume discount Rate per year: 5%)	
Total Capital Costs	$ 15,888,000
Present Worth of 30 Years O&M (Rounded to Nearest $1,000)	$ 1,276,000
Total Cost: Alternative 5 (Rounded to nearest $10,000)	**$ 17,160,000**

Key:

LS = Lump sum.
MSF = Million square feet.
O & M = Operations and maintenance.

CY = Cubic Yard.
LF = Linear foot.
SY = Square Yard.



LEGEND

2.5% →	GRADE ON FINISHED SLOPE
▼	FINISHED SLOPE APPROXIMATELY 1V ON 3H EXCEPT AS NOTED
— — —	IMPROVED DRAINAGE DITCH ADJACENT TO FINISHED SLOPES
→	DIRECTION OF DRAINAGE ON CAP
▨	ACCESS ROAD

NOTE:
CAP AS SHOWN DRAINS RUNOFF AWAY FROM CAP

ecology and environment engineering, inc.
International Specialists in the Environment
Chicago, Illinois

DESIGNED BY: C. NANCARROW

CHECKED BY: A. WHITMAN

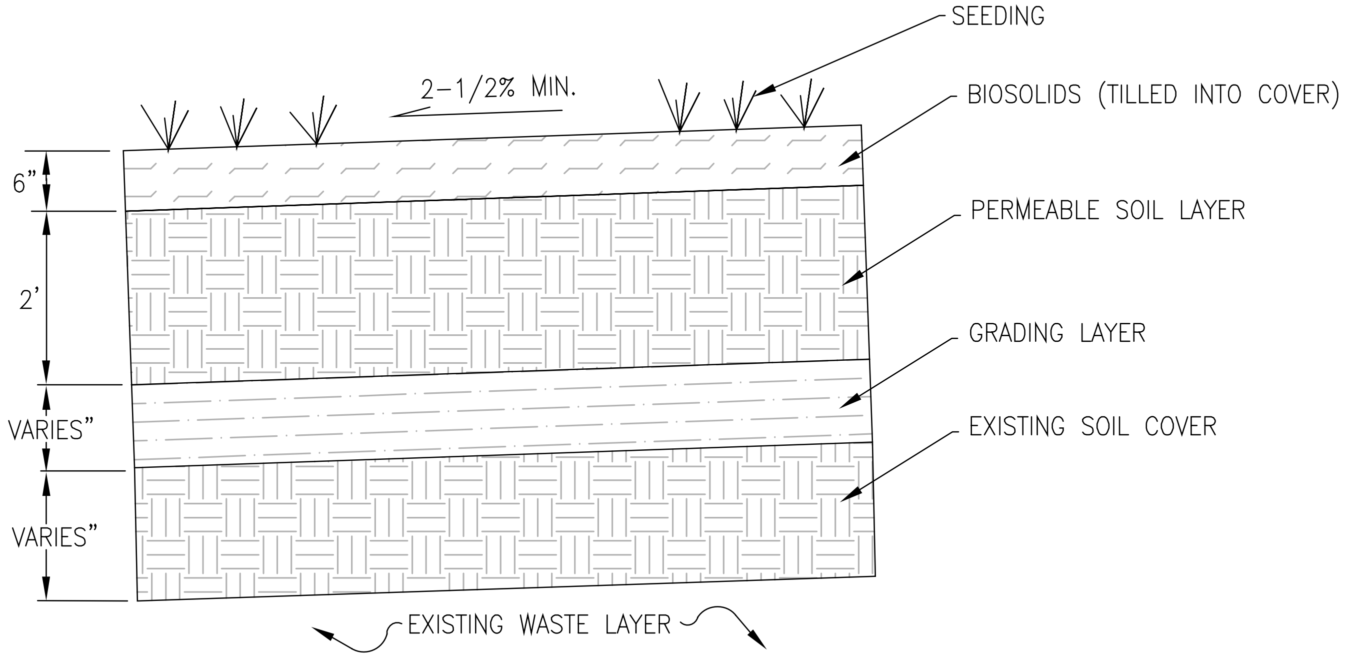
DRAWN BY: S. STEVENS

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

FIGURE 3-1
CONCEPTUAL DESIGN PLAN

LAKE CALUMET CLUSTER SITE
CHICAGO, COOK COUNTY, ILLINOIS

SCALE	DATE ISSUED	C.A.D. FILE NO.
1"=400'	3-30-06	FS_design_plan.dwg



PERMEABLE COVER SECTION (TYP.)

NTS

ecology and environment engineering, inc.
International Specialists in the Environment
Chicago, Illinois

DESIGNED BY:	T. CAMPBELL
CHECKED BY:	N. BROWN
DRAWN BY:	T. CAMPBELL

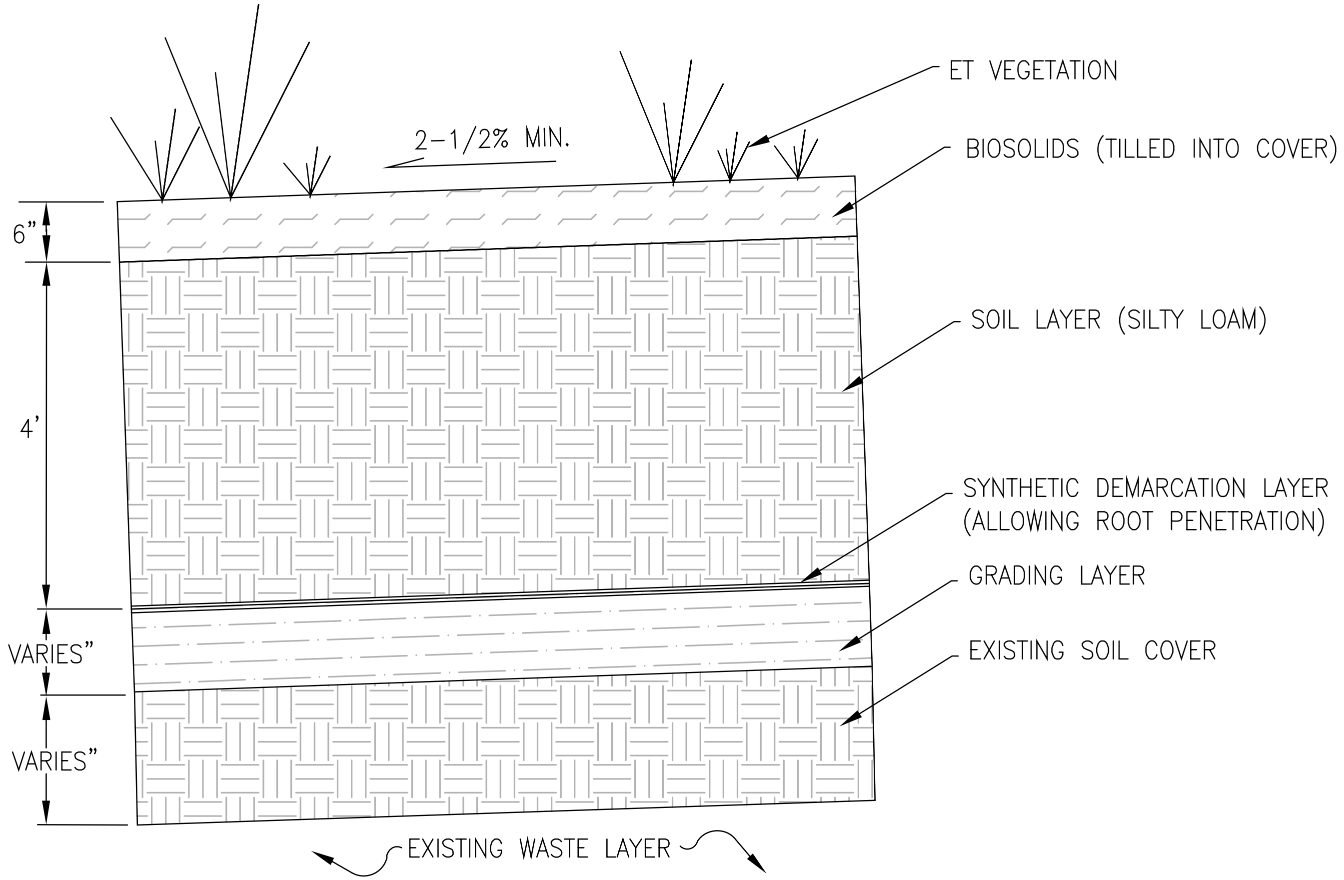
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

FIGURE 3-2

PERMEABLE SOIL COVER SECTION

LAKE CALUMET CLUSTER SITE
CHICAGO, COOK COUNTY, ILLINOIS

SCALE	DATE ISSUED	C.A.D. FILE NO.
NONE	3/30/06	PERMEABLE COVER SECTION.DWG



EVAPOTRANSPIRATION CAP SECTION (TYP.)

NTS

ecology and environment engineering, inc.
International Specialists in the Environment
Chicago, Illinois

DESIGNED BY: T. CAMPBELL

CHECKED BY: N. BROWN

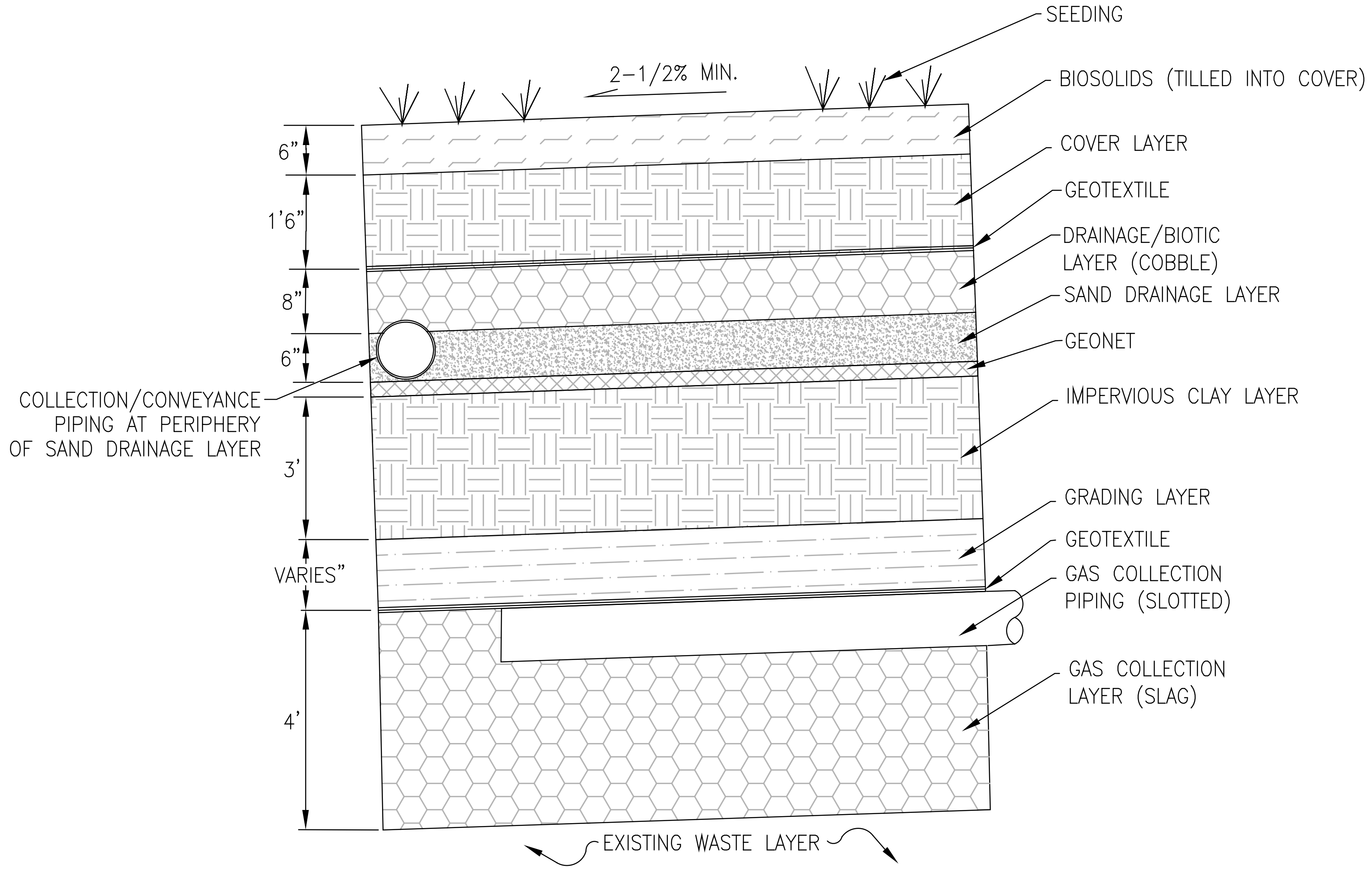
DRAWN BY: T. CAMPBELL

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

FIGURE 3-3

EVAPOTRANSPIRATION (ET) CAP SECTION
LAKE CALUMET CLUSTER SITE
CHICAGO, COOK COUNTY, ILLINOIS

SCALE	DATE ISSUED	C.A.D. FILE NO.
NONE	3/30/06	ET CAP SECTION.DWG



724 CAP SECTION ABOVE GAS COLLECTION LATERAL (TYP.)

NTS

ecology and environment engineering, inc.
International Specialists in the Environment
Chicago, Illinois

DESIGNED BY: C. NANCARROW/T. CAMPBELL

CHECKED BY: N. BROWN

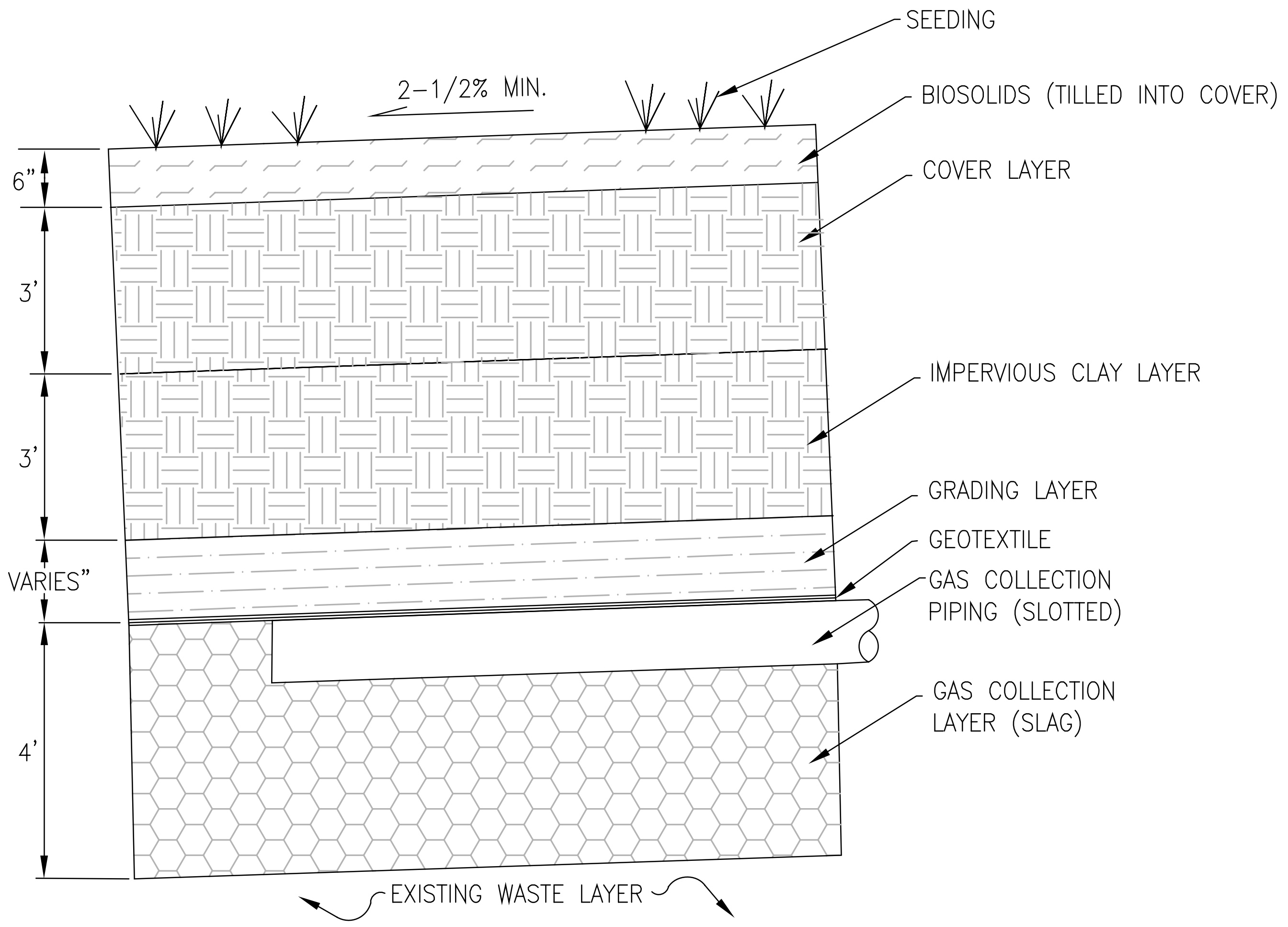
DRAWN BY: S. STEVENS/T. CAMPBELL

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

FIGURE 3-4

LOW-PERMEABLE 35 IAC PART 724 CLAY CAP SECTION
LAKE CALUMET CLUSTER SITE
CHICAGO, COOK COUNTY, ILLINOIS

SCALE	DATE ISSUED	C.A.D. FILE NO.
NONE	3/30/06	724 CAP SECTION.DWG



811 CAP SECTION ABOVE GAS COLLECTION LATERAL (TYP.)

NTS

ecology and environment engineering, inc.
International Specialists in the Environment
Chicago, Illinois

DESIGNED BY: T. CAMPBELL

CHECKED BY: N. BROWN

DRAWN BY: T. CAMPBELL

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

FIGURE 3-5

LOW-PERMEABLE 35 IAC PART 811 CLAY CAP SECTION
LAKE CALUMET CLUSTER SITE
CHICAGO, COOK COUNTY, ILLINOIS

SCALE	DATE ISSUED	C.A.D. FILE NO.
NONE	3/30/06	811 CAP SECTION.DWG

4

Detailed Analysis of Alternatives

The detailed analysis of alternatives is intended to provide the relevant information required to select a remedy. The evaluation of alternatives was conducted using EPA's nine primary evaluation criteria, which are listed in Section 300.430 in Paragraph (e) (9) (iii) of the NCP. These criteria are:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Short-term impacts and effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, and volume;
- Implementability;
- Cost;
- State acceptance; and
- Public acceptance.

It should be noted that the final two criteria (State and Community Acceptance) are used to modify the selection of an alternative. These criteria will be assessed after the public comment period that follows issuance of the Proposed Plan (the precursor to the IROD). Therefore, these two criteria will not be used in the evaluation presented in this report.

The remaining seven evaluation criteria will be used as the basis of the detailed analysis, which will provide in-depth information that can be used in selecting an interim remedial action alternative for implementation. Descriptions of each of the evaluation criteria are provided below:

Overall Protection of Human Health and the Environment – This criterion provides a final check to assess whether each alternative provides adequate protection of human health and the environment. The assessment of overall protection draws on the evaluation of the other criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of the overall protectiveness of an alternative will focus on whether a specific alternative achieves adequate protection and will describe how site risks posed through each pathway being addressed by the FFS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation will allow for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

Compliance with ARARs – This criterion will be used to determine whether each alternative will meet the identified ARARs. The detailed analysis will summarize which requirements are applicable, relevant, and appropriate to an alternative and describe how the alternative meets these requirements.

Short-Term Impacts and Effectiveness – This criterion will evaluate the effects that the alternative will have on human health and the environment during its construction and implementation phase.

Long-Term Effectiveness and Permanence – This criterion evaluates results of the interim remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation will be the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes remaining at the site.

Reduction of Toxicity, Mobility, or Volume – This criterion addresses the regulatory preference for selecting removal or remedial actions that employ treatment technologies permanently and significantly reducing the toxicity, mobility, or volume of the contaminants.

Implementability – This criterion evaluates the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required to construct and provide O&M.

Cost – Each alternative will have a detailed cost estimate prepared. The estimate will include:

- Estimation of capital and O&M costs; and
- Present worth analysis.

Costs developed as part of the FFS are expected to provide an accuracy of +/-30%.

In Section 4.1, the alternatives are evaluated individually using the above-referenced criteria. A summary of the individual analyses is presented in Table 4-1. In Section 4.2, a comparative analysis of the alternatives (e.g., Alternative 1 versus Alternative 2) is performed to show how the alternatives rate when compared to each other and to the evaluation criteria, and a summary of the evaluation is presented in Table 4-2.

4.1 Individual Comparative Analysis

4.1.1 Alternative 1: No Action

Under this alternative, no remedial action would be undertaken at the LCC site. The site would remain in its current condition with the existing soil cover thickness of 0 to 3 feet.

Alternative 1 provides no protection of human health or the environment, and ARARs would not be met. Since no construction activities would be performed, this alternative provides no adverse impacts in the short term.

With regard to long-term effectiveness and permanence, Alternative 1 provides none, in that no remedial action would be implemented. Additionally, there is no reduction of toxicity, mobility, or volume. Potentially contaminated surface water runoff would continue to migrate into Indian Ridge Marsh, and infiltrate into the buried waste causing the contaminants to continue to leach into the groundwater.

The No Action alternative is readily implementable in that nothing is required to be constructed, maintained, or monitored. There are no costs associated with this alternative.

4.1.2 Alternative 2: Capping of Existing Wastes with a Permeable Soil Cover

Under this alternative, construction of a permeable soil cover, grading for stormwater collection over the entire site, and vegetation of the entire site with native plants and prairie grasses would be undertaken.

Alternative 2 provides limited protection of human health and the environment. The permeable soil cover would reduce the risk associated with direct human exposure to the buried waste material. However, surface water infiltration into the waste would still occur, resulting in further contaminant migration into the groundwater. Additionally, animals would still be able to burrow though the cover and enter into the waste.

This alternative would not meet most of the ARARs. Under 35 IAC 742.1105, a low-permeability cover is required for soils having contaminant concentrations that exceed the soil component of groundwater ingestion exposure route. Based on the analytical results from the previous site investigations, the contaminant concentrations detected at the LCC site exceed this threshold. The completed soil cover and topsoil vegetative layer would not eliminate exposure routes to ecological receptors (i.e., burrowing animals) using the site as a food/habitat source. It is assumed that all location-specific ARARs (location near endangered species, wetlands, and secondary contact and indigenous aquatic life waters) would be waived since removal of waste materials is cost prohibitive. Action-specific ARARs for Illinois Pollution Control Board cover requirements (35 IAC 724, 811, and 817) would not be met by a permeable cap.

There are considerable short-term impacts associated with this alternative, which include road closures/restrictions, street cleaning activities, and control of fugitive dust and debris. This alternative does provide some long-term effectiveness and permanence in that human exposure to the buried waste would be reduced. However, animals may still be able to burrow into the waste.

Under this alternative, there would not be a significant reduction of toxicity, mobility, or volume; however, the soil cover would afford some protection from direct contact exposure to waste. The permeability of the cover would allow continued infiltration of precipitation, which would not reduce the migration of contaminants from the site. A disadvantage to the design is that prairie grass vegetation creates an “attractive nuisance” for birds and mammals; furthermore, burrowing animals can easily breach the cover. Implementing the alternative is simple and the design allows for future repairs to the cover to be easily made. Local tradesmen would be available to repair most conditions that may affect cover effectiveness.

4.1.3 Alternative 3: Capping of Existing Wastes with an Evapotranspiration (ET) Cap

Alternative 3 involves construction of an ET cap over the existing waste, which entails construction of a permeable soil cover, grading for stormwater collection, and vegetation with a mixture of warm- and cool-season native grasses, shrubs, and trees over the entire site to prevent infiltration and promote evapotranspiration.

4.1.3.1 Evaluation

Alternative 3 provides protection of human health and seasonal protection to the environment. The ET cap would prevent direct human exposure to the buried waste and would limit the amount of surface water infiltrating into the waste material. However, during periods of dormant plant growth, surface water would migrate into the waste and leach contaminants into the groundwater.

Under 35 IAC 742.1105, a low-permeability cover is required for soils having contaminant concentrations that exceed the soil component of groundwater ingestion exposure route. Based on the analytical results from the previous site investigations, the detected contaminant concentrations at the LCC site exceed this threshold. Additionally, 35 IAC 742.1105 requires a minimum of 10 feet of cover material to provide protection associated with the inhalation exposure pathway. As proposed, Alternative 3 would not meet this ARAR. During vegetative growth seasons, the ET cap can significantly reduce surface water infiltration. However, during dormant growth periods, infiltration would occur unabated. A special waiver from the State of Illinois would have to be obtained in order to construct this alternative to meet this requirement.

The ET cap proposed under this alternative would meet the requirements of an engineered barrier for the ingestion and inhalation exposure routes under 35 IAC 742.1105. The completed ET cap would eliminate all other exposure routes to ecological receptors using the site as a food source. It is assumed that all location-specific ARARs (location near endangered species, wetlands, and secondary contact and indigenous aquatic life waters) would be waived since removal of waste materials is cost prohibitive. Action-specific ARARs for Illinois Pollution Control Board cover requirements may not be met by an ET cap during the selected vegetation’s dormant season. The action-specific ARARs require that a barrier meeting a 1×10^{-7} cm/sec permeability be installed. It is uncertain as to whether an ET cap would meet these requirements during periods of active growth, and it is probable that during the winter months, the permeability requirements would not be met.

Under this alternative, IDOT material would not be extensively used. However, the soil would continue to be brought on to the LCC site and stockpiled. The soil needed to construct the ET layer would also have to be purchased and trucked to the site. Given the substantial increase associated with two separate and on-going shipments of materials coming to the site, this alternative has considerable adverse impacts in the short term. The amount of dust generation, noise, street cleaning, and material handling is effectively doubled because the IDOT material cannot be used.

Although this alternative does offer long-term permanence, it does require a high degree of maintenance. Maximizing plant uptake of water is key to the successful performance of this alternative. Ensuring plant health and survival would require constant monitoring and maintenance. Fertilization, pruning/mowing, harvesting, and replanting beyond the normal scope of O&M for a typical cap/cover system would have to be performed.

Under this alternative, there would not be a significant reduction of toxicity or volume. The ET cap would afford protection from direct contact exposure to waste and would decrease mobility of contaminants during periods when infiltration is controlled. The permeability of the cover would periodically allow infiltration of precipitation to continue the migration of contaminants from the site.

Technically, this alternative is implementable. From a construction standpoint, common construction equipment can be used, but the materials used in construction may require specialized blending to obtain the appropriate level of permeability and nutrients to sustain plant growth. Additionally, the engineering associated with plant selection will require individuals with specialized knowledge. It is uncertain as to whether this alternative can be implemented administratively. Since an ET cap will not meet the cover ARARs on a consistent basis, it is improbable that the appropriate permits could be obtained.

4.1.4 Alternative 4 - Capping of Existing Wastes with a Low-Permeability 35 IAC Part 724 Clay Cap

4.1.4.1 Description

Alternative 4 involves construction of a low-permeability clay cap meeting the requirements of Title 35 IAC Part 724 including gas collection and drainage layers, grading for stormwater containment and collection, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, and vegetation of the entire site with native plants and prairie grasses. This alternative differs greatly from the previous alternatives in that a low-permeability cap would be installed; whereas under the previous alternatives surface water can readily migrate through the cover systems and come in contact with the waste material.

4.1.4.2 Evaluation

Alternative 4 provides protection of human health and the environment. It will prevent direct and indirect human exposure to the on-site contaminants. The low-permeability layer will significantly reduce the amount of surface water infiltration that would come into contact with the buried waste materials. Additionally, the drainage layer system, which has a cobble layer component, would effectively prevent burrowing animals from coming into contact with the subsurface contamination.

Because this alternative includes a low-permeability clay layer, it would meet all the ARARs, including the requirements for an engineered barrier for the ingestion and inhalation, as well as the soil component of groundwater ingestion, exposure routes under 35 IAC 742.1105. The completed 724 cap would eliminate all other exposure routes to ecological receptors using the site as a food source; however, the prairie grass vegetation and pond would create an “attractive nuisance” for birds, waterfowl, and small mammals. It is assumed that all location-specific ARARs (location near endangered species, wetlands, and secondary contact and indigenous aquatic life waters) would be waived since removal of waste materials is cost prohibitive. All action-specific ARARs for Illinois Pollution Control Board (35 IAC 724, 811, and 817) cover requirements would be met by a 724 cap.

During construction, short-term impacts from grading and material placement of the various cover layers would ensue; longer construction time is another short-term impact. These short-term impacts may include road closures/restrictions, street cleaning activities, and control of fugitive dust and debris. Long-term effectiveness and permanence are the highest under this alternative. This alternative also includes the installation of an LFG collection system, which also increases this alternative's short-term impacts.

Under this alternative, there would not be a significant reduction of toxicity or volume. The 35 IAC Part 724 cap would afford protection from direct contact exposure to wastes and would be effective at decreasing the mobility of subsurface contaminants. The low permeability of the cover would greatly reduce infiltration of precipitation, which would assist in reducing migration of contaminants from the site.

This alternative is readily implementable. It can be designed to meet the requirements of all the ARARs, and no special waivers from the State of Illinois would be required. Although a gas extraction system is proposed, an existing flare system with the capacity to treat the expected volume of collected gas is in place. By having a flare system in place, air permits would have to modified, not obtained, reducing the amount of paper work and filings. The vegetative layer is standard for a cover system and would not require activities beyond what is normally expected. Since the flare is currently in operation, the addition of the new collection system should not prove to be problematic.

4.1.5 Alternative 5: Capping of Existing Wastes with a Low-Permeability 35 IAC Part 811 Clay Cap

4.1.5.1 Description

Alternative 5 involves construction of a low-permeability clay cap meeting the requirements of Title 35 IAC Part 811 including gas collection, grading for stormwater containment and collection, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, and vegetation of the entire site with native plants and prairie grasses. This alternative differs from Alternative 4 in that a drainage layer would not be incorporated into the design, which would further reduce leachate generation and prevent burrowing animals from compromising the clay layer. While not specifically required under 35 IAC 811, a gas collection system was added to prevent gas generation from potentially damaging the low-permeability clay layer.

4.1.5.2 Evaluation

Alternative 5 provides protection of human health and the environment. The low-permeability clay layer provides protection of human health by preventing exposure to the waste material. Additionally, having a permeability of less than

1×10^{-7} cm/sec, the cap would provide a significant reduction of surface water infiltration into the waste material.

The 811 cap proposed under this alternative would meet all the requirements for an engineered cap under 742.1105. The completed 811 cap would eliminate all other exposure routes to ecological receptors using the site as a food source; however, the prairie grass vegetation and pond would create an “attractive nuisance” for birds, waterfowl, and small mammals. It is assumed that all location-specific ARARs (location near endangered species, wetlands, and secondary contact and indigenous aquatic life waters) would be waived since removal of waste materials is cost prohibitive. Not all of the action-specific ARARs of the Illinois Pollution Control Board’s cover requirements would be met by an 811 cap. Under 35 IAC 724, a drainage layer is required; therefore, this ARAR would not be met.

Short-term impacts associated with Alternative 5 include dust generation, construction noise, and an increase in local truck traffic. Control measures such as rerouting of traffic, and street cleaning may have to be implemented.

Under this alternative, there would not be a significant reduction of toxicity or volume. The 811 cap would afford protection from direct contact exposure to waste and would be effective at decreasing the mobility of contaminants. The low permeability of the cover would greatly reduce infiltration of precipitation, which would reduce the migration of contaminants from the site.

Technically, this alternative is implementable. The proposed cap does not require any specialized construction equipment or engineering design. While an LFG collection system has been incorporated into this alternative, these components are common systems to most landfill closure plans and should not prove to be problematic to implement. Administratively, re-permitting of the existing flare system would have to be implemented and a waiver for not meeting the requirements of 35 IAC 724 would have to be obtained. While the new flare permit is obtainable, it is uncertain as to whether a wavier for the cap can be obtained.

4.2 Comparative Analysis of Alternatives

In this subsection, the five interim remedial action alternatives are evaluated against one another using the seven EPA criteria described at the beginning of this Section 4.

4.2.1 Overall Protection of Human Health and the Environment

With the exception of Alternative 1, No Action, all of the interim remedial action alternatives provide some level of protection. Of the four remaining alternatives, Alternative 4 (724 Cap) provides the greatest level of protection of human health and the environment. Alternative 4 provides the thickest low-permeability layer as well as a drainage layer, which would direct surface water that has infiltrated into the various layers of the cap away from the protective layer. The drainage layer system would also prevent burrowing animals from coming into contact with the waste. Additionally, LFG would be collected and routed to the flare system on Paxton I for thermal destruction. Alternative 5 (811 Cap) is similarly protective in that its low-permeability layer is the same thickness as Alternative 4 and also collects and provides for collection and destruction of LFG. However, there is no drainage layer associated with this alternative, so it is less protective of human health and the environment than Alternative 4.

Alternative 3 (ET Cap) is slightly more protective than Alternative 2 (Permeable Soil Cover) in that it is designed to limit the amount of surface water infiltration. However, during winter months when plant life is dormant, Alternative 3 would be expected to provide the same level of protection as Alternative 2.

4.2.2 Compliance with ARARs

With the exception of the No Action alternative, which does not meet any of the ARARs, the four remaining alternatives can be designed such that some, if not all, of the ARARs would be met. The main discriminator for this evaluation criterion is the type of cover system employed by the various alternatives. Therefore, this section will focus on how the action alternatives meet the ARARs associated with the covers.

Of the four interim remedial action alternatives, Alternative 4 (724 Cap) meets all the requirements presented for covers (i.e., 35 IAC 724, 742, 811, and 817). Alternative 5 (811 Cap) meets the requirements of 35 IAC 817, but not IAC 724. Alternatives 2 (Permeable Soil) and 3 (ET Cap) do not meet the requirements for a cover system since a protective barrier meeting the 1 x 10^{-7} cm/sec permeability standard is not provided.

4.2.3 Short-Term Impacts and Effectiveness

The No Action alternative would have the least short-term impact in that nothing would be implemented or constructed. The short-term impacts posed by Alternative 2 (Permeable Soils Cover) would be less significant than the other alternatives because this alternative involves the least amount of earthwork.

Given the extensive material handling associated with the cover systems and surface water drainage, Alternatives 4 (724 Cap) and 5 (811 Cap) would have more short-term effects than Alternative 2, with Alternative 4 posing slightly greater impacts than Alternative 5 in that a drainage layer would be installed as part of its construction.

Alternative 3 (ET Cap) has greatest short-term impacts. While the other alternatives use IDOT material, Alternative 2 requires a significant amount of soil to be imported to the site. Assuming that the IDOT material will continue to be brought on site, the additional shipments associated with bringing the ET cap material on site will greatly increase traffic. This causes Alternative 3 to have the most adverse effects in the short term.

4.2.4 Long-Term Effectiveness and Permanence

While Alternative 1 (No Action) provides no long-term effectiveness or permanence, all of the remaining alternatives would provide some level of long-term effectiveness, assuming proper O&M of the covers and ancillary systems.

All the interim remedial action alternatives can be readily maintained to consistently meet their design objectives. While Alternative 2 (Permeable Soil Cover) will be the easiest to maintain in that the vegetative cover requires standard care, surface water infiltration into the waste material will continue unabated. Therefore, Alternative 2 offers only slightly more permanence than Alternative 1.

The vegetative cover associated with Alternative 3 (ET Cap) will require significantly more care than Alternative 2. However, on yearly basis, there will be less surface water infiltration into the waste than under Alternative 2. Therefore, Alternative 3 offers more long-term permanence than Alternative 2.

Long-term effectiveness under Alternatives 4 and 5 would be approximately the same. While both alternatives require cover maintenance, they also require the operation of a gas collection system. The gas collection system should not prove to be problematic given the flare is in operation and utilizes experienced technicians. With the drainage system providing an additional reduction in surface water infiltration and preventing burrowing animals from entering the waste, Alternative 5 offers the most long-term permanence and effectiveness.

4.2.5 Reduction of Toxicity, Mobility, and Volume

None of the alternatives presented will reduce the volume or toxicity of the waste present on site. However, the mobility or ability to leach contamination into the groundwater or nearby surface waters would be different for several of the alternatives.

Alternative 1 (No Action) does not provide for any reduction in the mobility of contaminants. Of the four interim remedial action options, Alternative 2 (Permeable Soil Cover) would provide the least reduction in contaminant mobility because precipitation would readily infiltrate to the subsurface. Alternative 3 provides a slightly greater degree of reduction of contaminant mobility than Alternative 2. However, during periods of dormant plant activity, surface water would readily infiltrate through the cap providing approximately the same level of reduction in mobility as Alternative 2.

While Alternatives 4 and 5 are similar, Alternative 5 (724 Cap) provides a greater reduction of contaminant mobility in that a drainage layer is incorporated into its design. The drainage layer would further reduce the potential for surface water to infiltrate into the waste.

Implementability

Of the five alternatives, Alternative 1 (No Action) is the most implementable. Alternative 2 (Permeable Soil Cover) is the next most readily implementable alternative since it involves the least amount of soil grading and placement. Administratively, however, this alternative could be the most difficult since it does not meet the ARARs associated with a cover design.

Alternative 4 (724 Cap) is the most difficult alternative to construct. As stated previously, this alternative includes the installation of a gas collection system and a drainage layer, which each require additional construction effort and expertise. Alternative 5 (811 Cap) is only slightly more implementable than Alternative 4 in that the drainage layer would not be constructed, and a waiver for not meeting the requirements of 35 IAC 724 would be required.

Implementing Alternative 3 (ET Cap) would involve a similar level of construction and expertise as that posed by Alternative 5. While the cap is less complex than Alternative 5, special soils would have to be imported and additional O&M would be needed to ensure that plant life is maintained. Additionally, data gathering needs would be greater since water balance calculations would have to be performed to ensure that the cover system is functioning properly. As with Alternative 2, it is uncertain as to whether a waiver could be obtained for its cover.

Cost

Under this section, the costs associated with implementing the alternatives are compared against each other. Using the present worth value for each alternative, Alternative 3 (ET Cap) is the most expensive ($19,730,000) with the main cost driver being that the soils used to construct the ET layer will have to be purchased and imported. Alternative 4 (724 Cap) is the next most expensive alternative, having a present worth cost of $18,970,000, which is slightly more than the cost associated with Alternative 5 (811 Cap) of $17,160,000. The discriminating factor between these two alternatives is the installation of the drainage layer.

With no specialized layers or LFG collection system being implemented, Alternative 2 (Permeable Soil Cover) has a present worth cost of $11,900,000, which makes it the least expensive of the interim remedial action alternatives. For

Alternative 1 (No Action), there are no costs. Table 4-3 provides a summary of costs for each alternative.

Table 4-1 Individual Analysis of Alternatives
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Remedial Alternative	Evaluation Criteria						
	Protection of Human Health and the Environment	Compliance with ARARs	Short-Term Impacts and Effectiveness	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume	Implementability	Cost* Construction, 30-Year O&M, Total
Alternative 1: No Action	No additional protection provided.	Does not comply.	No short-term impacts.	Does not provide any effectiveness or permanence.	No reduction achieved.	Readily implementable.	$0 $0 $0
Alternative 2: Permeable Soil Cover	Provides protection of human health and limited environmental protection.	Can be designed to meet most ARARs. Does not comply with 35 IAC 724.1105, 724, 811, or 817.	Short-term impacts include increased truck traffic, noise, and dust generation.	Provides limited effectiveness and permanence.	No reduction in toxicity or volume, limited reduction in mobility.	Readily implementable. IDOT soils can be used for majority of cover. Waiver for cover must be obtained.	$10,900,000 $ 1,000,000 $11,900,000
Alternative 3: Evapotranspiration Cap	Provides protection of human health and limited environmental protection.	Can be designed to meet most ARARs. Does not comply with 35 IAC 724.1005, 724, 811, and 817.	Short-term impacts include increased truck traffic, noise, and dust generation.	Provides limited effectiveness and permanence. Vegetation requires extensive care.	No reduction in toxicity and volume, slight reduction in mobility.	Readily implementable. However, IDOT soils cannot be used. Waiver for cap must be obtained.	$18,730,000 $ 1,000,000 $19,730,000
Alternative 4: 35 IAC 724 Cap	Provides protection for human health and the environment.	Can be designed to meet all ARARs.	Short-term impacts include increased truck traffic, noise, and dust generation.	Provides long-term effectiveness; however, flare system must be operated and maintained to protect cap.	No reduction in toxicity and volume, but does reduce contaminant mobility.	Readily implementable. IDOT soils can be used for majority of work.	$17,700,000 $ 1,280,000 $18,980,000

Table 4-1 Individual Analysis of Alternatives
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

	Evaluation Criteria						
Remedial Alternative	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Short-Term Impacts and Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, and Volume**	**Implementability**	**Cost* Construction, 30-Year O&M, Total**
Alternative 5: 35 IAC 811 Cap	Provides protection for human health and the environment.	Can be designed to meet most ARARs. Does not comply with 35 IAC 724.	Short-term impacts include increased truck traffic, noise, and dust generation.	Provides long-term effectiveness; however, flare system must be operated and maintained to protect cap.	No reduction in toxicity and volume, but does reduce contaminant mobility.	Readily implementable. IDOT soils can be used for majority of work. Waiver from 35 IAC 724 ARAR must be obtained.	$15,900,000 $ 1,280,000 $17,180,000

* Costs rounded to nearest $10,000.

Table 4-2 Comparative Analysis of Alternatives
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

	Evaluation Criteria						
Remedial Alternative	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Short-Term Impacts and Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, and Volume**	**Implementability**	**Cost**
Alternative 1: No Action	Provides no increased protection and is least protective overall.	Provides no compliance.	Provides no short-term impacts.	Provides no long-term effectiveness.	No reduction is achieved.	The site remains the same; therefore, most implementable.	No cost associated with this alternative.
Alternative 2: Permeable Soil Cover	More protective than Alt. 1; provides limited protection to the environment since surface water migration through the waste will continue.	More compliant with ARARs than Alt. 1. Does not meet the ARARs associated with cover systems.	Least complex cover system and has the least adverse impacts in the short-term.	Limited effectiveness in the long-term, and does not offer permanence.	Regrading will allow for a limited reduction in mobility.	The cover system is the least complex; therefore it is more implementable than other alternatives.	Least expensive of all action alternatives.
Alternative 3: Evapotranspiration Cap	Provides human health protection and is more protective of the environment than Alt. 2. However, during dormant periods of plant growth, surface water will migrate through the cover.	More compliant with ARARs than Alt. 1. Does not meet the ARARs associated with cover systems.	More complex than Alt. 2, but less complex than Alt. 4 and 5. However, most material will have to be imported, greatly increasing truck traffic.	Vegetative cover will require extensive O&M. While more effective than Alt. 2, it is less effective than Alt. 4 and 5.	Reduces infiltration and mobility during the growing season; however during dormant growing periods, mobility will be the same as Alt. 2.	Based on cover construction requirements, more implementable than Alts. 4 and 5, but majority of soils must be imported, and a waiver for construction must be obtained.	Given that IDOT soils cannot be readily used, this alternative is the most expensive.

Table 4-2 Comparative Analysis of Alternatives
Focused Feasibility Study, Lake Calumet Cluster Site, Chicago, Cook County, Illinois

	Evaluation Criteria						
Remedial Alternative	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Short-Term Impacts and Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, and Volume**	**Implementability**	**Cost**
Alternative 4: 35 IAC 724 Cap	Provides the greatest level of protection of alternatives analyzed.	Only Alternative that can meet all the ARARs.	Most complex cover system. However, IDOT soils can be used, so less traffic and fewer impacts than Alt. 3.	Effective in the long-term; however, O&M of flare system is required.	Has the greatest reduction in mobility of all alternatives.	Most complex cover system to build; however, Alt 4 is still readily implementable.	Cost is 10% greater than Alt. 5.
Alternative 5: 35 IAC 811 Cap	Slightly less protective than Alt. 4 in that it does not have a drainage layer. Significantly more compliant than Alts. 1, 2, and 3.	More compliant than Alts. 1 and 2, and meets all ARARs with the exception of 35 IAC 724.	Has no drainage layer, therefore, short-term impacts are less than Alt 4.	Effective in the long term; however, O&M of flare system is required. This alternative is slightly less effective than Alt. 4 because it lacks a drainage layer.	Does not have a drainage layer; therefore, does not reduce mobility as well as Alt. 4.	Not having a drainage layer, is slight more implementable than Alt 5.	Second most expensive alternative. No drainage layer system. Main difference between this alternative and Alt. 4.

Table 4-3 Comparative Summary of Alternative Costs
Lake Calumet Cluster Site, Chicago, Cook County, Illinois

Alt.	Description	Capital Cost	O&M Cost	Alternative Cost
1	No Action	$0	$0	$0
2	Capping of existing wastes with a permeable soil cover	$ 10,899,000	$ 1,000,000	$ 11,900,000
3	Capping of existing wastes with an evapotranspiration (ET) cap	$ 18,730,000	$ 1,000,000	$ 19,730,000
4	Capping of existing wastes with a Low-Permeability 35 IAC Part 724 clay cap	$ 17,700,000	$ 1,280,000	$ 18,980,000
5	Capping of existing wastes with a Low-Permeability 35 IAC Part 811 clay cap	$ 15,900,000	$ 1,280,000	$ 17,180,000

5

Conclusions

EEEI was tasked by the Illinois EPA to prepare this Focused Feasibility Study for the Lake Calumet Cluster Site. The results from the human health risk assessment and ecological risk assessment indicate that there is an unacceptable level of risk associated with the buried wastes at the site. Therefore, the objective of the FFS was to develop and evaluate potential interim remedial action alternatives for the site. Since the buried waste is present at various locations throughout the 90-acre site, capping was considered the most viable approach to address the contamination. This is consistent with EPA's presumptive remedy guidance for municipal landfill sites.

Using EPA's guidance document, *Presumptive Remedy for CERCLA Municipal Landfill Sites*, the following Remedial Action Objectives were established for the site:

- Prevent direct and dermal contact with, and ingestion of, contaminated soil/waste contents;
- Prevent inhalation of dust;
- Minimize or eliminate contaminant leaching to groundwater;
- Prevent ingestion, adsorption, and bioconcentration of on-site surface water and sediment;
- Prevent explosion or fire from accumulations of LFG; and
- Prevent inhalation of COPCs in the LFG in excess of benchmark concentrations.

Using the presumptive remedy of capping, the following alternatives were developed for the LCC site:

- **Alternative 1 – No Action:** The LCC site would remain unchanged. No cover system would be implemented. As required by the NCP, this alternative is included to provide a basis for comparison with the remaining remedial action objectives.

- **Alternative 2 – Capping of Existing Wastes with a Permeable Soil Cover:** For this alternative, the entire site would have a permeable soil cover placed over it, while creating an appropriate grade for stormwater retention. Activities included under this alternative include site preparation/grading, placement of the cover material and planting of a vegetative cover, which consists of native plants and prairie grasses. This alternative would also utilize the imported IDOT fill material.

- **Alternative 3 – Capping of Existing Wastes with an Evapotranspiration (ET) Cap:** Under this alternative an ET cap would be placed over the majority of the site. The ET cap would utilize evaporation as well as vegetative uptake of surface water to prevent infiltration of surface water into the waste causing contaminants to leach into the groundwater. Potential vegetation to be used for this alternative includes a mixture of warm- and cool-season native grasses, shrubs, and trees. Given the necessary soil properties associated with an ET cover, the imported IDOT material would likely not be suitable for use with this alternative.

- **Alternative 4 – Capping of Existing Wastes with a Low-Permeability 35 IAC 724 Clay Cap:** This alternative involves construction of a low-permeability clay cap over the existing wastes while creating an appropriate grade for stormwater runoff. This alternative involves construction of a low-permeability clay cap meeting the requirements of IAC Title 35 Part 724, grading for stormwater containment and collection over the entire site, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, installation of a gas collection system, and vegetation of the entire site with native plants and prairie grasses.

- **Alternative 5 – Capping Existing Wastes with a Low-Permeability 35 IAC 811 Clay Cap:** Alternative 5 involves construction of a cover system which consists of a low-permeability clay layer overlain by a protective layer, which would protect it from freezing. Both the low-permeability layer and protective layer will be constructed using IDOT material. While not a requirement of 35 IAC 811, this alternative includes a gas collection system to protect the integrity of the clay layer. Additionally, grading for stormwater containment and collection over the entire site, construction of a stormwater retention pond with overflow to the Paxton I Landfill stormwater collection system, and vegetation of the entire site with native plants and prairie grasses would be performed.

Sections 3 and 4 of this FFS provided an evaluation of each of the alternatives, and a comparative analysis of the alternatives. The No Action alternative would leave the site in its present condition, and would provide no protection to human health and the environment. Alternatives 2 and 3 would be somewhat protective in that the waste materials would be covered, but infiltration would not minimize or prevent continued migration of contaminants from the site. Alternatives 4 and 5 are the most protective, covering the site with a low-permeability cap and reducing the potential for continued migration of contaminants.

In regard to the ARARs, only Alternative 4 could be implemented to meet all of the ARARs. Alternative 5 could meet the majority of ARARs; however, the requirements of 35 IAC 724 would not be met. Alternatives 2 and 3 do not meet the majority of the ARARs associated with capping/cover, and the No Action Alternative does not meet any of them.

Alternative 3 has the most adverse short-term impacts because the imported IDOT soil cannot be used for the majority of its cover installation, and the required additional soil material would have to be trucked to the site. Given that there is approximately the same amount of earthwork involved, Alternatives 4 and 5 have similar degrees of short-term effectiveness. Alternative 2 requires less earthwork, so it has less of an adverse effect in the short term than Alternatives 4 and 5. The No Action alternative has the least amount of adverse effects in the short-term since no remedial action is performed.

Alternative 1 provides no long-term permanence. Given that surface water will continue to migrate through the cap, leaching contaminants into the groundwater, Alternative 2 does not offer long-term permanence. During seasonal plant growth periods, Alternative 3 would reduce the amount of surface water infiltration. However, during periods of dormant vegetative activities, surface water infiltration into the waste material will occur. While more effective than Alternative 2, Alternative 3 does not provide long-term permanence. Both Alternatives 4 and 5 provide for long-term permanence. However, both alternatives require a flare system to be operated to address the collected LFG.

Using the presumptive remedy of capping, there will not be a reduction in toxicity or volume of contamination. However, there can be a reduction in mobility using this presumptive remedy. Alternative 5, which utilizes a clay cap and a drainage layer to prevent surface water from infiltrating into the waste, provides the greatest reduction in contaminant mobility. Alternative 5, which is similar to Alternative 4 but does not have a drainage layer, does not provide as much of a reduction in mobility as Alternative 4. Alternatives 2 and 3 are both constructed of permeable materials, and surface water will infiltrate into the waste, leaching contaminants into the groundwater. Given that Alternative 3 provides for evapotranspiration to occur, it does provide more of a reduction in mobility than Alternative 3. The No Action alternative provides for no reduction in mobility.

The most implementable alternative is Alternative 1, No Action. Given the amount of IDOT material that is presently or will be on the site, Alternatives 2, 4, and 5 are more implementable than Alternative 3, which will require the importation of the majority of soil for its cover system. Of the three alternatives using IDOT soils, Alternative 2 is the most implementable since its cover is relatively simple. However, it is doubtful that a waiver for the ARARs associated with capping could be obtained for this alternative. Given that it has more specific layers associated with its construction, Alternative 4 will be slightly more difficult to implement than Alternative 5.

Since the majority of its material will have to be purchased and transported to the site, Alternative 3 is the most expensive alternative to implement. With its multiple layers and LFG collection system, Alternative 4 is the next most expensive alternative, with Alternative 5 being slightly less. Alternative 2 is the least expensive of the interim remedial action alternatives because of its relatively simple design. Finally, there is no cost associated with the No Action alternative.

Under an agreement with the Illinois EPA, IDOT has been and continues to bring excess soil from its Dan Ryan expansion project to the LCC site. Wherever possible, the alternatives developed for this FFS have used the IDOT material as part of the soils needed for the construction of the various layers associated with its cover system.

6

References

Clayton Group Services, Inc., (Clayton), September 27, 2002, *Remedial Options Report for the Southeast Chicago Cluster Site*, Volume 1 of 2.

Ecology and Environment, Inc., (E & E) March 10, 1999a, *Results of Phase I Sampling Activities for the Lake Calumet Site*.

___________, November 30, 1999b, *The Nature and Extent of Contamination at the Lake Calumet Cluster Site*.

Environmental Response Team (ERT), 2001, *Baseline Ecological Risk Assessment* (BERA), EPA.

Harza Engineering Company, May 2001, *Comprehensive Site Investigation Report, Lake Calumet Cluster Site: Alburn, U.S. Drum, and Unnamed Parcel Areas*.

Illinois Environmental Protection Agency (Illinois EPA), January 2003, *A Study of the Merits and Effectiveness of Alternate Liner Systems at Illinois Landfills*, Joyce Munie, P.E., Manager, Permit Section, Bureau of Land, A Research Paper, submitted in Fulfillment of House Resolution 715, State of Illinois 92nd General Assembly.

Montgomery Watson Harza (MWH), February 2002, *Human Health Risk Assessment (HHRA) Report for the LCC site: Alburn, U.S. Drum II, and Unnamed Parcel Areas – Final Report*, prepared for the City of Chicago Department of Environment.

Persaud, D., R. Jaagumagi, and R. Hayton, 1993, *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*, ISBN 0-7729-9248-7, Ontario Ministry of the Environment, Toronto, Canada.

United States Environmental Protection Agency, (EPA), 1996, *Ecological and Toxicological (EcoTox) Thresholds*, EPA/540/F-95/038.PB95-963324, Office of Solid Waste and Emergency Response.

__________, 1991, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA/540/P-91-001).

__________, 1993, *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA 540-F-93-035).

__________, 1992, *Supplemental Guidance to RAGS: Calculating the Concentration Term*, Publication 9285.7-081, Washington, D.C.

__________, 1989, *Final Covers on Hazardous Waste Landfills and Surface Impoundments*.