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FEASIBILITY STUDY FOR THE TONAWANDA SITE

TONAWANDA, NEW YORK

NOVEMBER 1993

U.S. Department of Energy
Oak Ridge Operations Office
Formerly Utilized Sites Remedial Action Program

Documents Comprising the Draft
Feasibility Study/Proposed Plan-Environmental Impact Statement (FS/PP-EIS)
for the Tonawanda Site,
Formerly Utilized Sites Remedial Action Program

- Feasibility Study for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-234, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, November 1993.

- Proposed Plan for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-233, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, November 1993.

The following documents have been incorporated by reference in the Draft FS/PP-EIS:

- Remedial Investigation Report for the Tonawanda Site, DOE/OR/21949-300, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, August 1993.

- Baseline Risk Assessment for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-003, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, August 1993.

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TONAWANDA, NEW YORK

NOVEMBER 1993

prepared by
U.S. Department of Energy, Oak Ridge Operations Office, Formerly Utilized Sites Remedial Action Program

with technical assistance from
Science Applications International Corporation ESC-FUSRAP
under Contract No. DE-AC05-91OR21950

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

FIGURES

TABLES

TABLES (continued)

TABLES (continued)

Page

ACRONYMS

ACL	alternative concentration limit
ADT	average daily traffic
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AM	arithmetic mean
ARARs	applicable or relevant and appropriate requirements
BFI	Browning-Ferris Industries
BNAE	base/neutral and acid extractable
BRA	baseline risk assessment
CANIT	Coalition Against Nuclear Materials in Tonawanda
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COE	U. S. Army Corps of Engineers
CREAMS	Chemicals, Runoff, and Erosion from Agricultural Management Systems
DOE	U. S. Department of Energy
DOT	U.S. Department of Transportation
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERAP	Emergency Readiness Assurance Plan
FIA	Federal Insurance Administration
FS	feasibility study
FSRD	Former Site Remediation Department
FUSRAP	Formerly Utilized Sites Remedial Action Program
GM	geometric mean
HQ	hazard quotient
LLRW	low-level radioactive waste
LLW	low-level waste
LWRP	Local Waterfront Revitalization Program
MCL	maximum contaminant level
MED	Manhattan Engineer District
MGD	million gallons per day
MUSLE	modified universal soil loss equation
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring System
NCP	National Contingency Plan
NEPA	National Environmental Policy Act

ACRONYMS (continued)

NOI	notice of intent
NPL	National Priority List
NRC	U.S. Nuclear Regulatory Commission
NWI	National Wetland Inventory
NWS	National Weather Service
NYCRR	New York Compilation of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RIMS	Regional Input-Output Modeling System
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SCS	U.S. Soil Conservation Service
SHPO	New York State Historic Preservation Office
SLAMS	State/Local Air Monitoring System
SPARE Niagara	Stop Pollution and Radiation Entering Niagara
TBC	to be considered
TLV	threshold limit value
TSP	total suspended particulates
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
FWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

From 1942 to 1946, portions of the Linde property and buildings in the Town of Tonawanda, New York, were used for separation of uranium ores. These processing activities, conducted under a Manhattan Engineer District (MED) contract, resulted in radioactive contamination of portions of the property and buildings. Subsequent disposal and relocation of processing wastes from the Linde property resulted in radioactive contamination of three nearby properties in the Town of Tonawanda: the Ashland 1 property, the Seaway property, and the Ashland 2 property. Together these four properties are referred to as the Tonawanda site.

The U.S. Department of Energy (DOE) is conducting a cleanup of the Tonawanda site under the Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to identify and clean up or otherwise control sites where residual radioactive contamination remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

DOE is conducting a remedial investigation/feasibility study/proposed plan-environmental impact statement (RI/FS/PP-EIS) process for the Tonawanda site in accordance with procedures developed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Environmental Policy Act (NEPA). The PP is published separately but is considered an integral part of the RI/FS-EIS process. The PP highlights information from the FS and identifies the preferred alternative. It is the fourth major document in the RI/FS/PP-EIS package. The RI/FS/PP-EIS process will, after agency and public review, conclude with the issuance of a Record of Decision (ROD) that will identify the remedies selected for the contamination present at the Tonawanda site. Although the site is not currently on the National Priorities List (NPL), the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) will be consulted on the issuance of the ROD.

The RI report, a baseline risk assessment (BRA), and the FS are the primary evaluation documents prepared by DOE to summarize the findings of the integrated RI/FS/PP-EIS process. The RI report summarizes the findings of activities conducted at the Tonawanda site to determine the nature, extent, and potential for migration of the radioactive and associated chemical contamination resulting from MED operations. The BRA presents the findings of an assessment to determine the human health and ecological risks posed by the presence of radioactive and associated chemical contamination. The FS report identifies, develops, and evaluates remedial action alternatives for the site based on the nature and extent of contamination documented in the RI report. The FS report also evaluates the potential environmental consequences of the various remedial action alternatives identified.

MED processing activities contaminated surface and subsurface soils on the Linde property with uranium, radium, and thorium. Soils at the Ashland 1, Seaway Industrial Park, and Ashland 2 properties became contaminated when they received solid ore refinery wastes from the Linde property. Liquid wastes from MED activities at Linde were discharged at various times between 1943 and 1944 into sanitary and storm sewers, and into injection wells in the fractured bedrock strata and overlying contact-zone aquifers.

The BRA concludes that radioactive and MED-related chemical contaminants at the Tonawanda site could result in risks to human health and ecological resources. The major potential human radiation exposure pathways identified are direct external radiation and inhalation of particulates.

This FS document provides the information necessary to select the most appropriate methods to remediate and dispose of the MED-generated contaminants present at the Tonawanda site.

Historical and Present Property Use

Linde processed uranium under contract with MED from 1942 to 1946. The Linde property is now an operating industrial plant owned by Praxair Incorporated. The property is fenced and access is restricted to onsite workers.

The Ashland 1 property, originally known as the Haist property, was leased by MED for disposal of ore-processing residues. The U.S. Atomic Energy Commission (AEC) released the property for use following a 1958 radiological survey. Much of the contaminated soil from the site was removed to the Seaway and Ashland 2 properties during construction in the 1970s.

The Seaway Industrial Park has been a solid waste landfill for the past 50 to 60 years. Browning-Ferris Industries (BFI) currently operates it as a sanitary landfill.

A portion of the Ashland 2 property was used by Ashland Oil as a landfill for disposal of industrial and chemical by-products. Now vacant, it is partially fenced but accessible to trespassers on foot.

Nature and Extent of MED-related Radiological and Chemical Contamination

Uranium processing at the Linde property was the source of the MED-related contamination at all four properties. Results of investigations show the nature and extent of contamination at the four properties to be the following:

- Uranium, radium, thorium, and their respective radioactive decay products are the primary radiological contaminants in the surface and subsurface soils, sediments, and surface water. Uranium-processing effluents injected into wells contaminated the fractured bedrock strata underneath the Linde site.

- Radiological contamination is present in surface and subsurface soils at Linde as a result of handling uranium ores, temporarily storing ore-processing waste, and disposing of liquid process waste. Radiological contamination is present in surface and subsurface soils at Ashland 1, Seaway Industrial Park, and Ashland 2 as a result of disposal of processing wastes from Linde. The total quantity of radiologically contaminated soils and waste is approximately 268,400 m^3 (351,000 yd^3) as presented in the Remedial Investigation (RI) (BNI 1993).

- The Linde soils are covered almost entirely by asphalt and buildings. Four buildings at Linde have been found to contain radioactive contamination exceeding DOE guidelines. Contaminated soils in some areas of the Seaway property are buried under landfill debris. Contaminated soil at Ashland 1 and Ashland 2 include both surface and subsurface soils.

- The nature and extent of MED-related radiological and chemical contamination of groundwater on the four Tonawanda properties has been evaluated in the RI. There is no evidence of MED-related contamination of deep groundwater on the Ashland or Seaway properties. Contamination in the bedrock and contact-zone aquifer at Linde does not pose a threat to human health or to the environment due to low flow velocity and lack of an exposure route, as this aquifer is not a drinking water source (BNI 1993). Precipitated contamination detected in a bedrock fracture resulting from the injection of effluent at Linde is immobile. No exposure route exists to present a risk of exposure (BNI 1993).

- Nonradioactive chemical contaminants are known to be present at the site, and inorganic (metals) contamination of soils and sediments may be of concern. The RI concludes that the MED-related chemicals, primarily copper, lead, manganese, and vanadium, have not migrated from the radiologically contaminated soils. This provides for the use of MED-related radiologic contaminants as "tracers" to define the soils contaminated by MED activities for remediation.

- Analysis indicates only one instance of wastes mixed with radioactive contaminants that meet the definition of hazardous (i.e., toxic by characteristic) under the Resource Conservation and Recovery Act (RCRA). This condition was found in one soil sample (of 12 analyzed) obtained at Ashland 1 that contained a concentration of chromium exceeding the hazardous waste qualifying concentration (BNI 1993).

Need for Remediation

The RI determined that areas of soils and sediments located on all four properties comprising the Tonawanda site contained concentrations of radionuclides exceeding cleanup guidelines and other MED-related chemical contaminants (metals) exceeding background concentrations. Four buildings on the Linde property, formerly used during ore processing activities, were found to contain radioactive surface contamination exceeding removal guidelines. Surface waters were found to be transporting contamination to a limited extent from erosion of the contaminated soils. It was determined that the groundwater in various aquifers under the four properties was not significantly impacted by the site or former MED activities, and was not currently or projected to be used as a drinking water source. Remediation of site groundwater is not considered necessary.

According to the NCP, which establishes EPA regulations for compliance with CERCLA, acceptable exposure levels for known or suspected carcinogens are generally those that represent an excess upper bound lifetime cancer risk to an individual of between 1×10^{-6} and 1×10^{-4}. The BRA determined risks from radiological and chemical exposures if contaminated material was left onsite. For current use, two types of human receptors (employees and transients) could receive radiological doses. At Linde, employees may encounter mean radiological risks of 7×10^{-5} and reasonable maximum exposure (RME) risk of 4×10^{-4}. Radiological risks would remain similar in the future. For current use scenarios at Ashland 1, Seaway, and Ashland 2 properties, transients may be exposed to mean radiological risks of 5×10^{-9} to 1×10^{-6} and reasonable maximum exposure risks of 5×10^{-6} to 1×10^{-4}. Future employees at Ashland 1 and Ashland 2 may be exposed to mean radiological risks of 4×10^{-7} to 7×10^{-4} and reasonable maximum exposure risks of 2×10^{-5} and 1×10^{-2}. Transients in the future at Seaway may encounter a mean radiological risk of 7×10^{-7} and an RME of 2×10^{-4}. For current and future use, the mean radiological risk to a child wading in the creek is 2×10^{-7} and the RME risk is 9×10^{-7}. Chemical risk arises from potential soil ingestion with the highest RME risk (2×10^{-5}) being to current and future employees at Linde, associated primarily with the ingestion of arsenic. Potential noncarcinogenic health effects show hazard indices of less than 1 where 1 or greater is unacceptable. Metals, especially copper, lead, selenium, silver, vanadium, and zinc in soils and surface waters were the greatest sources of ecological risk by ingestion of soils and direct contact with surface waters.

Remedial Action Objectives

Summarized below are the remedial action objectives for the MED-related contaminated media:

- prevent release of contaminants from soils and sediments into surface water and groundwater;
- reduce risks associated with contact and with inhalation and incidental ingestion of soils and sediments;
- reduce volume, toxicity, and/or mobility of contaminants in soils and sediments;
- achieve chemical-specific applicable or relevant and appropriate requirements (ARARs) for soils, sediments, and surface water; and
- achieve ARARs through decontamination and/or demolition of the contaminated buildings at Linde.

Screening of Remedial Alternatives

Remedial technologies were identified during the RI as possible responses for remediation of soils and sediments and of buildings and structures containing radioactive contaminants at the Tonawanda site, and were screened for effectiveness, implementability, and cost. Goals for surface water were addressed through the remediation of contaminated site soils, which are sources of surface water contamination. Remedial alternatives that passed the remedy selection process are listed by medium:

Soils and Sediments

- Institutional controls/site maintenance — access restriction, deed restrictions, monitoring;
- Containment — clay or multimedia cap or soil cover for soils and sediments; walls, grading, and dikes for water diversion, during sediment remediation;
- Removal — partial or total excavation of soils and sediments;
- Treatment — in situ, onsite or offsite, physical or chemical; and
- Disposal/discharge — onsite land encapsulation, offsite disposal or reuse.

Buildings and Structures

- Institutional controls/site maintenance — deed restrictions, site security, and ambient air monitoring;
- Containment — surface sealing;
- Collection — partial demolition or complete demolition;
- Decontamination — physical procedures and chemical procedures;
- Demolition - building demolition; and
- Disposal — onsite land encapsulation or disposal at an offsite facility.

These technologies are combined to form sitewide alternatives for remedial action.

Summary of Remedial Alternatives

Alternatives for remedial action at the site were evaluated against the CERCLA criteria and NEPA values. These criteria and environmental consequences address such critical issues as technical feasibility; effectiveness in protecting human health and the environment; geology, soils, and wetlands; socioeconomic and institutional issues; land use and aesthetics; and cost. Remedial alternatives included in the detailed evaluation are discussed below:

Alternative 1: **No Action.** This alternative provides for no additional remedial action at the site. Periodic environmental monitoring is incorporated in this alternative. This alternative is not protective of human health and the environment.

Alternative 2: **Complete Excavation with Offsite Disposal.** Complete excavation of MED-contaminated soils (including those underneath buildings and Seaway refuse) and offsite disposal would remove the source of contamination from the site. At Linde, contaminated structures (Buildings 14, 30, 31, 38, and the subsurface vault) would be demolished. Rattlesnake Creek would be temporarily diverted to remove radioactive contaminants in sediments; the associated wetlands would be reconstructed. This alternative would protect human health and the environment and would meet applicable standards regarding acceptable levels of residual contamination.

Alternative 3: **Complete Excavation with Onsite Disposal.** Complete excavation of soils (including those underneath buildings and Seaway refuse) and onsite disposal would protect human health and the environment. At Linde, contaminated structures (Buildings 14, 30, 31, 38, and the subsurface vault) would be demolished. Institutional controls would be imposed to control access to the onsite disposal cell, and the cell would be designed to minimize future exposures or releases to the environment. Rattlesnake Creek would be temporarily diverted to remove radioactive contaminants in sediments; the associated wetlands would be reconstructed. Applicable standards regarding acceptable levels of residual contamination would be met.

Alternative 4: **Partial Excavation with Offsite Disposal.** Partial excavation of MED-contaminated soils would involve those contaminated soils that are accessible (i.e., not under Building 30 or landfill material). Physical and chemical methods would be used to selectively decontaminate Building 30. Buildings 14, 31, and 38 and the subsurface vault would be completely demolished at Linde. Soils from under Building 30 would be excavated when they become accessible. Rattlesnake Creek may need temporary diversion to remove radioactive contaminants in sediments; the associated wetlands would be reconstructed. Since most of the contamination (over 90% as defined in the FS) would be removed and institutional controls would prevent access to and disturbance of the contaminated soils left in place in the Seaway landfill, this alternative would protect human health. This alternative does not meet applicable standards for levels of residual radioactivity acceptable for unrestricted use. Therefore, restrictions would be required on the continued use of areas of these properties, or justification to impose supplemental standards would be developed.

Alternative 5: Partial Excavation with Onsite Disposal. Partial excavation of soils would involve those contaminated soils that are accessible (i.e., not under Building 30, pavement, or landfill material). Physical and chemical methods would be used to selectively decontaminate Building 30. Buildings 14, 31, and 38 and the subsurface vault would be completely demolished at Linde. Rattlesnake Creek may need temporary diversion to remove radioactive contaminants in sediments; the associated wetlands will be reconstructed. Since most of the contamination (over 90% as defined in the FS) would be removed and the non-excavated material would remain under the refuse at Seaway, this alternative would protect human health and would significantly reduce migration of contamination to surface water and groundwater. This alternative does not meet applicable standards for acceptable levels of residual radioactivity for unrestricted use at the Seaway landfill. Therefore, restrictions would be required on the future use of areas of these properties, or justification to impose supplemental standards would be developed.

Alternative 6: Containment with Institutional Controls. Containment would involve capping all accessible soils, temporarily diverting Rattlesnake Creek to remove radioactive sediments, and reconstructing associated wetlands. Radionuclides on the surfaces of buildings and structures would be contained by applying sealants. This alternative would protect human health and the environment by eliminating exposure pathways. Institutional controls would be required to prevent future access to and disturbance of the contained waste. Applicable standards regarding residual contamination and containment would not be met. Therefore, restrictions would be required on the future use of areas of these properties, or justification to impose supplemental standards would be developed.

Alternatives 2 through 5 require disposal of large quantities of contaminated soil. As part of the analysis of those alternatives, seven disposal options were evaluated:

- **Onsite disposal in a designed encapsulation cell**: The contaminated materials would be excavated and disposed in an encapsulation cell at Ashland 1, Seaway, or Ashland 2. The cell would have a clay liner that prevents upward migration of water into the cells and minimizes potential buildup of water within the cell. Infiltration of surface water into the cell would be minimized with an impermeable cap consisting of four feet of clay, three feet of protective rip-rap, sand, and topsoil layers. A typical design is shown in Figure 5-2.

- **Offsite disposal in an in-state land encapsulation cell**: This option involves disposal of the waste materials at a facility within the State of New York. The design requirements for an encapsulation cell offsite would be similar to that for an onsite cell. Because this facility does not now exist, the use of such an option may only be plausible for long range remedial actions. For the purpose of this

FS, it is assumed that DOE would develop a separate disposal facility dedicated to the New York FUSRAP waste.

- **Permanent disposal at a FUSRAP-dedicated disposal facility located in the eastern U.S.:** This option would involve disposal at a newly designed and constructed dedicated encapsulation cell. The design requirements for an encapsulation cell offsite would be similar to that for an onsite cell. This land encapsulation facility could be dedicated to the disposal of not only New York waste, but other FUSRAP waste as well. Because this facility does not now exist, the use of such an option may only be plausible for long range remedial actions.

- **Permanent disposal at a FUSRAP-dedicated disposal facility located in the western U.S.:** This option is the same as the above option; however, the new disposal facility would be located in the western U.S. Because this facility does not now exist, the use of such an option may only be plausible for long range remedial actions.

- **Offsite disposal located at an existing federal facility:** This option would be similar to the previous disposal option.

- **Offsite disposal at a commercially licensed low level waste (LLW) disposal: facility:** Under this option, the contaminated materials would be excavated and transported offsite to a commercially licensed LLW disposal facility for permanent disposal.

- **Offsite beneficial reuse:** The potential for the reuse of Tonawanda waste was also evaluated. Potential beneficial reuse options include using soil as cover in low-level radioactive waste (LLRW) facilities; fill material for airport expansion projects, fill material for roadbeds, or similar construction sites. Potential use as structural fill in such projects would require further investigation. More detailed analyses would be conducted for specific beneficial reuse opportunities identified to ensure protection of public health and the environment.

Analysis of Alternatives

The alternatives were each evaluated against CERCLA criteria and NEPA values and then compared with each other on the basis of the evaluations.

The no-action alternative, Alternative 1, was found least acceptable when evaluated against the CERCLA criteria and NEPA values and when compared with each of the other remedial alternatives. With no action, there would be no controls over access to and potential disturbance of contaminated soils and buildings that would result in unacceptable health and environmental risks and would not comply with the ARARs identified as required cleanup standards. By failing to be protective, this alternative cannot be considered as the preferred alternative.

The containment alternative, Alternative 6, was found less acceptable than the removal alternatives because of the long-term controls that would be necessary over large areas of the site to prevent future exposures to the capped contaminated soils. No liner system would be installed under the contaminants as a secondary means of migration control.

The partial excavation alternatives, Alternatives 4 and 5, were found more acceptable because most of the radiologically contaminated soils would be removed without disturbing ongoing operations at Linde and Seaway. Contaminated soil would be left only temporarily under Building 30 at Linde, to be removed when the building is no longer used. Institutional controls would be used to prevent future disturbance of contaminated soils currently buried under refuse at the Seaway landfill, to be left in place under these alternatives.

Alternatives 2 and 3, complete removal of all contaminated soils, are most protective of human health and the environment but would disrupt activities at Linde and Seaway and would require demolition of a building currently being used at Linde. It was found that removal with offsite disposal would be more costly than removal with onsite disposal and would provide no additional protection for public health or the environment. Additionally, offsite disposal would require a major effort to transport over 268,400 m^3 (351,000 yd^3) of contaminated soil and waste.

1. INTRODUCTION

From 1942 to 1946, several buildings and other portions of Linde property in the Town of Tonawanda, New York, were used for separation of uranium ores. These processing activities, conducted under a Manhattan Engineer District (MED) contract, resulted in radioactive contamination of portions of the property and buildings. Subsequent disposal and relocation of processing wastes from the Linde property resulted in radioactive contamination of three nearby properties in the Town of Tonawanda: the Ashland 1 property, the Seaway property, and the Ashland 2 property. Together these four properties and adjacent areas of contamination are referred to as the Tonawanda site (Figures 1-1 and 1-2). These properties also contain contamination from other sources not related to MED activities.

The U.S. Department of Energy (DOE) is conducting an evaluation of the Tonawanda site under its Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to identify and clean up, or otherwise control sites where residual contamination remains from activities conducted under contract to MED or the U.S. Atomic Energy Commission (AEC).

This document evaluates the alternatives for remedial action at the site. The proposed action for the site is remediation. It is based on historical data and the results of the remedial investigation (RI) that present information on the nature and extent of contamination, and the baseline risk assessment (BRA) that evaluates potential health and ecological risks if no remedial action is taken at the site. Action is warranted based on the potential for unacceptable exposure if existing access restrictions are not maintained in the future. The Feasibility Study evaluates potential remedial actions to address risk at the site. The RI, BRA, and FS comprise the primary evaluation documents for the integrated RI/FS-Environmental Impact Statement (EIS) package. The Proposed Plan (PP) is published separately but is considered an integral part of the RI/FS/PP-EIS process. The PP highlights information from the FS and identifies the preferred alternative. It is the fourth major document of the RI/FS/PP-EIS package. After the completion of the RI, BRA, FS, and the PP, and after public and agency review, the process will conclude with the issue of a Record of Decision (ROD) that will identify the remedies selected for the site.

The RI and BRA have been summarized and hereby incorporated by reference in the Tonawanda FS. Therefore, for the RI/FS/PP-EIS process for the Tonawanda site, the EIS consists of the FS and PP, and is hereafter referred to as an FS/PP-EIS.

Comments on the proposed remedial action at the Tonawanda site will be accepted for 60 days following issuance of the draft FS/PP-EIS. This period includes the required 30 days for review under CERCLA, plus an additional 30-day extension. The 60-day public review and comment period satisfies the minimum 45-day public review period granted for a draft EIS under NEPA. A public hearing will be held during the comment period to receive any oral comments the public wishes to make, or receive any written comments the public wishes to submit,

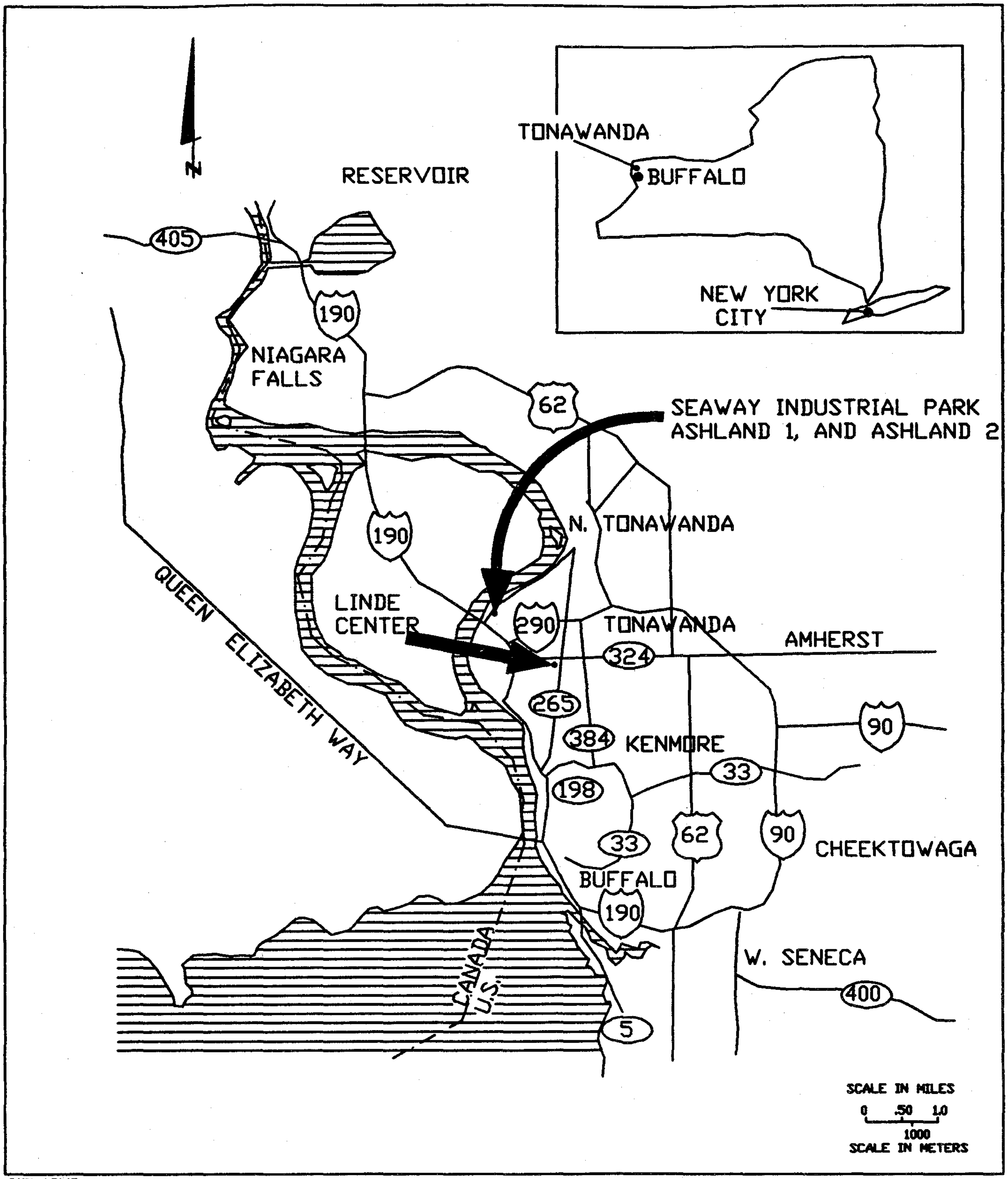

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FIGURE 1-1 REGIONAL SETTING OF ASHLAND 1, ASHLAND 2, LINDE CENTER, AND SEAWAY INDUSTRIAL PARK

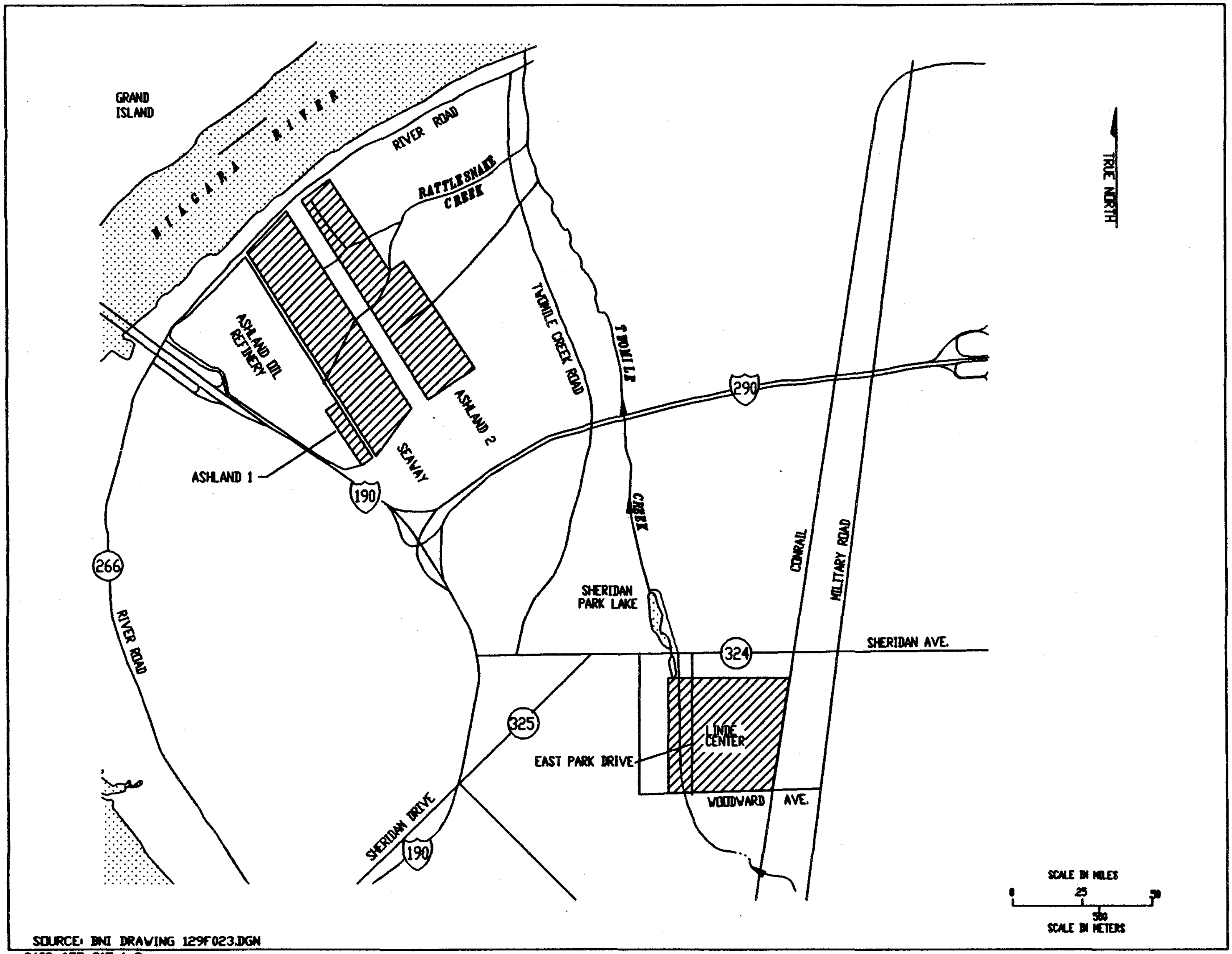

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Figure 1-2. Map of the Tonawanda Site Showing the Locations of Linde Center, Ashland 1, Seaway Industrial Park, and Ashland 2

regarding the preferred alternative or any other aspect of the draft FS/PP-EIS. Responses to public comments on the draft FS/PP-EIS will be presented in a response to comments document. The response to comments document, which combined with the draft FS/PP-EIS will constitute the final FS/PP-EIS, will be issued to the public for a 30-day waiting period. After the public comment waiting period, remedial decisions made for the Tonawanda site on the basis of the final FS/PP-EIS will be presented in the ROD.

1.1 PURPOSE AND ORGANIZATION OF THE REPORT

This FS report identifies, develops, and evaluates remedial action alternatives for the Tonawanda site based on the nature and extent of MED-related contamination documented in the Tonawanda RI report. It also evaluates the potential environmental consequences of various remedial actions. DOE's policy is to integrate NEPA values into the procedural and documentation requirements of CERCLA for remedial actions at sites for which it has responsibility (DOE Order 5400.4).

The FS report for the Tonawanda site is organized in accordance with guidance from DOE and EPA for remedial response actions at DOE facilities (DOE 1989, Ziemer 1991; EPA 1988a). The introduction, purpose, scope, description of related federal actions, and summary of information obtained through consultations with other agencies are detailed in Section 1. Section 2 describes the Tonawanda site, its history and environmental setting, the nature and extent of contamination, the transport and fate of contaminants, and summarizes the findings of the BRA, which was conducted to assess risks to human health and the ecosystem associated with site contaminants. Remedial action technologies are identified in Section 3 and screened for effectiveness in meeting the remedial action goals defined in that chapter. Several alternative actions are developed and screened in Section 4. A detailed analysis of alternatives using required CERCLA criteria and NEPA values is presented in Section 5. Section 5 also summarizes and compares the results of the analysis. Section 6 provides the references. At the end of the document are various Appendixes.

1.2 SCOPING PROCESS SUMMARY

The objective of the scoping process is to determine the range of issues to be addressed during the combined CERCLA and NEPA process. Scoping involves identification of potential actions and significant issues to be addressed, preliminary identification of the range of alternatives to be evaluated, a review and analysis of existing data, and identification of data needs.

On April 11, 1988, DOE published a notice of intent (NOI) in the *Federal Register* (53 FR 11901) to prepare an RI/FS/PP-EIS to remediate the Tonawanda and Colonie, New York, FUSRAP sites. The NOI presented background information on the proposed scope and content of the Tonawanda and Colonie projects and solicited comments and suggestions from members of the public, agencies, and other interested groups. A broad range of generic alternatives was cited in the NOI, including no action, treatment and/or disposal onsite or offsite, and containment or institutional controls. The NOI also listed environmental issues tentatively identified for analysis in the FSs. Subsequent to the publication of the NOI, DOE expressed its intent that the contamination at Colonie and Tonawanda would not be shipped from one site to the other.

As part of the scoping and planning process, a public scoping meeting for the Tonawanda FUSRAP project was held in the Town of Tonawanda on April 26, 1988, to solicit public comment on the scope of the CERCLA/NEPA process and the range of alternatives to be considered. An additional meeting was held at the request of local officials and the public for scoping purposes on June 16, 1988. A total of 315 comments were received at these scoping meetings. The public expressed preference for consideration of alternative sites for disposal outside of New York, and concern about possible groundwater contamination and the potential for adverse health effects (including cancer risks). Other concerns expressed during scoping were linked to the effects of the project on water quality and bringing additional wastes to Tonawanda (BNI 1993b). In conjunction with the research of these concerns, a review of pertinent literature and data, including completion of the BRA, was conducted to determine how the contamination at the site affects risks to human health and the environment. The FS includes a summary of the results of the BRA in Section 2.5.

A copy of the administrative record for actions at the Tonawanda site is being maintained by DOE at the Kenmore Branch Library, 160 Delaware Road, Village of Kenmore, NY 14217 (near Tonawanda), and is updated quarterly. A community relations program has been developed and is being implemented to inform the public of activities at the site. Through this program, DOE interacts with the public by means of news releases, public meetings, discussions with local interest groups, and by receiving and responding to public comments.

1.3 RELATED FEDERAL PROJECTS

DOE is presently planning response actions for the Colonie, New York, FUSRAP site. Because Colonie has contaminants and environmental impacts similar to those at the Tonawanda site, similar studies are being performed to select remedial action alternatives.

FUSRAP remediation projects in New Jersey for which RI/FS/PP-EISs are being prepared are the Maywood site in Maywood, Rochelle Park, and Lodi, and the Wayne site in Wayne, New Jersey.

DOE has prepared EIS documents for other programs and other sites under its remedial action program for treatment and storage of radioactive materials. Significant among these is the *Final Environmental Impact Statement; Long-Term Management of the Existing Radioactive Wastes and Residues at the Niagara Falls Storage Site* (DOE 1986). The EIS addresses DOE's planning and management of the long-term storage of existing radioactive wastes and residues at the NFSS. These, along with other FUSRAP documents, serve as references for implementing remedial action at the Tonawanda site.

1.4 CONSULTATION AND COORDINATION WITH OTHER AGENCIES

DOE is the lead agency for remedial action at the Tonawanda site. However, plans and activities at the site are being coordinated with EPA Region II. Activities are also being coordinated with appropriate New York State agencies including the New York State Department of Environmental Conservation (NYSDEC). The identification of federal and state regulations that may impact site remediation is being conducted in consultation with EPA Region II and NYSDEC, respectively. Through its community relations plan for the Tonawanda site, DOE also provides means for federal and state legislators, local and county officials, and the general public to participate in the decision-making process for site remediation.

Several other agencies responsible for natural or cultural resources addressed in the FS have been consulted. These include the U.S. Fish and Wildlife Service (FWS), New York State Historic Preservation Office (SHPO), U.S. Army Corps of Engineers (COE), U.S. Soil Conservation Service (SCS), and other state and county agencies.

2. SITE CHARACTERISTICS

2.1 SITE HISTORY

2.1.1 Background

This section presenting the site history and background was compiled from the Tonawanda RI report (BNI 1993) and prior characterization of the four properties comprising the Tonawanda site. All radioactive contamination for which FUSRAP is responsible in the Tonawanda area stems from uranium processing performed for MED at the Linde property. MED contracted with Linde (formerly Linde Air Products Corporation, a subsidiary of Union Carbide) from 1942 to 1946 to separate uranium from uranium ore at its ceramic plant. Linde was selected because of the company's experience in the ceramics business, which involved processing uranium to produce the "salts" used to color ceramic glazes. Under the MED contract, uranium from seven different sources was processed at Linde: four types of African ores (three low-grade pitchblendes and a torbernite) and three types of domestic ore tailings (carnotite from Colorado).

2.1.2 History of the Linde Property

Commercial operations at the Linde property began in 1943 after laboratory and pilot studies were conducted to develop methods for processing uranium. Five Linde buildings were involved in MED activities: Building 14, which was built by Union Carbide in the mid-1930s, and Buildings 30, 31, 37, and 38, built by MED on land owned by Union Carbide (Figure 2-1). Ownership of Buildings 30, 31, 37, and 38 was transferred to Linde when the MED contract was terminated. The buildings were used for laboratory and pilot plant studies for uranium separation, processing of uranium ores, and uranium separation.

Processing operations at the Linde property produced both solid waste and liquid effluent. The solid waste was removed from the site and the liquid waste was initially discharged to the sanitary sewer system; by April 1944, approximately 984,000 m^3 (26,000,000 gal) had been discharged. In June 1944, process changes had increased the pH of the effluent and discharge into the sanitary sewer was halted, and onsite deep-well injection of liquid effluent was implemented with the approval of MED. During periods of well injection when the injection wells became blocked with effluent, the effluent was discharged into a storm sewer that drained into a ditch north of the plant and ultimately into Twomile Creek. Ore processing operations, and consequently the well injection of wastewater, ended in July 1946 (Aerospace 1981).

Based on historical information presented in the RI report (BNI 1993), the Linde property has four sources of MED-related contamination: uranium processing buildings, surface and subsurface soils, immobilized processing effluents in fractured bedrock strata, and sediments in

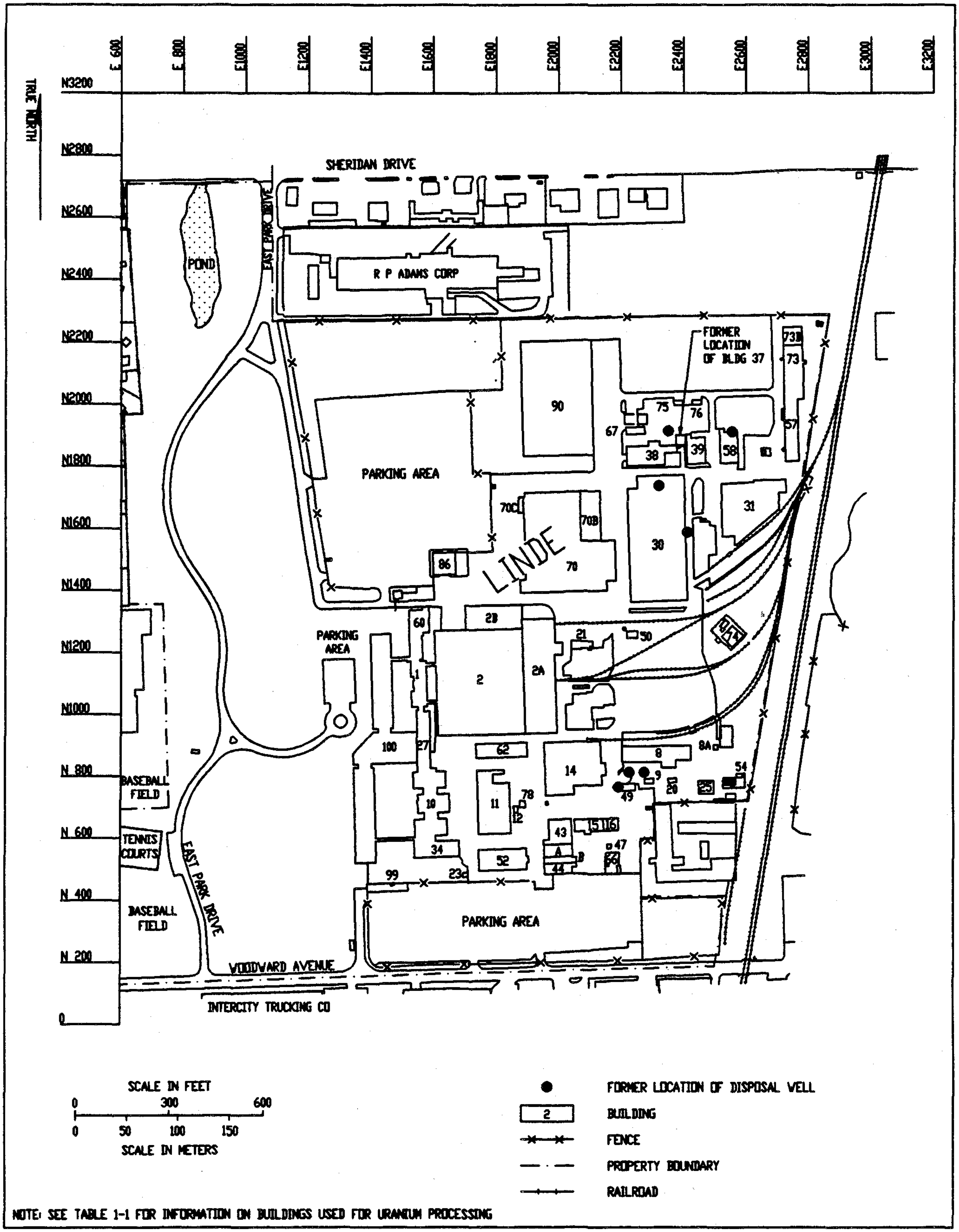

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Figure 2-1. Plan View of Linde

sumps and storm and sanitary sewers. The primary radioactive contaminants in the soils and sediments are uranium (U)-238, radium (Ra)-226, and thorium (Th)-230 and their respective radioactive decay products. For the purpose of this report, the notations "Ra-226," "Th-232," and "U-238" also refer to their associated decay products, which are assumed to be in equilibrium with the measured present activity. The primary radioactive contamination in the Linde buildings is alpha and beta-gamma fixed and removable radioactivity, which is above DOE residual radioactivity guidelines. DOE relies upon two types of guidelines for residual radioactivity, the first being generic, which is equivalent to the standard found in 40 CFR Part 192. These guidelines are 5 pCi/g (averaged over the first 15 cm) and 15 pCi/g (averaged over 15-cm thick layers of soil more than 15 cm below the surface). These generic guidelines apply to residual concentrations of Ra-226, Ra-228, Th-230, and Th-232. Where either Th-230 and Ra-226 or Th-232 and Ra-228 are present, the appropriate guideline is applied as the limit to the radionuclide with the higher concentration. If other mixtures occur, the sum of the ratios of the concentrations of individual radionuclides to their respective limits must not exceed 1. The other type of guideline is "derived," which establishes procedures to provide for treatment of hot spots and to take into account multiples or mixtures of radionuclides other than radium or thorium. Derived guidelines result in a more conservative approach. In any event, DOE follows as low as reasonably achievable (ALARA) standards to protect the public (EPA 1987).

In addition to MED-related contamination identified on the Linde property, the natural soils at Linde have been covered with a layer of fill ranging from 0 to 5.1 m (0 to 17 ft), which appears to contain additional contaminants including slag and fly ash. Both slag and fly ash are suspected sources of heavy metals and radionuclides including Th-232. This isotope of thorium was not present in the MED ores processed at Linde. The existence of this contaminant indicates a source of contamination not related to MED processing activities. Various organic compounds not related to MED ore processing were also detected during investigations on the Linde property (BNI 1993). Table 2-1 presents a list of various contaminants of interest for the Linde, Ashland, and Seaway properties, identified during the RI along with their probable sources.

Linde is presently an operating industrial plant owned by Praxair Incorporated. Portions of this site were previously owned by the Town of Tonawanda, Excelsior Steel Ball Company, Metropolitan Commercial Corporation, and the Pullman Trolley Land Company. Buildings on the site are currently used as offices, research laboratories, fabrication facilities, and warehouse storage areas.

2.1.3 History of the Ashland 1, Seaway, and Ashland 2 Properties

In 1943 when commercial operations began at the Linde property, efforts were also underway to identify a disposal site for waste residues produced during uranium processing at Linde. MED leased a 4-ha (10-acre) tract known as the Haist property to serve as a disposal site for ore refinery residues. The Haist site was later called Ashland 1. Residues deposited

Table 2-1. Constituents of Interest at the Tonawanda Site and Their Sources

Source	Constituent
Stage 1 Filter Cake	Copper[a] Calcium[a] Manganese[a] Lead[a] Sulfate[a] Iron Aluminum Magnesium Radium-226[a,b] Uranium-238[a] Thorium-230[a]
Stage 2 Filter Cake	Vanadium[a] Lead[a] Barium[b] Sulfate[a] Calcium Manganese Radium-226[a,b] Uranium-238[a] Thorium-230[a]
Processing Effluents	Sodium[a] Sulfate[a] Calcium Iron Molybdenum Chloride[b] Radium-226[a,b] Uranium-238[a]
Fly Ash	Arsenic[a] Nickel[a] Lead[a] Iron Manganese Uranium-238 Radium-226 Thorium-230 Thorium-232[a]

Table 2-1. (continued)

Source	Constituent
Slag	Magnesium[a] Calcium[a] Manganese Iron
Refinery Wastes[c]	Benzene[a] Toluene[a] Ethylbenzene[a] Longchain Hydrocarbons[a] Xylenes[a] Methylene Chloride Polynuclear Aromatics (PNAs) Chromium[a] Molybdenum[a] Lead Nickel Arsenic

[a] Analyte can be used as an indicator parameter for associated source.

[b] Analyte associated with African ore processing.

[c] Present primarily at Ashland 1 and 2.

Source: BNI 1992a.

at Ashland 1 from 1944 to 1946 consisted primarily of low-grade uranium ore tailings from processing American ores (African ore residues were transported from Linde to Lewiston, NY and Middlesex, NJ) (Aerospace 1981). Records indicate that 7250 metric tons (8,000 tons) of residues were spread over roughly two-thirds of the property to depths of 0.3 to 1.5 m (1 to 5 ft) (BNI 1993).

Following a radiological survey in 1958 by the Environmental Measurements Laboratory, AEC released the Haist property for use without removal of the residues. In 1960, the property was transferred to Ashland Oil and has since been used for this company's oil refinery activities.

In 1974, Ashland Oil constructed two petroleum product storage tanks and a drainage ditch on the Ashland 1 property. The majority of the excavated soil was transported to Seaway and Ashland 2 for disposal; the quantities of materials disposed of at each site are unknown. Any soil not transported offsite may have been used to construct the earthen berm around the storage tanks at Ashland 1. The storage tanks were removed by Ashland Oil in 1989.

A portion of the Ashland 2 property was used by Ashland Oil as a landfill for disposal of general plant refuse and industrial and chemical byproducts. The radioactive residues removed from Ashland 1 were deposited in an area of Ashland 2 adjoining the Ashland Oil landfill area. At present, the Ashland 2 property is vacant and is covered by grass, bushes, and weeds; no commercial operations are now being conducted.

The Seaway Industrial Park is presently operated by BFI. It has been owned by the Seaway Industrial Park Development Company since 1964. Seaway Industrial Park Development Company, formerly known as the North Waterway Company, owned this site before 1964.

Seaway Industrial Park has been used as a landfill for the past 50 to 60 years. The radioactive residues excavated by Ashland Oil from Ashland 1 during storage tank construction activities were deposited on three areas at Seaway. Since that time, portions of these residues have been buried under refuse and fill material.

Historical investigations of Ashland 1, Seaway, and Ashland 2 discussed in the RI (BNI 1993) indicate two sources of radioactive contamination at each of these properties: surface and subsurface soils, and sediments along Seaway drainage ditches and Rattlesnake Creek. The primary contaminants in the soils are U-238, Ra-226, and Th-230 and their respective radioactive decay products. The primary contaminant in the sediments is Th-230.

2.2 SITE DESCRIPTION

2.2.1 Bedrock and Soils

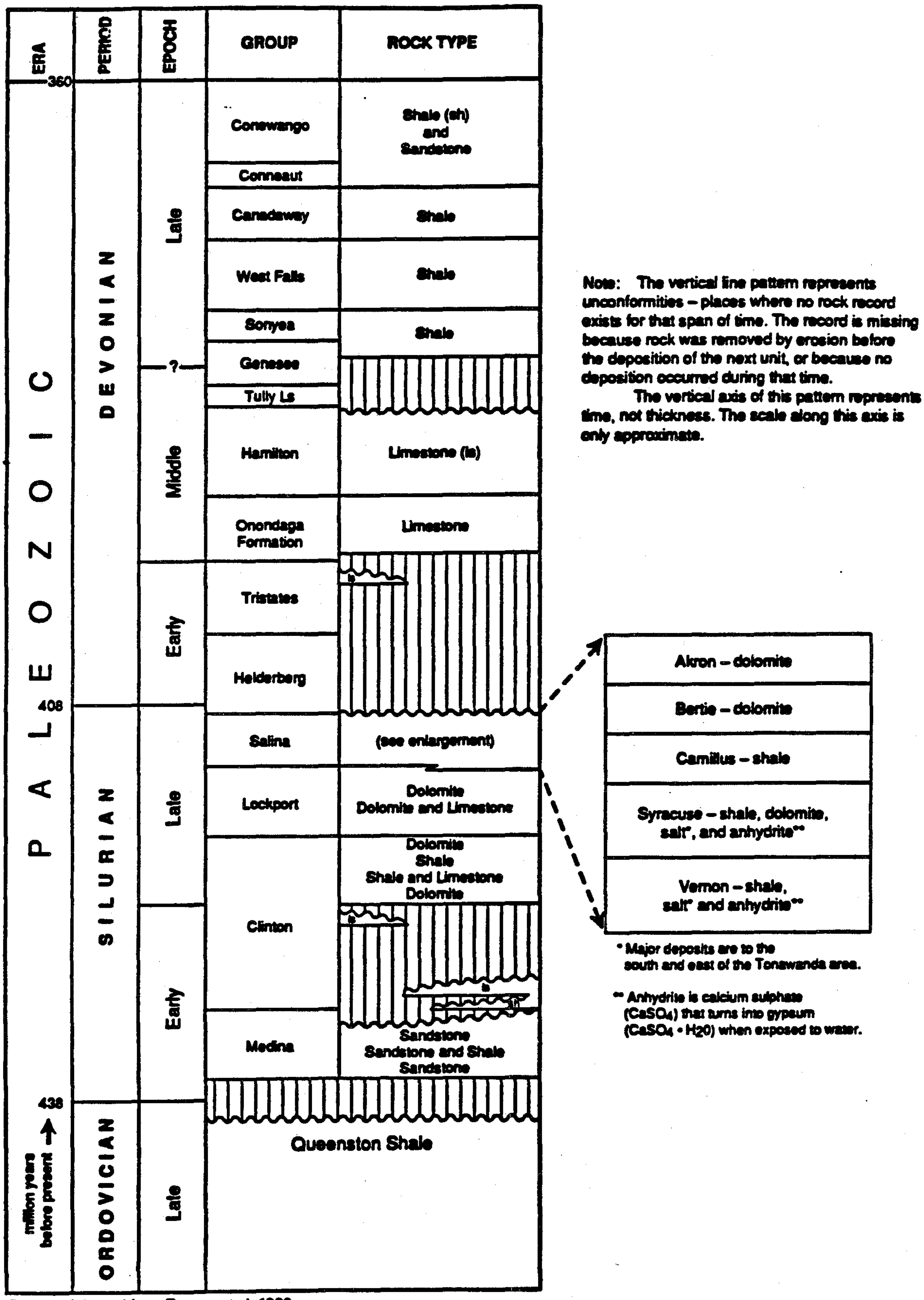
2.2.1.1 Bedrock Geology

The Tonawanda site is located within the Erie-Ontario Lowland Physiographic Unit of New York (Muller 1965; from BNI 1993). The Erie-Ontario Lowland has significant relief characterized by two major escarpments—the Niagara and the Onodaga. The Onodaga escarpment is a north-facing, east-northeast trending topographic rise that extends parallel to and immediately north of the Allegheny plateau, which is part of the Appalachian Upland. The Niagara escarpment exists approximately two-thirds of the distance between the Onodaga escarpment and Lake Ontario. The Niagara escarpment separates the Erie-Ontario Lowland into two segments—a northern, topographically-lower segment and a southern, topographically-higher segment (BNI 1993). The Tonawanda sites are located between the Niagara and Onodaga escarpments. The elevation of the ground surface is approximately 180 m (590 ft) above mean sea level at the Ashland properties and 183 m (600 ft) at the Linde site (BNI 1987). The four Tonawanda sites (Linde, Ashland 1, Seaway, and Ashland 2) are located east of the Niagara River, which is less than 1.6 km (1 mi) from Linde and 150 m (500 ft) from the Ashland–Seaway areas.

The bedrock underlying the northern segment of the Erie-Ontario Lowland, north of the Niagara escarpment, consists of Queenston shale of Ordovician Age. The rocks of the Niagara escarpment consist of Silurian Age carbonate rocks of the Lockport Group and dolomites, limestones, shales, and sandstones of the Clinton and Medina Groups. The southern segment of the Erie-Ontario Lowland, which extends from the Niagara escarpment to the Onodaga escarpment, is underlain predominantly by the Silurian Salina Group (which consists of shales and dolomites) and the Lockport Group (consisting of dolomites and limestones). The Onodaga escarpment is underlain by dolomites of the upper part of the Salina Group and limestones of the Devonian Onondaga Formation. The remainder of the southern segment of the Erie-Ontario Lowland is underlain by limestones of the Devonian Age Hamilton Group (BNI 1993). A generalized stratigraphic section for the Erie-Ontario Lowlands is depicted in Figure 2-2.

The near-surface rocks of the Erie-Ontario Lowlands are underlain by rocks ranging from the lower Cambrian Galway Formation through the Ordovician Lorraine Group. The sediments that formed these rocks were deposited on basement rock in a seaward-thickening wedge that lithified into shales, sandstones, and limestones. The basement rock in western New York is considered to be the southern extension of the Proterozoic Canadian Shield, a stable craton of metamorphosed rock.

The sedimentary material deposited from the Cambrian to the Ordovician was derived from erosion of the Adirondack and Appalachian Mountains that were forming at the time.



Source: Adapted from Rogers et al. 1990.

Figure 2-2. Stratigraphic Column for the Erie-Ontario Lowland

Middle to Upper Ordovician formations in western New York consist predominantly of shales and siltstones of marine origin. During the Silurian and Devonian periods, the sediments that make up the Erie-Ontario Lowlands continued to accumulate as a result of uplifting and erosion of the Appalachian Mountains. This deposition was infrequently interrupted by uplift of the Erie-Ontario Lowlands. This cycle of uplift and erosion resulted in shallow marine formations separated by erosional unconformities or depositional hiatus. There is no geologic record for the remainder of the Paleozoic, Mesozoic, or early Cenozoic eras due in part to preglacial exposure and erosion and to glacial erosion (BNI 1987).

The bedrock underlying the Tonawanda properties belongs to the upper Salina Group and consists of shale, dolomites with layers of gypsum, and occasionally halite of the Akron, Bertie, Camillus, Syracuse, and Vernon Formations. Locally, the carbonate portions of these formations are a massive, fine-grained limey shale with solution channelling through vertical joints and horizontal bedding planes. Massive gypsum layers [up to 1.5 m (5 ft) thick] are interbedded within the shales and dolomites. However, most of the halite and gypsum beds of the Salina Group are found in the Syracuse Formation (which is below the Camillus), and commercial deposits of gypsum may be associated with the Syracuse Formation rather than with the Camillus shale. Shales of the Salina Group at depths of 17 to 29 m (55 to 95 ft) constitute an irregular floor for the surficial deposits and are part of the groundwater system at the properties. Nineteen geologic boreholes were drilled at Ashland 1 and 2 and adjacent to the southeastern boundary of Seaway from 1.5 to 4.5 m (5 to 15 ft) into bedrock. At Linde, where liquid effluent had been injected into bedrock, eight boreholes were advanced into bedrock an average of 18 m (60 ft) (BNI 1993).

All RI boreholes with significant core recovery exhibited an extensively fractured zone within the top 3.7 m (12 ft) of the bedrock surface. The primary pattern, mostly planar to slightly undulating joint surface, is perpendicular to the core axis and/or parallel to the bedding planes and gypsum laminations. Most joint surfaces are characterized by partially to fully developed gypsum crystals, whereas a few joints are infilled with mud. Frequently, the jointing occurs at the contact between the gypsum and the shale. Most open fractures at this contact were probably induced by the coring process (BNI 1993). The average length of core retrieved was between 2.5 and 5.0 cm (1 to 2 in.). At the Ashland 1 site, a 0.3 m (1 ft) gypsum seam was encountered near the top of the bedrock surface. Gypsum seams of this thickness were not encountered in any other boreholes executed onsite. However, gypsum represents approximately 50% of the total rock near the bedrock surface.

The upper portion of the bedrock is slightly to moderately fractured and is slightly weathered. The bearing strength of the surfaces varies with the amount of gypsum present. With depth, the average core length increases substantially, indicating a reduction in fractures. Core samples retrieved from 3 m (10 ft) below the bedrock surface are only slightly fractured. Bedrock weathering also decreases with depth.

There is minor relief to the bedrock surface topography. At Linde the bedrock surface is relatively horizontal with minor undulations. The bedrock surface in the Ashland–Seaway areas slopes slightly to the northwest at approximately 45 m (135 ft) over 1500 m (5000 ft). An erosional scour, or paleochannel, has been mapped beneath the southern portion of the Ashland 2 property. This channel trends northwest, toward Twomile Creek.

2.2.1.2 Structural Features

There is little evidence of deformation associated with either extensional or compressional tectonics of the bedrock at the Tonawanda area. Studies of small earthquake focal mechanisms and logs of deep boreholes indicate that, with the exception of areas very near the surface, the principal regional stress is compression in a northeast-southwest direction. No surface faults have been reported in the Niagara area. The subsurface Clarendon-Linden Fault, suspected to be a basement-controlled feature 160 km (100 mi) east of the Tonawanda area, is a reverse fault striking north-south and dipping steeply to the east, with vertical offsets of 30 to 50 m (98 to 164 ft) in Ordovician through Silurian units. Glacial deposits overlying the Paleozoic section have not been affected by the fault (BNI 1987).

The land surface in the vicinity of the Tonawanda site has been subjected to rebound resulting from deglaciation. Calkin and Feenstra (1985; from BNI 1993) indicated that the land surface has risen approximately 53 m (172 ft) in the vicinity of the Tonawanda site as a result of this unloading. The release of pressure from the melting glaciers may have allowed the near horizontal bedding planes to open, creating avenues for the solution of the carbonate and evaporite rocks. (BNI 1993). Both LaSala (1968; from BNI 1993) and Johnston (1964; from BNI 1993) reported vertical and high angle fractures in cores retrieved from the Tonawanda area.

The number and concentration of fractures and solution cavities are critical in determining the water-bearing characteristics of the bedrock aquifer in the vicinity of the Tonawanda site. Since the number of fractures and solution cavities can vary significantly over a short distance, the water-bearing capacity of the bedrock aquifer can vary as well. Based on core samples retrieved from the site, the upper portion of the shale is generally weathered, brittle, and fractured with evidence of solution-widened cavities. The lower core samples are generally more competent and interbedded with gypsum with fewer occurrences of solution-widened cavities (BNI 1987). This is consistent with information reported in the geologic literature. LaSala (1968) reports that large yield wells in Tonawanda and North Tonawanda are supplied water from solution-widened cavities in the shallow portion of the Camillus Shale. Only the gypsum zones in the fractured rock, which are exposed to circulatory groundwater, become widened by solution. In the competent rock, where no fractures exist, the gypsum cannot be dissolved. Therefore, it is apparent that large changes in the water-bearing characteristic can occur over relatively short distances and with depth, as the percentage of gypsum and number of fractures decrease. As a result of the unpredictable occurrence of the gypsum zones and fractures, it would be nearly impossible to determine diameter, velocity, and quantity of groundwater flow through the solution cavities that may exist in the shallow bedrock aquifer.

2.2.1.3 Seismicity

The Tonawanda properties are within the Central Stable Region, which is considered tectonically stable. The U.S. Geological Survey classifies western New York as a Zone 3 earthquake risk region (BNI 1987). Earthquakes within this region have been of moderate intensity (Modified Mercalli VI or VII) or less (BNI 1987).

2.2.1.4 Soils

The prominent surficial deposits in the Tonawanda area were derived from late Wisconsin glaciation. The Tonawanda sites are located less than 3.2 km (2 mi) south of the Niagara Falls Moraine, and the Linde site is less than 8 km (5 mi) north of the Buffalo Moraine. The Tonawanda sites are approximately 4.8 km (3 mi) southwest of the former southern margin of glacial Lake Tonawanda [Figure 3-17 in the RI (BNI 1993)].

The advancing and retreating glaciers deposited till, a nonsorted, unstratified mixture ranging in size from clay to boulders, and coarse-grained sandy outwash/ice-contact deposits. Relatively thick deposits of silt and clay were deposited in the glacial lakes. The total thickness of glacial deposits in the Tonawanda area ranges from 17 to 29 m (55 to 95 ft) (BNI 1993).

Maps by Muller (1977; from BNI 1993) and Cadwell (1988; from BNI 1993) indicate that soil in the vicinity of the Tonawanda sites consists of lake sediments. However, based on the description of soil samples collected from borings executed by BNI (1993), Recra Research, and Wehran Engineering (1979; from BNI 1993), four distinct surficial deposits exist in the Tonawanda area: glacial till, varved lacustrine clay, glaciolacustrine deposits, and glaciofluvial deposits. For a detailed discussion of the surficial geology and geologic cross-sections, refer to Section 3 of the BNI RI (BNI 1993).

The uppermost unit which lies directly beneath a thin veneer of topsoil (less than 1 ft. thick), is a glacial till or till-like deposit that ranges in thickness from 6 to 12 m (20 to 40 ft) across most of the area of the Tonawanda properties. This unit is described as a massive silty-clay with varying amounts of sand and gravel. This unit is dense and compact (especially when dry), and localized desiccation cracks filled with clay and organic material extend to 4.5 m (15 ft) below the ground surface. BNI (1993) concluded that the fine grain-size of this material, in combination with the lack of structure, would not allow fluids to be readily transmitted through it.

A thin zone of varved clay exists below the till unit. This unit consists of alternating interbedded layers of silt, clay and locally very-fine-grained sand. The individual layers range in thickness from 1 mm to 5 cm (0.04 to 2 in.). The unit ranges in thickness from approximately 8.6 m (28 ft) at boring B29W11D on the Linde site to 1 m (3 ft) at borehole B55G44 on the Seaway property, and may be absent in some areas (BNI 1993).

2.2.2 Surface Water

2.2.2.1 Niagara River

Surface water from the Tonawanda properties drains via Rattlesnake Creek and Twomile Creek to the Niagara River (Figure 2-3). The 60-km- (37-mi-) long river connects Lake Erie to Lake Ontario and is divided into its upper and lower reaches by Niagara Falls. At Strawberry and Grand Islands, the river divides into two channels—the Chippawa Channel and the Tonawanda Channel, located west and east of Grand Island, respectively. The Ashland 1 and 2 and the Seaway sites are located along the upper reach of the river, adjacent to the Tonawanda Channel. The Tonawanda Channel is approximately 490 m (1600 ft) wide and 7.6 m (25 ft) deep as it passes by the Town of Tonawanda. The channel widens to approximately 1100 m (3600 ft) and becomes shallower, approximately 5 m (16 ft) deep, before it joins the Chippawa Channel.

The Niagara River drains an area of about 227,000 km^2 (88,000 mi^2). As a source of municipal drinking water, it serves a combined Canadian/U.S. population of more than 400,000 people. In New York, the City of Buffalo municipal water plant, located at the junction of Lake Erie and the Niagara River (upstream of the Tonawanda site), serves an additional 530,000 people. Treated wastewater from these same populations is returned to the river (NRTC 1984). Samples collected near Niagara Falls indicate that the Niagara River is predominantly a calcium bicarbonate type of water with a total dissolved solids content that varies from about 180 to 200 mg/L (180 to 200 ppm) (Archer et al. 1968). The average flow of the Niagara River is 6230 cms (220,000 cfs), with a maximum flow of 10,800 cms (380,000 cfs) and a minimum flow of 3400 cms (120,000 cfs). It is estimated that 42% of the flow in the Niagara River is to the east of Grand Island through the Tonawanda Channel, and the other 58% is through the Chippawa (during normal, non-icy conditions). The mean flow in the Tonawanda Channel is estimated to be approximately 2600 cms (92,000 cfs), with a maximum flow of 4500 cms (160,000 cfs) and a minimum flow of 1400 cms (50,000 cfs) (Crissman 1991). The mean velocity of water in the Tonawanda Channel is approximately 0.8 m/s (2.5 ft/s) near the confluence of Twomile Creek (BNI 1993).

Flooding along the Niagara River is generally caused either by ice jams or by strong southwesterly winds blowing across Lake Erie. Large amounts of precipitation generally do not cause flooding along the Niagara River because the ample storage capacity of Lake Erie greatly attenuates the flood waves. Although the Niagara River does not overtop its banks during

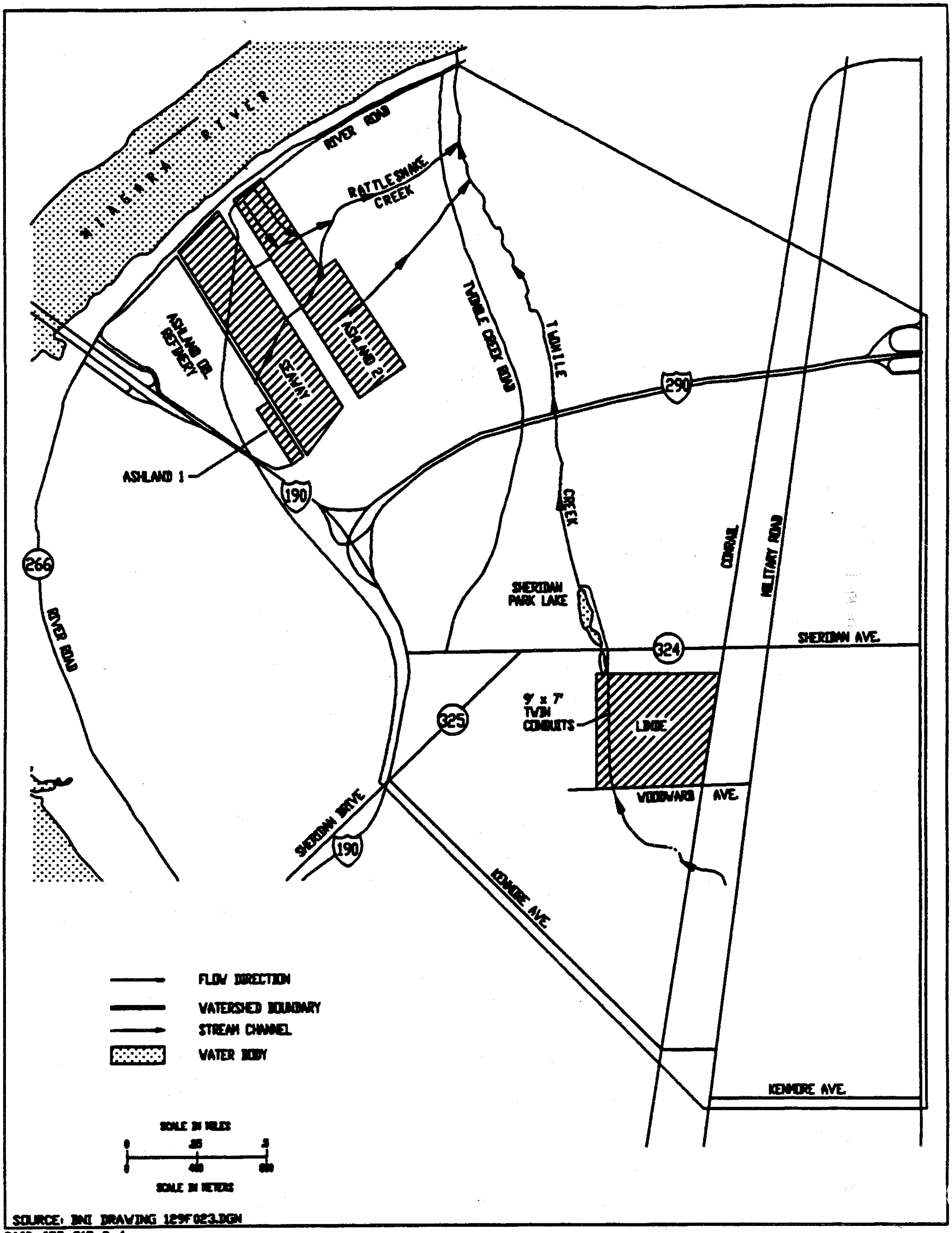


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Figure 2-3. Surface Waters at the Tonawanda Site

periods of high flow, it does back up into many of its tributaries and cause flooding in the tributary areas.

Niagara River flood stage elevations are shown in Table 2-2 (FIA 1979). These elevations are for the point at which Tonawanda Creek joins the Niagara River, approximately 1.9 km (1.2 mi) downstream of the confluence with Twomile Creek (Figure 2-3) (BNI 1993).

The Niagara River is classified by the NYSDEC as Class A-Special. The best usage of waters under this classification defined by NYSDEC is as "a source of water supply for drinking, culinary or food processing, primary and secondary recreation, and fishing." Class A-Special waters are protected under the New York Environmental Conservation law Article 15; which requires certain activities in the waters or along the banks to have state permits (NYSDEC 1991b).

2.2.2.2 Rattlesnake Creek

Rattlesnake Creek is a natural channel formed from surface drainage received from Ashland 1, Seaway, and Ashland 2. The 2300-m (7600-ft) channel drains 140 ha (340 acres) before joining Twomile Creek (Figure 2-3). Twomile Creek flows into the Niagara River approximately 300 m (1000 ft) downstream of the confluence with Rattlesnake Creek (BNI 1993). The Federal Insurance Administration (FIA) coordinated a flood analysis of both the Town of Tonawanda and the City of Tonawanda; no floodplains were identified with Rattlesnake Creek (FIA 1979).

Drainage from Ashland 1 travels under the Seaway property through an underground concrete conduit and exits at the Niagara Mohawk property line. Rattlesnake Creek receives this drainage, crosses the Niagara Mohawk property, and then crosses the Ashland 2 property. The creek channel is approximately 3 m (10 ft) wide and 1 m (3 ft) deep at bank-full capacity, and has a 1% slope on the Ashland 2 property. The channel and creek areas are vegetated with a thick growth of cattails and bulrushes, which limits flow velocities. These low lying areas are approximately 30 m (100 ft) wide on Ashland 2. Three small drainage ditches join Rattlesnake Creek after it crosses Ashland 2. The creek then travels approximately 980 m (3200 ft) before its confluence with Twomile Creek (Figure 2-3) (BNI 1993).

Stormwater runoff in Rattlesnake Creek was estimated in the Tonawanda RI (BNI 1993) using COE's HEC-1 computer model, which simulates the surface runoff in a drainage basin from a precipitation event. The model was used to estimate 2-, 5-, 10-, 25-, 50-, and 100-year floods using precipitation amounts from rainfall intensity-duration-frequency curves developed by the National Weather Service (NWS) for the Buffalo area (Erie and Niagara Counties 1981). Stormwater runoff in Rattlesnake Creek was estimated at the boundary of Ashland 2 where the creek's watershed contains approximately 45 ha (110 acres) and includes flow from Ashland 1, Seaway, and Ashland 2. The modeled peak flows (cfs) are listed in Table 2-3. Flood flows

Table 2-2. Niagara River Flood Stage Elevations (BNI 1992a)

Flood Stage Elevations				
2 yr	**10 yr**	**50 yr**	**100 yr**	**500 yr**
568.5 ft 173.5 m	569.7 ft 173.6 m	570.3 ft 173.8 m	570.5 ft 173.8 m	571.1 ft 174.1 m

Table 2-3. Stormwater Runoff in Rattlesnake Creek and Linde (BNI 1992a)

Return Period	Peak Flood Flow (24-hr Storm)	
yr	**cms**	**cfs**
Rattlesnake Creek		
2	1.1	40
5	2.4	83
10	3.2	113
25	4.1	143
50	4.8	171
100	5.8	204
Linde		
2	1.6	56
5	3.4	121
10	4.8	168
25	5.6	196
50	6.5	228
100	7.5	265

from Linde were also estimated and are addressed in the following discussion of Twomile Creek because Linde surface water runoff flows into this stream.

Currently, Rattlesnake Creek is classified by the NYSDEC as Class B, ". . . primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival." Class B waters are protected under the New York Environmental Conservation law, Article 15; which requires certain activities in the waters or along the banks to have state permits (NYSDEC 1991b).

2.2.2.3 Twomile Creek

Twomile Creek, also classified by the NYSDEC as Class B, originates south of the Linde property in a natural channel (Figure 2-3). The creek flow consists of groundwater discharge (base flow) and stormwater runoff. The creek enters a two-channel underground culvert and flows north, where the two pipes empty into two 3 m × 2.1 m (9 ft × 7 ft) box culverts that run side by side. These conduits also carry municipal storm sewer drainage from the eastern half of the Town of Tonawanda and the Village of Kenmore. Runoff from Linde enters the conduits through five outfalls. The two conduits eventually discharge through two large flow-control gates located on the face of the concrete dam impounding Sheridan Park Lake. The gates are pressure operated, releasing storm flow when necessary. When enough stormwater backs up and the gates are opened, the onslaught of water flushes out accumulated sediments in the conduits. Sediments are then deposited directly into the natural stream channel of Twomile Creek below the dam. This sediment is cleaned out every year by Sheridan park golf course maintenance staff and placed in a local landfill (Baldy 1992).

Twomile Creek continues northward approximately 3 km (2 mi) until it empties into the Niagara River 13 km (20 mi) upstream of Niagara Falls. The slope of Twomile Creek is less than 1%. During periods of base flow in Twomile Creek, the surface width of the water is approximately 6.1 m (20 ft) and the flow depth is between 0.6 to 1.2 m (2 and 4 ft). The depth increases as the creek approaches the Niagara River, where flow is controlled by the stage of the river (BNI 1993).

The FIA coordinated a flood analysis of both the Town of Tonawanda and the City of Tonawanda, but an in-depth study of Twomile Creek was not performed. The FIA determined that the 100-year flood will be confined to the creek's narrow, well-defined floodplain, which has not been encroached on (FIA 1979); the floodplain is not impacted by any of the alternatives analyzed in Section 5.3. However, Twomile Creek does overtop its channel banks frequently. For example, when the gates on the face of the dam open, the creek overtops its banks. It is estimated that the gates are opened an average of one to two times each year. The greatest observed flooding had a stage of approximately 1.8 m (6 ft) above the top of the channel bank (Patterson 1991). Each time the creek overtops its banks, sediment is deposited in the floodplain. A study of the floodplain indicates that, in some sections just below the dam, as much as 15 cm (6 in.) of sediment has been deposited in the last 15 years (Patterson 1991).

Using the HEC-1 model, peak stormwater runoffs for 24-hour storm events at the Linde site were estimated (BNI 1993). The values were calculated for peak flow at the point where Outfall 7 (Figure 2-4) joins the Twomile Creek twin cell conduit. The peak storm runoffs from Linde are shown in Table 2-3.

2.2.2.4 Linde Surface Drainage

All runoff at Linde collects in the facility's storm sewer system, which drains through seven outfalls (Figure 2-4). Outfalls 1 and 2 drain stormwater runoff from the southern end of the property and empty into a municipal storm sewer line under Woodward Avenue. This line connects with the two conduits carrying Twomile Creek underground, and the flow is carried downstream with the Twomile Creek flow.

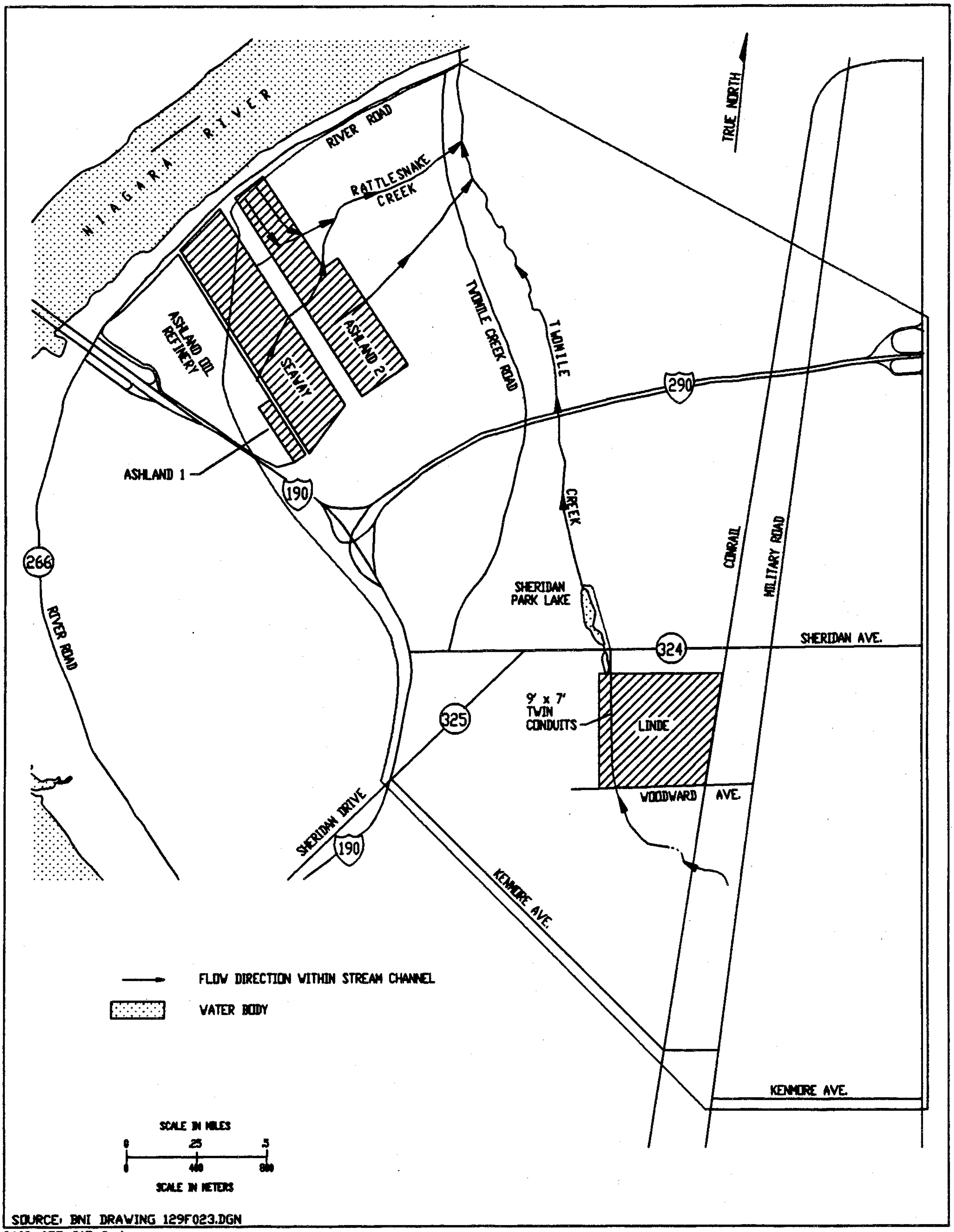
Outfall 3 carries runoff from a small area in front of the main office building. This flow enters a 90-cm (36-in.) culvert that connects to the Twomile Creek twin conduits. The fourth outfall drains the middle portion of the property, including runoff from the Building 14 area where several injection wells were historically located (Figure 2-4).

Outfall 5 collects runoff from a very small area in the western part of the property and connects with the Twomile Creek twin conduits through a 50-cm (20-in.) culvert. Outfall 6 receives runoff from most of the northern portion of the property including drainage from the areas around Buildings 30, 31, 38, and 58. Shallow groundwater from agricultural tile beneath the gravel-packed parking areas is also collected by Outfall 6. A 76-cm (30-in.) conduit conveys the collected water into the Twomile Creek twin conduits.

The seventh outfall collects runoff from the extreme northern section of Linde, including the Building 90 area. This drainage area also includes some underground agricultural tiles for shallow groundwater collection. The surface runoff from the northwest corner of the plant area is collected by a ditch located just outside the Linde fence and conveyed by a 76-cm (30-in.) culvert to the Twomile Creek twin conduit.

All conduits in the sewer system that are larger than 30 cm (12 in.) are reinforced concrete culverts. Conduits that are 30 cm (12 in.) or smaller are made of vitrified tile unless they lie under buildings or driveways, where heavy cast iron has been utilized to withstand the weight of the structure and activities.

The Tonawanda RI (BNI 1993) included modeling to estimate average annual surface runoff from each of the four properties comprising the Tonawanda site. The model used was the *Field Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems*, also known as the CREAMS model (Knisel 1980). The model generates surface runoff, evapotranspiration, and deep percolation data based on water balance using precipitation, temperature, and physical properties of the soil zone. Daily precipitation records from the NWS



SAIC 677-315 2-4

Figure 2-4. Storm Sewer Lines at Linde

station at North Tonawanda were used as input to the model (NWS 1989). The average annual precipitation used was 89 cm/yr (35 in./yr). The runoff at Linde was determined to be much higher than the unit runoff from the Ashland properties because of the large impervious areas at Linde and the fact that much of the Ashland properties are covered with grass, which promotes water retention. The average annual volume of surface runoff from Linde was estimated to be 315 ha-m (240 acre-ft), whereas the estimated annual gross erosion [calculated using the modified universal soil loss equation (MUSLE)] was 0.6 metric tons/yr (0.07 tons/yr) (BNI 1993).

2.2.2.5 Ashland 1 Surface Drainage

The drainage area at Ashland 1 includes the entire property. The topography is flat except where berms were created to surround storage tanks historically located on the property.

The portion of the property southeast of the bermed area is flat and covered with grass except for the dirt access road and electrical substation area. Drainage from this area is directed toward the ditch running along the east boundary, between Ashland and Seaway (Figure 2-5). An approximately 1.2-ha (3-acre) area is enclosed by the berms that surrounded the storage tanks formerly located on the site. The berms are approximately 2.1 m (7 ft) high at their highest point. Water from precipitation collects within the bermed area and infiltrates into the soil, evaporates, or flows to the east drainage ditch through small pipes that extend through the berm and under the access road to the ditch.

The western section of Ashland 1 is low-lying and vegetated with tall grass and bushes. Runoff from this area flows into the main ditch along the Seaway boundary by a small ditch running west that flows through a 30-cm (12-in.) steel pipe and then into the main ditch. The main ditch flows northwest into a low marshy area where the 1-m (3-ft) underground conduit opening exists that carries Ashland 1 drainage under Seaway.

As observed during an October 1991 site visit, the area within the berms at Ashland 1 is not completely vegetated. Some erosion during high rainfall events may occur as the water collected in this area drains to the main ditch. The berms are mostly covered with grass, which prevents erosion from the berm slopes. The western portion of the site also is not completely vegetated, and soil may erode from this area during heavy rainfall. The average annual surface runoff volume from Ashland 1 is approximately 6.6 ha-m (5 acre-ft), and the MUSLE estimate of the average annual gross erosion for the entire Ashland 1 was estimated at a computed 0.002 metric tons/yr (0.002 tons/yr) (BNI 1993).

2.2.2.6 Seaway Surface Drainage

The Seaway property consists of a long, narrow, rectangular landfill pile with side slopes of approximately 30% (BNI 1993). The ridge of the pile is at the center of the property,

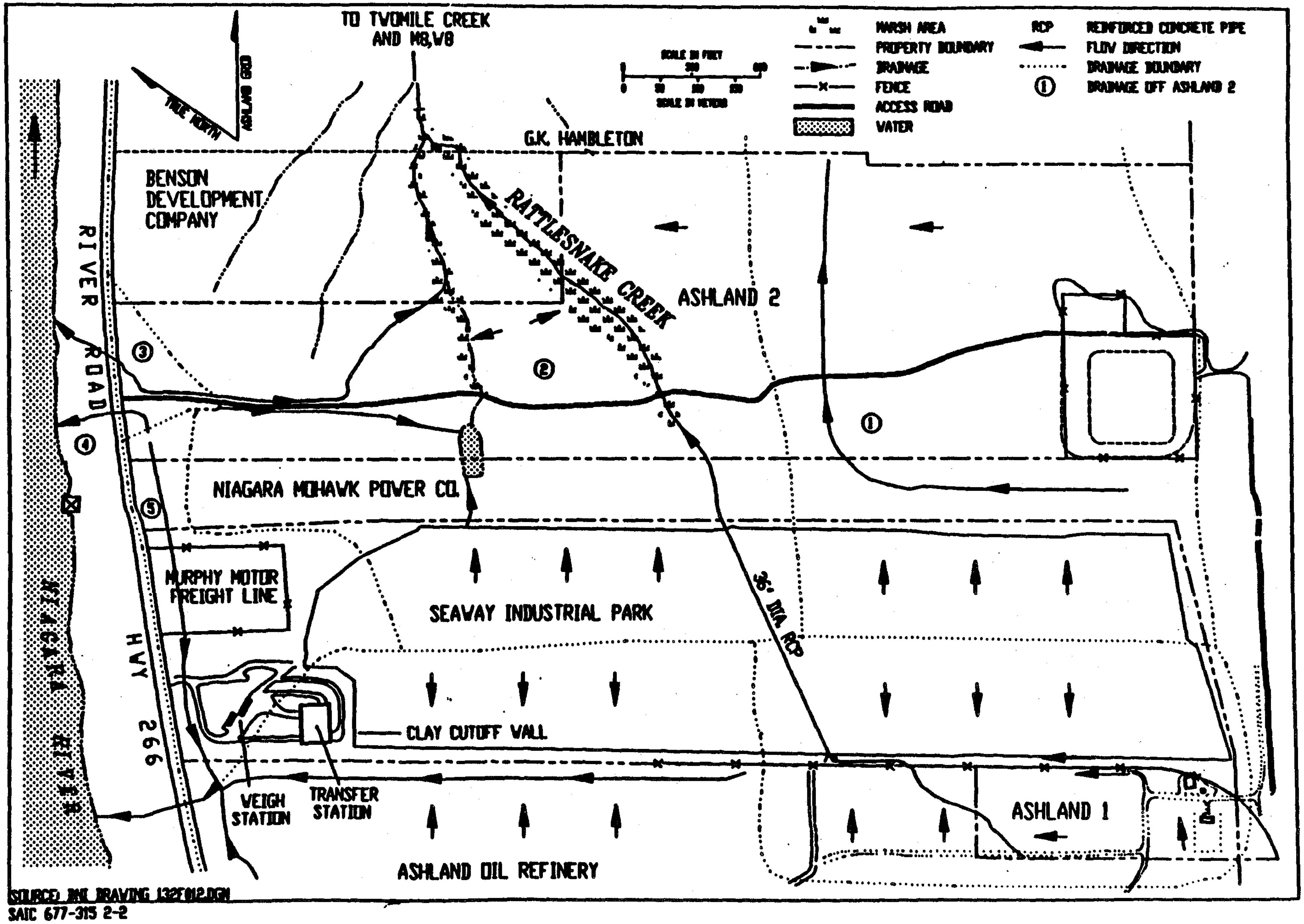


Figure 2-5. Drainage at Ashland 1, Seaway, and Ashland 2

resulting in half the surface runoff flowing southwest toward the Ashland refinery property and half flowing northeast onto Ashland 2.

Runoff to the southwest is directed to the drainage ditch along the Seaway-Ashland 1 boundary (discussed in the Ashland 1 surface drainage description). Most runoff from the northeastern slope is directed onto Ashland 2 as overland flow into the exiting channels at Ashland 2. The southeastern runoff enters the small drainage ditch in the southeast portion of Ashland 2, which eventually empties into Twomile Creek. The middle portion of Seaway drains into Rattlesnake Creek. The northwest area, which includes the area where residues were deposited, drains to the drainage ditch on the southern side of the Ashland 2 access road. The ditch runs under River Road and eventually empties into the Niagara River.

Engineering controls are implemented to prevent surface erosion of the landfill property at Seaway. This includes seeding with native grasses and terracing the steep slopes. The area where MED residues were deposited is vegetated with thick grass and is not allowed to be disturbed by the landfill operator, as directed by NYSDEC. However, erosion at Seaway is estimated to be much greater than at the other sites because of the steep slopes and bare soil on the pile (BNI 1993). The estimate average annual gross erosion using the MUSLE was determined to 9.1 metric tons/yr (10.0 tons/yr) (BNI 1993).

The ground surface at Seaway is fill dirt characterized with rills that favor surface runoff (BNI 1993). Using the CREAMS model, the average annual runoff volume at Seaway was estimated to be 121 ha-m (93 acre-ft) (BNI 1993).

2.2.2.7 Ashland 2 Surface Drainage

Storm runoff leaves the Ashland 2 property by five drainage channels. The southeastern portion of the property drains to a small 1-m (3-ft) wide ditch running northeast toward Twomile Creek. The ditch carries surface drainage from nearly 40% of the total properties area (BNI 1991). It travels under Twomile Creek Road through a 77-cm (30-in) culvert and empties into Twomile Creek approximately 6 m (20 ft) below the Fletcher Street bridge over Twomile Creek (BNI 1993).

Rattlesnake Creek is the main channel that drains Ashland 2. Approximately 60% of the property's overland runoff empties into Rattlesnake Creek (BNI 1993). The Ashland 1 drainage, which is carried under Seaway and exits Seaway at the Niagara Mohawk property, makes up part of the Rattlesnake Creek flow. A second channel, which drains the western portion of the property, joins Rattlesnake Creek just across the Benson Development Company property line. Runoff from Seaway is collected in this channel. Two other ditches draining the northern and southern sides of the property's access road flow into this ditch before it empties into Rattlesnake Creek.

Two channels drain small areas in the extreme western portion of the property; one on the north side of the access road, and one on the south side. These channels are directed under River Road and empty into the Niagara River.

The Ashland 2 property is covered with grass, wetland vegetation, and thick bushes that impede surface erosion. Soils at the property were disturbed in the past when the Ashland 1 residues were disposed there during operation of the Ashland Oil industrial landfill and during construction of a large berm that surrounded a petroleum storage tank in the southeast corner of the property. Some erosion probably occurred when soils were disturbed. Present erosion is limited due to the thick groundcover. However, heavy rainfall increases the likelihood for some soil erosion into the property's drainage channels. The estimated average annual gross erosion, using the MUSLE, was found to be 0.006 metric tons/yr (0.007 tons/yr) at the Ashland 2 property.

Surface soils at Ashland 2 are mainly silt loam except for Castille gravelly loam and fill soil from Ashland 1 in small areas (BNI 1993). Using the CREAMS model, the average volume of surface runoff from Ashland 2 was estimated at approximately 59 ha-m (45 acre-ft) (BNI 1993).

2.2.2.8 Groundwater

Based on the RI (BNI 1993), groundwater in the Tonawanda area may occur in three distinct hydrogeological systems:

- a perched system;
- a shallow semiconfined system; and
- a contact-zone aquifer at the contact between the basal unconsolidated unit and the weathered bedrock.

A detailed description of each hydrogeologic unit is presented in the RI, and is summarized below.

Perched Aquifer

Perched groundwater exists in the alluvial till deposits within surface water drainage depressions, fill material, and the upper portion of the till. With the possible exception of the groundwater in the alluvial deposits, the perched groundwater appears to be associated with precipitation events and is therefore intermittent. Due to the shallow position of this perched system, transpiration can have a significant impact on the amount of groundwater in this system.

This perched system is localized, representing subsurface migration of groundwater to local surface drainage systems (BNI 1993).

Based on the description of soil samples collected from borings executed through the shallow overburden, it can be concluded that the hydraulic properties of the perched system are both heterogeneous and anisotropic. As a result of this complexity and variability of the perched system it was determined that conventional monitoring wells would not be feasible. A conceptual model of the perched system suggests that monitoring the surface drainage system would be the most effective method for monitoring the perched system. Based on the soil descriptions of this unit (BNI 1993) and the fact that a varied clay unit exists below it, it is unlikely that the groundwater in the perched system would migrate into the underlying aquifer systems.

Shallow Semiconfined System

The shallow semiconfined system occurs in sand lenses within the glaciolacustrine unit discussed in Section 2.2.1.4. This system of sand lenses, which occurs 5 to 12 m (16 to 40 ft) below the ground surface is considered to be semiconfined because these sand lenses are surrounded by material of lower hydraulic conductivity, which allows the hydraulic head within the sand lenses to rise above the top of the sand lenses. The material of low hydraulic conductivity surrounding these sand lenses decreases this system's response to recharge from the shallow portion of the surficial aquifer. Monitoring wells installed within these sand lenses required two to five weeks to return to static conditions after they were sampled (BNI 1993).

Groundwater level data from seven monitoring wells installed into the sand lenses beneath the Ashland 1 and 2 sites were used to prepare a potentiometric surface map of the shallow semiconfined system. Based on the configuration of the potentiometric surface, the RI (BNI 1993) concluded that the shallow semiconfined groundwater system discharges to Rattlesnake Creek and adjacent wetlands. The conceptualized groundwater flow for this system may be through a series of hydraulically interconnected sand lenses, with recharge to and discharge from this system occurring in the uppermost sand lenses (BNI 1993).

Contact-Zone Aquifer

The coarser-grained sand and gravel basal unit overlying the bedrock and the shallow portion of the bedrock aquifer that contains fractures, joints, and solution cavities constitute the contact-zone aquifer. To obtain hydrogeologic and groundwater quality information for this zone, eleven monitoring wells were installed at Ashland 1 and Ashland 2 and eight wells were installed at Linde within this zone.

The groundwater in the contact-zone aquifer is under confined conditions, with the hydraulic head rising between 12 and 16.8 m (40 to 55 ft) above the top of the contact zone in the monitoring wells installed on both Ashland I and 2 and the Linde properties. The potentiometric surface maps constructed for this aquifer suggest a western to northwestern groundwater flow as described by the Erie and Niagara Counties Regional Planning Board (1978; from BNI 1993). The hydraulic gradients for this aquifer are low, ranging from 0.0003 to 0.0004 at the Seaway and Ashland 2 properties and from 0.0004 to 0.0005 by the Ashland 1 and southwest portion of the Ashland 1 property (BNI 1993).

The recharge for the contact-zone aquifer is most likely from exposed or minimally covered carbonate rocks (which constitute an aquifer) southeast of the Linde property; from coarse grained alluvial deposits along Elliot Creek approximately 9.6 km (6 mi) east of the Linde property, which may be hydraulically connected to the contact-zone aquifer; and from surficial deposits in the Tonawanda area. The regional groundwater flow direction in the contact zone suggests that the discharge area for this aquifer is the Niagara River; however, it is not likely that the contact-zone aquifer discharges groundwater into the Niagara River immediately adjacent to the Ashland-Seaway properties. The piezometric head levels for the contact-zone aquifer near the river are close to the elevation of the surface water in the river, suggesting that there is a hydraulic connection between the groundwater within the contact zone and the river at some locations (BNI 1993).

The hydraulic conductivity of the shallow bedrock aquifer within the contact zone ranged from 1.1×10^{-5} to 3.1×10^{-2} cm/sec (11 to 32,094 ft/yr) at the Ashland-Seaway properties and $< 7.4 \times 10^{-6}$ to 3.5×10^{-5} cm/sec (8 to 362 ft/yr) at the Linde property. Approximately 80% of the packer tests conducted at the Linde property were unable to accept water (i.e., no flow). Although the Salina Group contains soluble gypsum zones, drilling at the Tonawanda area did not reveal any major solution features that would significantly enhance the hydraulic conductivity of the shallow bedrock aquifer and act as conduits for rapid groundwater flow. Hydraulic conductivity measurements were not made on the surficial deposits directly overlying the weathered bedrock. Based on the descriptions of the soil, the RI (BNI 1993) estimated the hydraulic conductivity of this material to be 2.3×10^{-3} cm/sec (2400 ft/yr).

2.2.3 Air Resources

2.2.3.1 Climatology

The climate of New York is generally of the humid, continental type that prevails in the northeastern United States. Cold, dry air masses from the continental interior and prevailing warm, humid, southerly winds provide the dominant characteristics of the climate. Lake Ontario to the north and Lake Erie to the west have significant moderating influences on the climate of western New York. The lake waters warm slowly in the spring, maintaining cooler atmospheric temperatures over adjacent land areas. In the fall, the lake waters cool more slowly than the land areas, serving as a heat source and delaying the arrival of freezing temperatures (Gale Research Co. 1985).

The monthly normal temperature range for the Tonawanda area is -4° to 22°C (24° to 71°F), with a mean annual temperature of 9°C (48°F). Mean annual precipitation is 96 cm (38 in.), with an average annual snowfall of 240 cm (93 in), two-thirds of which occurs during the months of December through February. Monthly precipitation averages are fairly constant, ranging from 7.2 to 8.1 cm (2.8 to 3.2 in). Periods of low precipitation occur occasionally, although severe droughts are rare. The mean annual lake evaporation is 69 cm (27 in.). Winds are predominantly from the southwest with average monthly speeds that range from 16 to 23 kph (10 to 14 mph) (BNI 1993).

2.2.3.2 Air Quality

The Tonawanda site lies within the Buffalo metropolitan area and is part of the Niagara Frontier Air Quality Control Region. It is a highly developed urban area with significant residential, commercial, industrial, and transportation infrastructures.

The NYSDEC Division of Air Resources maintains an extensive air quality monitoring network within the state to determine compliance with state and National Ambient Air Quality Standards (NAAQS). The monitoring systems are all linked to the State/Local Air Monitoring System (SLAMS) and several are linked to the National Air Monitoring System (NAMS). These networks are sponsored by EPA and are designed to track local, regional, and nationwide air quality trends. There are 5 continuous and 17 manual air monitoring sites located within the Buffalo metropolitan area. Parameters monitored include the criteria pollutants sulfur dioxide (SO_2); carbon monoxide (CO); ozone (O_3); nitric oxide, nitrogen dioxide, oxides of nitrogen (NX); inhalable particulates (PM-10); total suspended particulates (TSP); and lead (Pb). Also, a few sites monitor acid deposition and toxics.

Two air monitoring stations are located at the Town of Tonawanda's sewage treatment plant, which is located approximately one mile northeast of the Ashland 1, Seaway, and Ashland 2 properties. These two stations monitor $S0_2$, coefficient of haze (COH), and PM-10. A third station, in the Town of Tonawanda, is located at the Holmes Elementary School approximately one quarter mile west of the Linde Center. The only parameter measured at this site is TSP.

Except for one exceedance of the 24-hour PM-10 standard, attainment was achieved for all state and federal ambient air quality standards in the Niagara Frontier Air Quality Control Region in 1990. In 1990, based on pollutant standards index values, overall air quality for the Buffalo area was "good" 15% and "moderate" 85% of the year (NYSDEC 1991a).

No ambient air monitoring is currently being conducted at any of the Tonawanda site properties and no direct measurements of air quality were made during the remedial investigation (BNI 1993).

2.2.4 Land Use

All four properties (Linde, Ashland 1, Seaway, and Ashland 2) are located in the Town of Tonawanda. The township is bound by the City of Tonawanda to the north, Amherst to the east, Buffalo to the south, and the Niagara River and Canada to the west. **Table 2-4** displays the approximate parcel size for the four properties.

Aesthetic resources vary from site to site. The Linde property is industrial looking and well maintained and visually nonobtrusive. Ashland 1, Seaway, and Ashland 2 sites are located in an industrial setting. Old refineries, a truck terminal, and other heavy industries are located in the area. Ashland 1 is located behind a vacant refinery that is now being utilized as a petroleum distribution center. Efforts are now underway to remove deteriorating refinery equipment. This property is very visible from Interstate 190 and is visually obtrusive. The Seaway property is a landfill. The majority of the property is a large mound covered in grass. The operating portion of the landfill, also visible from Interstate 190, is also visually obtrusive.

The Ashland 2 property is vacant and contains small trees and brush. Although unmaintained, the property is not visually obtrusive.

The township has adopted a zoning ordinance that regulates land uses. **Figure 2-6** shows zoning districts in the vicinity of the Tonawanda site. Zoning districts were established that permit varying degrees of land uses. There are three residential zoning districts, two commercial districts, and an industrial district. The Town of Tonawanda also has two other districts, performance standards and waterfront, that are described further in this section. The Town of Tonawanda is currently working on completing a comprehensive land use plan. In general, this plan will describe the existing socioeconomic and land use conditions, develop trends, and create a general strategy to follow to meet predicted future demands.

Residential and industrial land uses in the Town of Tonawanda are generally divided by Military Road (State Route 265). The majority of residential land uses and small businesses are located east of Military Road whereas light and heavy industries are generally west of the road. The Tonawanda site and two small residential clusters, Sheridan Park and Isle View Park, are also located west of Military Road.

Most of the Linde property is owned by Union Carbide Industrial Gases and houses the Linde Air Products Corporation. A small parcel, 1.9 ha (4.7 acres) located within the Linde property, is owned by the Erie County Industrial Development Agency. The Development Agency purchased the property as an incentive for Linde Air Products to expand. The Development Agency is exempt from paying property taxes on the parcel. The parcel is used by Linde as a logistics center.

Table 2-4. Parcel Size of Tonawanda Properties

Property	Parcel Size
Ashland 1	9.9 ac
Seaway	109.3 ac
Ashland 2	101.2 ac
Linde	101.2 ac

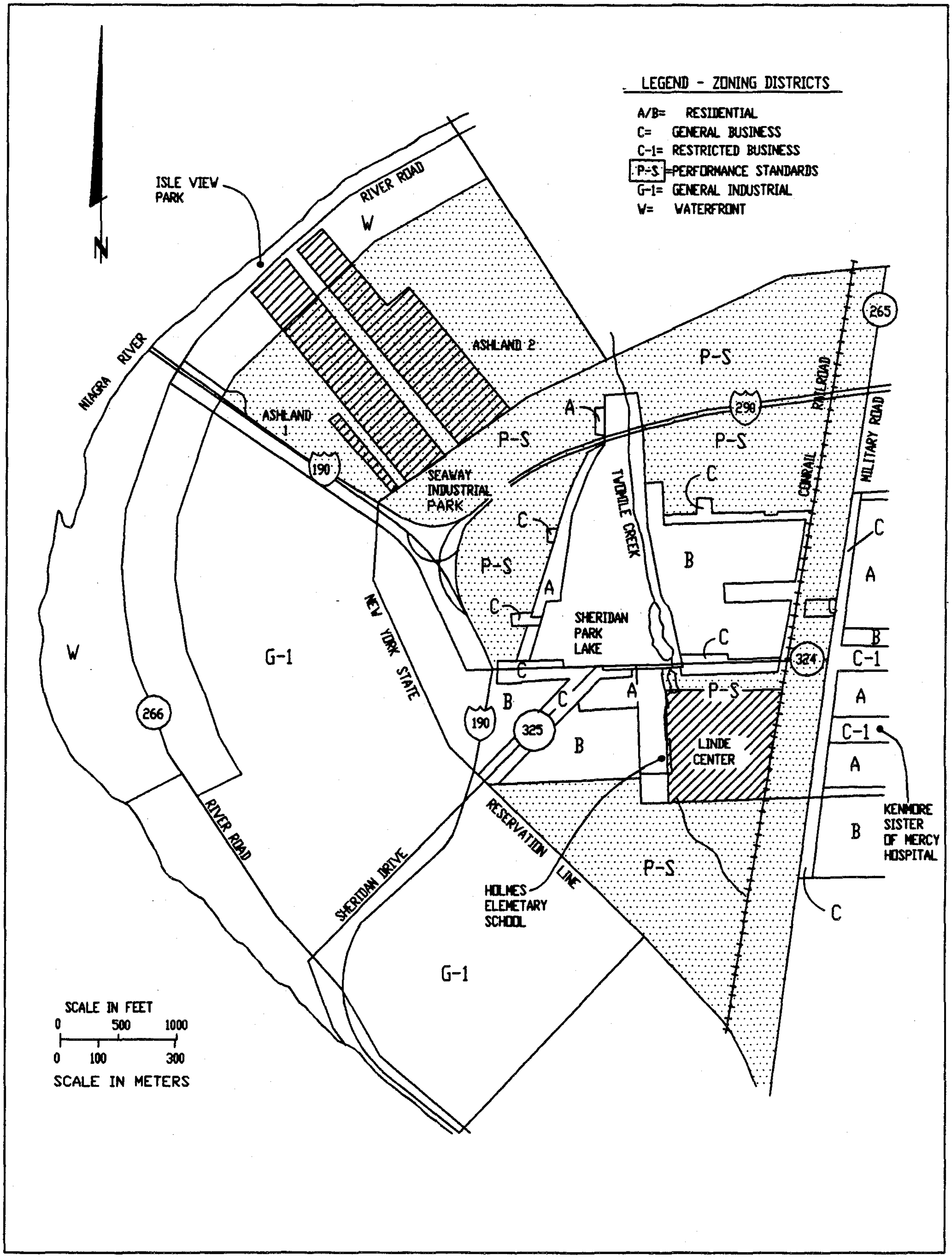


Figure 2-6. Zoning Boundaries

Land uses in proximity to the Linde property include the Consolidated Rail Corporation property, commercial and residential areas, and Kenmore Sisters of Mercy Hospital to the east, small businesses, light industries, and residential areas to the north, business and industrial areas to the south, and a low density residential area and Holmes Elementary school to the west. Sheridan Park, owned by the Town of Tonawanda's Parks and Recreation Department, is located one-fourth mile to the northwest of the Linde property. Twomile Creek flows through this property. Recreational uses include an 18-hole public golf course, picnicking, and playgrounds. Other sensitive uses within one mile of the Linde property include five schools, two community buildings, and a senior citizens' center. The Linde property is fenced and has a buffer zone of grass and trees around the main buildings.

The Linde property is located in a Performance Standards Zoning District. The purpose of the Performance Standards District is "to encourage and allow the most appropriate use of the land available now as well as approaching future commercial and industrial uses unhampered by restrictive categorizing, thus extending the desirability of flexible zoning, subject to change with changing conditions" (Code of the Town of Tonawanda 1990). Restrictions in this district permit an institution for human care or treatment or a dwelling unit only if the development abuts a residential zoning district. Other restricted uses include "junkyards, waste transfer or disposal, land mining and stockyards" (Code of the Town of Tonawanda 1990). Any proposed uses must follow the acquisition of a Performance Standards use permit. Performance Standards uses are not permitted that exceed New York state regulations or other standards listed in the zoning code book, such as standards for noise, odor emission, dust emission, and vibrations, as measured at the individual property line.

Zoning in the Linde property vicinity includes a business district to the north, a low-density residential area to the west, and the Performance Standard District to the south and east.

Ashland 1, Seaway, and Ashland 2 sites are located in the industrial area of the Town of Tonawanda. The border along the City of Tonawanda is approximately one-half mile from these properties. This border marks the only residential area near these properties that are accessible by River Road. In an area west of River Road, fronting the Niagara River, are Isle View Park, vacant land, industrial pipeheads, a wharf, and the Riverwalk bikeway trail. East of River Road are the three sites, vacant land, tank farms, a landfill, and truck terminals. Isle View Park includes a boat ramp, picnic tables, and fishing areas. The Riverwalk is a hike-and-bike path along the Niagara River that would eventually link downtown Buffalo with the Barge Canal in the City of Tonawanda. Several major sections have been completed, including the stretch in the Town of Tonawanda. A boating marina is three-quarters of a mile from these properties.

Ashland 1 and Ashland 2 are owned by Ashland Oil. Ashland 1 is located at the rear of property previously used by Ashland Oil for refining petroleum. The Ashland 1 property is now being used as a distribution center for petroleum products. Efforts are underway to remove deteriorating refining equipment. The Ashland 1 property is primarily grassland.

A portion of Ashland 2 was used in the past by Ashland Oil as a landfill for plant refuse and industrial and chemical byproducts. Ashland 2 also received soils containing radioactive residues from construction activities at Ashland 1. Ashland 2 is now vacant and overgrown with grass, bushes, and other vegetation.

All of Ashland 1 and most of Ashland 2 are in the Performance Standards Zoning District. The remaining portion of Ashland 2 is located in the Waterfront Zoning District. The purpose of the Waterfront District is "to protect the health, safety, economy and general welfare of the town by enhancing the visual, environmental, and physical character of this area and promoting the use of land within this district for appropriate and beneficial development" (Code of the Town of Tonawanda 1990). Any proposed use in this district must follow the acquisition of a Performance Standards use permit. Like the Performance Standards District, the Waterfront District allows for flexibility in the design and use of the site, and proposed uses are subject to careful review. The zoning ordinance further describes allowable uses (e.g., trail facilities, marinas, and restaurants) and design standards (e.g., setbacks and parking).

The Seaway property is owned by the Seaway Industrial Park Development Company and is used as a sanitary landfill operated by Browning-Ferris Industries (BFI). Like Ashland 2, the majority of the Seaway property is zoned as a Performance Standards District with the remainder designated as a Waterfront District.

The waterfront area of the Town of Tonawanda is being considered for major redevelopment. Development plans are being discussed for the area around Ashland 1, Seaway, and Ashland 2. A major component of these development plans is the relocation of River Road. Initial funding for the planning and design of the relocation has been approved. A portion of the road would be located approximately 1000 ft east of its present location and would run through the front portions of the Seaway and Ashland 2 properties. The road relocation would be approximately 600 ft from the contaminated area of Ashland 2 and 75 ft from the contaminated area on Seaway. Two documents are currently under review that involve the waterfront planning area. The first study is the draft *Local Waterfront Revitalization Program,* which would provide the regulatory framework for the revitalization program when it has been approved by the State of New York. The plan outlines the planning boundary, provides an inventory and analysis of current land uses, describes policies for the plan, and documents both proposed land uses and techniques to achieve them, and suggest ways in which agencies can interact to accomplish the proposed plan.

The planning area for this study generally extends from the City of Buffalo to the City of Tonawanda and from the Niagara River to the existing power lines. The area around the three sites which is discussed by the plan, is in what is called the Northern Sector, pertains primarily to the front portions of the Ashland 2 and Seaway sites near the Niagara River. Suggested future land uses for this area include a multi-family housing complex west of the relocated River Road; a riverfront park located next to the Niagara River that could contain mixed-use development such as a harbor, restaurant, hotel, and specialty shops; and office complexes. One portion of the plan states that "a critical factor to set developers and occupants of this sector at ease is the remediation of the three nearby radioactive sites, a priority DOE activity" (New York State Department of State Coastal Management Program 1991). The plan also states that "development of a portion of the Ashland property as a federal radioactive waste disposal site will result in a variety of negative impacts similar to those caused by any BFI expansion" (New York State Department of State Coastal Management Program 1991).

A second planning study for the revitalization of the waterfront is the *Waterfront Region Master Plan*. This plan provides more details as to the specific development of the waterfront area. The plan defines a planning region, sets goals and objectives, outlines a future plan, and recommends implementation strategies and phasing plans. Several issues were identified through which to meet the desired goals and objectives, including "remediation of inactive hazardous waste sites and reuse of the land for recreational and economic development uses which improve the quality of life" (Ernst and Young 1992).

The planning area east of the River Road relocation where the contaminated areas are located is proposed to be used for light industries and businesses, except for the remaining Seaway property that would be open space. The initial concept is to develop the southeastern section first because of its proximity to the existing Fire Tower Industrial Park. The area north of the River Road relocation is proposed to be a multi-family housing area and a Riverfront Park.

The plan offers detailed plans for developing six target action projects. Each project includes the initial cleanup and development of the sites so that new land uses can be encouraged. The overall plan takes a detailed look at each of the target areas and offers realistic, phased, integrated plans to achieve the development. The plan also outlines measures to strengthen the existing Town of Tonawanda zoning ordinance so that more specific uses are regulated within the Waterfront and Performance Standard Zoning Districts.

2.2.5 Ecological Resources

2.2.5.1 Terrestrial Biota

The Tonawanda site lies within the Beech-Maple Forest section of the Eastern Deciduous Forest division (Bailey 1980). This section extends in a narrow band along the eastern shore of Lake Erie from north-central Ohio and Indiana. Eyre (1980) shows the predominant forest cover type in this area as elm-ash-cottonwood (locally exhibited as ash-elm-maple), surrounded by a maple-beech-birch cover type. Black and green ash, red and silver maple, and American, rock, and slippery elm are typical trees of the area. Stand distribution and composition is influenced largely by topography and depth to water table. Aspen, pin cherry, hawthorn, and beech are common associates. Eastern hemlock and white pine, once abundant, have been logged and eliminated from much of the area. Most natural cover types remain as small woodlands or in undrained areas (Galvin 1979). Little or no actual forest habitat occupies any of the sites. Endangered and threatened species (state and federal) that could occur on the Tonawanda site are discussed in Section 2.2.5.4.

The Linde property supports several nearly mature eastern cottonwood, American sycamore, white ash, northern red oak, and shagbark hickory trees that were planted during landscaping activities. Urban lawns with plantings of shrubs were also established and are given periodic maintenance. Original vegetation was destroyed and natural plant succession has been disrupted during the industrial development and use of the Linde facility and surrounding area. Years of continuous industrial activity have left only marginal areas for natural plant communities. The property provides minimal urban wildlife habitat, supporting only the cosmopolitan species of birds and small mammals (FBDU 1981a). Contamination has been identified on 2.6 ha (6.3 acres) of this 41 ha (101 acres) property.

Ashland 1, a third of which was bermed as a containment area for petroleum product storage tanks, contains only a sparse cover of shrubs and grasses. Industrial development and related activities have significantly altered or eliminated any native plant communities. Wildlife is represented by bird and small mammal species such as rock dove (pigeon), mourning dove, killdeer, starling, common grackle, American robin, house mouse, Norway rat, eastern cottontail rabbit, and eastern gray squirrel. About two-thirds [2.6 ha (6.5 acres)] of this property has been identified as contaminated.

The Seaway property, an active solid waste disposal facility, supports sparse vegetation composed of shrubs and grasses. Vegetation on the property includes daisies, milkweeds, vetches, foxtail grasses, clovers, sorrels, and cattails. New York regulations require seeding with native grasses during the closure and post-closure phases of solid waste disposal facilities to slow erosion and promote evapotranspiration. Landfill operations and nearby industrial activity limit wildlife use of the area, although gulls and crows are visibly abundant. Contaminants of MED origin have been found on 6 ha (15 acres) of this 44 ha (109 acres) site.

Much of Ashland 2 is covered with a mixture of grasses, forbs, shrubs, and small trees. This cover varies in density from areas with essentially no vegetation to areas with dense stands of woody shrubs and trees. Habitat diversity is also enhanced by four potential wetland areas, one of which bisects the property (see Section 2.2.5.3). Because less habitat disturbance and conversion has occurred on Ashland 2, it may be expected to support a more diverse population of animals. The larger areal extent of Ashland 2 also increases its usefulness to wildlife (Cunningham 1992). In addition to the species mentioned for Ashland 1, a number of waterfowl species, red-winged blackbird, ring-necked pheasant mink, fox, raccoon, striped skunk, weasels, muskrat, opossum, and deer may use the property. About 2.2 ha (5.4 acres) of the 41 ha (101 acres) of this property contains contaminated soils and sediments.

2.2.5.2 Aquatic Biota

Biotic resources of the aquatic habitats on the Tonawanda site were not fully addressed in the RI or BRA. Therefore, additional information was obtained from other documented studies and surveys of nearby aquatic systems.

The pond, located in the northwest corner of the Linde property, is connected to Sheridan Park Lake by a culvert underneath Sheridan Drive. Sheridan Park Lake is stocked annually by NYSDEC with about 2000 adult calico bass (BNI 1988). An aquatic biota survey was conducted within 1.2 ha (3 acres) of Sheridan Lake in 1980 (NYSDEC 1992a). Fish species collected consisted of goldfish *(Carassius acratus)*, bullhead catfish *(Ictalurus nebulosus)*, goldfish x carp hybrid *(prinus carpio)*, black crappie *(Pomoxis nigramaculatus)*, rock bass *(Ambloplites rupestris)*, and yellow perch *(Perca flavescens)*. These species would also be expected to occur in the pond.

Twomile Creek [the 3-km (2-mi) section between Sheridan Park Lake and the Niagara River] and its tributaries are designated as Class B waters (Section 2.1.2.3). The lower reaches of nearby Tonawanda Creek are also classified as Class B waters by NYSDEC. Tonawanda Creek empties into the Niagara River about 2.4 km (1.5 mi) downstream of the mouth of Twomile Creek. A fish survey of Tonawanda Creek, performed in 1979 for the U.S. Fish and Wildlife Service, lists 20 species of cyprinids (minnows), catostomids (suckers), ictalurids (catfish), centrarchids (sunfish), esocids (pike), and percids (perch) (COE 1981). Species from the lower section tended to be more representative of warm-water habitats. Although a smaller stream, Twomile Creek would be expected to support similar but fewer species. Fish kills in Twomile Creek have been reported and are attributed to damaging water quality events within Rattlesnake Creek and its drainage channels. Leachate with a high ammonia concentration from the Seaway landfill was reported as responsible for a 1974 fish kill in the Twomile Creek area (NYSDEC 1974).

Sections of Twomile Creek's channel below Sheridan Park Lake are cleared of sediments annually by park staff. Increased water turbidity and disturbance of benthic and possibly of fish communities by physical removal are likely to result from this activity.

Information regarding aquatic invertebrate biota that may be considered typical of the Tonawanda site was obtained from previous aquatic surveys (NYSDEC 1992a). Survey locations and data sources include: (1) Ransom Creek (near Clarence Center in Erie County) and Tonawanda Creek, which represent communities typical of riffle habitats from streams and creeks in the area; and (2) Cayuga and Bergholtz Creeks in the Niagara Falls area, which represent invertebrate species typical of slower-moving stream habitats. The Ransom Creek survey consisted of the following dominants: Chironomidae (midges), Trichoptera (caddisflies), Ephemeroptera (mayflies), Plecoptera (stoneflies), Coleoptera (beetles), and Oligochaete (worms). The Cayuga and Bergholtz surveys consisted of crayfish, Odonate (dragon flies), snails, and hemipterans *(Belostoma)* as dominates. The drainage channels on the Ashland 1 and Seaway properties would not be expected to support any aquatic animal communities beyond those ordinarily found in manmade drainage systems. As water quality within these two areas has been identified as variable but generally low (BNI 1988), species present could be limited to those tolerant of degraded conditions. Flow begins within the bermed and level areas on Ashland 1. Runoff from the southwest slope of Seaway joins this flow and is conveyed by drainage ditches to the boundary of Seaway, where it is then ducted beneath the landfill within a 90-cm (36-in.) reinforced concrete pipe. Leachate infiltration into this pipe is suspected (Wehran 1979). This conduit surfaces at the Niagara Mohawk property line before the stream enters Ashland 2.

2.2.5.3 Floodplains and Wetlands

As stated in Section 2.2.2.3, the Federal Insurance Administration (FIA) coordinated a flood analysis of both the Town of Tonawanda and the City of Tonawanda, but an intensive study of Twomile Creek was not performed (FIA 1979). No portion of the Linde property is within the 100-yr flood zone of Twomile Creek since it is contained in twin box culvert conduits along the western boundary of the property. The 100-yr flood zone for the Niagara River lies between the river and River Road (BNI 1993), and no portion of Ashland 1, Seaway, or Ashland 2 is within the flood zone.

Review of National Wetland Inventory (NWI) maps (Tonawanda West and Buffalo Northwest quadrangles) identified an area onsite at Ashland 2 (Rattlesnake Creek) (Figure 2-7) as a palustrine emergent wetland with persistent narrow-leaved vegetation (i.e., cattails) and a seasonally saturated water regime. No floodplains and wetlands appear onsite at Linde, according to NWI maps, but surface runoff from the site drains into two offsite floodplain and wetland areas to the north and west (Figure 2-8). West of Linde, a marshy strip lying along twin conduits situated in a stream bed that runs parallel to the western boundary and empties into Twomile Creek is mapped as a palustrine emergent floodplain and wetland with persistent narrow-leaved vegetation and temporary water regime. On the northeast corner of Linde, a palustrine forested floodplain and wetland with broad-leaved deciduous vegetation and a temporary water regime was identified on NWI maps. Also, information in the *Soil Survey of Erie County, New York* (SCS 1986) indicates areas of Ashland 2 and Linde that meet the criteria for hydric soils. Types of hydric soils and soils with aquatic suborders that occur onsite are Wayland, Churchville, and Odessa-Lakemont (Table 2-5). In the technical guide for New York hydric soils (SCS 1989), Wayland is listed as a hydric soil; the Churchville and Odessa soils are listed as soils with potential hydric inclusions.

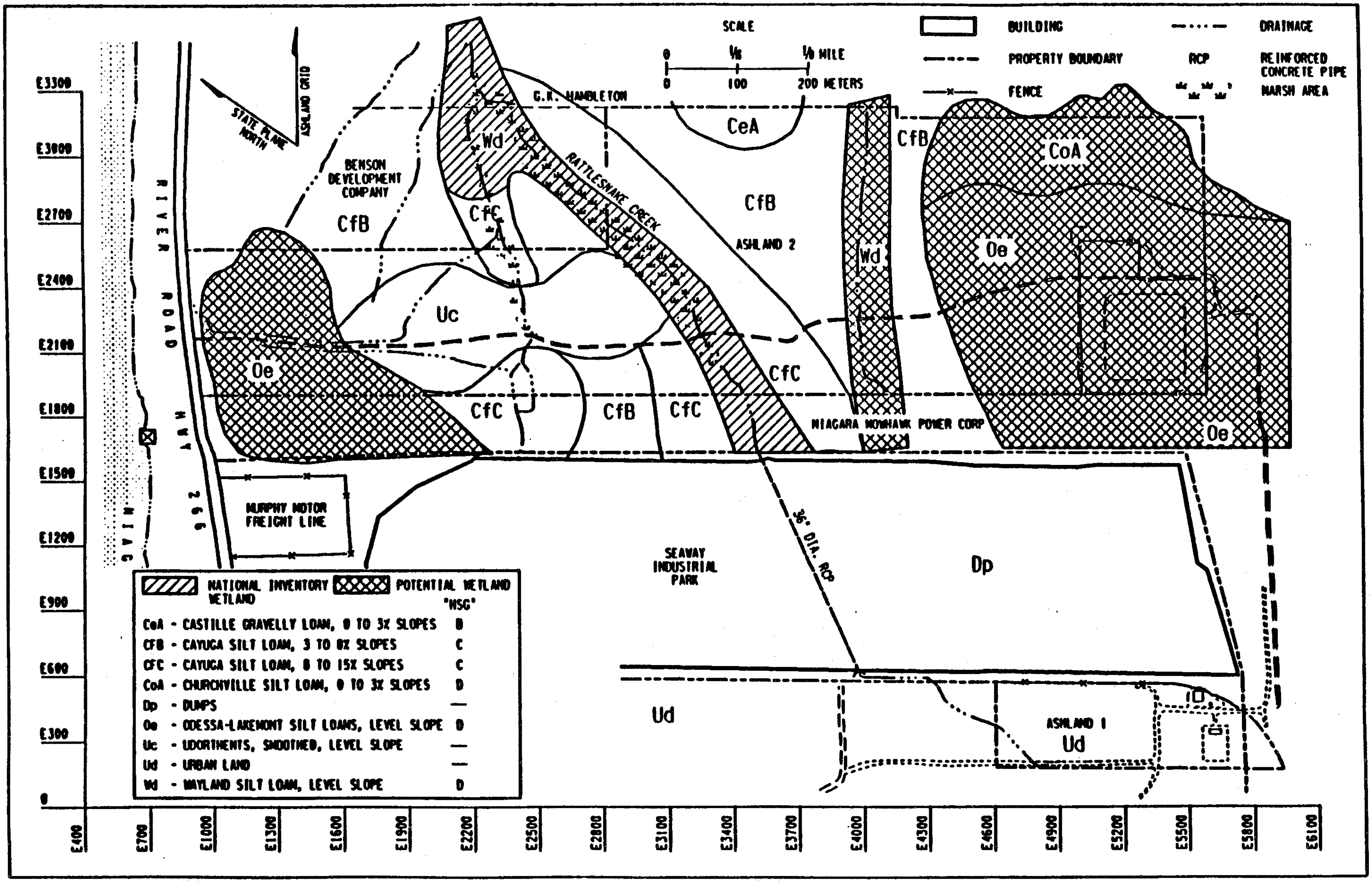


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Figure 2-7. Ashland 2 Wetland Areas

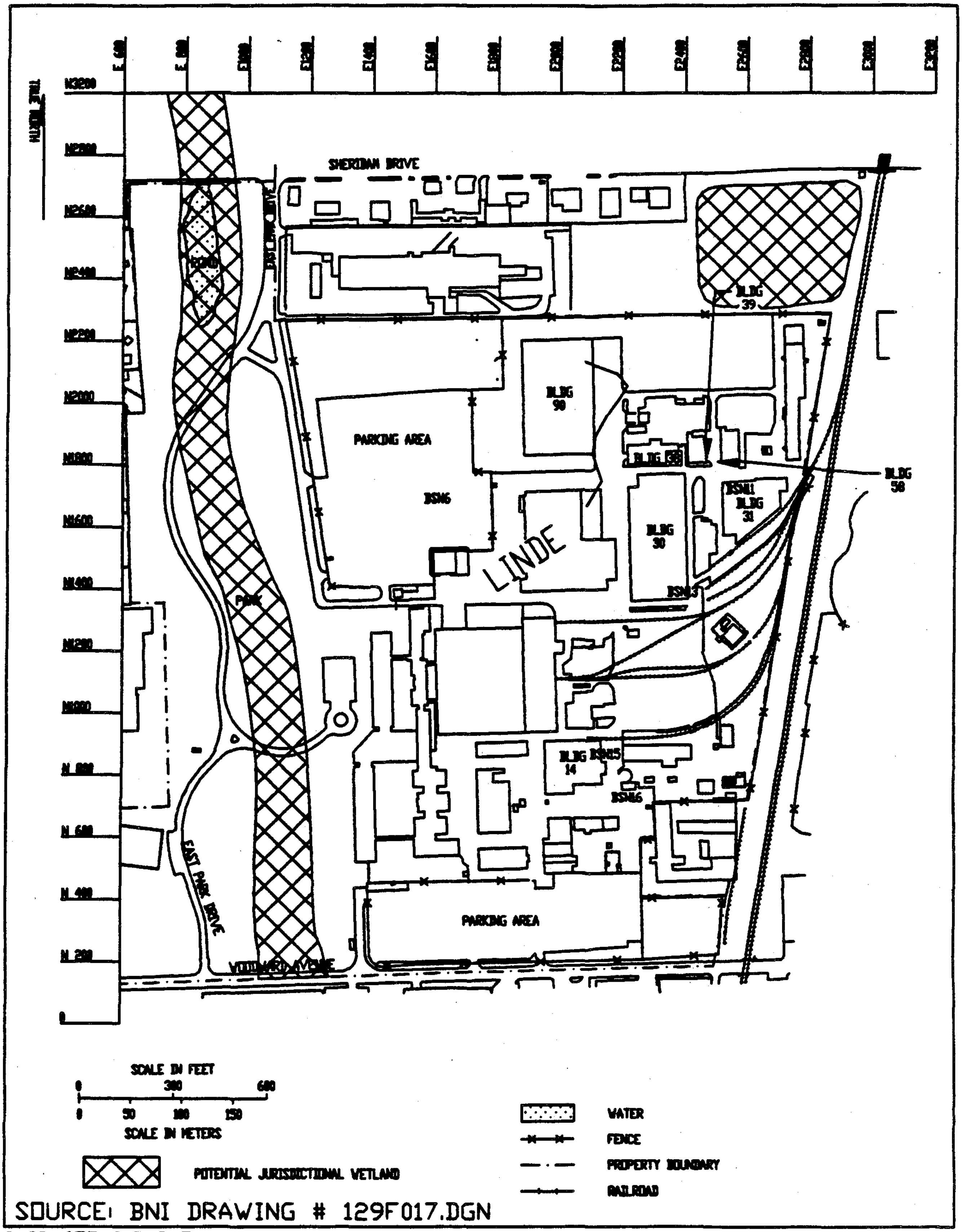

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Figure 2-8. Wetland Adjacent to Linde Property

Table 2-5. Soil Survey Information Used to Determine Wetland Extent at Ashland 2 and Linde

Map Symbol	Soil Series, Texture, Phase	Drainage Class [a]	Water Table Depth Requirement	Flooding	High Water Table	Potential for Wetland Plants [b]	Hydric Soil
CFB	Cayuga silt loam, 3-8% slopes	WD-MWD	-----	None	1.5-3.0 ft, perched, Apr-May	Poor	-----
CFC	Cayuga silt loam, 8-15% slopes	WD-MWD	-----	None	1.5-3.0 ft, perched, Apr-May	Very Poor	-----
Wd	Wayland silt loam	PD-VPD (permeability <6 in/h)	< 1.5 ft	None	+ 0.5-0.5 ft, apparent, Nov-Jun	Good	Listed (aquic suborder)
CeA	Castile gravelly loam, 0-3% slopes	MWD	-----	None	1.5-2.0 ft, apparent, Mar-May	Poor	-----
CoA	Churchville silt loam, 0-3% slopes	SPD	<0.5 - 1.5 ft	None	0-1.5 ft, perched-apparent, Dec-Jun	Fair-Good	Potential hydric inclusions (aquic suborder)
Uc	Udorthents, smoothed	ED-MWD	-----	-----	-----	-----	-----

[a] SPD = somewhat poorly drained; WD = well drained; MWD = moderately well drained; PD = poorly drained; ED = excessively drained; VPD = very poorly drained.
[b] Scale of very poor, poor, fair, good.

Source: *Remedial Investigation Report* (BNI 1992a).

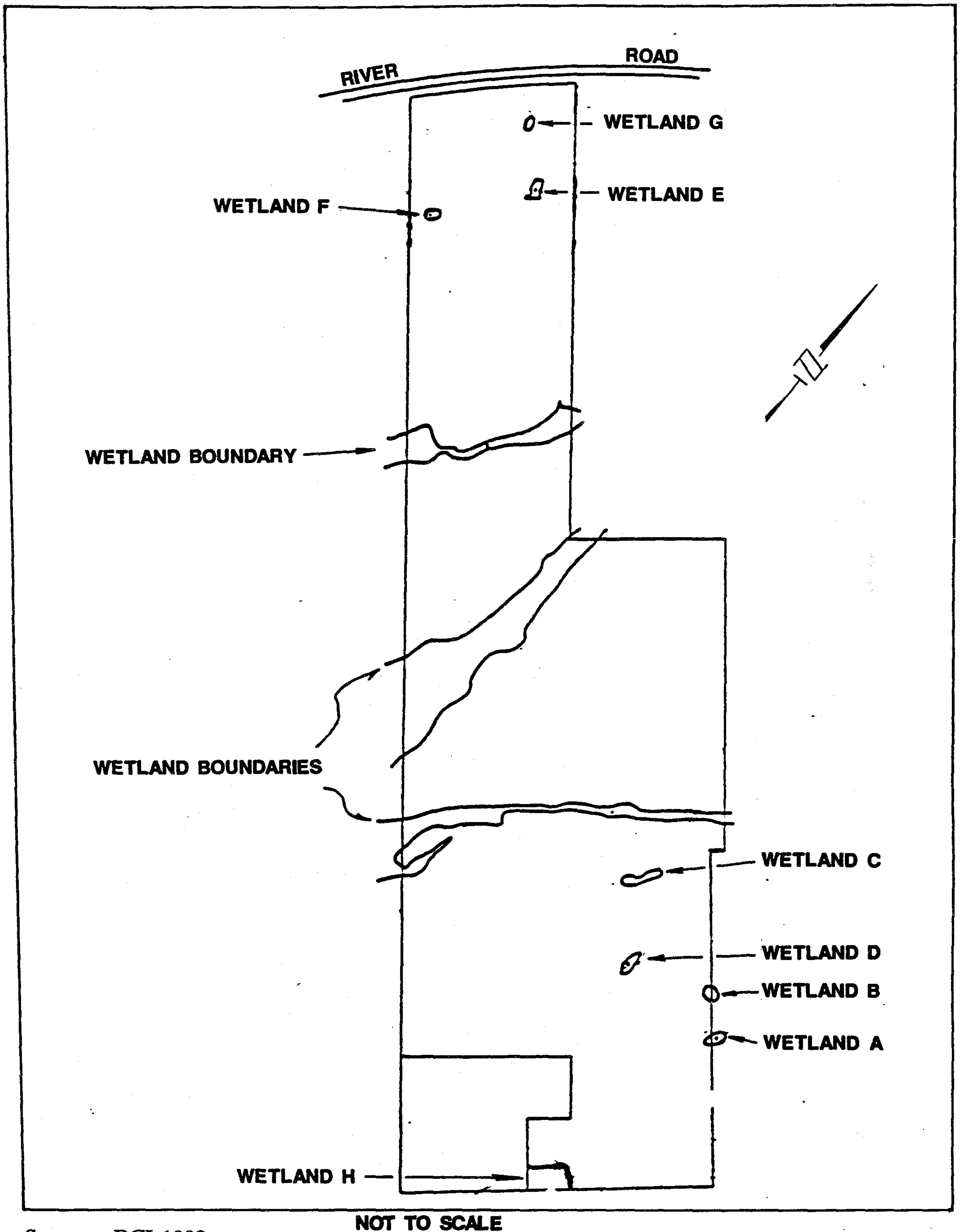
In 1976, an inspection was performed on the Twomile Creek watershed by the NYSDEC Division of Fish and Wildlife for the purpose of mapping eligible portions of the creek as New York state-regulated wetland (NYSDEC 1992b). A wetland area was identified in and along Twomile Creek in the vicinity of Twomile Creek Park and in and along its first tributary (Rattlesnake Creek). An uncontested fill in Rattlesnake Creek severed the wetland into two parts, each less than the 5 ha (12 acres) required for New York wetlands jurisdiction (NYSDEC 1992b).

Three distinct plant communities were identified in the wetland area. These included wooded wetland, emergent vegetation, and wet meadow vegetation. Species of wildlife that were either sighted or of whom signs were observed in the wetland included muskrat, redwinged blackbird, ring-necked pheasant, mallard (female and brood), raccoon, mink, and killdeer. The area is probably used to some extent by waterbirds such as herons, and because of the presence of flooded dead trees and good brooding cover, the area should provide woodduck breeding habitat (NYSDEC 1992b).

In October and November of 1990 and December of 1991, a wetland delineation was conducted on the Ashland 2 property (BCI 1992a). The delineations were performed as part of a proposed industrial park development plan. The 1990 delineation was conducted using the 1989 COE *Federal Manual for Identifying and Delineating Jurisdictional Wetlands.* In 1991 the site was reevaluated due to the implementation of the *Corps of Engineers (COE 1989) Wetland Delineation Manual* (Environmental Laboratory 1987) while the 1989 manual was being revised.

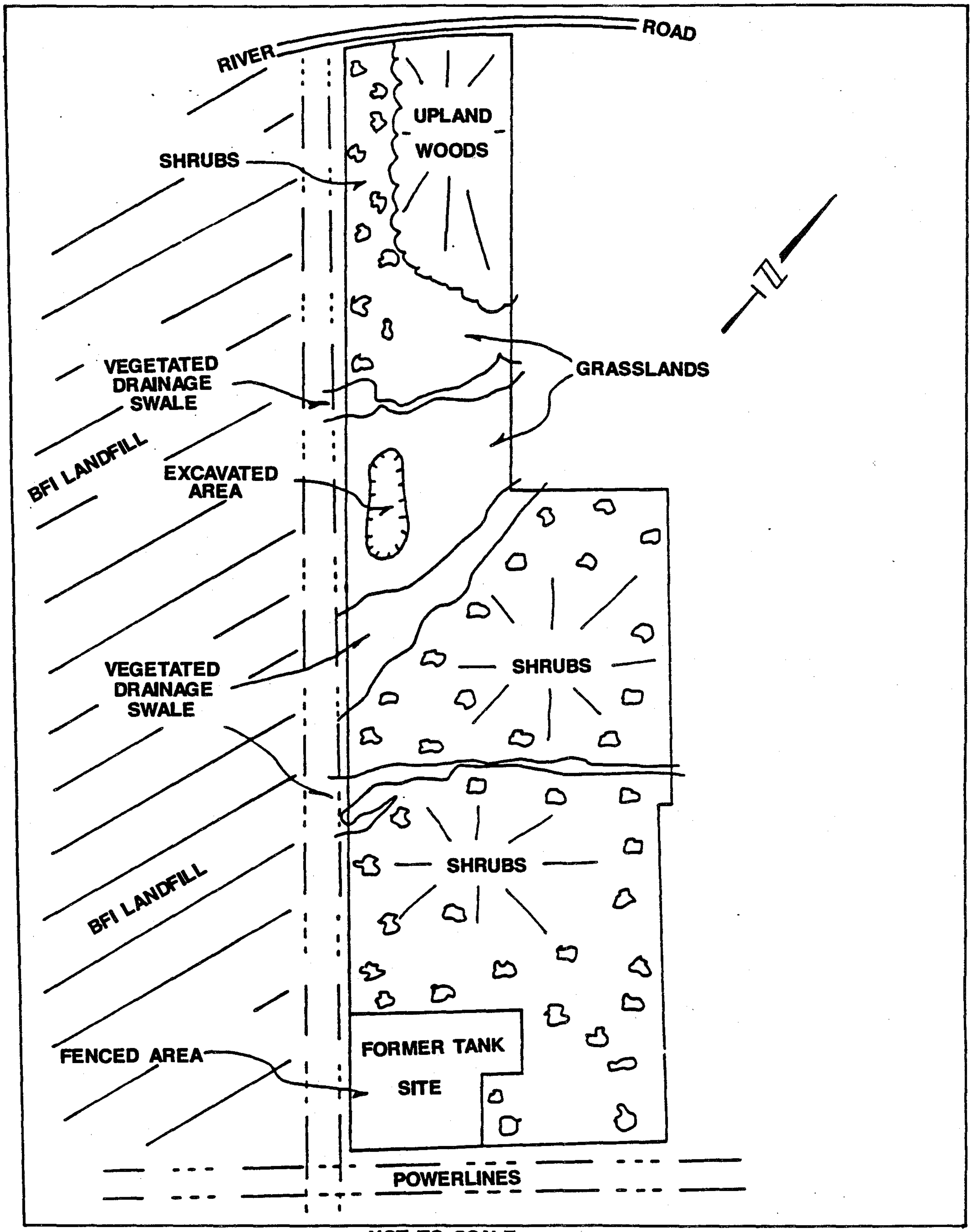
For the 1990 delineation, the intermediate onsite method was used with the quadrant transect sampling procedure throughout most of the site. After a general reconnaissance of the site, four transects were selected in which to examine and document habitats and soil types on the property. The three intermittent streams (drainage shales) were delineated using the routine onsite determination method. After a review of the 1990 delineation data, the southern part of the site was reexamined. Additional sample points and two transects were added to redetermine the boundaries of Wetland H. For all sample points, the standard 1.52-m (5-ft) radius was used to define the herbaceous cover and a 9.14-m (30-foot) radius was used for the remaining layers. Soil samples were taken with a soil bucket auger. Based on the results of the sample points, the wetland/upland boundary was identified by changes in elevation and vegetation. Wetland boundaries are shown on Figure 2-9.

The vegetative cover types on the site are shown on Figure 2-10. The forested area near River Road is dominated by common buckthom *(Rhamnus canthartica)* and hawthom *(Crataegus* sp.). Most of the site is characterized by a uniform dogwood-hawthorn shrub community. This facultative plant-dominated community is located on higher elevations and adjacent to the swales. At these sample plots, hydric soils and wetland hydrology were not present. The assumed landfill areas on the site are dominated by grasses and forbs, such as goldenrods and asters. These areas are shown as grasslands on Figure 2-10. The excavated



Source: BCI 1992

Figure 2-9. Ashland 2 Wetland Delineation



Source: BCI 1992

NOT TO SCALE

Figure 2-10. Ashland 2 Plant Communities

area has predominantly bare soils and no field indicators of jurisdictional wetlands. The former storage tank area was not investigated in detail, but it contains extensive stone fill with various pioneer herbaceous species and a stand of *Phragmites australis* in one corner. The three drainage swales met the three technical criteria for jurisdictional wetlands. They are dominated by nearly monocultural stands of the non-native common reed *(Phragmites australis)* and purple loosestrife *(Lythrum salicaria)* with occasional stands of cattail *(Typha latifolia)*. Hydrologic characteristics were apparent with saturated soils and standing water. Flowing water was not observed at the time of the site visits. Eight isolated wetlands met the three technical criteria for jurisdictional wetlands. Five are located in the southern portion of the site and three are in the northern portion. Wetlands G and H are located in the upland woods and have similar vegetation. The other six isolated wetlands are small depressions with nearly identical vegetation and distinct boundaries. The man-made ditches on the property are located along the access road or in other upland areas and have no upstream natural component. They are not considered to be subject to jurisdiction under Section 404 of the Clean Water Act and were not sampled for wetland criteria.

In summary, the total wetland area on the Ashland 2 site is 3.41 ha (8.42 acres). Of the total acreage, the drainage swales comprise 3.09 ha (7.63 acres) and the remaining small wetlands comprise 0.31 ha (0.77 acre).

2.2.5.4 Endangered and Threatened Species

Except for occasional transient individuals, no federally-listed or proposed endangered or threatened species under jurisdiction of the USFWS have been sighted in the project impact area (Corin 1992). The most likely listed species to appear on or near the sites are the osprey *(Pandion haliaetus)*, bald eagle *(Haliaetus leucocephalus)*, and peregrine falcon *(Falco peregrinus)* (FBDU 1981b; Gill 1989). The three sites nearest the Niagara River (Ashland 1, Seaway, and Ashland 2) are most likely to host transient individuals of these species. No listed or suspected critical habitats occur on any of the sites.

A New York state-listed threatened plant species, the stiff-leaf goldenrod *(Solidago tigida)*, occurs near the Tonawanda site. An onsite survey performed in August 1992 by a qualified scientist determined that this species is not present on any of the Tonawanda site properties (Cunningham 1992).

2.2.6 Archaeological, Cultural, and Historical Resources

A review of New York state records on archaeological, cultural, and historical resources indicates that none of these resources is close to the project area. Specifically, SHPO records do not indicate any known archaeological sites within a mile of the project area (Appendix D). In addition, SHPO records indicate that there are no cultural or historic sites near the project area listed on or eligible for the National Register of Historic Places (Moody 1992).

2.2.7 Socioeconomic and Institutional Issues

The relevant components of the social context for this assessment include economic and demographic conditions, local transportation infrastructure, ambient noise, and community well-being. This section describes the potentially affected environment with regard to each of these components.

2.2.7.1 Demographics

The Tonawanda site is located in the Town of Tonawanda (a different municipality from the City of Tonawanda) in northern Erie County close to the border with Niagara County. As shown in Table 2-6, the Town of Tonawanda has a higher relative population density than the averages for Erie or Niagara Counties or for the state. The communities surrounding the Town of Tonawanda are the City of Tonawanda to the north, the Town of Amherst to the east, and the City of Buffalo to the south. (The Niagara River and the border with Canada are to the west). These communities also have higher population densities than the averages for the counties and the state. Therefore, the Tonawanda site is in the middle of a relatively urban population center.

According to the 1990 U.S. census, the population of the Town of Tonawanda at that time was 82,464, down slightly from the 83,800 estimated in 1986 (see Table 2-6).

Annual population data are available for Erie and Niagara Counties from 1980 to 1989; an examination of these data shows the trends in population growth over the decade for this region. As shown in Table 2-7, the number of people living in Erie and Niagara counties has declined between 1980 and 1989. This decline occurred when New York experienced growth in population at an average annual compound rate of 0.2%.

2.2.7.2 Economic Background Description

This section describes the economic factors that may be affected by the remediation alternatives considered for the Tonawanda site, including Linde, Ashland 1, Seaway, and Ashland 2. Each alternative will be evaluated for its impact on population, housing, and employment. Population has been discussed under Demographics; this section focuses on baseline information on housing and employment. The first step in providing background for the impact analysis is to define a region of influence for the proposed action. All onsite activity related to the alternatives would take place at the Tonawanda site, which is physically located in Erie County, New York. Although the site itself represents a small portion of the county, the actions taking place at the site may impact the whole county's economy. Because Tonawanda is so close to Niagara County, it is anticipated that there would be effects experienced by that county, also. Erie and Niagara Counties form an urban trade area and define the Buffalo-Niagara Falls Metropolitan Statistical Area. Therefore, the region of

Table 2-6. 1986 and 1990 Population and 1990 Population Density in the Areas Surrounding the Tonawanda Site

Region	1986 Population	1990 Population	Land Area (Square kilometers)	Land Area (Square miles)	1990 Persons Per Square Kilometer	1990 Persons Per Square Mile
Town of Tonawanda	83,800	82,464	48.7	18.8	1,693.3	4,386.4
Surrounding Muncipalities:						
Town of Amherst	109,500	111,711	138.0	53.3	809.5	2,095.9
City of Buffalo	324,820	328,123	105.2	40.6	3,119.0	8,081.8
City of Tonawanda	18,240	17,284	9.8	3.8	1,763.7	4,548.4
Surrounding Counties:						
Erie County	964,700	968,532	2,705.7	1,044.7	358.0	927.1
Niagara County	216,900	220,756	1,354.5	523.0	163.0	422.1
New York State	17,772,000	17,990,455	47,377.0	18,292.3	379.7	983.5

Sources: Bureau of the Census, U.S. Department of Commerce, 1990 Census of Population and Housing, Summary Population and Housing Characteristics, New York, 1990 CPH-1-34, August 1991; Bureau of the Census, U.S. Department of Commerce, County and City Data Book, 1988.

Table 2-7. Trends in Population Growth, 1980-1989, Erie and Niagara Counties and the State of New York

Year	Erie County Population (Thousands)	Niagara County Population (Thousands)	Total Region Population (Thousands)	Annual Percent Change (%)	New York State Population (Thousands)	Annual Percent Change (%)
1980	1,014.0	227.0	1,241.0		17,565.3	
1981	1,005.8	225.2	1,231.0	-0.8%	17,556.8	-0.0%
1982	998.6	222.0	1,220.6	-0.8%	17,569.4	0.1%
1983	986.8	219.7	1,206.5	-1.2%	17,660.3	0.5%
1984	975.4	217.2	1,192.6	-1.2%	17,713.1	0.3%
1985	968.1	216.8	1,184.9	-0.6%	17,746.3	0.2%
1986	961.0	216.2	1,177.2	-0.6%	17,805.1	0.3%
1987	956.4	215.3	1,171.7	-0.5%	17,835.6	0.2%
1988	958.7	216.9	1,175.6	0.3%	17,909.4	0.4%
1989	954.8	216.8	1,171.6	-0.3%	17,950.8	0.2%
Average Annual Growth 1980-1989	-0.7%	-0.5%	-0.6%			0.2%

Source: Regional Economic Information System, Bureau of Economic Analysis, *Personal Income by Major Source and Earnings by Industry*, Table CA5, April 1991.

influence for the economic and demographic analysis conducted for each alternative is the two-county region of Erie and Niagara counties.

Tables 2-8 and 2-9 report summary statistics on housing in the Town of Tonawanda and the two counties of the region of influence. As shown in Table 2-9, the total number of housing units has grown over the last decade. Table 2-10 shows that most of the housing units in the Town of Tonawanda are single-family homes (69.5%), followed by multi-family units (29.5%) and mobile homes (1.0%). This distribution differs from that at the state level, which shows the greatest number of units in the multi-family category (51.1%), followed by single-family units (44.7%) and mobile homes (4.2%). The average household size is slightly smaller in the region of influence than at the state level. Vacancy rates in the region of influence were lower for home-owner units than that experienced by the state; however, rental vacancy rates were higher in the region of influence than in the state. For the Town of Tonawanda, vacancy rates were lower than in the region of influence and the state.

Tables 2-10 through 2-12 provide background data on employment in the Erie-Niagara Region. There were a total of 625,889 people employed in Erie and Niagara Counties in 1989. Of this total, 532,674 were employed in the private sector, 89,257 were employed by governmental enterprises, and 3,958 were employed on farms. The distribution of employment by sector is shown in Table 2-10. The service sector accounted for most employment in 1989, followed by manufacturing and retail trade. The greatest growth in employment between 1980 and 1989 occurred in the agricultural services sector, followed by services and construction. Table 2-11 shows the breakdown in average earnings per employee by sector. The highest earnings were in the mining sector, followed by manufacturing, federal civilian employment, and transportation and public utilities. The greatest growth in average earnings between 1980 and 1989 is shown to be for the military, followed by state and local governments, and farming.

Table 2-12 shows the number of establishments by industry sector in Erie and Niagara Counties. The greatest number of establishments are reported for services and retail trade, followed by construction, wholesale trade, finance, insurance, and real estate. The most growth in establishments between 1988 and 1989 has been experienced in mining (7.1%), farming (6.8%), and construction (6.5%).

Table 2-13 shows per capita income trends for the region. It shows values in both nominal dollars and in constant dollars, using the Consumer Price Index with a 1982 through 1984 base as the deflator. Per capita income increased at an average annual rate of 6.6% in the Erie-Niagara region; however, the real rate of increase averaged only 1.9% per year, which is equal to the growth in income described by the Consumer Price Index.

Table 2-8. Change in the Number of Housing Units, 1980 and 1990, In the Areas Surrounding the Tonawanda Site

Region/County	Total Housing Units 1980	Total Housing Units 1990	Average Annual Change 1980-1990
Town of Tonawanda	34,018	34,589	0.17%
Erie County	389,038	402,131	0.33%
Niagara County	85,209	90,385	0.59%
Total Region	474,247	492,516	0.38%

Sources: Bureau of the Census, U.S. Department of Commerce, 1980 Census of Housing, Volume 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics, Part 34, New York, HC80-1-A34, August 1982; Bureau of the Census, U.S. Department of Commerce, 1990 Census of Population and Housing, Summary Population and Housing Characteristics, New York, 1990 CPH-1-34, August 1991.

Table 2-9. Housing Characteristics in the Areas Surrounding the Tonawanda Site, 1990

Region/County	Single Family Units	Multi-Family Units	Mobile Homes	Total Occupied Units	Average Persons Per Unit	Home Vacancy Rate	Renter Vacancy Rate
Town of Tonawanda	24,045	10,212	332	33,765	2.44	0.4	3.8
Erie County	225,152	166,360	10,619	376,994	2.57	0.8	6.6
Niagara County	58,133	27,627	4,625	84,809	2.60	0.8	5.4
Total Region	283,285	193,987	15,244	461,80	2.58	0.8	6.4
New York State	3,231,127	3,693,005	302,759	6,639,322	2.71	1.9	4.9

Source: Bureau of the Census, U.S. Department of Commerce, *1990 Census of Population and Housing Summary Population and Housing Characteristics, New York*, 1990 CPH-1-34, August 1991.

Table 2-10. Distribution of Erie and Niagara County Employment, 1980 and 1989

Employment Sector	1980			1989			Average Annual Growth 1980-1989		
	Erie	Niagara	Total	Erie	Niagara	Total	Erie	Niagara	Total
Farming	2,918	2,191	5,109	2232	1,726	3,958	-2.9%	-2.6%	-2.8%
Agricultural Services	1,596	322	1,918	2,647	576	3,223	5.8%	6.7%	5.9%
Mining	543	104	647	530	159	689	-0.3%	4.8%	0.7%
Construction	17,168	3,418	20,586	22,556	4,805	27,361	3.1%	3.9%	3.2%
Manufacturing	103,890	33,090	136,980	78,343	24,366	102,709	-3.1%	-3.3%	-3.1%
Transportation & Public Utilities	25,042	3,468	28,510	23,382	4,200	27,582	-0.8%	2.2%	-0.4%
Wholesale Trade	26,708	2,695	29,403	27,699	2,896	30,595	0.4%	0.8%	0.4%
Retail Trade	84,031	15,722	99,753	99,920	20,116	120,036	1.9%	2.8%	2.1%
Finance, Insurance, & Real Estate	28,927	3,304	32,231	37,822	3,474	41,296	3.0%	0.6%	2.8%
Services	110,313	18,677	128,990	154,930	24,253	179,183	3.8%	2.9%	3.7%
Government & Government Enterprises	76,850	13,024	89,874	76,240	13,017	89,257	-0.1%	-0.0%	-0.1%
Federal, Civilian	8,821	1,295	10,116	9,105	1,361	10,466	0.4%	0.6%	0.4%
Military	3,359	733	4,092	2,652	528	3,180	-2.6%	-3.6%	-2.8%
State & Local	64,670	10,996	75,666	64,483	11,128	75,611	-0.0%	0.1%	-0.0%

Source: Regional Economic Information System, Bureau of Economic Analysis, Table CA25, *Full-Time and Part-Time Employees by Major Industry for Counties and Metropolitan Areas (Number of Jobs)*, April 1991.

Table 2-11. Average Earnings Per Industry for Erie and Niagara Counties, 1980 and 1989[a]

Employment Sector	1980			1989			Average Annual Growth 1980-1989		
	Erie	Niagara	Total	Erie	Niagara	Total	Erie	Niagara	Total
Farming	7,034	6,834	6,948	14,500	10,874	12,919	8.4%	5.3%	7.1%
Agricultural Services	10,405	7,661	9,944	14,093	11,382	13,609	3.4%	4.5%	3.5%
Mining	59,000	54,298	58,244	44,711	58,786	47,959	-3.0%	0.9%	-2.1%
Construction	20,943	19,297	20,670	28,038	25,598	27,609	3.3%	3.2%	3.3%
Manufacturing	23,334	25,219	23,789	33,048	36,381	33,838	3.9%	4.2%	4.0%
Transportation & Public Utilities	23,525	19,750	23,066	31,797	26,759	31,030	3.4%	3.4%	3.4%
Wholesale Trade	18,256	15,568	18,010	27,708	23,136	27,276	4.7%	4.5%	4.7%
Retail Trade	7,780	7,763	7,777	11,230	10,289	11,072	4.2%	3.2%	4.0%
Finance, Insurance, & Real Estate	11,630	8,817	11,342	20,883	13,075	20,226	6.7%	4.5%	6.6%
Services	11,608	9,970	11,371	19,286	15,924	18,831	5.8%	5.3%	5.8%
Government & Government Enterprises	14,728	14,027	14,626	28,139	25,213	27,713	7.5%	6.7%	7.4%
Federal, Civilian	20,163	20,294	20,180	31,199	29,924	31,033	5.0%	4.4%	4.9%
Military	4,212	4,363	4,239	9,050	7,360	8,769	8.9%	6.0%	8.4%
State & Local	14,533	13,933	14,445	28,493	25,484	28,050	7.8%	6.9%	7.7%

[a] In dollars.

Sources: Regional Economic Information System, Bureau of Economic Analysis, Table CA25, *Full-Time and Part-Time Employees by Major Industry for Counties and Metropolitan Areas (Number of Jobs)*, April 1991; and Table CA5, *Personal Income by Major Source and Earnings by Industry for Counties and Metropolitan Areas (thousands of dollars)*, April 1991.

92-048PSY/010593

Table 2-12. Number of Establishments by Sector in Erie and Niagara Counties, 1988-1989

Employment Sector	1988 Establishments			1989 Establishments			Average Annual Growth		
	Erie	Niagara	Total	Erie	Niagara	Total	Erie	Niagara	Total
Agricultural Services	221	44	265	236	47	283	6.8%	6.8%	6.8%
Mining	23	5	28	26	4	30	13.0%	-20.0%	7.1%
Construction	2,090	403	2,493	2,193	461	2,654	4.9%	14.4%	6.5%
Manufacturing	1,290	296	1,586	1,262	310	1,572	-2.2%	4.7%	-0.9%
Transportation & Public Utilities	723	173	896	744	189	933	2.9%	9.2%	4.1%
Wholesale Trade	1,839	229	2,068	1,837	235	2,072	-0.1%	2.6%	0.2%
Retail Trade	5,884	1,434	7,318	5,989	1,429	7,418	1.8%	-0.3%	1.4%
Finance, Insurance & Real Estate	1,677	277	1,954	1,677	285	1,962	0.0%	2.9%	0.4%
Services	7,195	1,358	8,553	7,338	1,383	8,721	2.0%	1.8%	2.0%

Sources: Bureau of the Census, U.S. Department of Commerce, County Business Patterns, 1988, New York, CBP-88-34, 1990; Bureau of the Census, U.S. Department of Commerce, County Business Patterns, 1989, New York, CBP-88-34, 1991b.

Table 2-13. Trends in Per Capita Income for Erie and Niagara Counties, 1980-1989

Year	Per Capita Income (Dollars)			Real Per Capita Income (1982-84 = 100 Dollars)		
	Erie	Niagara	Total	Erie	Niagara	Total
1980	9,865	9,450	9,789	11,972	11,468	11,880
1981	10,777	10,277	10,686	11,856	11,306	11,755
1982	11,285	10,812	11,199	11,694	11,204	11,605
1983	11,916	11,259	11,796	11,964	11,304	11,844
1984	12,971	12,301	12,849	12,484	11,839	12,367
1985	13,659	12,956	13,530	12,694	12,041	12,575
1986	14,393	13,462	14,222	13,132	12,283	12,976
1987	15,207	14,105	15,005	13,386	12,416	13,208
1988	16,436	15,069	16,184	13,893	12,738	13,680
1989	17,724	16,183	17,439	14,294	13,051	14,064
Average Annual Growth:						
1980-1989	6.7%	6.2%	6.6%	2.0%	1.4%	1.9%

Source: Regional Economic Information System, Bureau of Economic Analysis, Personal Income by Major Source and Earnings by Industry For Counties and Metropolitan Areas (thousands of dollars), Table CA5, April 1991.

2.2.7.3 Community Issues

Community well-being, or quality of life, refers to the collective definition of the community as a desirable place in which to live. The interpretation of quality of life is necessarily subjective, and is filtered through individual perceptions and experience. As described by Milbrath (1989), "objective conditions may contribute to or detract from the experience of quality but human reactions are not automatic to physical conditions; the experience occurs only subjectively" (pp. 68-69). A sense of physical well-being is considered to be an important component of a person's experience of quality of life. As Milbrath explains (p. 68), personal reports are the best indicator of experiences of quality; however, a general survey of the Tonawanda community was not undertaken for this assessment. A study of quality of life on the Niagara Frontier conducted by Milbrath showed that people's experiences of quality of life clustered into various lifestyles. Lifestyles that emphasized fulfillment in interpersonal relations and enjoyment of nature emerged as very important to people of the Niagara Frontier, more so than consumptive lifestyles. Public comments, during and following two public meetings held in the community during 1988, appear to support the notion that cleaning up, revitalizing, and increasing public access to the Tonawanda waterfront are strongly associated with community quality of life in the area. Local waterfront revitalization efforts reportedly receive widespread support by the local populace.

The economy of western New York, particularly the western portion of Erie and Niagara Counties, has been dominated since the early 1900s by heavy industry. Many of these industries were located along the Niagara River and Erie Canal system for access to water for industrial processing, cooling, and transportation. Such operations in the Town of Tonawanda presently include General Motors, Dunlop Tire, DuPont, Niagara Mohawk Power, and Tonawanda Coke. Public complaints about air quality and odors from operations at such locations were frequent in the past, although these have subsided as environmental conditions have gradually improved, primarily due to the shutdown of many industrial operations. Some local sources attribute these environmental improvements, in part, to vigorous enforcement practices by the NYSDEC. However, numerous hazardous waste sites have resulted from past industrial activities. Fourteen waste disposal sites are located within the Town of Tonawanda waterfront area, including two active sites — the Seaway Industrial Park and the Niagara Mohawk disposal site (New York State Department of State Coastal Management Program 1991). The local decline of industrial activities has led to an underutilization or abandonment of industrial facilities in the area. Although a continuing decline of heavy industrial use appears likely in the future, recent and ongoing capital investments in the area virtually guarantee the long-term presence of some heavy industry along the Tonawanda waterfront (New York State Department of State Coastal Management Program 1991; Ernst and Young 1992).

During public scoping meetings held by DOE on April 26, 1988, and June 16, 1988, and the formal comment periods that followed, citizens in communities near the site expressed uncertainties about existing and future impacts of the contamination at the Tonawanda site. The primary concerns are presented in summary form in Table 2-14. A total of 315 comments were submitted orally and in writing from private citizens, public officials, and local organizations. DOE's responses to the comments are presented in the Work Plan/Implementation Plan (BNI 1993b) for the Tonawanda site. As evident in the comments, concerns about health effects are heightened by the proximity of Holmes School, Kenmore Sisters of Mercy Hospital, Sheridan Park, and residential areas to the contaminated properties. Other expressed concerns include potential impacts on local waterfront development plans, contamination of groundwater and surface water (including the Niagara River, the source of public drinking water), radiological impacts to public health and safety, a preference for consideration of alternative disposal sites outside of New York State, opposition to bringing additional wastes to Tonawanda, and potential effects on property values and business recruitment. Additional concerns were expressed involving safety issues, particularly local capability to respond to an emergency involving radioactivity. Several comments were made with reference to other radioactive and hazardous waste sites in the general area, including nearby community experience at Love Canal.

The nearest residences to the Ashland 1, Seaway, and Ashland 2 properties are located approximately one mile east in the City of Tonawanda. A citizens' group in this area was formed in response to concerns about the Seaway Industrial Park landfill's effect on property values and the overall quality of life in the community. The group, Stop Pollution and Radiation Entering Niagara (SPARE Niagara), has as its primary goal to ensure that the landfill is closed as planned and to prevent any expansion or extension of landfill operations. In response to concerns of SPARE Niagara and the Coalition Against Nuclear Materials in Tonawanda (CANIT), DOE agreed, in *a Federal Register* notice published December 15, 1989, to include the Seaway property in the environmental study with the other three properties instead of, as initially proposed, evaluating Seaway as a separate action that might lead to an earlier ROD. Both SPARE Niagara and CANIT expressed satisfaction with this resolution.

The location of the Ashland-Seaway properties within 1000 feet of the Niagara River has prompted some public concern that the river, which is the source of public drinking water, may become contaminated. A related issue is concern about conflicts with local efforts to protect the river, to provide public access, and to encourage compatible economic development along the waterfront.

At Linde Center, residences are located within a half mile north and east of the property. Holmes School is located within one quarter mile of Linde Center. Sheridan Park is situated between Linde Center and the Ashland-Seaway properties. No public issues pertaining to the Linde facility are apparent, based upon a report of community interviews (Wiltshire 1988). Linde Center employs approximately 1200 workers.

Table 2-14. Summary of Public Scoping and Written Comments Related to the Environmental Impacts of the Response Actions at Tonawanda[a]

Subject	Total Number of Comments
Alternatives (siting and transportation)	
Alternative sites outside New York	58
No additional wastes sent to Tonawanda	24
Alternative sites within New York	1
Alternative containment designs	2
Design reliability/alternative containment design	3
Temporary vs. permanent storage	1
Additional alternatives	1
Seaway wastes considered in study	3
Alternative disposal methods (ocean disposal, incineration)	3
Alternative treatment methodologies	1
Tonawanda wastes to Colonie[b]	1
No action	1
Disposal at other FUSRAP sites	1
Disposal at uranium mines	1
Incorporate at West Valley site[c]	1
Containerize transported wastes	1
Technical and institutional issues	
Improved public awareness	22
Timetable (schedule)	3
Terminology and participating organizations clarified	3
Federal/state/local involvement (including voting)	9
Cost/benefit analysis	1
Waste characterization and containment	
Type, amount, and method of onsite storage	2
Location of waste cell (without Colonie wastes)	1
Decontamination procedures, complexities, and problems	2
Other FUSRAP sites decontaminated to date	2
Monitoring and maintenance	
Current site activities	1
Results of past onsite and offsite monitoring	2
Monitoring done since 1976	1
Accuracy of monitoring and equipment	1
Post-closure monitoring/cell reliability	7
Background on FUSRAP program and sites	3
Post-closure public education	1
History of site and other radiological waste removal activities	6

Table 2-14 (continued)

Subject	Total Number of Comments
Ownership	
Financial responsibilities of past owners	2
Current ownership of sites	2
Compensation to owners of sites	1
More review/feasibility studies/characterization studies	3
Response actions seem to be already decided	1
Liability/zoning ordinances/state regulations	6
Security	2
Environmental consequences	
Water quality (including groundwater)	33
Land Use	
General	7
Recreation	3
Agriculture	1
Housing	1
Industrial/commercial	2
Gas reserves	1
Socioeconomics	8
Floodplain/wetlands	4
Geological faults/earthquakes	5
General	1
Health and Safety Issues (radiological impacts)	
General (including cancer risks)	40
Fire hazards and related issues	4
Transportation accidents	4
Stress and mental anguish	1
Proximity of public (e.g., residents and school children)	3
Airborne contamination from excavation	1
Chemical hazards	2
Decontamination (vehicles and people)	1
Mortality estimates for various alternatives	1
Need for waste excavation after 40 year	1
Cumulative Impacts	
All FUSRAP sites	1
All wastes sites in Tonawanda	3

[a] Source: Public meeting on the remediation of the Tonawanda FUSRAP site, April 26, 1988 and June 16, 1988

[b] Colonie, N.Y. is also a FUSRAP site where radioactive contamination related to the MED project is undergoing remediation.

[c] West Valley, N.Y. is a former nuclear fuel reprocessing facility. Currently the site is now part of the West Valley Demonstration Project which is implementing new technologies for the remediation of nuclear materials. Nuclear waste is also being stored at the site on an interim basis.

2.2.7.4 Institutional Environment

The four properties comprising the Tonawanda site are located in the Town of Tonawanda in Erie County. The eastern boundary of the City of Tonawanda, a separate jurisdiction, is located within one half mile of Ashland 2. The Town of Tonawanda is governed by an elected supervisor and six elected council members who serve as legislators and town administrators. The Village of Kenmore is within the Town of Tonawanda and has its own government. The Town of Tonawanda government offices are located within the Village of Kenmore, but none of the four Tonawanda properties is within the village boundaries.

The Erie County elected government includes a county executive and a county legislature. DOE meets frequently with the Erie County Department of Environmental Planning to coordinate environmental review. The hazardous waste sites in the portion of Ashland 2 not designated as DOE's responsibility under FUSRAP fall under the regulatory authority of NYSDEC. Some of these sites have been investigated for possible inclusion on the National Priorities List (NPL). DOE would have responsibility for remediating any contaminated portions of the NYSDEC area that corresponds with the DOE FUSRAP area.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) creates a comprehensive scheme for allowing state governments to participate in decisions regarding the cleanup of hazardous waste. In particular, it requires any site to which hazardous materials are transported for disposal to be in compliance with all applicable state and federal laws. The role of local governments in any state permitting process would depend largely on the provisions of New York law.

Local institutional attention has been focused on the untapped recreational potential of the waterfront since the 1970s (New York State Department of State Coastal Management Program 1991). Recent investments (described in Section 2.1.4) represent a commitment to waterfront revitalization. State funds have been appropriated for relocation of River Road to accommodate residential and office space development.

Community involvement in FUSRAP activities at the Tonawanda site has included a coalition of elected officials and bipartisan politicians from municipalities, counties, and the state. CANIT formed in opposition to the initial remedial action alternatives proposed by DOE in 1988. The primary issue of CANIT concerned the potential for moving FUSRAP waste from the Colonie, New York site to Tonawanda. This issue was subsequently resolved through a moratorium agreement and Congressional action against the transfer of outside wastes to Tonawanda. DOE agreed to comply with a Congressional report on the 1988 Department of Defense appropriations bill stating that DOE should not move or study the move of any FUSRAP waste within the State of New York to the Town of Tonawanda.

A major focus of CANIT has been to support local initiatives for compatible development along the waterfront by ensuring that FUSRAP remedial alternatives do not entail restricting or conflicting land uses. Although community-wide preference is for offsite disposal, public comments suggest that a disposal location at the rear of Ashland 2 would be less unacceptable than one in proximity to the area proposed for redevelopment, particularly if truck access avoids use of River Road. The draft Local Waterfront Revitalization Program (LWRP), which would provide the regulatory framework for the development program when it has been approved by the state, concludes that "development of a portion of the Ashland property as a federal radioactive waste disposal site will result in a variety of negative impacts similar to those caused by any BFI expansion" (New York State Department of State Coastal Management Program 1991). The BFI expansion is described in the document as having the potential to "continue the high volume truck traffic along River Road, eliminate redevelopment of the Ashland site for less intensive uses, and continue the negative image many residents have of the Town shoreline" (New York State Department of State Coastal Management Program 1991). The lead agency for implementing the LWRP will be the Town of Tonawanda Board; the Town Supervisor is designated as the local official responsible for overall management and coordination of activities. Implementation of the LWRP is being coordinated through an intermunicipal Erie County Waterfront Task Force and the Town of Tonawanda LWRP Advisory Committee, the latter responsibility being assumed by the Town of Tonawanda Planning Board (New York State Department of State Coastal Management Program 1991).

A near-term development action anticipated to occur prior to or during DOE's implementation of the selected remedial alternative at the Ashland-Seaway properties is the realignment of River Road, which parallels the Niagara River and provides access to riverfront facilities. Funds were appropriated in July 1992 by the state to begin the construction project (Dimmig 1992). The realignment would be located approximately 1000 feet east of the existing River Road and would curve through the present location of the Ashland 2 and Seaway properties. It is intended to provide separation between planned light industrial uses and the future residential site along the riverfront. The existing River Road is envisioned as a public pedestrian/bike promenade adjacent to the residential neighborhood. The plans anticipate that the new River Road alignment would experience reduced truck traffic and would be able to function as a boulevard essentially for automobiles. The design phase is anticipated to begin in late 1992. The total construction activities are expected to require approximately two to three years. Local planning and development authorities express optimism that the implementation of the River Road relocation initiative would spur commencement of other phases of the waterfront development program (Dimmig 1992).

2.2.7.5 Ambient Noise

Humans can hear a large range of sound pressures. The decibel (dB) is used to express these sound levels over a wide physical range. Decibels are not linear units like miles or pounds; rather, they are representative points on a sharply rising, logarithmic curve. Each ten units represents an increase of tenfold, twenty units means a hundredfold (10 × 10), thirty units a thousandfold (10 × 10 × 10), and so on. Thus, one hundred decibels is 10 billion times as intense as one decibel. For comparison, the rustle of leaves is rated at 10 decibels, moderate traffic noise ranges around 65 decibels, and a jet takeoff at 60 meters is 120 dB or greater. The human ear does not perceive sound at low frequencies in the same manner that it does at higher frequencies. Sounds at low frequency do not seem as loud as those of equal intensity at higher frequencies. The A-weighting network is provided in sound analysis systems to simulate the human ear. The A-weighted sound levels are expressed in units of decibels and are used throughout this section unless noted otherwise.

Several federal agencies have established guidelines and standards for sound level emission (noise). These agencies have also recommended ambient sound levels requisite to protect human health and welfare from excessive noise impact. The EPA (1974) recommended a 70 dB $L_{eq(24)}$ exposure limit (ambient sound level) as a guideline for continuous exposure and a 55 dB (L_{dn}) as the level where ambient noise is an annoyance to outdoor activity. These are only guidelines and not regulatory standards. ($L_{eq(24)}$ represents the sound energy averaged over a 24-hour period while L_{dn} represents the L_{eq} with a 10 dB increase for noise that occurs at night). The Federal Highway Administration (1976) established a 70-decibel standard for noise levels during the peak hour of traffic. This standard is used as an indication of what is an acceptable limit for highway noise. EPA established noise emission standards for various types of construction equipment, railroad operations, and specific vehicles (EPA 1976a,b). These are true standards which must be met by the manufacturer and maintained by the operator.

No local noise regulations apply to the area surrounding the Linde, Ashland 1, Seaway, and Ashland 2 properties and noise is not regulated at the state level. The U.S. Occupational Safety and Health Administration (OSHA) regulates worker safety related to noise levels. No known studies are available on existing background noise levels near the site properties and adjacent transportation routes.

No measurements of ambient sound levels were made at Linde or the Ashland 1, Seaway, Ashland 2 properties; instead, sound levels were characterized at these sites according to typical values of ambient sound levels that have been measured in similar situations (National Academy of Sciences 1977).

Estimated ambient sound levels at Linde and Ashland 1, Seaway, and Ashland 2 were derived from existing land uses and by the area's population density. The area surrounding Linde is used for a mixture of industrial, commercial, recreational, public, and residential purposes. The population density in the area within 1 mile of the site is about 5,940 people per square mile. Based on the area's population density, the ambient day-night sound levels, (L_{dn}) would be about 60 dB, as shown in Table 2-15. Actual ambient sound levels are probably higher because of the industrial operations onsite and the proximity to a railroad, Sheridan Drive, and Military Road.

Table 2-15. Typical Values of Day-Night Sound Levels (L_{dn})

Land Use Description	Population Density (people/mi²)	L_{dn} - dB
Rural, undeveloped	20	35
Rural, partially developed	60	40
Quiet suburban	200	45
Norman suburban	600	50
Urban	2,000	55
Noisy urban	6,000	60
Very noisy urban	20,000	65

Source: National Academy of Sciences, 1977.

Ashland 1, Seaway, and Ashland 2 are located in an industrial area along River Road. Ashland 1 and Ashland 2 are currently not being used. The Seaway property is an operating sanitary landfill. The population density of the area is about 2,276 per square mile. Based on the area's population density, the ambient noise level would be about 55 dB. Actual ambient sound levels are probably slightly higher due to the landfill operation, traffic on River Road, and other industrial activities.

2.2.7.6 Transportation Infrastructure

The Tonawanda site lies within the Buffalo-Niagara Falls Statistical Area and is served by a highly developed network of efficient transportation systems including water, rail, highway, and air.

Major highway transportation routes at the Tonawanda site are shown on Figures 1-1 and 1-2. The main interstate routes are 1-190 and 1-290. Major state routes include River Road (State Route 266), Grand Island Boulevard, Sheridan Drive (State Routes 324 and 325), and Military Road (State Route 265). Other potentially affected routes at the site include Twomile Creek Road, East Park Drive, and Woodward Avenue.

The Linde Center is located to the southwest of the intersection of Sheridan Drive, a four-lane state highway (State Route 324), and Military Road (State Route 265), a two-lane state highway. Access to the Linde Center is from Sheridan Drive at its northern boundary and Woodward Avenue at its southern boundary. Riverview Boulevard on the west side of Linde is a two-lane local street that is residential in character. The segment of Sheridan Drive adjacent to Linde, east of State Route 325, has an average daily traffic (ADT) volume of 15,100 as of 1991 (Niagara Frontier Transportation Committee 1991). Sheridan Drive west of Route 325 has an ADT of 8,000. Twomile Creek Road is an Erie County minor arterial road that intersects Sheridan Drive at the western side of Sheridan Park; it has an ADT of 3,900 between Sheridan Drive and I-290. The section of Sheridan Drive between I-190 and Military Road is characterized by freely moving traffic with no excessive congestion and with well-operating intersections. Military Road has heavier volumes and more congestion than Sheridan Road or the interstate highways, as well as numerous intersections providing access to residential neighborhoods (Nowicki 1992). Interstate 190 can be accessed from an interchange at the western end of Sheridan Drive as well. River Road (State Route 266), the primary highway serving the Tonawanda waterfront, is a four-lane undivided highway with an ADT of 10,000 north of the South Grand Island Bridge to Twomile Creek Road. River Road may be accessed from either Grand Island Boulevard or the interstate system. Interstate highways 190 and 290 are characterized by higher traffic volumes and greater speeds than Grand Island Boulevard, and include merge and diverge points that may increase the potential for accident. Although Grand Island Boulevard involves intersections and driveways, traffic is continuous and moves at a relatively slow, stable speed. An access road provides a loop from River Road through

Ashland 1, skirting the western end of Seaway and traversing the length of Ashland 2 to connect with River Road just north of the Seaway-Ashland 2 boundary.

Weight restrictions are posted on roads in the vicinity. Legal weight is permitted unless otherwise posted. Overweight trucks must obtain a permit from the New York State Department of Transportation. Because the roads and highways surrounding the site are well-travelled by trucks servicing the industrial facilities, they are not likely to contain restrictions against legal weight trucks. One exception is Twomile Creek Road, maintained by the City of Tonawanda, which is limited to a maximum of 5-ton gross-weight vehicles, essentially precluding tractor trailer truck traffic (The Saratoga Associates 1992).

Rail service to the Tonawanda area is provided by the Conrail System with main tracks located outside the Linde site's eastern boundary. Several railroad spurs extend from the Conrail tracks onto the Linde property. Rail spurs from the Wonalancet Branch of the Conrail System are located near the Ashland 1, Seaway, and Ashland 2 properties. These spurs could potentially be used for the removal of contaminated material from the Tonawanda site.

Public transportation is provided by the Niagara Frontier Transportation Authority. Bus frequency is generally one per hour Monday through Saturday.

2.2.7.7 Public Services

Capacity and adequacy of utilities in the site area are generally good, as they were designed for the heavy water, sewer, and power demands of industrial users. The existing town-owned sewage treatment plant, located on Twomile Creek Road, has a capacity rated at 50 million gallons per day (MGD) and currently averages a 15-MGD demand. Trunk lines parallel most of the west side of River Road. The Town of Tonawanda Local Law 3-84 requires certain types of industrial effluent to be pretreated prior to discharge into the sanitary line. The existing water treatment plant, operated by the Town of Tonawanda, has a 26-MGD design capacity with a 14-MGD current demand (Ernst and Young 1992). The water intake lies just offshore of Strawberry Island, which is located on the Niagara River. Adequate supplies of electrical and natural gas services are available in the area to accommodate new development (New York State Department of State Coastal Management Program 1991).

The Town's solid waste is disposed of at the Occidental Waste to Energy Plant in the City of Niagara Falls, New York. The plant is operating at approximately 81% capacity, which is considered to have sufficient remaining capacity for estimated growth along the waterfront in the foreseeable future (New York State Department of State Coastal Management Program 1991).

Emergency services for the Tonawanda area are coordinated through the Buffalo regional office of the New York State Department of Health, which is the lead agency for emergency response. The Buffalo office has available three radiation specialists and equipment and capability to take soil, water, and air samples, which are sent back to a laboratory for analysis. The office has a 24-hour telephone number available for emergencies during off-hours. Procedures and responsibilities for response to an incident involving radioactive materials are outlined in the New York State Radiological Plan, including a list of persons from appropriate agencies who would be immediately notified. Although Erie County does not have a radiological program, nearby Niagara County Health Department has personnel trained in radiological health. Local emergency responders (i.e., fire and police personnel) have received emergency training for radiological situations (Condon 1992).

Several large hospitals are available in the Buffalo metropolitan area. The Kenmore Sisters of Mercy Hospital, located off Military Road just east of Linde, has a nuclear medicine department and personnel trained in procedures to deal with cases involving radiological contamination (Ignatz 1992). This hospital is within a 10-minute drive from either the Linde or the Ashland-Seaway properties.

In a reportable incident or accident involving radioactive materials at the Tonawanda site, the Town of Tonawanda would be the first responder. Erie County would be called if conditions were beyond the Town's capacity to respond. Erie County could serve as a coordinating agency between the New York State Department of Health and any agency that may be needed upon request by the Town of Tonawanda. A Radiological Response Plan is now being prepared by Erie County. Agency personnel coordinate with SUNY Buffalo which operates a small nuclear reactor as a joint research activity with a private business. Other resource people are available at the West Valley Nuclear Fuel Services to advise or assist. The Town of Tonawanda has developed evacuation plans to be implemented in the event of a hazardous materials emergency (Ignatz 1992).

The Emergency Readiness Assurance Plan (ERAP), a requirement of DOE Order 5500.10, outlines the goals and annual requirements of the FUSRAP emergency response program. The levels of radioactive and hazardous material contamination at FUSRAP sites do not pose any acute health risk to either onsite workers or the general public in credible accident scenarios. The predominant risks are to onsite personnel in association with construction activities and onsite building fires. Plausible offsite risks include exposures to hazardous materials and/or radioactivity through spills into surface waters, onsite building fires, or direct contact following a transportation accident. FUSRAP emergency planning emphasizes spill control and cleanup techniques. The ERAP specifies that during emergency incidents originating on or impacting FUSRAP sites, offsite emergency responders would be coordinated by the DOE Former Sites Remediation Department (FSRD) or its contractor representative in charge of emergency management. The site specific safety and health plan for the Tonawanda site delineates emergency management authority for the site. DOE would coordinate with local emergency responders at least annually to provide an opportunity for site tours and to assure offsite preparedness.

2.3 NATURE AND EXTENT OF CONTAMINATION

The following section discusses the nature and volume of wastes considered for the remedial action and summarizes the conclusions drawn from analysis of radiological, chemical, and hydrogeological data collected during characterization and RI activities at the Tonawanda site.

2.3.1 Nature and Extent of Contamination at Linde

The MED-related contamination at Linde resulted, for the most part, from three activities associated with uranium processing: the handling of uranium ores, the temporary storage and handling of solid residues before they were shipped offsite for disposal, and the disposal of liquid waste from the uranium processing operations.

2.3.1.1 Radioactive Contamination in Surface and Subsurface Soils

Previous investigations discussed in the RI (BNI 1993) have shown that U-238, Ra-226, and Th-230 are the primary MED-generated radionuclides of concern in the surface and subsurface soils at Linde. Previous investigations have also shown that surface radiological contamination was incorporated into the subsurface soils during construction and renovation activities at Linde.

Areas of MED-related radiological contamination of soil at the Linde property and vicinity are depicted in Figure 2-11 (BNI 1993). The RI activities determined that MED-related radioactive contamination is located in four general areas.

Area 1 contains primarily superficial radioactive contamination located in the northwest corner of the main parking area at Linde (see Figure 2-12). Previous investigations as presented in the RI (BNI 1993) indicated the contamination does not extend deeper than 1.2 m (4 ft).

Area 2 contains primarily superficial contamination located along the northern boundary of Linde and the northeastern corner of the main parking area (see Figure 2-12). A temporary storage pile for the consolidation of radioactively contaminated soils and windrow materials is located in this area. Previous investigations indicate that contamination does not extend deeper than 1.2 m (4 ft).

Area 3 is located along the fence line in the northeastern corner of the property (see Figure 2-13). Evidence of radioactive contamination in this area extends off the property and encompasses a railroad spur formerly used to haul uranium ore into Linde. Characterization and RI sampling results show that the radioactive contamination is present to a depth of 1.2 m (4 ft) in the area west of the railroad tracks and to a depth of 0.6 m (2.0 ft) east of the tracks.

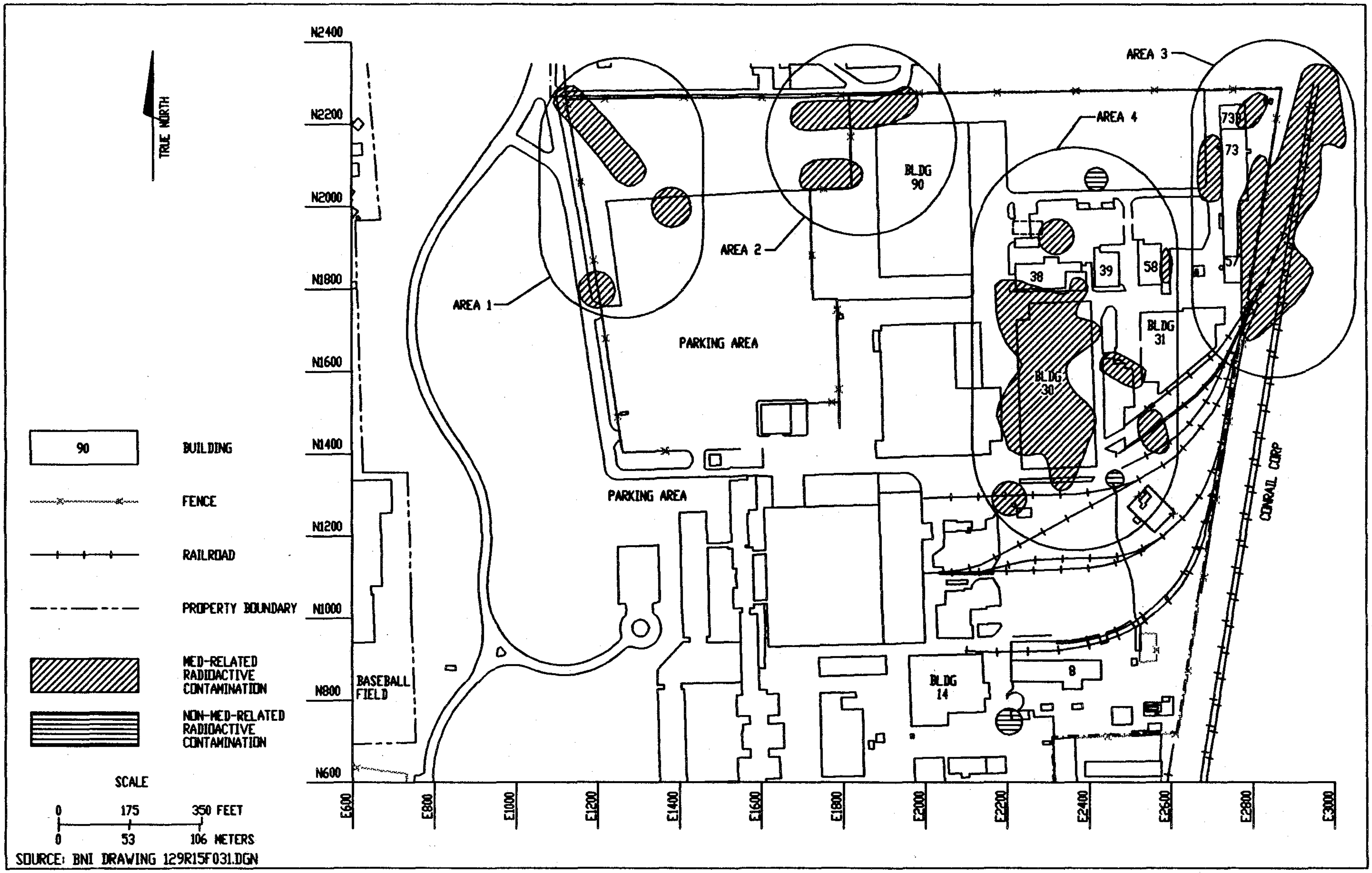


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Figure 2-11. Areas of Radioactive Contamination at Linde

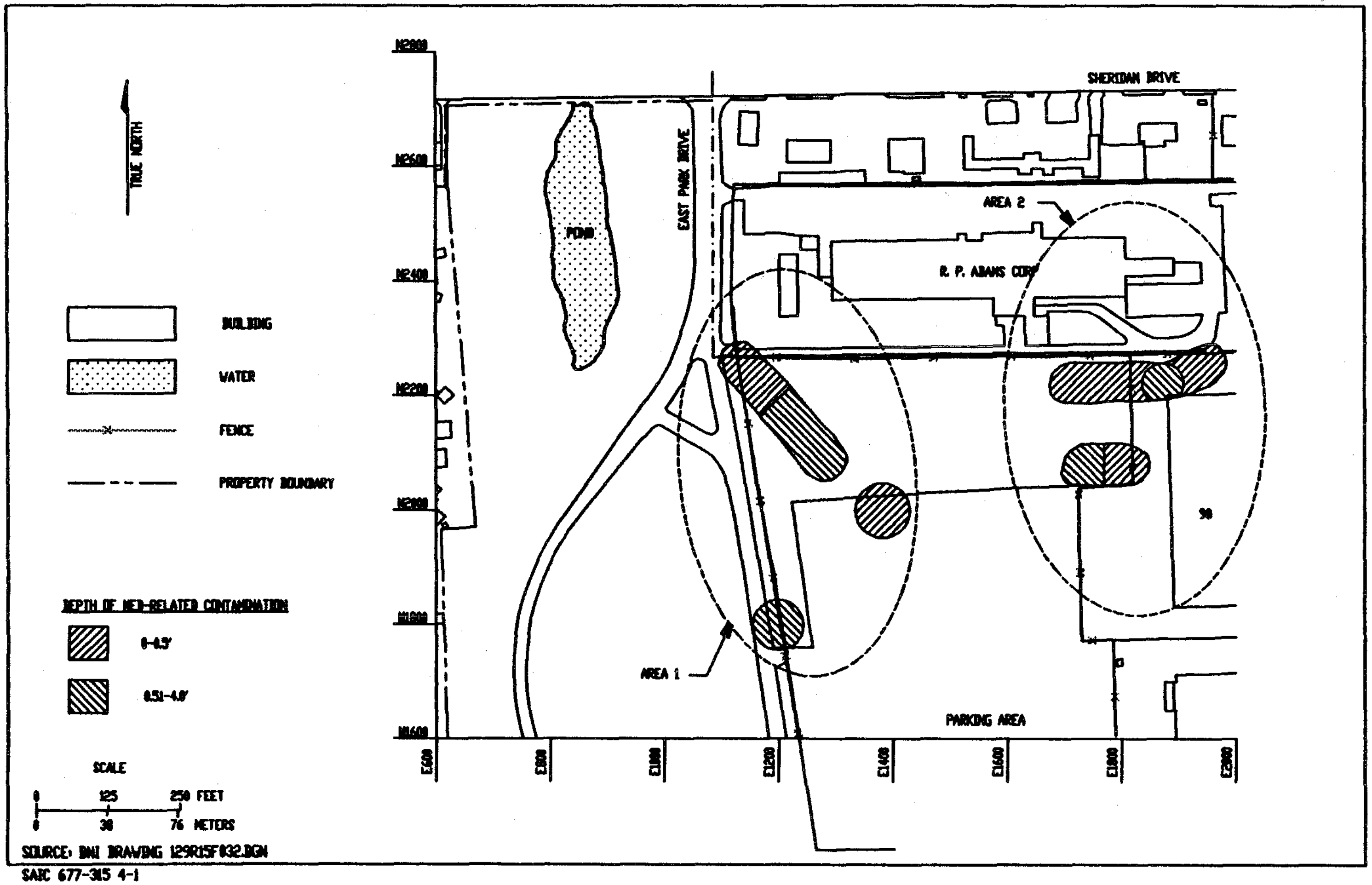

Figure 2-12. Areas 1 and 2 of Radioactive Contamination at Linde

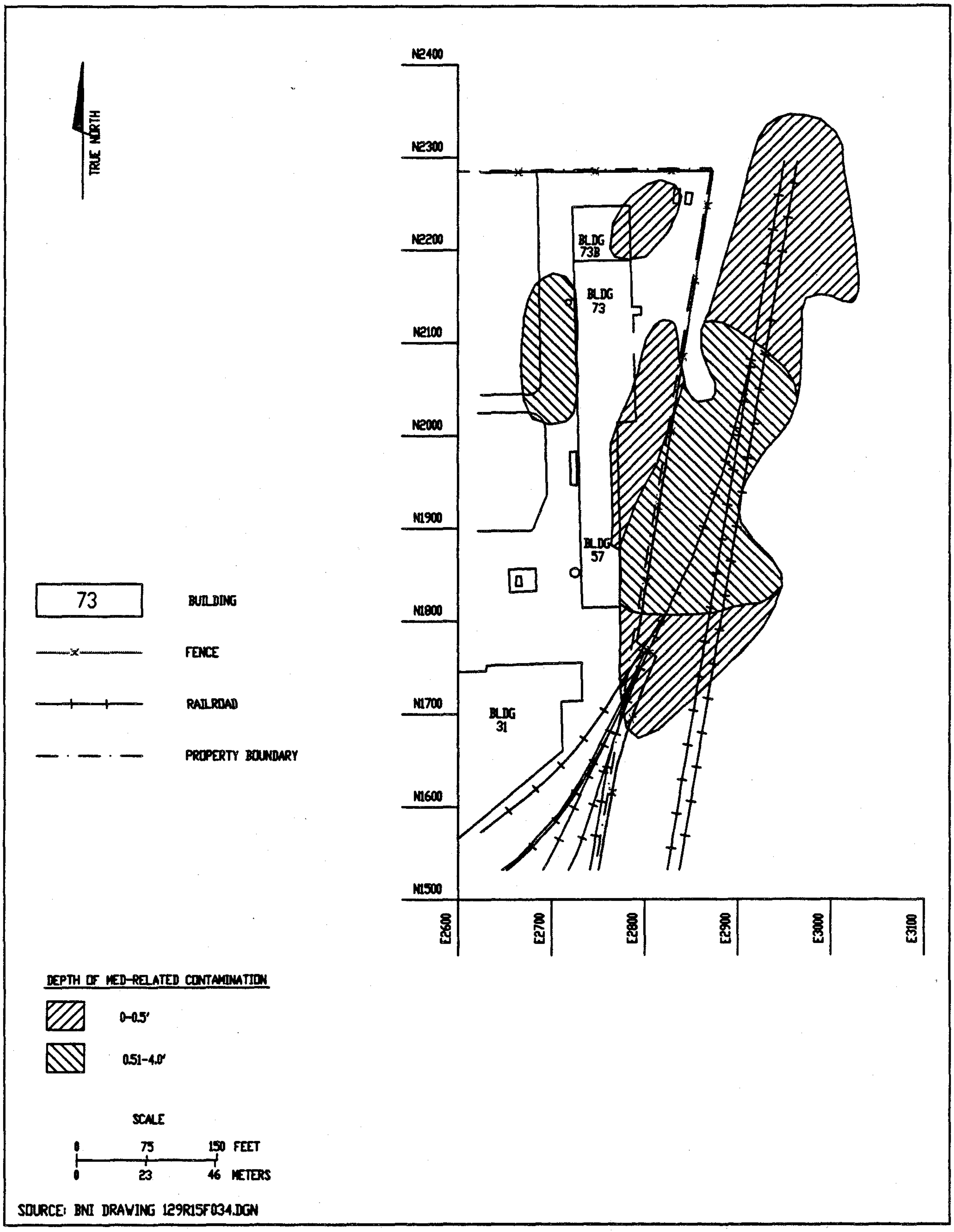

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Figure 2-13. Area 3 of Radioactive Contamination at Linde

Area 4 includes the areas of Buildings 30, 31, 38, 58, and the blast wall outside Building 58 (see Figure 2-14). Sampling results from the characterization show that the soil beneath Building 30 is radioactively contaminated to a depth of 2.4 m (8 ft).

Table 2-16 presents the approximate volumes of MED-related radiologically contaminated soils present on the Tonawanda properties (BNI 1992). For the purpose of developing these estimates, areas depicted in Figures 2-12 through 2-19 were used, along with their associated depths of contamination, to calculate the estimated volumes of radiologically contaminated soil to be addressed in the remediation activities. These volumes include a 20% construction increase to account for incidental over-excavation of contaminated soils.

2.3.1.2 Chemical Contamination in the Surface and Subsurface Soils

The nonradioactive MED-related contaminants in the surface and subsurface soils at Linde were determined to be metal precipitates expected to be found in MED filter cake (as listed in Table 2-14). The RI evaluated the possible existence of RCRA hazardous waste at all four Tonawanda properties and concluded that only one area of Ashland 1 might contain hazardous waste.

Sampling results from several boreholes indicated MED-related metals at concentrations above background for soils in the Tonawanda area. The RI investigation determined that the metals related to the MED processing have remained with the MED-related radionuclides, rather than migrating from the MED waste materials. In addition, the RI concluded that the commingled contaminants have remained immobilized in the near-surface soils (BNI 1993). This allows for the use of the MED-related radionuclide contaminants as a "tracer" for defining areas requiring remediation for both radionuclide and non-radionuclide MED contaminants. By addressing the radiologically contaminated soils, the commingled MED-related inorganics (metals) would also be addressed.

2.3.1.3 Contamination in Surface Water

The RI reported no surface water contamination from MED-related activities in surface waters onsite or directly downstream from the Linde property.

2.3.1.4 Contamination in Sediments

Results of RI sampling of downstream sediments indicated no radionuclide concentrations above background. Concentrations of MED-related metals were slightly higher than upstream, but were within background values determined for Tonawanda soils.

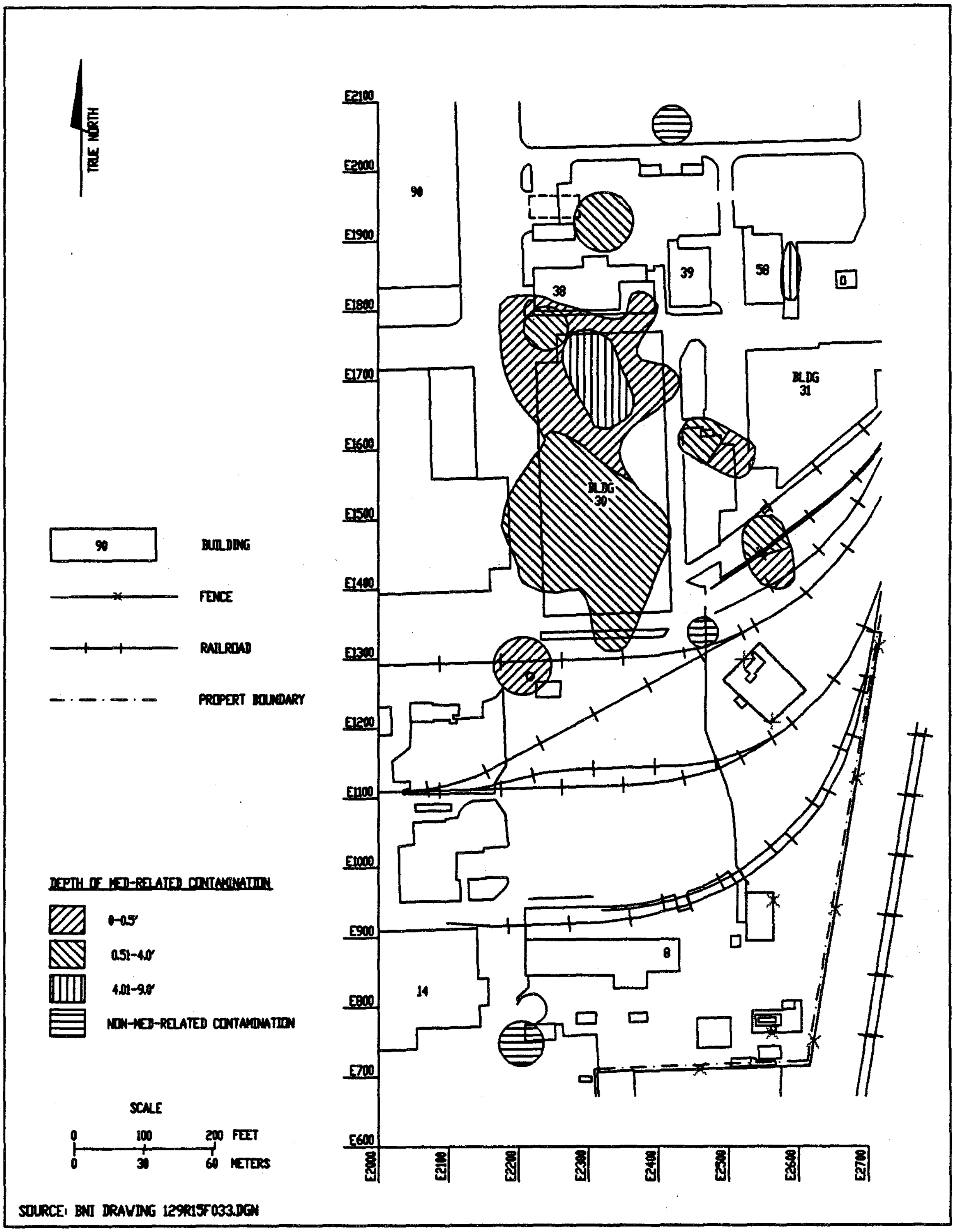

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Figure 2-14. Area 4 of Radioactive Contamination at Linde

Table 2-16. Volumes of MED-Related Radiologically Contaminated Soils at the Tonawanda Properties

Property/Area		Volume (yd^3)
Linde	Open - Areas	33,900
Linde	Under Buildings	13,500
Ashland 1		120,200
Ashland 2		52,100
Seaway		117,000
Total Volume of Soil		336,700

Source: BNI 1992

Radioactive contamination was detected in sediments found in sumps inside Building 30 as well as in the sanitary and storm sewers. The sediments in the Building 30 sumps were found to contain concentrations of U-238, Ra-226, and Th-230 above guideline levels. Samples taken in the sanitary and storm sewers at various locations indicated U-238, Ra-226, and Th-230 contamination. The contamination may have resulted from process liquid collection systems used during operations or during the construction of the concrete floor. Contamination detected in the sanitary and storm sewers resulted from the disposal of production effluents into these systems. No sampling of the sumps or drain systems was undertaken during the RI; however, as the RI indicates, it is unlikely that the conditions found during previous studies in 1981 have changed. However, the RI concludes that the exact extent of contamination in the drain system will need to be determined during the remedial action. For estimating purposes, an assumed volume of 38 m^3 (50 yd^3) of contaminated sediment in the drain system has been calculated.

2.3.1.5 Contamination of Groundwater

Deep Aquifer. As a result of the discharge of U-238 processing waste effluent into the injection walls at Linde, the effluent either entered the upper part of the bedrock unit or it entered the contact zone aquifer. Groundwater in the vicinity of one set of injection wells still exhibits elevated concentrations of sodium, sulfate, and chlorides, and exhibits a higher pH (>9) than natural formation water. An assessment of groundwater flow velocities in the bedrock and contact zone aquifers presented in the RI concludes that the injected fluids remain in the local area. This conclusion is consistent with the analytical results of the groundwater sample that is still more representative of the injected fluids than of the formation water (BNI 1993).

Perched groundwater system. The Linde site is covered by a layer of fill overlying undisturbed soils primarily composed of clay and sandy clay. These soils have low permeabilities, precluding significant infiltration of precipitation. Groundwater within the fill layer, therefore, tends to flow laterally, discharging into local streams and wetlands. RI investigations of these receiving surface water bodies did not indicate that this groundwater zone has been contaminated by site activities.

Shallow semi-confined system. No wells have been installed in this system at Linde, but it is assumed that conditions at Linde would be similar to conditions found in this system at Ashland 2. Analysis of groundwater samples from the silty sand lenses within the glaciolacustrine clays at Ashland 2 revealed chemical and radiological compound concentrations at or very near background concentration. This demonstrates that these lenses, typical to this shallow semi-confined system, are effectively isolated from water infiltration from the ground surface (BNI 1993).

2.3.1.6 Deep Subsurface Conditions

During the RI activities two boreholes were drilled in the vicinity of three former injection wells. Gamma scanning of the core material collected at 30 m (100 ft) showed radioactivity at levels above background. A core sample collected from this depth indicated an estimated concentration of U-238 (176 pCi/g) and contained a visible layer of yellow material within a small fracture zone.

2.3.1.7 Buildings at Linde

Four buildings at Linde contain radioactive contamination that originated from the U-238 processing activities in these buildings. The site characterization indicated that both fixed and removable alpha and beta-gamma radioactivity and U-238, Ra-226, and Th-230 are the primary contaminants in the processing buildings.

The results of the building surveys performed during site characterization indicated the following results:

- Readings exceeding DOE guidelines were obtained in Building 14 on the first floor in an area in the center of the building where the tile and carpet had been removed.

- Investigations of Building 30 revealed radioactivity exceeding DOE guidelines on the floor in the southern third of the building, on interior walls, on vent fans, and on overhead rafters.

- Readings exceeding DOE guidelines were obtained from several locations along the floor and walls and from dust particles from Building 30; only two measurements on roof vents of Building 31 exceeded DOE guidelines; no radioactivity was detected in other areas.

- Most of the surfaces in Building 38 had fixed radioactivity exceeding DOE guidelines. Some samples produced highly elevated readings.

A subsurface storage vault located near Building 73 was investigated during studies of the Linde site. The vault may have been used to store radioactive materials. The RI concluded that the vault may be approximately 3 × 6 m (10 by 20 ft) and .6 to 1.2 m (2 to 4 ft) below the surface (based on results of ground-penetrating radar investigation) (BNI 1993). This vault would be considered as a building and included in discussions of building remediation.

For the purposes of evaluating remedial alternatives for the Linde site, the volume of demolition material that might be generated during remediation of the Linde buildings was estimated to be 10,900 m^3 (14,200 yd^3). This estimate assumes total demolition of the four buildings.

2.3.2 Nature and Extent of Contamination at Ashland 1, Seaway, and Ashland 2

Linde wastes resulting from the processing of American ores were originally disposed at Ashland 1. Waste from this property was later removed and transported to the Seaway landfill property and to Ashland 2 during construction activities at Ashland 1, resulting in the radioactive contamination of these properties (see Figure 2-15). In addition, during construction activities at Ashland 1, surface radioactive contamination was introduced into the subsurface soils and distributed to the drainage ditch. Surface and subsurface soils are the primary source of radioactive and MED-related metal contamination at Ashland 1 and 2. The surface soils are also a potential source of radionuclide contamination of surface water, sediment, and the shallow groundwater system.

2.3.2.1 Radioactive Contamination in Surface and Subsurface Soils at Ashland 1

Figure 2-16 shows the areas of contamination at Ashland 1 as documented in the RI report. Based on this presentation, the amount of surface area covered by radioactively contaminated soil is estimated as 26,360 m^2 (31,520 yd^2). The contamination ranges in depth from the surface to 5 m (15 ft). U-238, Ra-226, and Th-230 and their respective radioactive decay products are the primary radionuclides of concern at Ashland 1. For the purposes of evaluating remedial alternatives for the site, an estimate of the volume of radiologically contaminated waste was calculated based on the RI presentation of contaminated areas and depths. This volume is estimated as 91,000 m^3 (120,200 yd^3).

Th-230 is found throughout Ashland 1 and the vicinity at levels ranging from 0.6 to 4400 pCi/g at depths of 0.6 m (2.0 ft) or less. Elevated levels of Th-230 were detected mainly in the southern portion of the property and along the northern property line. U-238 contamination appears in the southern and western portions of the property with either Th-230 or Ra-226 or both. U-238 contamination results range from 0.9 to 1500 pCi/g. Depth of U-238 contamination varied. Ra-226 contamination, found less frequently than U-238 or Th-230, is present on the southern and western portions of Ashland 1. Ra-226 concentrations range from 0.6 to 750 pCi/g.

2.3.2.2 Radioactive Contamination in Surface and Subsurface Soils at Seaway

Radioactive contamination has been detected in three major areas (A, B, and C) of the landfill and also in the drainage ditch. The estimates of volumes of contaminated soils in Areas B and C were based on the RI presentation of areal extent shown in Figure 2-17 as 19,800 m^3 (25,900 yd^3). Radioactive contamination in Area D of the landfill is actually located predominantly on Ashland 1 as shown in Figure 2-18. Data limitations exist for areas B and C;

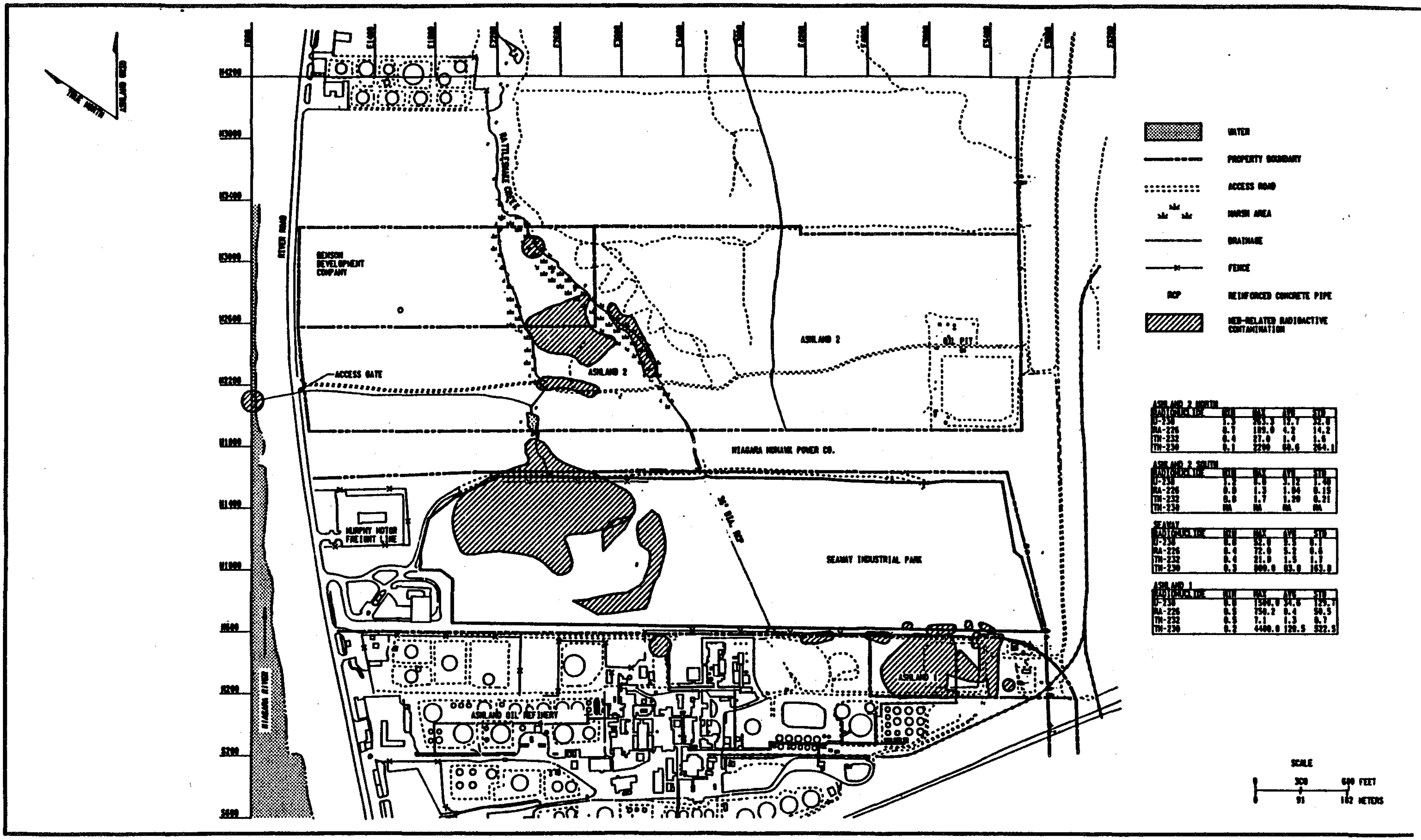

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Figure 2-15. Areas of Radioactive Contamination at Ashland 1, Seaway, and Ashland 2

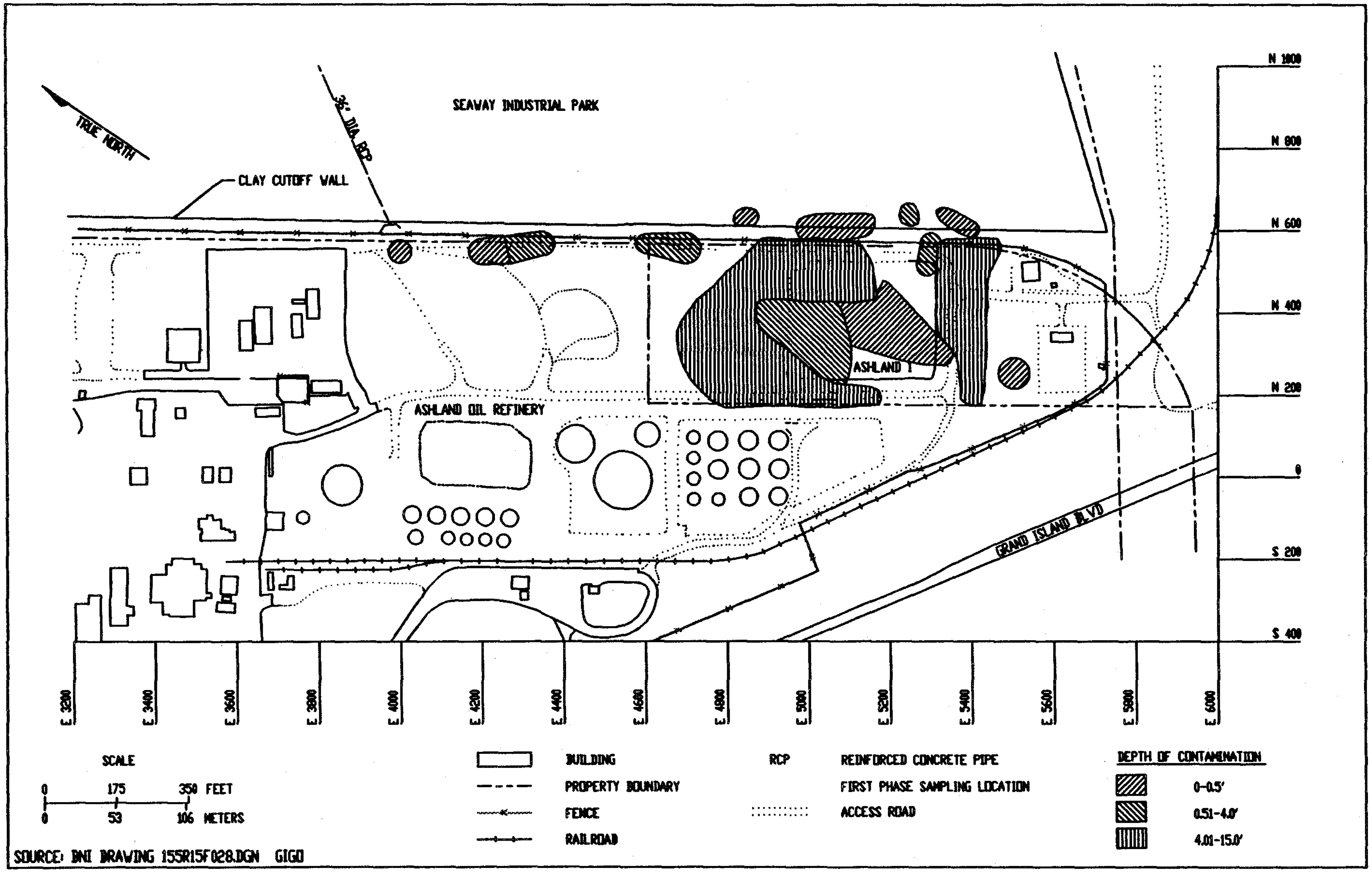

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Figure 2-16. Depths of Radioactive Contamination at Ashland 1

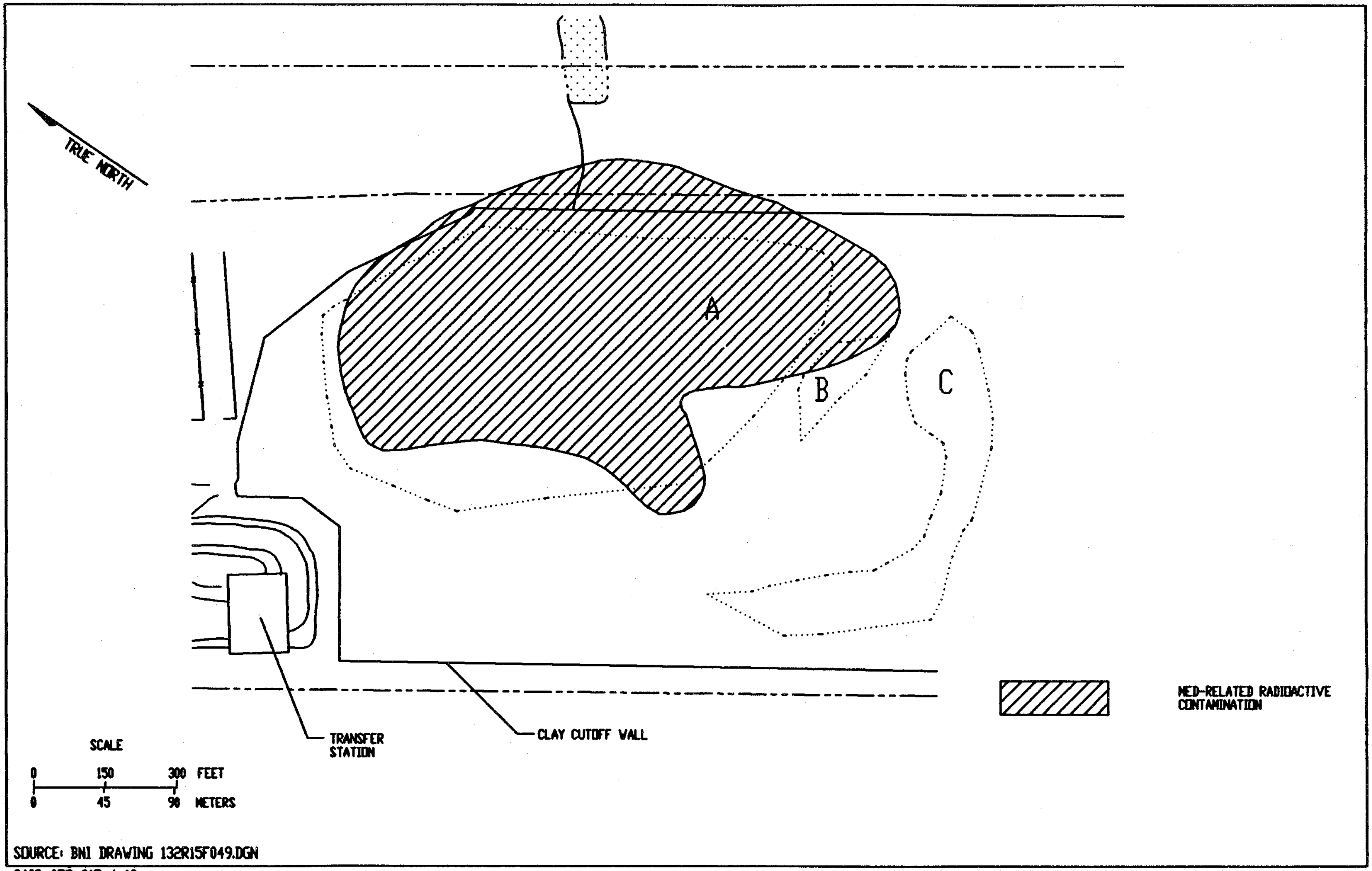

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Figure 2-17. Area A Contamination at Seaway

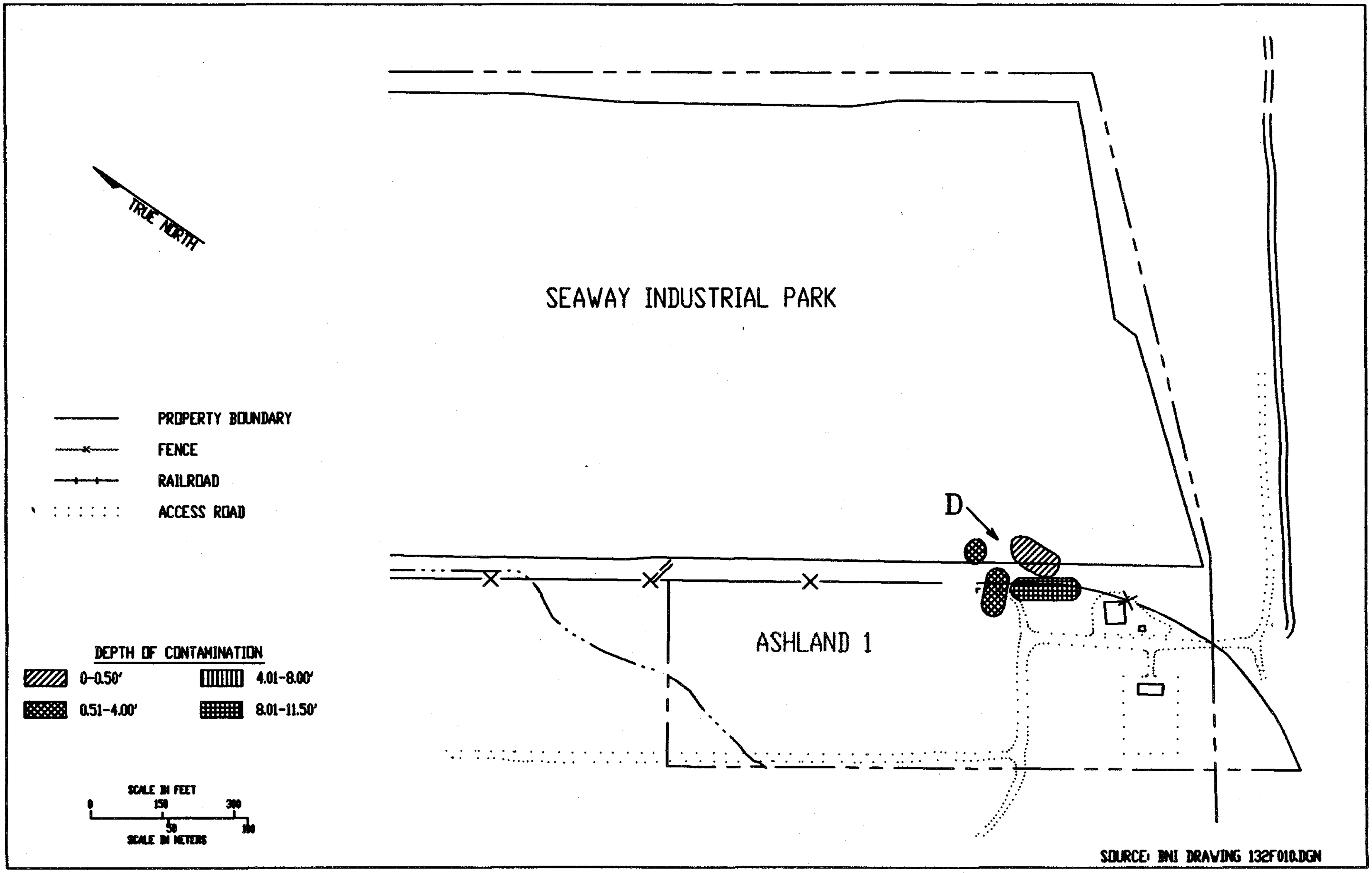

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Figure 2-18. Area D Contamination at Seaway

however, the total volume of contaminated soils at Seaway (A, B, and C) is estimated to be 89,500[3] m^3 (117,000 yd^3). Th-230 was determined to be the primary radioactive contaminant at Seaway.

2.3.2.3 Radioactive Contamination of Surface and Subsurface Soils at Ashland 2

Based on RI results, approximately 39,800 m^3 (52,100 yd^3) of radioactively contaminated soil exists at Ashland 2 and its vicinity (BNI 1993). This estimate is based on the presentation of areas and depths of contamination at Ashland 2 in the RI report (see Figure 2-19). The surface area covered by radioactively contaminated soils is estimated to be 14,440 m^2 (17,270 yd^2). Contamination was found to exist at depths of 3 m (9 ft) or less. Th-230, U-238, and Ra-226 and their respective radioactive decay products are the primary radionuclides of concern at Ashland 2.

Th-230 was detected throughout the contaminated areas and along the drainage creeks of Ashland 2 at levels that exceed DOE guidelines. For the most part, Th-230 was detected from surface levels to a depth of 2 m (6 ft) at concentrations ranging from 0.1 to 2200 pCi/g. U-238 was detected mainly in the center of the large contaminated area along with Th-230 and/or Ra-226. U-238 was detected at concentrations ranging from 1.3 to 263 pCi/g primarily between the surface and 1 m (3 ft). Ra-226 contamination is present mainly in the center of the large contaminated area but occurs less frequently than Th-230 or U-238. Ra-226 typically appears in the same area and at the same depth as U-238 contamination. Ra-226 concentrations ranged from 0.7 to 189 pCi/g.

Investigations of areas outside Ashland 2 indicated that only one borehole out of 25 first phase boreholes and auger-hole samples had a Th-232 concentration exceeding guidelines and only one borehole had Ra-226 concentrations exceeding guidelines. The potential source of the Th-232 (not a MED-related radionuclide) is addressed in the RI, which concludes that disposed flash is the source of this contaminant. Th-230 is the primary contaminant in the area northwest of Ashland 2.

2.3.2.4 Organic and Inorganic Contamination of Surface and Subsurface Soils at Ashland 1, Seaway, and Ashland 2

Characterization results indicate that soils at Seaway and Ashland 2 are not RCRA hazardous. One soil sample (of 12 first phase samples) at Ashland 1 failed the EP toxicity test for chromium during the first phase sampling. Second phase sampling for TCLP constituents (4 samples) in the same area did not detect the presence of leachable chromium. As a result of the one positive finding, it would be necessary to further characterize the soils from this area during remediation. For the purposes of evaluating the remedial alternatives, it is assumed that the soil is not RCRA hazardous. Volatile organics and base/neutral and acid extractables

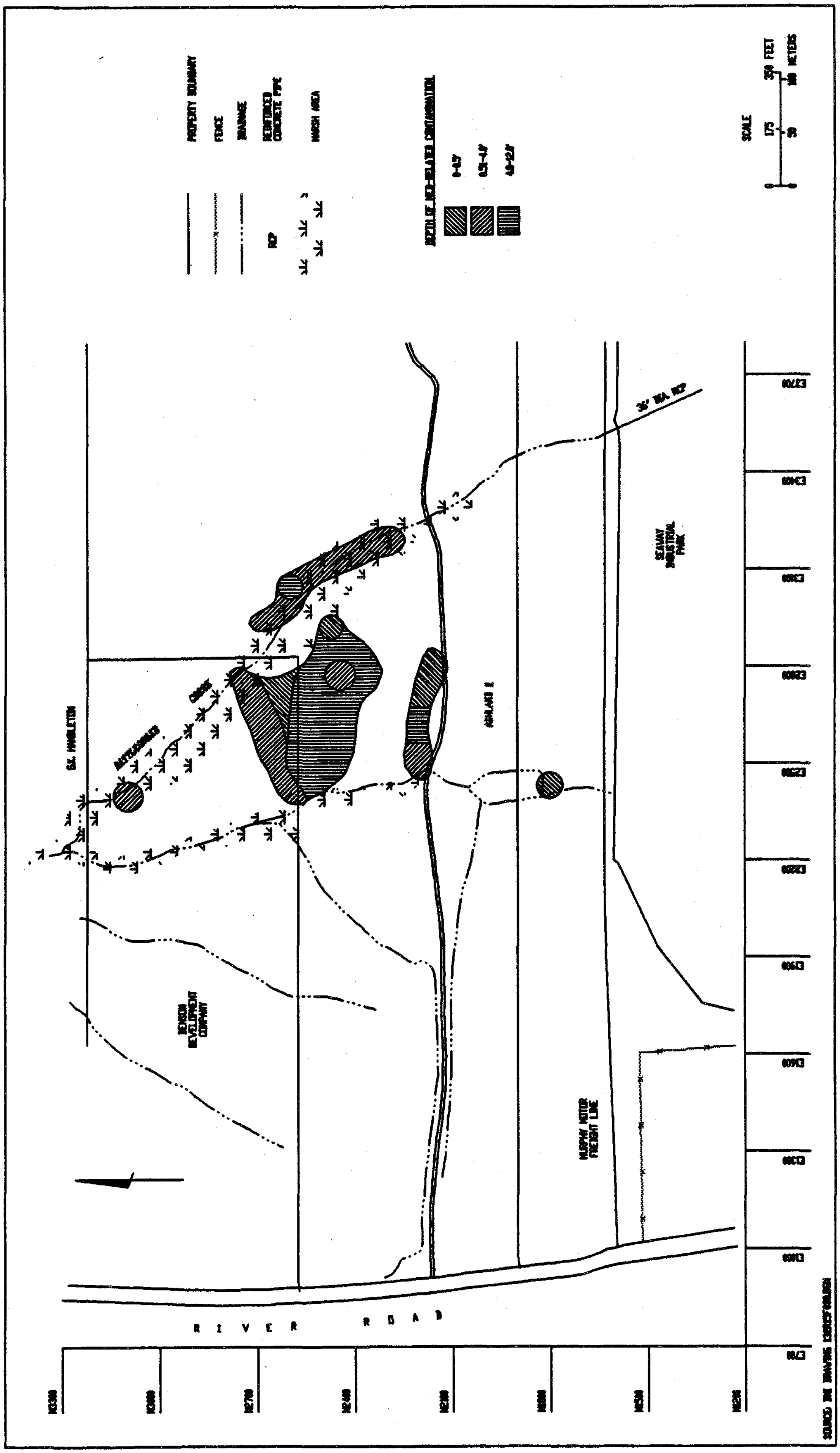


Figure 2-19. Areas of Contamination at Ashland 2

(BNAEs) not associated with MED activities are present throughout Ashland 1 and Ashland 2 in the surface, subsurface, and undisturbed soils.

Concentrations of lead and vanadium (MED filter cake constituents) at Ashland 1 and Ashland 2 range from scarcely to substantially above background levels. Background levels were established using results of analyses of soils located in the southern portion of Ashland 2 as presented in the RI (BNI 1992). Lead was detected at a high concentration of 7500 ppm compared with a background concentration of 36.7 ppm; vanadium at a high of 2290 ppm with a background of 25.6 ppm. These high concentrations were all detected on Ashland 1. The highest concentrations of these metals were lower on Ashland 2, but were still at least 10 times the background concentrations. As was concluded for the contaminated soils at Linde, the metals related to MED processing activities probably remain with the MED-related radionuclides in the contaminated soil and would, therefore, be addressed as the radionuclide contaminated soils are addressed in remedial activities at the site.

2.3.2.5 Contamination of Surface Water

The primary surface water systems at Ashland 1, Seaway, and Ashland 2 are the drainage ditch from Ashland 1 that forms the headwaters of Rattlesnake Creek, the drainage system on the southern portion of Ashland 2, and the two drainage ditches that serve a portion of the Seaway landfill.

U-238, Th-230, and Ra-226 and their respective radioactive decay products are the primary radionuclides of concern in surface water. Surface water downstream of Ashland 1 and Seaway (onsite at Ashland 2) appears to be influenced by radioactively contaminated soils and sediments. Metals were detected in Rattlesnake Creek and in the Ashland 2 south drainage ditch system.

2.3.2.6 Contamination of Groundwater

Deep Aquifer

No contamination has been detected in the deep aquifer at the Ashland and Seaway properties. The thick layer of low permeable clay overlying the bedrock precludes migration of contaminants into the deep aquifer (BNI 1993).

Shallow Semi-confined System

The silty sand lenses of this groundwater system are isolated by the surrounding thick lake clay section. Contaminant concentrations measured during investigation activities are at or near measured background concentrations, indicating the isolation of this system from surface water infiltration (BNI 1993).

Perched Groundwater System

A thin layer of fill overlies the thick clay deposit at the Ashland and Seaway properties. Groundwater in this zone tends to flow laterally to discharge points in local surface water bodies. Only slightly elevated concentrations of radioactive contaminants were detected in samples collected in this zone; however, the concentrations were below DOE Derived Concentration Guides (DCG) (BNI 1993).

2.4 CONTAMINANT FATE AND TRANSPORT

This section examines the fate and transport of contaminants at the site. Contaminant release mechanisms depend on the source, the compound, environmental factors, and the medium into which the compound is released. The following sections summarize the applicable release mechanisms and environmental transport media for each property at the Tonawanda site.

2.4.1 Linde

The principal sources of radiological contamination at Linde are the contaminated surface and subsurface soils, subsurface rock contaminated with processing effluent from disposal well injections, contaminated structures and equipment, and effluent water disposed of during the period of uranium processing. The primary mechanisms releasing potential contaminants from these sources into the environment are leaching of subsurface contaminants into the groundwater, storm water runoff and infiltration, resuspension of contaminated particulate matter, and Rn-222 emission.

2.4.1.1 Contaminant Release Mechanisms

Groundwater contacting effluent from the contaminated liquids formerly disposed into the bedrock could result in migration of radionuclides in the groundwater aquifer. U-238, Ra-226, and Th-230 were detected in bedrock samples collected from the contaminated zone. Concentrations of these contaminants were found to be close to soil background concentrations.

The clayey matrix of the surface soil and the large areas of the Linde site covered with asphalt and buildings reduce the amount of infiltrating water and increase the amount of runoff. Runoff from the property primarily enters storm drains located throughout the site, which discharge to Twomile Creek.

Infiltration occurs in the area of the site covered with gravel and vegetation. Water infiltrating the surface and subsurface soils may become contaminated with particulate or dissolved contaminants and may join the shallow groundwater system, or the contaminated water may pond and slowly percolate into the clay aquitard. Water percolating through the clay could lose migrating contaminants by adsorption before reaching the groundwater aquifer, thereby attenuating the contamination.

Linde surfaces are largely covered by vegetation, asphalt, or gravel; therefore, the potential for contaminants to become airborne is minimal. This potential could increase if the contaminated areas were disturbed; the principal potential human receptors would be site workers and site trespassers. Resuspension of contaminated particulates in Buildings 30 and 38 is also a release mechanism for the contaminants at Linde. If activities conducted in Buildings 30 and 38 generate dust, resuspension may become a primary release mechanism.

Emissions of Rn-222 may be a potential hazard in areas where Ra-226 contamination is located on the ground surface and exposed so that radon emitted in gaseous form could migrate to the atmosphere.

Based on these source and release mechanisms, the primary transport media at Linde would be groundwater, surface water, sediment, and air.

2.4.1.2 Transport Mechanisms and Potential Exposure Pathways at the Linde Property

Groundwater

The Linde site has a layer of fill material overlying a layer of low permeability glaciolacustrine and varved lacustrine silty clay approximately 18 to 27 m (60 to 90 ft) thick. This allows only a low rate of percolation and therefore very little transport to the shallow contact-zone and bedrock aquifers. The conductivity of the perched groundwater system in the fill layer is much higher.

Perched Groundwater System

Due to its relatively high conductivity, water in the perched groundwater system at Linde flows horizontally at an average velocity of 33 m/yr (100 ft/yr). This flow discharges into nearby drains and creeks. High contaminant retardation and low percolation rates in the clay prevent significant contaminant migration to the shallow aquifer.

Deep Aquifer

Groundwater in the deep aquifer in the immediate proximity of the Linde property exhibits elevated concentrations of sodium, sulfate, and chlorides and has a higher pH (9+) than the natural formation water. The generally low permeability of the shale and the computed flow velocities indicate that the groundwater in this aquifer is fairly immobile (BNI 1993).

Surface Water

Radionuclide concentrations in surface water at Linde are at background levels, and radioactive contaminants do not appear to be migrating from Linde at above-background concentrations via surface water.

The potential for migration of radionuclides and metals to surface water is limited because most areas of surface contamination at Linde are vegetated, paved, or covered with gravel. Contaminant movement could increase if these areas were disturbed. Potential exposure routes involve recreational activities on Twomile Creek. Potential receptors include individuals using Twomile Creek for recreational activities or ingesting fish caught in these waters, trespassers on the Linde site, and terrestrial and aquatic biota, through ingestion and dermal contact.

Sediment

Th-230, U-238, and Ra-226, at concentrations exceeding DOE guidelines, are present in the storm sewer sumps. Low concentrations of the radionuclides were also found onsite and downstream. MED-related metals detected in sediment include copper, lead, and magnesium. Of these metals, magnesium may be migrating with sediment from Linde at above background concentrations. These metals are also typically found in area soils. The potential for radionuclide transport in sediment is limited by the vegetative or paved cover at the Linde site.

Potential exposure routes are associated with activities along Twomile Creek that may bring individuals into contact with sediments. Potential receptors include site workers, individuals engaged in activities along Sheridan Lake and Twomile Creek, site trespassers, and terrestrial and aquatic biota.

2.4.2 Ashland 1, Seaway, and Ashland 2

The principal sources of contamination at Ashland 1, Seaway, and Ashland 2 are the contaminated surface and subsurface soils. The primary mechanisms that release compounds from these media into the environment are stormwater runoff and infiltration.

2.4.2.1 Contaminant Release Mechanisms at Ashland 1, Seaway, and Ashland 2

Stormwater runoff is the primary release mechanism for surface soil and subsurface soil contaminants at Ashland 1 and Ashland 2 because the clayey matrix of the surface soil reduces the amount of infiltrating water and increases the amount of site runoff. Runoff from Ashland 1 enters drainage ditches or collects in the low-lying wetland areas. A 36-inch concrete pipe drains collected surface water from Ashland 1 under the Seaway landfill to the Ashland 2 property. Leaks in this concrete drainline may either receive additional flow from under the landfill or may release water to the groundwater under the landfill. Ashland 2 runoff drains onto the surrounding properties and drainage ditches or collects in the low-lying areas. Seaway runoff drains onto the surrounding properties and drainage ditches north of the landfill and ditches adjacent to Ashland 1 and 2.

At Ashland 1 and Ashland 2, infiltration occurs in the areas covered with gravel and vegetation. Water infiltrating the surface and subsurface soils may join the perched groundwater system and discharge to adjacent surface water bodies, or it may pond and slowly percolate into the clay aquitard and discharge to Rattlesnake Creek downstream of the Ashland property (BNI 1993), or it may instead simply pond and slowly percolate deeper into the clay aquitard. Infiltration at Ashland 2 may discharge into the wetland areas. A major portion of the Seaway landfill has an impermeable cap minimizing infiltration. Areas at Seaway where the landfill is not completed are covered each day with soil to inhibit infiltration.

The potential for future mechanical resuspension of contaminants, prior to excavation, is minimal because soils at Ashland 1, Seaway, and Ashland 2 are covered by vegetation, gravel, clay, and, to a limited extent, asphalt.

Emission of Rn-222 may be a potential hazard in areas where Ra-226 contamination is located on the ground surface. Depending on the depth of contamination and the soil type, radon emitted beneath the ground surface may decay before reaching the atmosphere because it is a heavy gas and has a short half-life. Because of its short half-life and the length of travel time through clay aquitard, Rn-222 beneath the ground surface would probably not be transported to the groundwater aquifer. Rn-222 in the shallow groundwater system would decay before or soon after entering the surface water system.

Based on these sources and release mechanisms, the primary transport media would be the perched and shallow groundwater systems, surface water, and sediments. Air could become a transport medium if activities disturb the covering of the contaminated areas; radionuclide - contaminated soils could be exposed thereby to potential resuspension, increasing the probability of release and transport via stormwater runoff, and causing movement of Rn-222 to the ground surface.

2.4.2.2 Transport Mechanisms and Potential Exposure Pathways at Ashland 1, Seaway, and Ashland 2

Groundwater

Groundwater monitoring results indicate that radioactive contaminants from the contaminated areas on the Ashland properties are not migrating to the deep or shallow confined groundwater systems. The thick clay layer above the groundwater acts as an aquitard to mitigate downward migration of contaminants. Slightly elevated concentrations of radioactive contaminants, well below DOE DCGs and drinking water standards, were recorded in one well located in the perched groundwater system. The highest concentrations detected in this well in over three sampling events in 1989 were Ra-226, 1.4 pCi/l and Th-230, 0.2 pCi/l. This groundwater system is not used for drinking water supply.

Surface Water

The two predominant pathways for contaminant transport to surface water at the Ashland and Seaway properties are (1) direct surface water runoff carrying dissolved and particulate contaminants and (2) discharge of the perched groundwater system which might contribute dissolved contaminants to the surface water (BNI 1993).

The potential for migration of radionuclides and metals from these properties to surface waters is limited because most areas of surface contamination are vegetated or covered with gravel. The potential for migration into surface waters could increase during large storm events.

Recreational activities on lower Twomile Creek are potential routes of exposure through ingestion and dermal contact. Twomile Creek is not known to be used as a drinking water source. Potential receptors include site workers, individuals using lower Twomile Creek for recreational activities or ingesting fish caught in these waters, site trespassers, and terrestrial and aquatic biota.

Sediment

The major transport pathway for contaminants to reach area sediments is direct surface water runoff into area streams carrying suspended contaminated soils. Because of settling, the contaminant concentration in the sediments decrease with distance from the source area (BNI 1993).

The potential for radionuclide migration to sediment is limited because most of the areas of surface contamination are vegetated or covered with gravel. The rate at which contaminants might move into sediment could increase if the surface of the contaminated area was disturbed.

Potential exposure routes include activities along Rattlesnake Creek and lower Twomile Creek that would allow individuals to contact the sediment in these waters or to be exposed to the sediment onsite. Dermal contact is the most likely exposure pathway; absorption of radionuclides or metals through the skin is unlikely. Potential receptors include site workers, individuals coming into contact with sediment along Rattlesnake Creek and lower Twomile Creek, site trespassers, and terrestrial and aquatic biota.

Seaway Drainage Ditches

Elevated concentrations of Th-230 may be migrating from Seaway via the drainage ditches north and south of Area A. Additionally, the 36-inch concrete pipe under the landfill may be receiving in-flow from the groundwater under the landfill or may be discharging water to the groundwater through leaks and joints. Water leaking from the pipe might enter the leachate collection system at the landfill. U-238 concentrations are also elevated in the Seaway drainage ditch on the Ashland 2 side of the site. Potential receptors include site workers coming into contact with sediment in the Seaway drainage ditches, site trespassers, and terrestrial and aquatic biota.

The radionuclides in sediment in the Ashland 2 south drainage ditch do not appear to be migrating at above-background levels. Potential receptors include site workers, individuals coming in contact with sediment in the Ashland 2 south drainage ditch, site trespassers, and terrestrial and aquatic biota.

2.4.3 Contaminant Persistence

Wastes from uranium processing operations at Linde included radionuclides (U-238, Ra-226, and Th-230) and metals (see Table 2-1). Waste disposal was either to waste piles, sanitary sewers, storm sewers, or deep well injection. The chemical forms of the inorganic waste material may have changed with time due to chemical processes in the environment, but the original elemental constituents of the contaminants remain present in other chemical forms and, therefore, are persistent in the environment. The new chemical forms may exhibit different properties from the originally disposed wastes. The primary radionuclide constituents present at the Tonawanda site persist in the environment because of their relatively long half-lives.

2.4.4 Factors Affecting Contaminant Migration

The various factors that affect potential contaminant migration at the Tonawanda site include groundwater flow velocity, pH, soil type, stormwater runoff, and wetland retention. Measurements of the groundwater surface indicate that the hydraulic gradient is relatively low or flat. Contaminants entering the groundwater system may move at a rate slower than the groundwater flow velocity because of analyte-specific retardation factors.

Groundwater at the Tonawanda site has significant levels of chloride and sulfate ions as well as hydroxyl and carbonate ions. This condition leads to the formation of sparingly soluble radionuclide compounds, which reduces the concentration of radionuclides in solution and thereby limits the potential for migration through groundwater and surface water systems (BNI 1993).

Clay particles in the Tonawanda soil further reduce the potential for contaminant migration. Ion exchange and adsorption, two principal physical mechanisms for attenuation or immobilization of radionuclides and other inorganics by soil, are enhanced by the presence of clay particles. Therefore, the leaching of constituents from the contaminated soils at the Tonawanda site is partially mitigated by the tight clay matrix and the thickness of the clay layer [7.5 to 20 m (25 to 85 ft)] between the areas of contamination and the major groundwater aquifer.

Contaminant migration via surface water and sediments is influenced by factors such as stormwater runoff, erosion of surface soils, and drainage system characteristics. Erosion of surface soils generates particulates transported by stormwater runoff to the surface water and sediment systems. Drainage characteristics, such as vegetation and channel confinement, determine the ability of the surface water to flow and transport suspended solids.

Linde is an industrialized property, and most of the area is impervious, resulting in significant stormwater runoff. Buildings and asphalt reduce the potential for soil erosion. All site runoff is transported via the plant's storm sewer system to Twomile Creek. The lack of erosion and exposure of surface soil contamination affords minimal potential for contaminant migration, as indicated by the downstream surface water and sediment sampling results. The wetland along Rattlesnake Creek can mitigate the potential for contaminant migration via surface water and sediment systems. Several characteristics of wetlands present on the site facilitate removal of surface water constituents. The quiescent water conditions are conducive to sedimentation of suspended solids, and aquatic plant roots and stems increase the potential for adsorption and filtration of contaminants. Additionally, organic sediments in the wetlands adjacent to Ashland 2 present ion exchange and adsorption capacity.

There is no evidence of erosion on Ashland 1. The only exposed ground is the unpaved roads on the site; thus, opportunity for soil transport is reduced. Water pumped out of the bermed area and into the Ashland 1 drainage ditch contains only small amounts of sediment because the sediment settles out while the water is slowly pumped from the area. The drainage ditch along the Seaway fence contains thick vegetation during most of the year and has a slope of approximately 2%; therefore, any sediment reaching the ditch should settle out before reaching the Seaway pipe and migrating to Ashland 2. The sediment contamination downstream of Ashland 1 may be attributed to relocation of contaminants during construction of the berm and drainage ditch.

Seaway has a sharp relief compared with the surrounding area. The surface of the waste pile is steep; both sheet and rill erosion can occur on the slopes. However, the potential for contaminant migration from these closed landfill areas is minimal because the areas are capped and vegetated. Approximately half the stormwater runoff from the exposed Area A of Seaway flows to the south; the other half flows to the north. The drainage ditches to which the flows are directed show elevated radioactive contamination.

Ashland 2 is covered with grass, thick brush, and wetland-type vegetation, which impede stormwater runoff and reduce the potential for release of surface soil contamination. Sediment transport is minimal because of the level ground surface and the thick ground cover.

Downstream of Ashland 2 and the Ashland 2 wetland, radionuclide concentrations in surface water are the same as background; surface water concentrations of barium, boron, magnesium, nickel, potassium, and sodium decrease between onsite and downstream locations, indicating that the wetland on Ashland 2 may be mitigating the surface water contamination of these contaminants.

Concentrations of U-238 in sediments are higher in the wetland area than upstream or downstream. The elevated concentrations may be attributable to the fact that Rattlesnake Creek and the wetland area are partially in the radioactively contaminated area, or that the wetland is affecting deposition of radionuclides into the sediments. Th-230 and Ra-226 concentrations remain consistent between upstream and downstream sampling locations.

2.5 BASELINE RISK ASSESSMENT

As part of the ongoing analysis at the Tonawanda site, the BRA was prepared to evaluate risk to human health and the environment from the radioactive and chemical contaminates present at the various properties comprising the Tonawanda site. The BRA assumed no remedial action and serves as a baseline for evaluating available remedies.

During the RI phase of the RI/FS-EIS process, multi-media samples were collected for radiological and chemical analyses from a number of locations throughout the Tonawanda site and its vicinity, from areas later determined contaminated by MED-related wastes, and also from areas not impacted by MED-related sources. Data used in the BRA include results of sitewide sampling. Therefore, the assessment includes, in part, risks in site areas not impacted by MED-related sources. DOE has no authority to identify or clean up such areas. The presentation of risks in this BRA should not be interpreted as indicating DOE responsibility for remediation of site areas not impacted by MED-related sources.

2.5.1 Contaminants of Concern

Radiological Data

Numerous radiation surveys and site characterization studies have been conducted at the Tonawanda site. Data from these studies and the RI report (BNI 1993) were reviewed and used to select contaminants of concern (COC) for detailed evaluation in the subsequent exposure assessment and risk characterization.

Data from surface and subsurface soil, ground and surface water, and sediment were analyzed to identify potential radiological COCs. Radionuclides were selected as COCs if the mean of detected concentrations was twice the mean background concentration for that radionuclide. The radiological COCs selected for this risk assessment are Th-230, U-238, Ra-226, and their associated decay products, including Rn-222. Although Th-232 in soil was not identified as a COC, it was retained in the assessment.

Chemical Data

Chemical data were evaluated on the basis of sample quantitation limits, laboratory qualifiers and codes, and blanks. COC screening criteria for chemicals consisted of comparison with background concentrations, comparison to sample quantitation limits, and frequency of detection. Chemicals were selected as COCs if the mean concentration of the sample population exceeded twice the mean background concentration and if the frequency of detection warranted inclusion under the COC screening criteria. The final list of COCs utilized for calculating human health risk was comprised of those chemicals that remained after application of the screening criteria and for which appropriate toxicity factors were available. The chemical COCs retained for evaluation in the quantitative risk assessment included metals, volatile organic compounds, and base/neutral acid extractables.

2.5.2 Exposure Assessment

In the exposure assessment, a detailed evaluation of each property was completed to identify and characterize contaminant sources and release mechanisms, transport media, exposure points, exposure routes, and human receptors. Human receptors included employees and transients. Two categories of exposure scenarios were considered: current and future land use. In the future scenarios, land use could remain as it is now or could change to a plausible future land use, such as conversion to industrial property.

Conceptual site models identifying primary contaminant sources, contaminant release mechanisms, exposure pathways, and receptors were determined for radionuclides and chemicals for use in the quantitative health risk assessment. This was accomplished by using measurements of media collected in an area where receptors may come in contact with the contamination, and by using onsite measurements made with radiation detection instruments that directly measure radiation exposure rate. Where measured radiation exposure rates were not available, the exposure was modeled on measured soil concentrations of radionuclides.

For future and current use scenarios, radiation doses were estimated for inhalation of particulates and radon, ingestion of soil, and direct external exposure. Chemical intakes were calculated for soil ingestion, inhalation of soil particulates, and ingestion of surface water and sediment.

2.5.3 Toxicity Assessment

Cancer and chemical toxicity are the two general endpoints for health effects from exposure to site contaminants. Cancer induction is the primary health effect associated with radionuclides at the site. Several toxic effects are linked with exposure to carcinogenic and noncarcinogenic contaminants.

2.5.4 Risk Characterization

Risk estimates are presented for current and future use scenarios for hypothetical human receptors at the Tonawanda site. Radiological and chemical risks are estimated separately.

For the radiological assessment, risk is defined as the lifetime probability of cancer morbidity and does not include genetic or noncarcinogenic effects. Cancer risk estimates and noncarcinogenic health risk estimates are presented for the chemical COCs where toxicity values are available. Cancer risks for both radionuclides and chemicals are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of pathway-specific exposure to carcinogenic contaminants. The potential for noncarcinogenic effects from chemical exposures is evaluated by calculating the hazard quotient (HQ) for each COC. The HQ is the ratio of the calculated daily intake over the estimate of the daily exposure. HQs for each chemical COC are then summed to obtain a hazard index for the specific pathway.

2.5.4.1 Uncertainties Related to Risk Estimates

Uncertainties attributable to the numerous assumptions incorporated in the risk estimations are inherent in each step of the risk assessment process. A key factor affecting the exact identification of COCs for the Tonawanda site is associated with the limitations imposed by the available database. Limited toxicity data available for chemical contaminants prevented the calculation of risk for several chemical COCs. In addition, the COCs identified for the BRA might include chemicals that contribute to overall site risk, but are not necessarily attributable to past ore processing activities at the site.

Because of the inherent uncertainties in the risk assessment process, the results of the human health assessment presented in the BRA should not be taken to represent absolute risk. Rather, estimated risks should be considered to represent the most important source of potential risk at the site, which, once identified, might be evaluated in more detail and remedied appropriately during the remedial action process.

3. IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

This section describes the development and the screening of remedial action technologies for the Tonawanda site. Identifying and screening technologies establishes a wide range of waste management options to consider further in the detailed analysis.

3.1 INTRODUCTION

The purpose of this identification and screening process is to identify a range of suitable remedial action technologies and remedial options that can be assembled into remedial alternatives capable of addressing the existing contamination at the Tonawanda site (i.e., Linde, Ashland 1, Seaway, and Ashland 2 properties). *EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988a) has established a structured process for identifying and screening relevant technologies for remediation of contaminated sites. The goal of the remedy-selection process established by EPA is to select remedial actions that protect human health and the environment, that maintain protection over time, and that minimize untreated waste. The FS process ensures that appropriate remedial actions are developed and evaluated, and that pertinent information required to select a recommended remediation approach is presented.

The National Contingency Plan (NCP) specifies six criteria for developing remedial alternatives. These were used to develop the preliminary alternatives for remedial action at the Tonawanda site and include:

- using treatment to address principal risks as defined by the BRA;
- using engineering controls for waste that poses a relatively low long-term risk or when treatment is impractical;
- combining methods, such as treatment with engineering controls, to protect human health and the environment;
- supplementing engineering controls with institutional controls, as is appropriate, for short- and long-term management to prevent or to limit exposure;
- using innovative technology; and
- returning usable groundwaters to their beneficial uses or preventing further degradation.

Selecting a response action proceeds in a series of steps designed to reduce the universe of potential alternatives to a group of viable alternatives from which a final remedy may be selected. The selection of remedial action alternatives for the site involves:

- identifying preliminary remedial action objectives specific to the contaminated environmental media;

- identifying general response actions (e.g., removal, treatment, and disposal) required to attain the remedial action objectives and to cover the scope of possible remediation activities for the affected sites;

- identifying remedial action technologies (e.g., physical treatment processes) and remedial options (e.g., soil washing, solidification) that can be applied for each of the general response actions and performing an initial screening to reduce the number of remedial options for detailed evaluation; and

- evaluating viable remedial options on criteria of effectiveness, implementability, and cost to define a set of options from which to develop alternatives that address the site as a whole.

Section 3.2 develops remedial action objectives for each medium of interest, identifies contaminant-specific applicable or relevant and appropriate requirements (ARARs), other applicable ARARs, likely exposure routes, and likely receptors. Allowable exposures or target cleanup levels are developed based on the ARARs and on the findings of the BRA.

Section 3.3 identifies general response actions that satisfy remedial action objectives for each medium of interest at the site, and presents a preliminary identification of the areas to which these actions may need to be applied.

Sections 3.4 and 3.5 identify and screen remedial action technology types under each general response action for soils and sediments and for buildings and structures, respectively. Technology types are screened on the basis of site-specific technical feasibility at the Tonawanda site. Under each technology type, remedial options are identified and screened.

In Section 3.6, remedial options identified in the previous section for each medium of concern are evaluated and screened by criteria of effectiveness, implementability, and relative cost, with greatest emphasis on effectiveness.

3.2 REMEDIAL ACTION OBJECTIVES

Remedial action objectives are site-specific requirements that define the extent of cleanup required to achieve overall cleanup objectives. They are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure.

Several elements comprise a remedial action objective. These are (1) the contaminant-specific numerical cleanup limits (i.e., remediation goals or target cleanup levels) for all affected environmental media, (2) the spatial area of attainment, and (3) the restoration time-frame. EPA specifies two "threshold criteria" for deriving target cleanup levels for contaminated environmental media at waste sites (EPA 1988a):

- The remediation objectives must afford overall protection of human health and the environment.

- Concentrations of contaminants (including radionuclides) in the environment must comply with federal and state ARARs.

EPA says that a remedial alternative must satisfy these "threshold criteria" to be eligible for selection (55 FR 8666).

ARARs are not a uniformly derived set of similar standards and do not consider the effects of combined exposures to mixtures of chemicals. ARARs cannot always be met as remediation goals for technological reasons, as well as cost factors, but where that is true, a waiver could be invoked to excuse the deficiency. Although alternatives for site remediation must comply with ARARs, due to site-specific factors (e.g., multiple chemicals and multiple exposure pathways), a cleanup level set at the level of a single chemical-specific requirement may not adequately protect human health or the environment. Remediation objectives are developed through the risk assessment process if:

- an ARAR is not protective (based on results of the BRA);

- an ARAR does not exist for the specific chemical or pathways of concern; or

- multiple contaminants result in an unacceptable cumulative risk.

Health advisory levels should be identified or developed to ensure that a remedy is protective.

The purpose of the RI/FS is to assess site conditions and evaluate alternatives to the extent necessary to select a remedy. A draft report presenting the findings of the RI describing Tonawanda site conditions was completed in December 1992 (BNI 1993). The primary objective of this FS is to ensure that appropriate remedial alternatives are developed and evaluated so that relevant information concerning the remedial action options can be presented to decision-makers for selection of an appropriate remedy.

EPA guidance (EPA 1988a) requires that remedial alternatives be developed that protect human health and the environment by eliminating, reducing, and/or controlling risks posed by the site. Recycling is to be considered and implemented if possible. The alternative-development process consists of several steps described below.

The first step in the development process is to identify remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and preliminary remediation goals. The goals are based on acceptable risk-based exposure levels that protect human health and the environment, and are developed by considering ARARs and the following factors [1990 NCP Section 300.430(e)(2)(i)(A)]:

- For noncarcinogenic toxicants, acceptable exposure levels are those concentrations to which the most susceptible human population may be exposed over a lifetime without adverse effects.

- For known or suspected carcinogens, acceptable exposure levels are those concentrations that represent an upper-bound excess lifetime cancer risk to an individual of between 10^{-6} and 10^{-4} as determined by the dose-response relationship. This range is intended to provide case-by-case flexibility, although the 10^{-6} risk level is the point of departure for determining goals for alternatives when ARARs are unavailable or not sufficiently protective.

- Other factors related to technical limitations, uncertainty, and other pertinent information are also considered.

- In the case of multiple contaminants, where the attainment of ARARs will result in a cumulative risk in excess of 10^{-4} (the extreme of the acceptable range), acceptable exposure limits based on exposure to new carcinogenic toxicants or cancer risk (described above) must be considered.

- Water quality criteria established under Sections 303 or 304 of the Clean Water Act shall be attained where relevant and appropriate.

- An alternative concentration limit (ACL) may be established in accordance with CERCLA Section 121(d)(2)(B)(ii).

- Environmental evaluations shall be performed to assess threats to the environment, especially sensitive habitats and critical habitats of species protected under the Endangered Species Act.

A requirement under federal and state environmental laws may be either "applicable" or "relevant and appropriate" but not both. Identifying ARARs is a two-step process: first, to determine if the regulation is applicable; then, if not, to determine if the regulation is both relevant and appropriate. The terms below are defined in the 1990 NCP (Section 300.5) as follows:

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state statutes that are more stringent than federal requirements apply.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is suited to the particular site. Only those state statutes more stringent than federal requirements are relevant and appropriate.

Site-specific factors used to identify ARARs include the characteristics of the remedial action, hazardous substances present, and physical circumstances of the site. These factors are compared to the requirement under evaluation to determine if it is directly applicable or if it is relevant and appropriate. In some cases, only part of a requirement may be found to be relevant and appropriate. A determination that a requirement is relevant and appropriate will result in an ARAR that must be complied with to the same degree that it is applicable. A waiver of the ARAR may be invoked if it can be justified under the 1990 NCP Section 300.430(f)(1)(ii)(C) (Section 2.2.7).

Remedial actions may have to comply with several different types of requirements. The classification of ARARs described below was developed to provide guidance on how to identify and comply with ARARs (EPA 1988a).

Chemical-specific requirements are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment.

Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations.

Action-specific requirements are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

To-Be-Considereds (TBCs) are nonpromulgated advisories or guidances issued by federal or state governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances TBCs can be considered along with ARARs in determining the necessary level of cleanup for protection of health or the environment.

3.2.1 Preliminary Identification of ARARs

CERCLA requires the selection of remedial actions at waste sites that protect human health and the environment and that are cost-effective and technologically and administratively feasible. Section 121 of CERCLA specifies that response actions must be undertaken in compliance with ARARs established in federal and state environmental laws.

3.2.1.1 Chemical-Specific ARARs

Chemical-specific ARARs are health or risk-based numerical limits. These values are federal or state requirements establishing acceptable amounts or concentrations of contaminants found in or discharged to the ambient environment (EPA 1988a). EPA specifies that if a contaminant has more than one ARAR, compliance with the most stringent is required.

A very limited number of ARARs are available for deriving remediation goals for radionuclides at CERCLA waste sites. However, a number of TBC values may form a strong basis for development of remediation goals. Requirements and guidelines for the management and control of radioactive materials have been developed by DOE and EPA. Certain states have implemented regulatory programs for managing radioactive waste. **Table 3-1** is a summary of radiation protection standards that may be ARARs for the Tonawanda site. Additional information on these requirements is presented below.

DOE is responsible for managing all nuclear materials at facilities under its jurisdiction and is exempt from NRC licensing and regulatory requirements. DOE Order 5820.2A outlines cleanup standards for radioactive waste at DOE sites and is generally consistent with the standards developed for other sites by the Nuclear Regulatory Commission (NRC). It is, therefore, not necessary to include the NRC regulations as "relevant and appropriate" criteria, unless DOE Order 5820.2A does not clearly address a specific condition that might affect the protection of human health and the environment (NRC 1993). DOE Orders for handling and cleaning radioactive materials have not been formally promulgated so they are considered TBCs.

Table 3-1. Radionuclide Soil Concentration Guidelines

Radionuclide	Soil Concentration Guidelines
Ra-226 Ra-228 Th-230 Th-232	5 pCi/g when averaged over the first 15 cm (6 in.) of soil below the surface; 15 pCi/g when averaged over 15-cm (6-in.) thick soil layer below the surface layer.[a]
U-238	A guideline value of 60 pCi/g for uranium has been established for the Tonawanda site.[b]

[a] 40 CFR 192.12, DOE Order 5400.5
[b] BNI 1992a

DOE orders are legally binding for DOE and all of its contractors and are enforceable under the Price-Anderson Amendment Act of 1988, which amended the Atomic Energy Act.

State environmental standards are those promulgated by the state to protect environmental quality and may be applicable or relevant and appropriate for evaluating remedial actions at waste sites in that state. The availability of and numerical values for these standards vary widely from state to state. If state standards are available, and if these differ from ARARs proposed by EPA, EPA guidance specifies that the more stringent of the two standards be used (55 FR 8666).

According to EPA, a requirement may be determined to be relevant and appropriate if the established health or environmental limit is based on an exposure scenario similar to the potential exposure at a CERCLA site (55 FR 8666). EPA considers this the focal point for determining if a requirement is relevant and appropriate.

Limited legislative guidance is available for establishing chemical-specific remediation goals for contaminants in soils (EPA 1991a). Action levels for chemicals in soils have been proposed by EPA as part of the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (55 FR 30798). These guidelines are risk-based limits to be used in determining the need for corrective measure studies at RCRA solid waste management units. When formally promulgated, these requirements may become ARARs for CERCLA remedial actions. Currently, the RCRA action levels would not be considered ARARs for the Tonawanda site under the CERCLA program. Guidelines for radionuclide residuals in soils and on surface structures were presented in the RI report for the Tonawanda site. These values are based on DOE Order 5400.5, noted previously, and on the *FUSRAP Management Requirements and Policies Manual* (DOE 1992).

3.2.1.2 Location-Specific ARARs

Location-specific ARARs are restrictions on activities or on concentrations of contaminants that may occur at a given location. It is necessary to evaluate the jurisdictional and legislative requirements of each regulation to determine the applicability of location-specific ARARs for a given site. Appendix F includes a comprehensive listing of location-specific requirements. As shown, however, most of these are not applicable or relevant and appropriate for the Tonawanda site.

3.2.1.3 Action-Specific ARARs

Action-specific requirements are technology- or activity-based limitations on actions that may be taken at a waste site regarding management of toxic or hazardous materials. These ARARs are triggered by the selection of a particular remedial action and may invoke performance standards or technologies as limits on levels of contaminants in effluents or residues.

Appendix F presents a comprehensive overview of potentially applicable action-specific requirements. Requirements for the management of radionuclides and non-radiological contaminants are considered. Note that many of the requirements listed include chemical-specific guidelines. This listing is refined as the FS progresses and the alternatives for site remediation are refined.

3.2.2 Derivation of Preliminary Remediation Goals

The requirement that a remedial alternative will meet chemical-specific ARARs does not ensure that the proposed alternative is protective and, thereby, potentially acceptable. This can be determined only by (1) evaluating the combined carcinogenic risk associated with the ARAR limits for all chemicals at a given site (assuming additivity of effect in the absence of data on synergism or antagonism); (2) establishing that ARARs do not exceed EPA toxicity benchmarks for noncarcinogenic effects (i.e., reference doses or reference concentrations), and are sufficiently protective when multiple chemicals are present; (3) determining whether environmental effects (in addition to human health considerations) are adequately addressed by the ARARs; and (4) evaluating whether the ARARs adequately cover all significant pathways of human exposure identified in the BRA.

The establishment of remediation goals or target cleanup levels typically begins during project scoping or concurrently with preliminary RI activities. Because these preliminary remediation goals (PRGs) are first established before completion of the BRA, they are initially equated with ARARs or other readily available environmental or health-based limits. As the RI/FS progresses, the results of risk assessment and the subsequent identification of additional ARARs modify the preliminary remediation goals. Ultimately, final remediation goals are derived that ensure that remedial alternatives comply with ARARs and protect human health and the environment. The final remediation goals are derived during the FS and are documented in the ROD.

Based on the available EPA guidance, an outline may be developed of the general approach to derive remediation goals (EPA 1991a):

- identify subject contaminants of concern;
- list all available ARARs;
- identify potential exposure pathways and receptors at risk;

- develop exposure scenarios and characterize environmental concentrations/ activities at the points of exposure using available monitoring data and/or the results of environmental fate modeling;

- if ARARs are available for all subject chemicals and environmental media, evaluate the overall protectiveness to human health of exposure to the chemicals at ARAR levels and take into consideration combined exposure across chemicals and multiple pathways;

- if the ARAR levels are found to be protective, adopt these as remediation goals (cleanup levels); and

- if ARARs are not available for all subject chemicals, or are not found to be protective of human health, derive cleanup levels based upon the results of risk assessment.

The exposure pathways that form the basis for risk characterization in the BRA should be used in deriving target cleanup levels. Chemical-specific remediation goals for contaminants must afford overall protection to human health and the environment. Overall protection as defined by EPA must take into consideration combined exposure across all contaminants and pathways of concern for receptor groups at primary risk of exposure.

3.2.3 Remedial Action Objectives for the Tonawanda Site

The RI conducted on the Tonawanda properties identified MED-related contamination present in site soils, sediments, drain lines, bedrock, and isolated instances of surface water contamination around the Ashland 2 property. The RI concluded that contamination found in the bedrock at Linde, resulting from the injection of waste effluent into the groundwater, is immobile (BNI 1993). Based on existing information, no exposure pathway exists concerning this bedrock contamination. No impact on area groundwater has been identified; therefore, no remedial action objectives were developed for Tonawanda groundwater or the bedrock.

The radiologic contamination found in the surface water between Seaway and Ashland 2 results from the mobilization of contaminated soils from the Ashland and Seaway properties. Impacts to the area surface water are best remediated by preventing the future migration of contaminated soils from the site into area surface water.

Remedial action objectives for the Tonawanda site were developed for contaminated soils and sediments and for contaminated buildings. The objectives are designed to be specific for media, contaminant type, and routes of exposure, but general enough to allow for a range of treatment and containment alternatives to be developed. Media-based remedial action objectives are discussed below.

Preliminary remedial goals for the cleanup of radiologically and chemically contaminated soils and sediments have been assumed to be the radionuclide soil concentration guidelines (Table 3-1). The BRA for the Tonawanda site supports the proposition that cleanup to those guidelines would also be protective of human health.

3.2.3.1 Remedial Action Objectives for Soils and Sediments

The soils at the Tonawanda site are contaminated with radionuclides and metals from the processes formerly conducted at the Linde facility. The BRA identified these surface and subsurface soils as posing a threat to human health and the environment because of the following major MED-related COCs: Ra-226, U-238, Th-230, copper, lead, and vanadium. Additionally, these contaminants could potentially migrate to other onsite media including groundwater, surface water, river and stream sediments, and the sediments in various wetland areas.

Based on these conditions, the preliminary remedial action objectives for Tonawanda soils are to:

- prevent or mitigate the release of COCs to the groundwater below the site by leaching and into the surface water by surface runoff;
- reduce risks to human health associated with direct external exposure to, direct contact with, and inhalation and incidental ingestion of radiological and chemical contaminants in the surface and subsurface soils and sediments of the site; and
- reduce the volume, toxicity, or mobility of COCs in the soil.

Like the site soils discussed above, the sediments located in the area of the site are contaminated from the activities formerly conducted at the Linde facility. The COCs for the wetlands areas are the same as those identified in the soils of the site. Direct external exposure to these contaminants is the dominant pathway that poses a risk to human health and the environment. Like the contaminated soils, the sediments also pose the threat of continued release of contamination to the groundwater and surface water at the site. Therefore, the remedial action objectives for the sediments are to:

- prevent or mitigate the release of COCs to the groundwater below the site by leaching and into the surface water network by surface runoff;
- reduce risks to human health associated with direct external exposure, to contact with, and incidental ingestion of radiological and chemical contaminants in the surface sediments of the wetland area; and
- reduce the volume, toxicity, or mobility of COCs in the sediment.

Table 3-2 presents a summary of remedial action objectives for each potential exposure route/scenario for soils and sediments.

3.2.3.2 Remedial Action Objectives for Radioactively Contaminated Buildings and Structures

The remedial action objectives developed for the radioactively contaminated buildings and structures on the Linde property involve eliminating the potential for direct contact with radioactive contaminants and preventing the contaminants from further migrating into the environment via ambient air and/or ground surfaces. Health risk-based ARARs establish the cleanup goals required for these contaminated buildings and structures. Table 3-3 presents a summary of remedial action objectives for each potential exposure route/scenario for radioactively contaminated buildings and structures.

3.3 GENERAL RESPONSE ACTIONS

General response actions were developed to satisfy the preliminary remedial action objectives for radiologically and chemically contaminated soils, sediments, and buildings. Each medium is discussed separately below.

For the purposes of this FS, the acceptable concentrations equal the PRGs established for the site based on contaminant-specific ARARs. To develop cleanup goals for the radiologically contaminated soils and sediments at the site, the soil concentration guidelines (Table 3-1) were used.

3.3.1 General Response Actions for Soils

General response actions developed for soils are intended to mitigate, to the extent possible, contaminant releases into the groundwater, surface water, and air, and to prevent direct external exposure and direct contact with contaminants.

At the Tonawanda site, areas of contaminated soils have been identified on all four properties. Analytical results show areas of soil contaminated with radionuclides associated with the former use of the Linde property for MED/AEC activities. These radiologically contaminated soils also have been found to contain other organic and inorganic contaminants. As discussed in Section 2.3, some inorganic contaminants may have resulted from MED activities and are likely still to be mixed with the MED-related radionuclide contaminated soils and will therefore be removed or contained through the actions taken on the radiologically contaminated soils.

The purpose of this FS is to develop and evaluate alternatives to remediate radiological and chemically contaminated wastes generated during MED-related activities (to the extent to

Table 3-2. Remedial Action Objectives for Soils and Sediments at the Tonawanda Site

Potential Exposure Route/Scenario	Remedial Action Objectives
Direct contact/ingestion of surface soil (human occupational). Inhalation of particulates. Direction radiation.	Prevent contact/ingestion of soil contaminants of concern above 10^{-4} to 10^{-6} excess cancer risk, 1.0 noncarcinogenic hazard index, and state criteria.
Ingestion of drinking water potentially contaminated due to leaching of constituents into shallow groundwater and migration to deep aquifer.	Prevent ingestion of contaminants of concern above maximum contaminant levels, 10^{-4} to 10^{-6} excess cancer risk, 1.0 non-carcinogenic hazard index, and state criteria.
Exposure of aquatic organisms due to leaching of contaminants into shallow groundwater and migration to surface water, sediments, and bioaccumulation.	Prevent the transport of contaminants of concern in surface soils to the marsh and tideflat waters in concentrations that would cause exceedance of surface water or sediment ARARs.
Exposure of aquatic organisms due to erosion and transport of surface soil by runoff to surface water, sediments, and bioaccumulation.	Prevent the transport of contaminants of concern in surface soils to the marsh and tideflat waters in concentrations that would cause exceedance of surface water or sediment ARARs.
Direct contact or ingestion of surface/root zone soils by environmental species.	Prevent risks to environmental receptors from soil sources containing concentrations of contaminants of concern that constitute an environmental hazard or exceed acute or chronic toxicity levels.
Exposure of aquatic organisms due to migration of groundwater to surface water and adsorption onto sediments. Exposure of aquatic organisms due to erosion of surface soil and deposition in receiving waters and bioaccumulation.	Prevent the migration of contaminants of concern from onsite sources to sediments which would result in concentrations that constitute an environmental hazard and/or would cause exceedance of sediment quality ARARs.

MCL = maximum concentration limit (for drinking water).

Table 3-3. Remedial Action Objectives for Radioactively Contaminated Buildings and Structures at the Tonawanda Site

Potential Exposure Route/Scenario	Remedial Action Objectives
Direct external exposure - the dominant pathway. Inhalation of particulate contaminants in ambient air (onsite human occupational).	Prevent exposures inhalation of contaminants of concern above TLVs[a], PELs[b], 10^{-4} to 10^{-6} excess cancer risk, 1.0 noncarcinogenic hazard index, and state criteria.
Inhalation of particulate contaminants in ambient air (offsite human residential).	Prevent inhalation of contaminants of concern above 10^{-4} to 10^{-6} excess cancer risk, 1.0 noncarcinogenic hazard index, state criteria.
Inhalation of particulate and contaminants in ambient air by environmental species.	Prevent risks to environmental receptors from inhalation of air containing concentrations of contaminants of concern that constitute an environmental hazard or exceed acute or chronic toxicity levels or chemical-specific ARARs.

[a]TLV = threshold limit value (American Conference of Governmental Industrial Hygienists).
[b]PEL = permissible exposure limit (Occupational Safety and Health Administration).

which DOE is responsible) at the Tonawanda site. Therefore, for the purpose of this study, only soils contaminated with radionuclides above background concentrations and exceeding DOE cleanup guidelines (and the commingled non-radiological contaminants) have been addressed. The RI and characterization studies of the four Tonawanda properties have further indicated that with the exception of one sample at Ashland 1 (of 12 first round samples obtained from Ashland 1 soil), the soils found to contain radionuclide contaminants in addition to other organic and inorganic contaminants do not exhibit RCRA characteristics of toxicity as determined by Toxicity Characteristic Leaching Procedure analysis (BNI 1993). Later sampling in the same area of Ashland 1 failed to detect any soils failing TCLP tests for metals. However, due to the existence of potentially hazardous constituents at all properties, additional RCRA testing will be required during remediation. If during the removal activities, waste testing finds pockets of RCRA hazardous waste, alternate disposal procedures will be instituted to dispose of the mixed waste at a RCRA permitted hazardous waste facility. For the purposes of this report, it has been assumed that the waste generated during remediation will not be hazardous under RCRA definition.

Containment and excavation actions to remediate the contaminated soils were evaluated for potential application at the Tonawanda properties. In addition, treatment options were considered for in situ, onsite, and offsite actions. Disposal was a major consideration for each excavation and response action. Institutional controls were also considered as a response action for soils. A no-action scenario was also considered that included environmental monitoring.

3.3.2 General Response Actions for Sediments

General response actions developed for contaminated sediments in wetland areas of the site and in sumps and drain lines on the Linde property are similar to those considered for the site soils. Actions considered for the contaminated sediments existing within drainage channels and in Rattlesnake Creek include revegetation, grading, erosion control measures, and temporary diversion of surface water to access and remove contaminated sediments, and protection of the surface water by preventing the release of contaminants. Activities related to the closure of wetland areas will, however, differ due to the need to restore the areas to wetland conditions.

3.3.3 General Response Actions for Buildings and Structures

The general response actions applicable to remediating buildings and structures at the Linde site are primarily to mitigate the release of radioactive contaminants in order to prevent exposures to humans and the environment (See Table 3-3). Containment and decontamination actions were identified as potential applications at the Linde site. Also, removal actions in conjunction with treatment and ultimate disposal were considered. A no-action response was evaluated as well as other alternatives including institutional controls.

3.3.4 Summary of General Response Actions per Medium

To properly evaluate the various technologies and remedial options available, media of concern that have similar physical characteristics, such as soils and sediments, are grouped together. During earth intrusion and/or building decontamination/demolition activities, fugitive emissions would be minimized via water and foam applications. Appropriate air pollution control equipment would be required as part of any response action that may have the potential to emit pollutants. Air monitoring would be required as part of any health and safety plan. Therefore, concerns relating to air impacts are addressed as part of the response actions developed for soil and sediments, and buildings and structures.

The media of concern and their respective general response actions are as follows:

Soils and Sediments	Buildings and Structures
No Action	No Action
Institutional Controls	Institutional Controls
Surface Water Controls	Containment
Containment	Decontamination
Removal	Removal
Treatment	Treatment
Disposal	Disposal

3.4 IDENTIFICATION OF REMEDIAL ACTION TECHNOLOGIES AND OPTIONS FOR SOILS AND SEDIMENTS

For each of the response actions identified in Section 3.3, the universe of remedial options was reviewed for those applicable to the soil and sediment contamination and site conditions at the Tonawanda site. This preliminary review establishes the overall set of remedial action technology process options and eliminates those that cannot realistically be applied to the site. Technologies considered to be too difficult to implement at the site, that would not be effective in a reasonable amount of time, that are not applicable to the contaminants of concern, or that were determined to be unreliable were eliminated from further consideration. Table 3-4 presents the results of this review.

3.4.1 No Action for Soils and Sediments

Under the no-action alternative, no remedial action would be implemented and the present status of the sites would continue unmitigated. This response action will be retained throughout the FS evaluation, as it represents the current site practices of routine environmental monitoring

Table 3-4. Review of Remedial Options for Soils and Sediments at the Tonawanda Site

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
1. No Action	None			
	· Includes Continued Environmental Monitoring	No action taken to reduce risk. May include an environmental monitoring program.	Required for consideration by NCP[a] and NEPA[b].	Retained
2. Institutional Controls	Site Security			
	· Fencing/Signs	Restrict access with fences; post warning signs.	Easily implementable.	Retained
	Land Use Controls			
	· Deed Restrictions · Deed Notices	Initiate deed restrictions and/or notices to constrain future use of the site. Could also include purchase of land and easements as necessary to implement remedial actions.	Implementable, but may require buying of property.	Retained
	Site Maintenance			
	· Mowing · Vegetative Cover Repair	Activities to ensure adequate vegetative cover is maintained.	Easily implementable.	Retained
	Environmental Monitoring			
	· Monitoring of Media	Periodic sampling to identify increasing or decreasing risks.	Implementable at all locations.	Retained

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
3. Surface Water Controls	Revegetation			
	· Grasses, Legumes, Shrubs, Trees	Planting of trees, grass, and shrubs to stabilize the surface and reduce erosion by wind and water. Also, contributes to development of fertile soils and better site appearance.	Can be compatible with a cap or soil cover. Can be applicable at all sites except developed areas at Linde. Should be used with most alternatives.	Retained
	Grading			
	· Scarification and Contour Furrowing	Use procedures to reshape the land surface in order to manage surface runoff, infiltration, and erosion.	Can be implemented at certain locations along Rattlesnake Creek to prevent flooding water from transporting contaminated sediments from creek bed.	Retained
	Erosion Control			
	· Silt Fence and Hay Bales	Erosion control devices are placed at edge of work areas to control sediment runoff.	Easily implementable. Effective in protecting wetlands and streams.	Retained
	Diversion Systems			
	· Dikes and Berms	Well compacted earthen ridges or ledges constructed immediately upslope from or along the perimeter of contaminated areas.	Not applicable for large amounts of surface water flow; provides only short-term protection. Would not be applicable at locations along creek downstream from the sites where the surface water flows are large.	Retained

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
3. Surface Water Controls (Continued)	· Levees and Floodwalls	Earthen embankments that function as flood protection structure in areas subject to flooding. Floodwalls perform similar functions, but are constructed of concrete.	Contain only floodwater; not applicable to flooding from storm runoff. Not considered to be required at Rattlesnake Creek and drainage ditches.	Eliminated
	· Encase in Pipeflow	Divert surface water flow through pipes in stream bed; prevent further contamination of sediments.	Not applicable for large surface water flows.	Eliminated
4. Containment	Capping		A cap would reduce direct contact exposure to contaminated soils and reduce leachate production. Implementable.	
	· Clay	Place compacted clay with soil over contaminated media.	Potentially applicable.	Retained
	· Asphalt	Application of a layer of asphalt over areas of contamination.	Potentially applicable.	Retained
	· Concrete	Installation of concrete slabs over contaminated areas.	Potentially applicable.	Retained
	· Synthetic Membrane Liners	Installation of a liner over areas of contamination.	Potentially applicable.	Retained
	· Multi-layered Cap	Different layers of different media over areas of contamination.	Potentially applicable.	Retained
	Soil Cover			
	· Topsoil and Vegetative Layer	Place topsoil and vegetative layer over areas of contamination.	Would reduce contact with contaminated soils/sediments.	Retained

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
5. Removal	<u>Excavation</u> · Complete · Partial	Physical removal of contaminated soil/sediment (by bulldozer, backhoe, front-end loader, scrapers, dragline, or clamshell bucket).	Implementable; however, considerations should be given to address impacts that could result to human health and environment.	Retained
6. Treatment · Onsite/Offsite	<u>Volume Reduction Processes</u>	Volume reduction processes can be accomplished by physical or chemical methods. Chemical extraction techniques use chemicals to extract the contaminants from soils. Physical separation techniques are mechanical methods for separating mixtures of soils to obtain a concentrated form of the desired fraction. Other ancillary treatment technologies may be required to support containment, treatment, or disposal actions.	Considering the nature of contamination in the soils and the presence of clay in the soils reducing the required permeability, in situ treatment was not considered applicable. Treatment after excavation is still potentially applicable. Any treatment extract may result in the consideration of mixed wastes for further treatment and/or disposal.	
	· Soil Washing	Contaminants extracted from soil using water, surfactants, acids, or bases. Detoxified soil is returned to site or disposed of offsite. Concentrated wastewater requires additional treatment.	Effective for treatment of uranium, radium, and thorium. Volatile and nonvolatile metals can be treated as well. However, clay and silt are not economically treated and wastewater may require additional treatment.	Eliminated
	· Organic Solvent Extraction	Contaminants extracted from soil using organic solvents. Detoxified soil is returned to site or disposed of offsite. Concentrated wastewater requires additional treatment for chemicals and soluble radionuclides.	Effective for treatment of radionuclides (principally uranium and radium), and volatile and nonvolatile metals. However, interference results from fine solids and large volumes of hazardous constituents generated.	Eliminated

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
6. Treatment (Continued)	Volume Reduction Processes (Continued)			
	· Screening	Mechanical separation of particles is based on size.	Screens are subject to plugging which could decrease efficiency.	Retained
	· Classification	Separation of particles occurs according to their settling rate in a fluid, usually water.	Potentially applicable. Soils with high clay content sandy soil with humus material are very difficult to process.	Retained
	· Flotation	Used for separation of particles in the size range of 0.1 to 0.01 mm.	Potentially applicable. A suitable additive should usually be added to make flotation effective.	Retained
	· Gravity separation	Separation of particles occurs due to difference in material density. Separation is also influenced by particle size, shape, and weight.	Potentially applicable. One drawback of gravity concentration equipment is its low handling capacity. Clean water is also required.	Retained
	· Brickmaking	Soils and contaminants are formed and compressed into bricks using conventional brickmaking technology.	Potentially applicable for volume reduction. Additional costs may be warranted if disposal space is limited and costs are expensive.	Retained
	Immobilization Processes			
	· Vitrification	High temperature is used to reduce organic compounds to carbon monoxide, hydrogen, and carbon. Radionuclides and inorganic compounds become entrained in glass and siliceous metals.	Potential effectiveness for radioactive contaminants and nonvolatile metals compounds.	Retained

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
6. Treatment (Continued)	· Solidification	Immobilizes contaminants by adding a solidifying agent (e.g., polymer, cement, fly ash, lime) to excavated soils; mixed and cured to form a solid low-permeability matrix.	Demonstrated effectiveness for treatment of radionuclides, and volatile and nonvolatile metals.	Retained
	Biological Process			
	· Biodegration	Bio-oxidation of organic matter by cultured micro-organisms.	Not effective for radiologically contaminated soils and sediments.	Eliminated
	Thermal Processes			
	· Rotary Kiln · Fluidized Bed	Uses high temperature oxidation to degrade organic contaminants.	Not effective for destruction of radiologic compounds.	Eliminated

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
7. Storage/Disposal	Disposal of contaminated soils can be accomplished onsite or offsite. Prior to disposal, interim storage may be required. Storage can be onsite in covered piles or indoors in a properly designed building. Offsite storage can be at a federally-managed facility. Material will have to be appropriately containerized (where applicable) and transported via trucks or rail.			
	<u>Onsite Disposal</u>			
	· Designed Land Encapsulation	Excavated soils are redeposited onsite at a location that has been provided with complete barrier protection.	May be difficult to implement because of public opposition.	Retained
	<u>Offsite Disposal</u>			
	· Offsite Disposal at Dedicated DOE-FUSRAP Facility within the State of New York	Disposal would occur in a designed land encapsulation cell for all New York State FUSRAP waste.	Locating a site will require RI/FS-EIS. Potentially applicable.	Retained
	· Existing DOE Facility	Disposal occurs at an existing DOE-managed facility with the capacity to accept wastes.	Potentially applicable.	Retained
	· Offsite Disposal at Commercially Licensed Facility	Excavated soils are redeposited offsite at a location that has been provided with complete barrier protection (natural and/or geotextile fabric liners and impermeable materials).	An appropriate location offsite may be difficult to identify.	Retained
	· Land Spreading	Low-level contaminated waste is excavated, transported, and spread on unused land ensuring that radioactivity levels approach the natural background level.	Locating a site will require RI/FS-EIS. Potentially applicable. Land spreading would contribute to a nonpoint source pollution problem generated by native soils.	Eliminated

Table 3-4. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Option	Comments	Screening Status
7. Storage/Disposal (Continued)	· Offsite Disposal at a Nationally Dedicated DOE-FUSRAP Facility at an east coast location	Disposal would occur in a designed land encapsulation cell for all FUSRAP wastes.	Locating a site will require RI/FS-EIS. Potentially applicable.	Retained.
	· Offsite Disposal at a Nationally Dedicated DOE-FUSRAP Facility at a west coast location	Disposal would occur in a designed land encapsulation cell for all FUSRAP wastes.	Locating a site will require RI/FS-EIS. Potentially applicable.	Retained.
	· Engineered Geologic Repository	Geologic repositories are used to provide secure and remote containment for contaminated wastes.	Use of geologic repositories would involve the cost of reconstruction and may pose safety hazards.	Eliminated
	· Ocean Disposal	Dumping of materials with trace quantities of contaminants.	Not applicable. Contaminants higher than trace.	Eliminated
	· Beneficial Reuse	Contaminated soils are utilized as fill under hard surface public roads or airport runways.	Selection of a site may require BRA/RI/FS-EIS.	Retained
	· Permitted/Licensed Treatment and Disposal Facility	Transportation of contaminated soils to offsite treatment/disposal facility.	Not applicable because an appropriate treatment/disposal facility does not exist for the contaminants of concern.	Eliminated

[a] NCP = National Contingency Plan.
[b] NEPA = National Environmental Policy Act.

to detect further releases to the environment. It also serves as a baseline option for the CERCLA and NEPA evaluation process.

3.4.2 Institutional Controls for Soils and Sediments

The available institutional controls (fencing and posting of signs at the site, deed restrictions, site maintenance, and continued monitoring), as described in Table 3-4, can reasonably be implemented at the Tonawanda site. Technologies in this category can reduce exposure to the contamination but do not reduce the volume, mobility, or toxicity of the identified hazards. Environmental monitoring is usually a component of institutional control to determine migration and attenuation of contaminants at the site. The effectiveness of these actions remains to be determined, as such controls are highly dependent on the general public's willingness to comply with the legal restrictions. At properties not owned by DOE, deed restrictions and onsite security may be difficult to implement. Implementation of deed restrictions and onsite security may require that DOE buy property to ensure that these restrictions are adhered to for the sole purpose of minimizing contaminant exposures to the public health and the environment. Implementation of institutional controls with the assistance of state and local agencies are being conducted at other CERCLA sites.

3.4.3 Surface Water Controls for Soils and Sediments

A surface water control system would consist of stabilizing the stream bank to prevent erosion of stream sediments and/or diverting the surface water stream from the contaminated areas to access and remove contaminated sediments. At Rattlesnake Creek and other drainage ditches, stream banks can be stabilized through revegetation (e.g., grasses, legumes, shrubs, and trees) and grading (i.e., scarification and contour furrowing). Installation of erosion control devices such as silt fence and hay bales at the perimeter of the work areas is a cost effective means to minimize sediment runoff into wetlands and streams. Diversion can be implemented with dikes and berms, levees, flood walls, and pipe encasement. Implementing a diversion system in the creek would be an interim measure until dredging of contaminated sediments could be completed. Use of dikes and berms was retained as a cost effective technology in order to divert surface water flows away from the contaminated areas. Levees and flood walls are principally constructed as flood protection structures in areas subject to flooding. Levees and flood walls were screened out because of their limited applicability. Piping surface water flow is not applicable at the site. Creek flow is generally low or nonexistent near the sites, and the potential for redeposition of sediments due to stream flow is minimal. In addition, providing pipe flow is much more expensive than other options.

3.4.4 Containment for Soils and Sediments

Containment actions include technologies that involve little or no treatment but that protect human health and the environment by physically preventing contact with contamination.

Containment response actions reduce or eliminate contaminant migration and exposure routes by way of physical barriers. Engineered caps and soil covers, presented in Table 3-4, can be used to cover the contaminated soils and sediments at appropriate locations at the site to prevent the public from coming into direct contact with the waste. Barrier materials can be either natural low-permeability soils (e.g., clay), asphalt, concrete, synthetic membrane liners, or a multi-layered cap. The disadvantage of capping is that it does nothing to eliminate the source of radioactivity from the areas of concern; it simply impedes release by shielding and trapping. A soil cover (topsoil and vegetative layer) would primarily reduce exposures but would not eliminate the potential for migration.

3.4.5 Removal of Soils and Sediments

For soils and sediments, removal of contamination from areas of concern would involve complete or partial excavation and removal through physical means (i.e., using a bulldozer, backhoe, front-end loader, scrapers, dragline, or clamshell bucket). These response actions do not involve treatment but may be combined with treatment and/or disposal methods in developing remedial alternatives.

3.4.6 Treatment of Soils and Sediments

Treatment options include technologies that specifically reduce the toxicity, mobility, and/or volume of contaminants by chemical, physical, biological, or thermal processes. CERCLA, as amended, favors treatment processes that reduce contaminant mobility, toxicity, or volume, unless site conditions limit their feasibility. It should be noted that radioactive contaminants are not destroyed by treatment technologies. The volume of contaminated material may be reduced, but the concentration of contaminants will be much higher in the reduced volume. Therefore, some type of containment and/or disposal will be a required element of the final remedy. Treatment options considered will reduce the volume of wastes to be disposed, or will immobilize the contaminants for ultimate disposal. In the subsequent discussions of treatment options, current data on treatment feasibility are addressed. Treatment options are currently being evaluated for all FUSRAP residuals; feasible technologies may be identified for cost-effective volume reduction. Such technologies would be utilized for the Tonawanda residuals, if appropriate.

Volume-reduction technologies identified in Table 3-4 include chemical processes such as soil washing and organic solvent extraction. Physical volume reduction processes consist of screening, classification, flotation, gravity separation, and brickmaking. Immobilization technologies are either physical processes such as vitrification or chemical processes such as solidification.

Biological techniques are used mainly for organically contaminated media and do not pertain to the radioactivity contaminated waste materials at the Tonawanda site.

Thermal technologies involve destroying or incinerating waste materials with a rotary kiln or fluidized bed equipment. Generally, the incineration technologies are used extensively for destruction of organic compounds. Incineration is not an effective treatment for the contaminants at the Tonawanda site. A reduction in waste volume would occur, but additional waste streams such as ash, wastewater, and gaseous waste would be generated that would require additional treatment and/or disposal.

The treatment options for soils and sediments identified in Table 3-4 are capable of being implemented in three basic methods: in situ treatment, onsite treatment, and offsite treatment. These treatment methods are described below and the options have been initially screened within each treatment method as it relates to the implementability and effectiveness of the technology and the COCs.

3.4.6.1 In Situ Treatment

In situ treatment allows the contaminants which exist in the various media to be addressed in place. In situ treatment is preferable when removal is not feasible and when in situ permeabilities promote easy dispersion of treatment reagents. The advantages of in situ treatment are that it:

- does not require handling the media and thus reduces the risk of exposure,
- minimizes disposal of waste materials, and
- results in minimal disturbance to the existing site.

For the in situ treatment option, in situ chemical extraction methods such as organic solvent extraction and both immobilization technologies known as solidification and vitrification can be considered.

Some form of in situ chemical extraction (e.g. soil washing or organic solvent extraction) could be attempted by injecting a surfactant into the ground through injection wells. Recovery wells would then have to be installed to withdraw the solution and treat it further to remove the radioactive contaminants. In situ solution mining has been used by industrial uranium extraction and processing companies in the western United States for high-radioactivity-level processing. The technology has principally been used in sandy soils found in the western United States. Contamination of the perched groundwater and the shallow semi-confined aquifers discussed in Section 2 could occur because of the large volume of waste products generated resulting from the injection of surfactants and the inherent difficulty in controlling the treatment process. Extensive site testing and evaluation (i.e., pilot testing) would have to be conducted to determine if this technology would be effective for the low activity soils. According to the boring logs from the RI, the uppermost soil unit at the Tonawanda site is a glacial till that ranges in thickness from 6 to 12 m (20 to 40 ft). Since the COC exist primarily in the glacial till, dispersion of surfactants through injection wells would not be effective due to the low permeability associated with the glacial till. Because of the uncertainty regarding the effectiveness of the technology on the site soils, and because of possible negative environmental impacts such as a release of more mobile forms of contamination into the aquifer, this technology has been eliminated from further consideration.

In situ solidification can be achieved by injecting a solidifying agent into the contaminated material. If the process is successful, the contaminated material will be bound together within a solidified matrix. Application of in situ solidification would require extensive and detailed testing on a bench and pilot scale. It may be difficult to ensure that solidification has been effective on the complete soil mass. Because the method is being conducted in situ, only centralized areas of contamination can be treated; scattered pockets of contamination may have to be addressed by some other method. The treated area and the large surrounding area of buffer zone would have to be purchased and fenced off. The area would not be appropriate for future use because of the continued existence of solidified contaminants onsite. Because of the uncertain implementability and effectiveness regarding dispersion of solidifying agents into a low permeability soil and the significant negative impacts of the technology, in situ solidification will not be considered further.

In situ vitrification can be used to convert radioactively contaminated soils into a stable, glass-like solid mass. This is accomplished by setting up electrodes within the boundary of the contaminated soils and passing electrical current through the electrodes. The soils within the boundary are heated to their melting temperatures and solidify to a glassy mass upon cooling. There are several drawbacks to in situ vitrification. The very high temperatures required for the process destroy any life forms in the soils not only within the vitrification boundary but in a large area outside the boundary. It would also be difficult to ensure that all wastes within the in situ matrix have been vitrified. Conducting the process in situ would mean that only centralized areas of contamination could be vitrified; scattered hot spots of contamination could not be treated. Implementation of in situ vitrification would be impractical because of the dispersed and heterogenous nature of affected media at the Tonawanda site. The metal precipitates at Linde and metal concentrations at the other Tonawanda properties above U.S. background concentrations could result in shorting of the electrodes. The vitrified mass, although immobilized, would remain radioactive, which would require continued monitoring, and future use of the site would be prohibited. Because of its uncertain effectiveness and significant negative environmental impacts, the in situ vitrification option will not be considered further.

Physical volume reduction processes such as screening, classification, flotation, gravity separation, and brickmaking are not applicable technologies for in situ treatment.

3.4.6.2 Onsite Treatment

The onsite treatment response allows for contaminants which exist in the various media to be treated in above-ground units within the site boundaries. It first requires removal of the contaminated media.

Onsite treatment has several advantages over in situ treatment:

- It allows treatment of contaminated material in above-ground units where the process environment can be controlled to provide greater reliability and effectiveness than in situ applications for any given treatment process.

- The treatment technology for above-ground processes is more advanced than for in situ treatments.

- The advantages of consolidating the material to be treated and the ability to mix or otherwise handle it greatly increase the cost effectiveness of most treatment processes over in situ applications.

Several ex situ physical process options were screened for technical implementability, including soil washing, organic solvent extraction, solids/particle separation (screening, classification, flotation, and gravity separation), brickmaking, vitrification, and solidification.

Soil washing can be used to mechanically and/or chemically scrub soils to remove contaminants. This technique can remove contaminants by dissolving them in a solution or by separating the contaminants through particle-size distribution. Soil washing techniques generally are used for removal of heavy metal and organic contaminants. Soil washing can be used alone or in combination with other treatment options. This method could reduce the volume of contaminated soils, but concentrates those contaminants of concern when used as a pretreatment response. Contaminated coarse sand and gravel soils have effectively been treated by soil washing for a wide range of organic, inorganic, and radioactive contaminants. Soils containing a large amount of clay and silt typically are not effectively treated by soil washing because radionuclides tend to adhere to fine-grained particles. The Tonawanda site soil types are primarily fine-grained. At best, the effectiveness of soil washing is related to the ratio of fine-grain to coarse-grain soils ratio. The volume reduction realized is directly proportional to the amount of coarse-grained material removed from the waste stream.

Chemical extraction processes can be employed in which the waste soils are mounded onto an impermeable pad and the extracting chemical allowed to percolate through the solid matrix. The leachate is collected for further processing. In more complex processes, better control is achieved of operating parameters such as temperature and residence time, and a sequence of operating steps is employed. The main disadvantage of chemical extraction processes is the increased operating and capital costs due to expensive reagents, higher operating temperatures, and the potential for equipment corrosion. The extraction processes to remove radionuclides have been demonstrated for the tailings and refuse piles from uranium processes with the goal of cost-effectively reclaiming the radionuclides for resale. In addition, the resulting extract is highly toxic and could create a waste stream more harmful than the original waste mixture.

Although volume reduction technologies utilizing chemical processes have been extensively used in extracting uranium from mineral ores (which are high-activity materials), their use in cleaning contaminated soils to acceptable limits has been limited to laboratory and pilot plant testing (EPA 1988b). Soils at the Tonawanda site have low radionuclide activity and would require longer residence times, resulting in larger volumes of more dilute hazardous solutions. The applicability of these technologies for the fine-grained soils at the Tonawanda site would have to be determined through extensive laboratory and pilot-scale testing. The volume reduction for the radioactivity contaminated materials would be proportional to the amount of coarse-grained soil present in the waste which based upon the boring logs in the RI is minimal. Locating a site for this treatment process would require extensive permits and other regulatory controls. At this time, volume reduction technologies utilizing chemical processes have, therefore, been screened out due to the potential of generating large volumes of hazardous solutions, limited effectiveness of treating low activity soils, and the inability to effectively reduce the volume of contaminants due to the fine-grained nature of the waste.

Solids separation techniques can be used to separate solids by physical processes such as mechanical screening, classification, flotation, and gravity separation. This technology has been used to extract radionuclides from ores. Generally, this option has been used as pretreatment for a primary treatment process. The success of implementation of solids separation techniques varies with soil/radionuclide particle-size distributions. A treatability study is being conducted to determine if there is a relationship between radionuclide concentrations and particle-size distribution for the Maywood FUSRAP site in New Jersey. Solids/particle separation involves the separation of contaminated material to concentrate the contaminants of concern; contaminants associated with a specific particle size can be mechanically separated out of the soil media. Chemicals may be added in small amounts to adjust pH and to improve efficiency of the process. This process option is potentially applicable and has been retained for further consideration.

The application of brickmaking for volume reduction in environmental restoration is relatively new. The proven conventional brickmaking technology to be used on contaminated soil could potentially reduce disposal volume and, therefore, reduce disposal costs. Brickmaking technology was proposed by the Mound facility in Miamisburg, Ohio, to compact and package contaminated soil. Mound has been evaluating soil for its brickmaking properties with the help of a U.S. brickmaking equipment manufacturer. The brickmaking process extrudes the soil into rectangular blocks that can be cut into any desired length. A disposal volume reduction of 23% was proposed for the contaminated soil (DOE 1992). This process could be used at the Tonawanda site to further reduce the volume of concentrated residuals in a combination of treatment steps or as a single treatment option for reduction of contaminated soil volume, if disposal site capacity becomes a concern.

Vitrification involves the immobilization of inorganic constituents in waste by dissolving the waste into a glasslike matrix. Vitrification is a high-temperature process [conducted at 1100–1400°C (2012-2552°F)]; therefore, small quantities of inorganics may be volatilized during the process. Afterburners may be required on the exhaust stream to convert the partially burned organics to carbon dioxide. In vitrification, glassmaking constituents and waste are blended and then fed into a glassmaking furnace. In the high-temperature furnace, the waste materials are dissolved or suspended in the molten glass. Upon cooling, a solid mass forms that contains the dissolved or suspended waste. The waste soil would require a drying pretreatment step to reduce the moisture content below 5% free moisture level.

After vitrification, the waste constituents are unavailable for reaction due to their chemical bonding and entrapment within the glass matrix. Vitrification has also been shown to reduce the gamma dose rate for gamma-emitting radionuclides due to the increase in density of the vitrified matrix. In addition, both alpha and beta emitters are sealed in the glass matrix formed during the vitrification process (EPA 1991b). Ex situ vitrification has been determined to be potentially applicable.

Solidification techniques, also known as stabilization or fixation, apply to solid, liquid, or sludge waste. Solidification techniques can reduce the mobility of contaminants and thereby reduce potential hazards to human health and the environment. Solidification combines a formulated reagent with the waste to create a solidified matrix. Stabilization technologies can be categorized by the primary stabilizing agent used (i.e., thermoplastic-based or organic-polymer-based). Stabilization has been used effectively to stabilize soils contaminated with inorganic waste streams.

Solidification of excavated soil employs various cement- and silicate-based mixtures to act as physical solidifying agents. Solidification may significantly increase the volume of waste for disposal. The resulting solids resist leaching, thereby minimizing the migration of contaminants to groundwater. Therefore, this process option is potentially applicable.

3.4.6.3 Offsite Treatment

This response involves completely removing the contaminated media from the site and treating it at a full-scale, fixed offsite facility. Offsite treatment involves removal of the contaminated soils and sediments, possible pretreatment, containerization, and transportation to an offsite facility. All permits required for transportation of the waste must be obtained.

There are no known operational DOE or commercial offsite facilities which can receive and treat wastes from the Tonawanda site. Siting of any offsite facility requires extensive pilot tests and design and permitting procedures. A multitude of emergency treatment technologies are being developed and tested at various DOE and commercial pilot plant treatment facilities. Therefore, the offsite treatment option would not be considered further until a full-scale treatment facility is developed, permitted, and constructed, which is appropriate for the treatment of the Tonawanda wastes.

3.4.7 Disposal of Soils and Sediments

Onsite disposal enables the contaminants which exist in the various media to be handled onsite without any offsite transportation requirements; therefore, it is preferred over offsite disposal whenever feasible and protective. Disposal could occur in an encapsulated cell that would be built onsite with complete barrier protection consisting of natural low-permeability soils.

Offsite disposal involves completely removing the contaminants which exist in the various media and disposing it offsite. For the Tonawanda soils and sediments, these actions could involve containerization (where applicable) and transportation before ultimate disposal of the soils and sediments. All necessary permits for transportation and disposal of the waste would have to be obtained. This response is preferable when onsite disposal is not feasible due to technical constraints.

Transportation options include truck, barge, or rail. Transportation of the radionuclide-contaminated soils and sediments from the Tonawanda site would require compliance with regulations controlling the transport of radioactive materials. Waste soils would have to be containerized appropriately (where applicable) to provide required shielding and to comply with applicable packaging requirements. Appropriate containers include 55-gal drums, steel boxes, or wooden crates. Bulk transportation would also be considered where appropriate.

Of the offsite disposal options, land spreading, disposal in engineered geologic repositories, ocean disposal, and disposal at a permitted licensed treatment and disposal facility would not be considered further. Offsite disposal at a new specially-designed facility at a location within New York, a new specially-designed facility on DOE property (in either the eastern or western U.S.), an existing federal facility, or an existing commercially-licensed facility, as well as beneficial reuse, would be considered further.

The land-spreading disposal option has not been demonstrated as a viable option at other contaminated sites. The types of materials that could be accepted would probably fall within a very narrow range of physical and chemical characteristics, such that only a small portion of the soils from the sites could be disposed of and removed. Potential problems associated with emission of respirable particles containing low radionuclide activity levels exist. Land spreading allows for uncontrolled contact with the atmosphere and, therefore, does not fully protect human health and the environment. This option is inconsistent with DOE Orders. In addition, land spreading could contribute to nonpoint source pollution problems generated by native soil. Land spreading, therefore, would not be considered further.

Disposal of the contaminated soils in engineered geologic repositories is another option. Geologic repositories are typically considered for high-activity wastes and may not be appropriate for the Tonawanda site low-activity soils. The use of geologic repositories would involve the cost of reconstruction and possible consequent safety hazards. Due to these concerns, engineered geologic repositories would be expected to be the most expensive of the disposal options. Disposal in geologic repositories is, therefore, not warranted for the low-activity soils at the site and will not be considered further.

The disposal of materials in the ocean is regulated under 40 CFR 220 through 225 and 227 through 229. Dumping is controlled via a permit system. Dumping of materials with trace quantities of radionuclides is authorized by 227.6(b) if the material will not cause significant undesirable effects as tested according to 227.6(c). Although FUSRAP wastes should easily pass any immediate hazard test criteria, the radionuclides are probably present in more than "trace" quantities, eliminating the ocean disposal option. In any event, radioactive materials must be contained as per 40 CFR 227.11 to prevent their direct dispersion or dilution in ocean waters. According to 40 CFR 227.11(b)(1), materials must decay to environmentally innocuous materials within the life expectancy of the container and/or the matrix. This requirement precludes the disposal of materials with long half-lives. Therefore, ocean disposal will not be considered further.

A new disposal facility designed and constructed at an offsite location could be used for waste disposal. Such a location could either be in the State of New York or on existing federal land, or federally purchased land, in either the eastern or western portion of the U.S. The requirements of such a facility would be similar to those of an onsite land encapsulation cell. Potential problems associated with this option would include difficulties in locating a site for the cell. Political and social issues and regulatory requirements enforced by the State of New York or other states may contribute to the difficulty in implementing this option. Because this option of a new disposal facility could reduce potential exposure and minimize the migration of contaminants, it will be considered further.

There is no DOE facility in the general area that could be used for disposal. A permanent facility is located in Niagara Falls, but cannot accept additional waste for disposal. DOE radioactive waste facilities that accept offsite wastes outside the Tonawanda region include the Hanford Reservation facility in Hanford, Washington and the Nevada Test Site. All these facilities will be considered further as disposal options.

Several privately-owned commercial facilities that may provide disposal capacity for FUSRAP waste include the Envirocare facility in Utah; the United States Ecology operates a site near Richland, Washington; the Chem Nuclear Systems facility near Barnwell, South Carolina; the American Nuclear Corporation–owned facility in the Gas Hills District of Wyoming; and the Texcorp Industrial–owned facility in Del Rio, Texas. In addition, United States Ecology has filed license applications for two new low-level waste (LLW) facilities in Ward Valley, California and Butte, Nebraska, to serve the Southwestern and the Central Interstate Compacts, respectively. Chem Nuclear Systems presently has filed a license application for an LLW facility near Martinsville, Illinois for the Central Midwest Compact. Use of any of these facilities for Tonawanda would depend upon them obtaining the appropriate license(s) for the Tonawanda material.

Beneficial reuse involves excavating the contaminated soil and using it in a constructive manner, such as industrial fill material during construction of roads, highways, airports, and landfill cover. For beneficial reuse in roadbed applications, to comply with the level of control specified in 40 CFR 192, only newly-constructed interstate highways or airport runways would be appropriate for such dispersal. In addition, potential hazards exist to workers who might be exposed during the construction phase. If the material was used as industrial fill, demonstration would be required that groundwater in the subsurface would not be affected and that the soil meets the specifications for fill. Additional possible uses for the soil might be as "fill" material in waste disposal cells at operating disposal facilities. NRC approval will also be obtained, as necessary, for any uses of the radiologically-contaminated soils at facilities not owned by DOE. Beneficial reuse would be retained for further consideration.

Finally, transportation of contaminated material to a permitted/licensed treatment and disposal facility is considered not applicable because no facility currently exists.

3.5 IDENTIFICATION OF REMEDIAL ACTIONS TECHNOLOGIES AND OPTIONS FOR BUILDINGS AND STRUCTURES

Table 3-5 summarizes the preliminary review of remedial options applicable to buildings and structures at the Tonawanda site. Buildings and structures are located only at the contaminated Linde site; no buildings at the other properties require remediation.

3.5.1 No Action for Buildings and Structures

Under the no-action alternative, no remedial action would be taken to reduce risk, and the present status of the buildings and structures would remain unchanged. This alternative would be retained throughout the FS evaluation, as it represents the current site practice of routine monitoring for radioactivity inside and outside the buildings and structures. Further, it serves as the baseline case for the CERCLA and NEPA evaluation process.

3.5.2 Institutional Controls for Buildings and Structures

Institutional controls that could be considered for the Tonawanda site include site security and posting of signs, deed restrictions and notices, and continued monitoring, as identified in Table 3-5. Access restrictions with appropriate posting of signs and monitoring are already in effect at Linde. Use of deed restrictions and notices to prevent direct contact of the public with the contaminated areas of the buildings may be difficult to implement at Linde because DOE does not own the property. Purchase of buildings by DOE may be required. Implementation of institutional controls with the assistance of state and local agencies is being conducted at other CERCLA sites.

3.5.3 Containment of Radionuclides on Buildings and Structures

The radionuclide contaminants on the surfaces of buildings and structures can be contained by applying a sealant. This would minimize direct contact with radioactive contaminants, control mobility, and prevent further spread of contamination into the ambient atmosphere. Sealing could be accomplished by painting, applying resins or plastics, and using other impermeable materials. Surface sealants do not remove contaminants or absorb radioactive contaminants, although some loose contaminants may be absorbed by the sealants. Surface

Table 3-5. Review of Remedial Action Technologies and Options for Buildings and Structures at the Tonawanda Site

Response Action	Remedial Technologies and Options	Description of Remedial Technology Process Option	Comments	Screening Status
1. No Action	None			
	• Includes Continued Environmental Monitoring	No actions taken to reduce risk.	Required for consideration by NCP[a] and NEPA[b].	Retained
2. Institutional Controls	Site Security			
	• Fencing/Signs	Restrict access with a fence. Post warning sign.	These steps are already being implemented at Linde.	Retained
	Institutional Actions			
	• Deed Restrictions • Deed Notices	Initiate deed restrictions to constrain future use and prevent direct contact with the building surfaces.	May be extremely difficult at Linde. May require purchase of buildings.	Retained
	Environmental Monitoring			
	• Monitoring of Ambient Air	Periodic sampling and continuous monitoring of ambient air and buildings and structures.	Air monitoring is already being conducted at Linde.	Retained
3. Containment	Surface Sealing	Surface sealing involves covering the contaminated surfaces with appropriate sealants to prevent direct contact with the contaminants, control mobility and further spread of contaminant.	Does not remove or treat the contaminants.	
	• Painting	Use of paints on masonry and wooden surfaces.	Short term measure; maintenance required.	Retained
	• Application of Resin/Plastic	Spray application of plastic/resin to form an impermeable barrier.	Short term measure; maintenance required.	Retained
	• Use of other impermeable materials	This could include the use of plastic sheeting or wall board.	Short term measure; maintenance required.	Retained

Table 3-5. (continued)

Response Action	Remedial Technologies and Options	Description of Remedial Technology Process Option	Comments	Screening Status
4. Removal	Demolition	Removal of contaminated buildings and structures using heavy construction equipment.	Demolition of buildings and structures is a long-term process and would have to be scheduled in proper sequence with proper coordination with building owners.	
	• Partial Demolition	Blasting, wrecking, sawing, drilling or crushing of appropriate section of buildings and structures.	This results in reduced volume of materials that would have to be disposed of.	Retained
	• Total Demolition	Complete demolition of buildings and structures using appropriate methods.	More easily done. Best suited if entire building is contaminated.	Retained
5. Decontamination	Physical Decontamination Procedures			
	• Scrubbing, scrapping, sanding, grinding; pelletized CO_2 (dry ice) or sand blasting	All methods employ physical force to achieve mechanical separation of contaminant from the surface of the material.	Works best on wooden and masonry surfaces. Collection of dust and particulate matter is important.	Retained
	Chemical Decontamination Procedures			
	• Use of water, solvents, acids and bases, and complexing agents	A variety of chemicals are used to dissolve contaminant present on the surface.	Waste water or extractants should be collected to prevent spread of contaminants.	Retained
6. Treatment	Volume Reduction			
	• Shredders • Impact Crushers • Hammer Mills	Following demolition activities, structural solid waste can be reduced in volume to minimize transportation and disposal costs.	Applicable primarily to wooden structures. Air pollution controls would be required.	Retained as a pretreatment option prior to disposal
7. Storage/Disposal	Onsite Disposal and Offsite Disposal	Disposal options would be the same as those identified under soils/sediments.	Any wastes generated from decontamination and dismantlement of building surfaces would be disposed of along with the contaminated soils from the sites.	Retained
	Offsite Disposal in a Solid Waste Landfill	Demolition debris is transported to a solid waste landfill for disposal.	Radioactivity of demolition debris must be below required levels for disposal in a solid waste landfill, where allowed by state regulations.	Retained

[a] NCP = National Contingency Plan.
[b] NEPA = National Environmental Policy Act.

sealants are not effective in reducing direct gamma exposure. The mobility and further spread of contaminants into the ambient air is reduced. This reduces the potential for dermal contact, ingestion, and inhalation exposure; however, direct external exposure may not be significantly reduced.

3.5.4 Removal of Buildings and Structures

This response action involves a variety of methods to completely or selectively demolish buildings, structures, or equipment by blasting, wrecking, sawing, drilling, and crushing. If the walls, roofs, or other surfaces of the buildings or structures are contaminated, it may be appropriate to decontaminate or remove the contaminants before demolition. The appropriate demolition method to be used would require evaluation during the design stage. For the purpose of this screening, all the methods mentioned above would be considered appropriate.

3.5.5 Decontamination of Buildings and Structures

Several decontamination procedures can be implemented to remove the contaminants inside buildings and structures. It is expected that most of the decontamination methods can reduce the contaminant levels below the applicable standards. If the decontamination efforts do not effectively remove the contaminants to the appropriate levels, the buildings and structures may have to be decommissioned, demolished, and disposed.

Decontamination can be accomplished by using water, solvents such as acids and bases and complexing agents, or mechanical methods such as scrubbing, scraping, sanding, grinding, or blasting the building surfaces with pelletized carbon dioxide or sand. Any media utilized during the decontamination process would require testing to determine appropriate disposal methods. For building surfaces not amenable to decontamination, partial demolition would provide protection in meeting standards.

3.5.6 Treatment of Buildings and Structures

Following demolition of buildings and structures, the volume of demolition waste can be reduced with shredders, impact crushers, and hammer mills to minimize transportation and disposal costs. Volume reduction would apply to wooden and sheet metal structures only, and would be cost effective if a large volume of demolition debris required removal and disposal. Air pollution controls would be required to control particulate emissions. This remedial option would be considered a pretreatment option for the disposal response actions.

3.5.7 Disposal of Materials from Remediation of Buildings and Structures

Options for disposal of demolished building materials would be similar to that for soils and sediments. In addition, if the building materials are decontaminated to levels allowing for the release of the material by DOE for unrestricted use, they can be disposed at a solid waste disposal facility.

All remedial options identified in Table 3-5 for buildings and structures are retained for further evaluation.

3.6 PRELIMINARY EVALUATION AND SCREENING OF REMEDIAL OPTIONS

In this step, the number of potentially applicable remedial options is reduced by using the criteria of effectiveness, implementability, and cost to evaluate and screen the options. This step eliminates those options not viable for the Tonawanda site from further consideration and focuses on options that are effective and implementable in addressing the contamination at the site. At this stage, effectiveness is the most important criterion with less emphasis on implementability and cost.

Effectiveness Evaluation Criteria

The identified remedial options were evaluated to ensure that they would effectively protect human health and the environment and satisfy the general response actions defined for the media of concern. The ability and effectiveness of each specific remedial option to reduce the contaminant concentrations or exposure levels or to sufficiently recover contaminated media for subsequent treatment were evaluated on their protection of human health and the environment and their lack of adverse environmental effects. The performance evaluation of a particular option involved a technical assessment of the option's ability to achieve the remedial action objectives. Another criterion of the performance evaluation was the useful life of a technology process, or the length of time that it performs its intended function. As part of the effectiveness evaluation, it was also determined how well-proven and reliable the process is with respect to the radioactive contaminants and geologic conditions at the site. Reliability is an important concern because of the significant operation and maintenance (O&M) requirements associated with most technology process options and the importance of protecting human health and the environment. Long-term management requirements for residual contamination and/or untreated wastes reduce the effectiveness of a technology. Therefore, the degree of long-term management required for each technology was considered as part of the evaluation.

Implementability Evaluation Criteria

Implementability criteria encompass both the technical and institutional feasibility of remedial options. Two criteria are that (1) the remedial option is constructable, and that (2) it can be constructed and implemented within a reasonable period of time. Constructability addresses both onsite and offsite conditions. The time required for implementation and for realization of beneficial results is critical in protecting human health and the environment. Safety is another aspect of technical feasibility. Short- and long-term threats to public safety and the safety of site workers were identified. Exposure of onsite workers or the public to hazardous substances was also considered for excavation and demolition activities.

The institutional aspects of implementability are also important. In selecting remedial technology process options, primary consideration was given to options that attained ARARs. Further, for each remedial option, the ability to obtain necessary approval from government agencies is important. In addition, the availability of approved treatment and disposal facilities, and capacities and availability of necessary equipment and skilled workers to implement the technology were considered.

Site- and waste-limiting characteristics that might influence the effectiveness and implementability of a remedial option were considered as well. Site- and waste-limiting parameters used in the preliminary evaluation and screening of remedial options included:

- waste volume,
- waste matrix,
- physical/chemical hazards (such as volatility, solubility, and specific chemical constituents in the waste matrix),
- present configuration that might influence the final disposition of the contaminated wastes, and
- environmental impacts of each remedial option.

Cost Evaluation Criteria

Cost played the smallest role in the initial screening of remedial options. Relative capital costs and O&M costs were used rather than detailed estimates. During this phase, the cost analysis was based on engineering judgment, and each remedial option was evaluated as to whether costs were high, low, or moderate relative to other remedial options within the same class of remedial technology.

The preliminary evaluation and screening of remedial options are presented separately for soils and sediments (Section 3.6.1) and for buildings and structures (Section 3.6.2).

3.6.1 Preliminary Evaluation and Screening of Remedial Options for Soils and Sediments

Table 3-6 presents the results of the preliminary evaluation and screening of remedial options for soils and sediments. Brief summaries of those results are provided in the following sections.

3.6.1.1 No Action

To comply with the integration of NEPA values with CERCLA requirements and procedures, this response action is retained throughout the FS evaluation.

Table 3-6. Preliminary Evaluation and Screening of Remedial Options for Soils and Sediments at the Tonawanda Site

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
1. No Action	None				
	· Includes Continued Environmental Monitoring	Would not be effective in reducing risk.	There are no process options.	Low O&M[a] cost for monitoring.	Retained; required for consideration by NCP[b] and NEPA[c].
2. Institutional Controls	Site Security	Fencing may reduce direct contact with contaminated soil, but would not comply with all remedial action objectives.	Tonawanda properties are already fenced and security is already being implemented by owners. Implementation at other properties may be difficult.	Moderate capital; very low O&M costs.	Retained
	Deed Restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination.	Implementable only at DOE-owned properties.	Negligible costs.	Retained
	Environmental Monitoring	Useful for documenting and evaluating conditions, but does not reduce the risk by itself.	Implementable.	Low capital; moderate O&M costs.	Retained
3. Surface Water Controls	Scarification and Contour Furrowing	Effective in controlling infiltration, diverting runoff, and minimizing erosion.	Implementable in Rattlesnake Creek only at strategic location; more easily implementable at drainage ditches from site. Periodic regrading may be required. Large quantities of cover soil may be necessary.	Moderate costs.	Retained for use in specific locations along Rattlesnake Creek.
	Grasses, Legumes, Shrubs, and Trees	Effective in reducing erosion and stabilizing the surface of a covered disposal site, thereby improving the effectiveness of a cap. Phytotoxic chemicals in cover soil could impact growth of vegetation. May require soil treatment prior to planting.	Implementable. Applicable only to areas with soil cover. Not suitable potentially without grading, capping, and venting.	Moderate capital; Moderate O&M costs.	Retained for use as an interim measure to control erosion and reentrainment.
	Erosion Control	Effective in minimizing erosion.	Implementable at all properties.	Low costs.	Retained
	Site Maintenance	Effective in reducing erosion when vegetative cover is maintained.	Implementable at all properties.	Low capital and O&M costs.	Retained

Table 3-6. (continued)

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
3. Surface Water Controls (continued)	Dikes and Berms	Effective as a short-term measure in controlling and diverting flow.	Implementable. Not effective for unsloped drainage areas larger than 5 acres. Also, not applicable for large amounts of surface water flow. Applicable only for short-term protection.	Moderate costs.	Retained for use in specific locations along Rattlesnake Creek and drainage ditches from sites.
4. Containment	Clay Cap	Effective; susceptible to cracking (certain minimum moisture content should be maintained at all times), but has self-healing properties.	Implementable as an interim measure only. Capping of sediments may be difficult.	Moderate capital; low O&M costs.	Retained
	Asphalt Cap	Effective.	Can be used, but is highly susceptible to cracking.	Low capital.	Eliminated[d]
	Concrete Cap	Effective.	Can be used, but is highly susceptible to cracking.	Low capital.	Eliminated[d]
	Synthetic Membrane Liner	Effective.	Implementable, but soil cover must be maintained over liner to prevent degradation.	Moderate capital; moderate O&M costs.	Eliminated[d]
	Multimedia Cap	Effective and least susceptible to cracking.	Implementable, but would restrict future land use. Can be used as effectively as a clay cap with the same restrictions.	Moderate capital; low O&M costs.	Retained
	Soil Cover (Topsoil and Vegetative Cover)	Effective only in reducing direct contact exposure and not infiltration.	Implementable at site soils with low activity levels.	Moderate capital; low O&M costs.	Retained
5. Removal	Partial Excavation	Would be particularly effective in removing high concentration levels of contamination.	Implementable at Linde where only certain portion of the soils may have to be removed. Excavation of sediment in Rattlesnake Creek is practical. Excavation of soils in some areas may be difficult due to specific land use in that area (e.g., where there are roads, buildings, and property rights requirements.	High costs.	Retained

Table 3-6. (continued)

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
5. Removal (continued)	Complete Excavation	Would be effective in removing all areas of contamination to the required action levels.	Can be implemented easily at Ashland 1 and 2. Excavation would be conducted to the cleanup level. See also comment on Partial Excavation.	High costs.	Retained
6. Treatment[e]	Screening	Would be effective in separating fine particles with radioactivity. Saturated soils would require dewatering before screening.	Implementable; however, substantial additional information would be required and pilot tests would have to be conducted.	High costs.	Eliminated
	Classification	Soils with a lot of clay would be difficult to process.	Difficult to implement for large volumes of soils due to slow throughput rates.	High costs.	Eliminated
	Flotation	Particularly useful only in removing silt particles (0.1 to 0.01 mm).	Difficult to implement for large volumes of soils due to slow throughput rates.	High costs.	Eliminated
	Gravity Separation	Fine particles with radioactivity can be separated.	Implementable; however, substantial additional information would be required and pilot tests would have to be conducted. Also, only a limited amount of solids can be processed at a time.	High costs.	Eliminated
	Brickmaking	Potentially effective for volume reduction.	Implementable; conventional brickmaking equipment needed.	Moderate costs.	Eliminated
	Vitrification	Effective in treating radioactive contaminants in the soil/sediment matrix. Not effective on wastes with high moisture content. Natural limestone in native soils may cause problems.	Implementable; however, energy requirements would be high.	High costs.	Retained
	Solidification	With the use of available innovative technologies radionuclides can be treated along with organics and inorganic chemicals. Organic contaminant could hinder curing of solid matrix.	Implementable; but treatability testing would be required to determine optimum mix ratios.	High costs.	Eliminated

Table 3-6. (continued)

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
7. Storage/ Disposal	Onsite Disposal by Land Encapsulation	Effective, if an appropriate location can be found.	May not be easily implementable. Must comply with all applicable regulations. Presence of radionuclides in waste could make siting a disposal area difficult.	Moderate to High costs.	Retained
	Offsite Land Encapsulation at a Dedicated DOE FUSRAP Facility (New York, Eastern, or Western U.S.)	If properly designed in accordance with all regulatory requirements, can be an effective disposal option.	May not be easily implementable because capacity may not be available. Must comply with all applicable regulations. Presence of radionuclides could make siting a disposal area difficult.	Moderate to High costs.	Retained.
	Offsite Existing DOE Facility	Effective, if an appropriate location can be found.	May not be implementable because capacity may not be available.	High costs.	Retained
	Offsite Disposal at a Commercially Licensed Facility	Effective, if an appropriate location can be found.	May not be implementable because capacity may not be available. Must comply with all applicable regulations.	Moderate to High costs.	Retained
	Beneficial Reuse	Potentially effective for soils with low activity levels. Potential impacts to human health and the environment may still exist from the presence of radionuclides.	Implementable if specific projects can be identified for use such as construction fill or road bed fill.	Moderate to High costs.	Retained

[a] O&M = Operation and maintenance.
[b] NCP = National Contingency Plan.
[c] NEPA = National Environmental Policy Act.
[d] An asphalt and concrete cap and synthetic membrane liner have been eliminated in favor of a clay and multimedia cap. Following CERCLA guidance, one process option is chosen as representative of that particular remedial technology. More than one process option can be chosen if warranted. A clay or multimedia cap is best suited for the Tonawanda site.
[e] Treatment options are current being evaluated for all FUSRAP residuals; feasible technologies may be identified for cost-effective volume reduction.

3.6.1.2 Institutional Controls for Soils and Sediments

The remedial options under this response action include site security, deed restrictions, site maintenance, and environmental monitoring as presented in Table 3-6. All sites already have site security with a protective fence and locked gates that permit only authorized personnel to enter. In addition to the security measures already in place, warning signs would be posted around the sites. An inspection of the fence and gates would be required to determine if repairs are warranted to prevent unauthorized access to the site.

Restrictions on future development at the properties would be incorporated into the property deeds to limit land use should the property be sold in the future. Deed restrictions may not be effective for the property DOE does not own.

Soils and sediments would be monitored to ensure that contaminants do not disperse offsite, where they could impact human health and the environment.

3.6.1.3 Surface Water Controls for Soils and Sediments

Grading (scarification and contour furrowing) is the general term for techniques used to reshape the surface of areas in order to manage surface water infiltration and runoff while controlling erosion. These techniques are effective when used with other management methods such as capping and vegetation. Certain portions can be implemented at the stream and at areas of the site adjacent to the stream where runoff could enter Rattlesnake Creek. Grading has been retained as a remedial option.

Establishing a vegetative cover by planting grasses and shallow rooting shrubs is a cost-effective method of stabilizing a disposal surface, especially when preceded by capping and grading. It is easily implementable and costs are generally low. Vegetative covers are retained for further consideration.

Erosion control methods utilizing hay bales and silt fencing are implementable, cost-effective solutions for minimizing offsite migration of contaminated soil particles. Establishing these erosion control barriers at the limits of the work area would be included as part of any earth intrusion activity. Erosion control methods would be considered further.

Dikes and berms are well-compacted earthen ridges or ledges constructed immediately upslope from or along the perimeter of contaminated areas. These structures are to provide short-term protection (for no more than a year) for critical areas by intercepting runoff and diverting water flow. They can be implemented in Rattlesnake Creek in the short term until contaminated sediments are dredged from the site. They can also be designed and implemented at the drainage ditches emanating from the site and leading to Rattlesnake Creek. This remedial option has been retained for further consideration.

3.6.1.4 Containment for Soils and Sediments

The containment response provides protection for human health and the environment by reducing direct contact with contamination. The potential remedial technologies identified include in situ capping and providing a soil cover. The various remedial containment options are presented in Table 3-6.

Migration of radionuclides to groundwater could still occur even with a properly constructed cap because of the lack of an engineered base liner. Considering the half-lives of most radionuclides, a cap may have to be maintained for several hundreds or thousands of years. Such a long-term maintenance commitment would be impractical. Capping can be accomplished by a clay or a multimedia cap, both of which are potentially applicable. Asphalt and concrete caps were screened out because they are susceptible to cracking. A synthetic membrane liner was screened out due to high maintenance requirements. A clay or multimedia cap is best suited for the site because of its lower maintenance requirements. A soil cover in the form of topsoil and vegetation was also retained for potential application at some locations.

Cap design and construction should consider the need to:

- attenuate the gamma radiation associated with present radium [for normal soils, the depth of cover required for gamma radiation shielding is on the order of 60 cm (23 in.)];
- provide long-term minimization of water infiltration into the contaminated material;
- function with minimum maintenance;
- promote drainage and minimize erosion; and
- have a permeability less than or equal to the permeability of any bottom liner system present or of the natural subsoils (EPA 1988a).

Both the clay cap and the multimedia cap are effective and implementable in containing contaminated soils and sediments. The capital costs for a multimedia cap are slightly higher than that for a clay cap due to the additional cost for a synthetic membrane liner.

3.6.1.5 Removal of Soils and Sediments

The partial or total excavation of soils and sediments were both considered and the options retained for potential application at the Tonawanda site as indicated in Table 3-6. It may be appropriate to focus on the highest concentration levels of contamination at some areas of the site and still comply with the remedial action objectives. Complete excavation of all the contaminated soils to an appropriate radionuclide concentration may have to be performed as well.

A variety of equipment can be used to excavate soils, including backhoes, cranes and attachments (drag lines and clamshells), and dozers and loaders. Sediments can be excavated using mechanical, hydraulic and pneumatic dredging equipment. It is expected that during excavation of soils and sediments using the conventional equipment described above, typical dust and runoff control techniques would adequately protect workers and the public. However, if required, special procedures can be implemented to minimize worker exposure to dust and particulate matter.

Excavation would be highly effective in addressing the contaminated soils at the sites. At the Linde and Seaway properties, excavation would have to be coordinated with the owners to ensure minimal disruption of ongoing activities. Excavation costs are expected to be high.

3.6.1.6 Treatment for Soils and Sediments

Representative volume-reduction methods, such as physical separation processes and brickmaking and ex situ immobilization technologies such as vitrification and solidification were selected for further evaluation. Table 3-6 presents the preliminary evaluations and screening of remedial options for soils and sediments at the Tonawanda site.

Physical separation processes could include screening, classification, flotation, and gravity separation. Screening is the mechanical separation of particles by size. Screening is normally limited to materials larger than 250 microns, with finer sizing using other methods. The amount of moisture in the feed affects the efficiency of screening. A common problem with screens is the blocking of the screen aperture with slightly oversized particles. The fine-grained soils at the Tonawanda site which are less than 250 microns in size would not be effectively screened. Therefore, this process will not be considered further.

Classification is the process in which particles are separated according to the settling rate in a fluid. Classification was screened out and will not be considered further because soils with high quantities of clay and sandy soil containing humus material (such as those at the Tonawanda site) are hard to process due to the very slow settling rate of fine-grained particles plus the very low throughput rates. Also, classification would require extensive pilot-scale testing to determine its applicability at the Tonawanda site.

Flotation is a complex process, and effectiveness depends on particle size, rate of feed, control of chemical additives, and handling of the refined product. Flotation is an expensive process and is particularly useful in removing colloidal particles ranging in size from 0.1 to 0.01 mm (0.004 to 0.0004 in.)(silt particle size ranges). Flotation would not be considered further because of its inability to remove clay particles which have grain sizes less than 0.01 mm (0.0004 in.).

Gravity methods of separation are used to treat a variety of materials utilizing a shaking table and wash water. These methods take advantage of differences in material densities to bring about separation. Therefore, separation is influenced by particle size, density, shape, and weight. All gravity separation devices keep particles slightly apart so that they can move past each other to separate into layers of dense and light minerals. Fine-grained soils (especially clay particles) exhibit very slow settling rates. The slow settling rates of the clay particles would lead to very low throughput rates. Therefore, the selection of this process would not be appropriate for the fine-grained soils at the Tonawanda site.

AWC, Inc., has developed a physical separation system (TRUclean Process) to remove plutonium contamination from various media, including FUSRAP soils. Pilot plant tests indicate that the system is capable of a modest volume reduction. The pilot TRUclean plant has been operated at throughputs of a cubic foot to several cubic meters per hour. Multiple passes are usually required. Reduction of high activity soil (>100 pCi/g to 5 pCi/g) has not been demonstrated. Operational difficulties are encountered when processing soils with a significant percentage of fines. Further, the full-scale plant throughput would be expected to approach only 15 m^3/h (530 ft^3/h) (AWC, Inc. 1987a). The TRUclean Process was used on soils from the DOE FUSRAP site at Hazelwood, Missouri. Decontamination to below 5 pCi/g was achieved on single–yard quantities of materials originally containing up to 10 pCi/g. No process rates or times were given in the report (AWC, Inc. 1987b).

Physical separation processes would require extensive pilot testing to determine their applicability to the complex mixture of soils at the sites. Physical separation processes that achieve separation of particles based on size and density (through the use of air or water as the medium) would, therefore, be ineffective. Also, the air and water streams used in the process could be contaminated, requiring further treatment. Although studies conducted so far show that some separation can be achieved, the overall usefulness of the physical separation processes is questionable. Due to the fine-grained nature of the waste at the Tonawanda site, the treatment required for the effluent, and the slow throughput of soils, all physical-separation technologies were screened out.

Brickmaking (DOE 1992) could potentially be used to further reduce the volume of concentrated treatment residuals at the end of a treatment stream or as a single-treatment option for reduction of contaminated soil volume. The capital and O&M costs are considered moderate as they relate to other treatment options due to costs associated with a tunnel kiln and associated air pollution control equipment. The use of brickmaking as a treatment option for volume reduction with offsite disposal is not expected to be cost effective based on preliminary cost estimates. The proposed volume reduction would not justify the additional handling of contaminated soil and potential risk to workers. Therefore, brickmaking is not a cost effective solution.

The immobilization technologies considered for further evaluation would reduce the leachability of the radioactive materials and limit the spread of contaminants. The resultant product is also easier to handle for further actions.

The vitrification process (EPA 1991b) is energy-intensive and requires specialized equipment and personnel. This treatment option could potentially be used for volume reduction and immobilization. Implementation of this process would still require disposal within a secure facility. The capital and O&M costs for this option are considered high with respect to other treatment technologies. Vitrification technologies would be considered further because they are not dependent upon fine-grained soil particles for ease of implementation and effective maintenance.

Solidification, which is also potentially applicable, involves adding an appropriate binding matrix that produces a monolithic block of waste with high structural integrity. The contaminants do not interact chemically with the solidification agents, but are mechanically bonded. Solidifying agents include asphalt, cement, and resins. This process option has moderate capital and high O&M costs. Processing fine-grained soils is difficult at best even under optimal conditions. Clays when excavated under field conditions typically retain moisture at higher percentages as compared to coarse-grained soils. The ability of fine-grained soils to retain moisture leads to clod sizes in excess of three inches which makes it difficult to disperse solidifying agents evenly. Even if the fine-grained soils are dried, the soil tends to desiccate in large clumps. If processed, these dried fine-grained soils would require pulverization. Solidification may work well initially but its long term effectiveness is unknown with respect to radioactively contaminated soils, and because of its increase in disposal volume, this option will not be considered further.

3.6.1.7 Disposal of Soils and Sediments

The disposal options considered for further evaluation are onsite and offsite at new and existing federal and commercial facilities and beneficial reuse. The potential options include:

Onsite disposal. This option involves the design and construction of a new encapsulated disposal facility onsite. The design would be similar to that described under the out-of- state FUSRAP-dedicated facility and capacity would be for an estimated 282,100 m^3 (369,000 yd^3). A new onsite disposal cell has moderate capital costs with moderate O&M. There would be no disposal fees for onsite disposal. Section 5.2.1.3 contains a description of this disposal option.

In-state FUSRAP-dedicated. This option involves the design and construction of a new encapsulated disposal facility located within the State of New York capable of receipt and disposal of all FUSRAP New York sites waste (382,100 m^3 [499,800 yd^3]). The design would be the same as that described under the out-of-state FUSRAP-dedicated facility. The location of this facility has not been identified. Section 5.2.1.3 contains a description of this hypothetical disposal facility.

Out-of-state FUSRAP-dedicated DOE-owned. This option involves the design and construction of a new encapsulated disposal facility for all FUSRAP waste (1,990,000 m^3 [2,600,000 yd^3]), to be located at a DOE facility in either the eastern or western portion of the U.S. The location of this facility has not been identified.

A new offsite disposal facility has high transportation and moderate, capital, and O&M costs. There would be no disposal fees with a dedicated FUSRAP facility.

New disposal facilities would be similar to the existing DOE facility developed for the uranium mill tailings program and constructed at Canonsburg, Pennsylvania. The specific design would follow DOE's conceptual design for an encapsulated, above-ground facility for FUSRAP waste (BNI 1989) and would use all natural materials with a projected life of 200 to 1000 years. Use of synthetic liners and mechanical leachate collection systems as long-term systems are avoided due to their susceptibility to damage and failure. The materials used in this design are all readily available at a reasonable cost. The aboveground design minimizes the possibility of groundwater infiltration into the waste while maximizing separation from the water table.

The new disposal facility option would require completion of siting studies, an environmental impact assessment with public review, and the necessary approvals prior to construction. This facility design would be expected to ensure long-term effectiveness and permanence and, therefore, provide for the long-term protection of the public and the environment. Section 5.2.1.3 contains a description of these two hypothetical disposal facilities.

Out-of-state DOE-owned. This option is implementable because it involves use of an existing DOE disposal facility. The existing facility considered is the Hanford Reservation located in Hanford, Washington. Existing DOE facilities have high capital costs due to disposal and transportation fees. The selection of a single site for this analysis is an assumption only, and other sites may also be available. Section 5.2.1.3 contains a description of this disposal option.

Out-of-state commercial. This option is also implementable, provided a license is obtained, because it involves use of an existing commercial disposal facility. The existing facility considered is Envirocare of Utah's facility located in Clive, Utah. Existing disposal facilities have high capital costs due to disposal and transportation fees. The selection of a single site for this analysis is an assumption only, and other sites may also be available. Section 5.2.1.3 contains a description of this disposal option.

Beneficial reuse. This option involves the reuse of contaminated media for applications such as landfill covers, construction fill, or roadbed fill. The implementability of this option would be considered low until use for the materials is identified.

3.6.2 Preliminary Evaluation and Screening of Remedial Options for Buildings and Structures

The results of the preliminary evaluation and screening of remedial options for buildings and structures are presented in Table 3-7. Brief summaries of those results are provided in the following sections.

Table 3-7. Preliminary Evaluation and Screening of Remedial Options for Buildings and Structures at the Tonawanda Site

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
1. No Action	None - Includes Continued Environmental Monitoring	Would not be effective in reducing risk.	There are no process options.	Low O&M[a] cost for monitoring.	Retained; required for consideration by NCP[b].
2. Institutional Controls	Site Security	Fencing may reduce direct contact with contaminants to a certain extent, but will not comply with all remedial action objectives.	Fencing and site security is currently being implemented at Linde.	Not Applicable.	Retained
	Institutional actions	Effectiveness depends on continued future implementation. Does not reduce contamination.	May not be implementable at non-DOE-owned properties.	Negligible costs, but could be high if DOE had to buy properties.	Retained
	Monitoring of Ambient Air	Useful for documenting and evaluating conditions, but does not reduce risk by itself.	Implementable. May be difficult to implement at properties not owned by DOE.	Low capital; moderate O&M costs.	Retained
3. Containment	Surface Sealing	Limits dermal and inhalation exposure for a limited time. Not effective in long term.	Implementable; but coordination with building owners would be required. May be difficult to implement at properties not owned by DOE.	Low costs.	Retained
4. Removal	Partial Demolition	Effective on buildings where contamination is limited.	Implementable with appropriate equipment and procedures. There are no major buildings that cannot be demolished but ownership issues may present a problem.	Moderately High costs.	Retained
	Complete Demolition	Effective.	Implementable. Use of Buildings 14, 30 and 31 at Linde is important to owners, so scheduling and sequence of demolition is important.	Moderately High costs.	Retained

Table 3-7. (continued)

Response Action	Remedial Option	Effectiveness	Implementability	Cost	Screening Status
5. Decontamination	Physical Procedures (scraping, grinding, etc.)	Effective on concrete, wood, and masonry surfaces; not very effective on metal surface.	Implementable; availability of vendors may be low.	Moderately High costs.	Retained
	Chemical Procedures	Effective for contaminants that are hard to remove by physical means. Poor for porous materials. Waste must be capable of being dissolved in chemical.	Implementable; collection of decontamination material is required.	Moderately High costs.	Retained
6. Disposal	Onsite Disposal by Land Encapsulation	Effective, if an appropriate location can be found.	May not be easily implementable. Social and political issues may dictate implementability. Must comply with all applicable precautions. Presence of radionuclides in waste could make siting a disposal area difficult.	High costs.	Retained
	Offsite Disposal	Effective, if appropriate location can be found.	May not be implementable because capacity may not be available.	High costs.	Retained
	Solid Waste Landfill	Effective decontamination processes required dependent upon building material.	Implementable if building debris is decontaminated below non-detectable levels.	High costs.	Retained

[a] O&M = operation and maintenance
[b] NCP = National Contingency Plan

3.6.2.1 No Action for Buildings and Structures

To comply with the integration of NEPA values with CERCLA requirements and procedures, this response action will be retained throughout the FS evaluation.

3.6.2.2 Institutional Controls and Site Management

The options of implementing site security with appropriate posting of signs and continued monitoring of the ambient air for radioactivity levels have been retained for further consideration. These are already being implemented at the Linde property. The option of deed restrictions to prevent direct contact of the public with the contaminated building areas was retained as well. DOE purchase of land and buildings would ensure control over the Linde property and site contaminants.

3.6.2.3 Containment of Radionuclides on Buildings and Structures

Surface sealing with paints, resins or plastics, or other impermeable materials has been retained for further evaluation. The principal objective of surface sealing is to reduce the mobility of the contaminants and to reduce the further spread of contaminants into the ambient air or onto personnel working in the vicinity of the buildings. It is effective in containing contaminants in the short term. It is not effective in reducing direct gamma exposure.

3.6.2.4 Removal of Buildings and Structures

Partial and complete demolition/dismantlement were both retained for further evaluation at the Tonawanda site. An appropriate demolition/dismantlement method can be selected to effectively remove the contaminated buildings and structures.

3.6.2.5 Decontamination of Buildings and Structures

All available physical decontamination options such as scrubbing, scraping, scabbling, sanding, grinding with sand and grit, or pelletized carbon dioxide blasting have been retained for further evaluation. Physical methods generally do not work well on metallic surfaces, but with the proper choice of equipment they may still be used. The actual method employed will be addressed during the design phase.

Chemical decontamination procedures would include using water, solvents, acids and bases, and complexing agents. Chemical procedures work best on metal surfaces. The choice of chemical to be used would be site- and material-specific and would depend on the contaminants to be removed, the surface requiring decontamination, and the location of the building or structure surface (whether it is located at a point where it could impact public health or the environment).

A number of physical and chemical methods have been used successfully in decontaminating buildings and equipment at other sites. At the Tonawanda site, levels of radioactivity on the building surfaces are relatively low and typical decontamination procedures would be effective and implementable as well.

3.6.2.6 Disposal of Buildings and Structures

For the disposal of decontaminated building materials, the options considered for soils and sediments would be applicable as well. If a large volume of building debris is generated by demolition activities, it may be economical to reduce the volume of material to be transported and disposed with shredders, impact crushers, and hammer mills. In addition, for building debris decontaminated to levels allowing for the release of the material for unrestricted use, disposal of materials in a solid waste landfill has been retained as an option for further evaluation.

3.7 SUMMARY OF EVALUATION AND SCREENING AND LIST OF POTENTIALLY APPLICABLE REMEDIAL OPTIONS

The list of potential remedial options determined to be applicable for soils and sediments and for buildings and structures by the preliminary evaluation and screening is summarized in Tables 3-8 and 3-9, respectively. The potential remedial options are listed in the tables under each response action. These remedial options will be used to develop alternatives to remediate the site as a whole. The development of alternatives is discussed in Section 4.

Table 3-8. List of Potential Radiological Remedial Options Retained for Soils and Sediments at the Tonawanda Site

INSTITUTIONAL CONTROLS

- Site Security
- Deed Restrictions/Government Purchase of Land
- Site Maintenance
- Environmental Monitoring

SURFACE WATER CONTROLS

- Revegetation
- Grading
- Erosion Control
- Dikes/Berms

CONTAINMENT

- Clay Cap
- Multimedia Cap
- Soil Cover/Revegetation

REMOVAL

- Partial Excavation
- Complete Excavation

TREATMENT

- Vitrification

Table 3-8. (continued)

STORAGE/DISPOSAL[a]

- Onsite Land Encapsulation
- Offsite Land Encapsulation in a Dedicated DOE FUSRAP Facility (New York, Eastern or Western U.S.)
- Disposal at a DOE Facility
- Disposal at a Commercially Licensed Facility
- Beneficial Reuse

[a] Will include containerization and transportation options.

Table 3-9. List of Potential Remedial Options Retained for Buildings and Structures at the Tonawanda Site

INSTITUTIONAL CONTROLS

- Site Security
- Deed Restrictions
- Ambient Air Monitoring

CONTAINMENT

- Surface Sealing

REMOVAL

- Partial Demolition
- Complete Demolition

DECONTAMINATION

- Physical Procedures
- Chemical Procedures

STORAGE/DISPOSAL[a]

- Onsite Land Encapsulation
- Offsite Land Encapsulation in a Dedicated DOE FUSRAP Facility (New York, Eastern or Western U.S.)
- Disposal at a DOE Facility
- Disposal at a Commercially Licensed Facility
- Solid Waste Landfill

[a] Includes volume reduction by shredders, impact crushers, and hammer mills prior to disposal.

4. DEVELOPMENT AND SCREENING OF REMEDIAL UNIT-SPECIFIC ALTERNATIVES

4.1 INTRODUCTION

Following a review of remedial options, several further steps are involved in the process of developing remedial alternatives to address the remedial action goals established for a site. The technically feasible options retained after the preliminary screening and evaluation in Section 3 are combined in this section to form remedial action alternatives. Alternatives are then developed to address either the entire site or a remedial unit (i.e., a specific contaminated medium or a specific area of the site). Alternatives for remedial units are then carried through the FS process separately or combined into comprehensive alternatives for the entire site. This approach is flexible and allows alternatives to be combined at various points in the process. However, a final detailed evaluation must be performed for alternatives that address the entire site. The identification and development of remedial units for the Tonawanda site are discussed in Section 4.2.

Remedial action alternatives were developed that protect human health and the environment and that encompass a range of appropriate waste management options. Appropriate options involve eliminating the hazardous substances at the site, reducing hazardous substances to acceptable levels, and preventing exposure to hazardous substances; or some combination of elimination, reduction, and exposure prevention. While developing alternatives for the Tonawanda site, emphasis was placed on alternatives that permanently and significantly reduce waste volume, toxicity, or mobility. However, review of emerging technologies in Section 3 has limited the selection of applicable technologies to ex situ vitrification. Furthermore, alternatives were developed to comply with the remedial action objectives described in Section 3.2, which relate to the degree to which each alternative is protective of human health and the environment.

4.2 REMEDIAL UNITS FOR THE TONAWANDA SITE

The establishment and use of remedial units in an FS allow adequate flexibility to address a specific portion of the remediation activity in a manner that is convenient for addressing the remediation of the entire site. The entire remediation activity is thus divided into specific elements, and alternatives are developed for each element. It is important that alternatives developed for each remedial unit be compatible with one another. The four remedial elements identified at the Tonawanda site are:

- "Accessible" soils (on all properties);
- "Access-restricted" soils (on Linde and Seaway properties);
- Buildings and structures (on the Linde property); and
- Contaminated sediments (on all properties).

These four remedial units are briefly defined below:

"Accessible" Soils Remedial Unit includes all soils containing radioactive contaminants above DOE guidelines that can be easily excavated without affecting any serviceable buildings, structures, commercial properties, or employees working near these properties. Soils at Ashland 1 and 2 fall into this remedial unit. Stockpiled soils at Linde and Seaway (Area A) also have been termed accessible soils. At Linde, contaminated soils under the pavement, rail line, and buildings to be demolished (14, 30, and 31) are considered accessible. Accessible sediments at Linde include those found in sumps inside Building 30 and in the storm sewers.

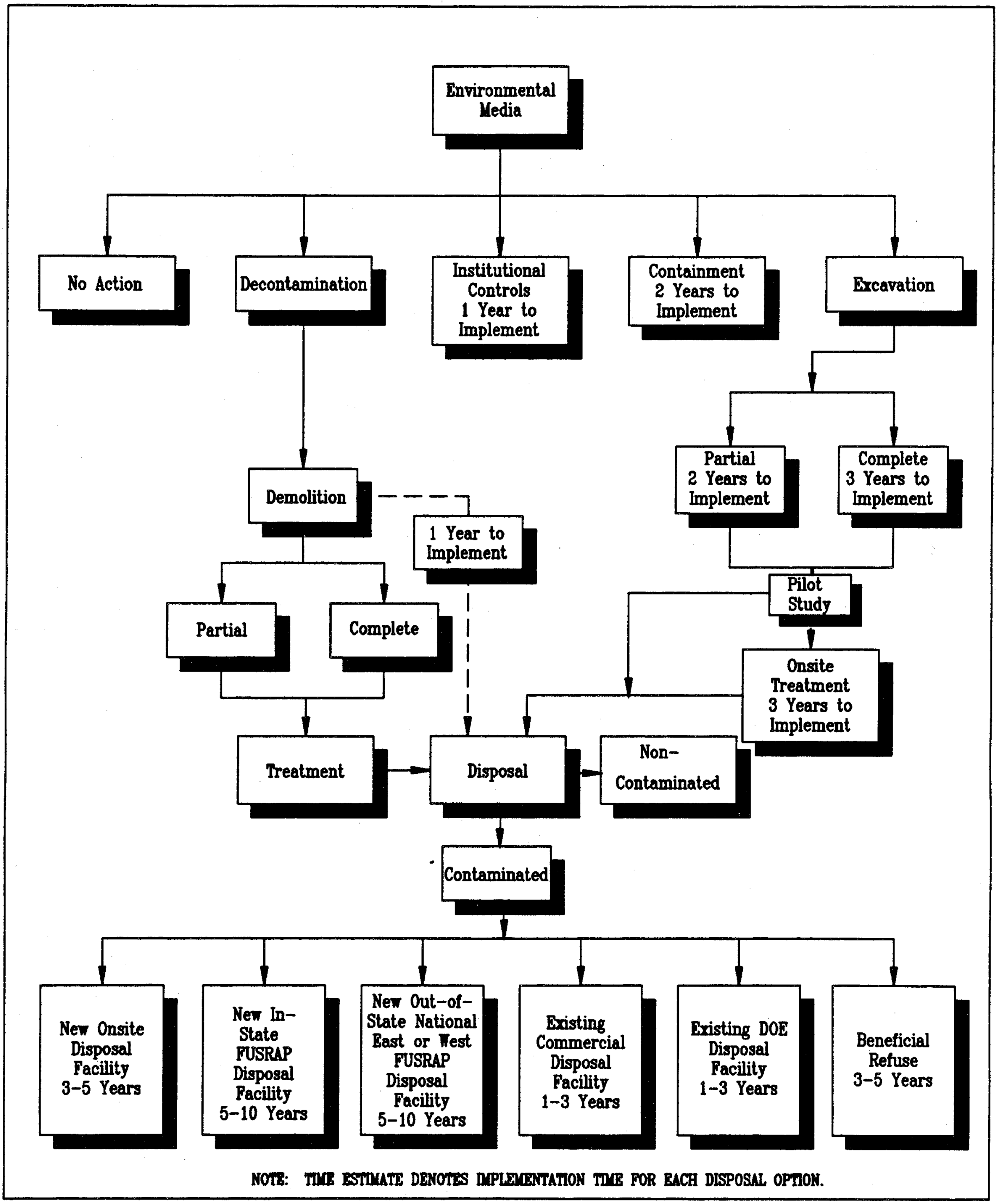
"Access-Restricted" Soils Remedial Unit includes soils containing radioactive contaminants above DOE guidelines under serviceable buildings and structures and under refuse-filled areas at Seaway. Contaminated soils at Linde under building 30 and contaminated soils within the commercial landfill at Seaway (Areas B and C) are included in this remedial unit.

Buildings and Structures Remedial Unit includes radiologically contaminated building materials at the Linde site.

Contaminated Sediments Remedial Unit includes radiologically contaminated sediments in Rattlesnake Creek, contaminated sediments in the Seaway–Niagara Mohawk drainage ditch, and contaminated sediments within the wetland area at the Linde property.

4.3 IDENTIFICATION OF PRELIMINARY REMEDIAL UNIT-SPECIFIC ALTERNATIVES

Preliminary remedial alternatives identified for each remedial unit are described below. The process for identifying remedial unit-specific alternatives is shown in Figure 4-1.



SAIC 677-315 4-20

Figure 4-1. Process Model for Identification of Alternatives

4.3.1 "Accessible" Soils

The contaminated soils identified by previous investigative activities at the site contain radionuclides and other inorganics potentially related to MED/AEC activities. The RI identified soils contaminated with above background concentrations of inorganics (metals) in areas that contain radioactive contamination (known to be MED/AEC-related), and in areas that do not exhibit radioactive contamination (especially in the eastern portion of Ashland 2). For the purpose of this study, only soils contaminated with radionuclides, known to be generated by MED/AEC activities have been considered. Further identification of the source of contamination in the non-radioactively contaminated areas may be necessary to determine responsibility for remediation (if required). Based on DOE guidelines, the volume of accessible soils requiring remediation is conservatively estimated at 237,700 m^3 (310,850 yd^3).

Under complete excavation, all accessible soils with radioactive contamination above the recommended DOE guidelines and the commingled non-radiologic contaminants would be removed. Treatment and disposal options that were combined with complete excavation were evaluated first and foremost on their effectiveness in protecting human health and the environment, and last, based on relative costs associated with each option. The alternatives developed for accessible soils include:

- no action,
- institutional controls,
- containment,
- removal followed by disposal; and
- removal followed by treatment and disposal.

Disposal options evaluated as part of the removal alternatives include:

- onsite designed land encapsulation facility,
- offsite disposal at a dedicated FUSRAP facility (New York, national east or west location);
- offsite commercially licensed facility,
- offsite federal facility, and
- beneficial reuse.

No action. This alternative consists of performing no remedial actions and maintaining a status quo at the site. Periodic environmental monitoring of contaminant levels through collection and analyses of samples is incorporated in this alternative.

Institutional controls. This option considers implementing deed restrictions, site security, and conducting environmental monitoring. The site is already enclosed by a fence that prevents direct access to the site. Security also is maintained at these properties.

Future use of the site could be restricted through land use restrictions. Notation would be made to record the presence of radionuclide contamination and restrict future development and site use. In some areas this may require purchase of the property by DOE (i.e., Seaway). In other areas such as Linde, it may not be implementable. Access restrictions would continue to be instituted by the property owner to preclude exposures to the public health from the radiologically contaminated buildings at Linde.

The objective of environmental monitoring is to evaluate whether the contaminant levels are changing and if the contaminants are migrating offsite. Environmental monitoring would involve routine, periodic sampling of the soils at the site.

Containment. This alternative incorporates capping of the site to prevent direct contact of contaminants in the soil with the public and reduce further spread of contaminants. This alternative will have to be implemented along with institutional controls that incorporate deed restrictions to prevent unrestricted use of the site. Environmental monitoring of the media also will be an important element of the alternative to ensure that contaminants are not migrating offsite.

Removal Options

Excavation followed by disposal. Any soils that exceed the cleanup guidelines for radium, thorium, and uranium, along with the commingled non-radiological contaminants contained in the radiologically contaminated soils, would be excavated. Soils within 15 cm (6 in.) of the ground surface would be considered contaminated if radium and thorium concentrations are above 5 pCi/g, and deeper soils would be considered contaminated if radium and thorium concentrations are above 15 pCi/g (Section 3.2.1.1). This option would assure eliminating adverse health effects and contamination. Standard techniques for excavation would be used at the properties. Dust control, soil erosion and sediment control, and other health and safety precautions would be taken during excavation.

Excavation followed by treatment and disposal. After excavation, soils are treated onsite using vitrification technologies. After processing, vitrified soils are disposed of onsite or at a DOE facility.

Disposal Options

The following six options selected for disposal involve a combination of onsite and offsite disposal options. Offsite disposal options include disposal in a designed encapsulation cell at existing or generic locations described below. Vitrification has been retained as a potential pretreatment option prior to transportation and/or disposal. This technology is applicable with any of the six disposal options.

Onsite disposal in a designed encapsulation cell. The contaminated materials would be excavated and disposed in an encapsulation cell located at Ashland 1, Ashland 2, or Seaway. The cell would have a liner that prevents upward migration of water into the cells and minimizes potential buildup of water within the cell. Infiltration of surface water into the cell would be minimized with a cap. Erosion preventative measures and protection against burrowing rodents would be incorporated. The cell would be constructed to lie above the groundwater table. Monitoring wells would be installed around the cell to detect any breaks in the cell. Air monitoring equipment should be provided for the duration of the life of the cell.

Offsite disposal in an in-state land encapsulation cell (generic location). This option involves disposal of the waste materials at a facility within the State of New York. The design requirements for an encapsulation cell offsite will be similar to that for an onsite cell. The development of a disposal facility within the State of New York to handle the New York FUSRAP waste is a technically viable possibility. It is, however, assumed that the state and EPA would require DOE to build and maintain any cells dedicated to the New York FUSRAP waste.

Offsite disposal at a commercially-licensed disposal facility. Under this option, the contaminated materials would be excavated and transported offsite to a commercially licensed disposal facility for permanent disposal. Contaminated materials may be transported in bulk via truck, rail, or barge, or may require containerization. Strict compliance with all federal and state regulations regarding the transportation of the waste would be maintained. All trucks, rail cars, or barges utilized to haul contaminated materials would be inspected prior to use. The route of transportation and an emergency response program will be established to respond to accidents. The existing facility considered for estimating purposes is Envirocare of Utah's facility located in Clive, Utah.

Offsite disposal located at an existing federal facility. This option would be similar to the above related option, utilizing a commercially-licensed facility. The existing facility considered is the Hanford Reservation located in Hanford, Washington. There is a potential for Hanford to use the Tonawanda contaminated soils for closure of contaminated areas at the Hanford Reservation. However, for the purpose of this study, we have assumed that the Tonawanda waste will be disposed in a disposal cell in the Hanford disposal area.

Permanent disposal at a national FUSRAP-dedicated disposal facility in an eastern or western location. This option involves disposal at a dedicated, newly designed, and constructed encapsulation cell. The design requirements for an encapsulation cell offsite would be similar to that for an onsite cell. This land encapsulation facility could be dedicated to the disposal of not only New York FUSRAP waste, but other FUSRAP waste as well.

Permanent disposal of select soils through beneficial reuse. Potential beneficial reuse options include using excavated soil as: cover in low-level radioactive waste facility; fill material for airport expansion project; fill material for roadbeds; or similar construction applications. More detailed analyses would be conducted for specific beneficial reuse opportunities identified to ensure protection of public health and the environment. Much of the siting and design criteria required for a land encapsulation cell would be applicable for disposal of soils as fill material.

4.3.2 "Access-Restricted" Soils

"Access-restricted" soils are those that exceed the cleanup levels for radionuclides, but where access to these soils is currently constrained (i.e., under buildings, structures, landfill material, and paved areas). These soils may pose a minimal risk to current site workers because they are subsurface soils and are contained under existing serviceable structures, or landfill debris. Soils under Building 30 at Linde will remain "access-restricted" only so long as the building remains intact. The volume of "access-restricted" soils at Linde requiring remediation based on DOE guidelines is conservatively estimated at 4,130 m^3 (5,400 yd^3). If the buildings or structures are abandoned and subsequently demolished the soils will become accessible for future DOE removal. Radioactively contaminated soils buried within (or under) the commercial landfill at Seaway (Areas B and C in Figure 2-17) are considered "access-restricted." For the purposes of evaluating remedial alternatives, the volume of contaminated soils in areas B and C of the Seaway Landfill have been estimated at 19,800 m^3 (25,900 yd^3).

Once the soils become accessible, the remedial options available will be those discussed in Section 4.4.1. However, for purposes of analyses, these soils are being evaluated separately to better identify differences (e.g., additional cost required as a result of building demolition, possible stormwater system reconstruction, and removal of solid waste at the Seaway landfill). In addition, a phased approach is being considered which provides for short-term controls until soils become accessible. Accordingly, the following alternatives were identified for the "access-restricted" soils remedial unit:

- no action and

- institutional controls.

No Action. This alternative consists of performing no remedial actions and maintaining a status quo at the site. Periodic environmental monitoring of contaminant levels through collection and analyses of samples is incorporated in this alternative.

Institutional Controls. The institutional controls will be similar to that for "accessible" soils.

4.3.3 Contaminated Sediments

Remedial alternatives at Rattlesnake Creek and associated ditches located at Ashland 1, Seaway, and Ashland 2 consist of diverting surface water flow at specific locations along the creek to permit excavation of contaminated sediments, and grading the stream embankments at specific locations to reduce erosion and re-suspension of stream sediments. After excavation of sediments, sediment treatment and disposal options are identical to those developed for accessible contaminated site soils. Based on DOE guidelines, the volume of sediments requiring removal is conservatively estimated at 7700 m^3 (10,100 yd^3).

Contaminated sediments located within storm lines and sumps at Linde have been estimated to be 38 m^3 (50 yd^3). Estimates of the volume of sediments within the storm lines were based on the layout and flow direction of the storm lines, pipe size of the storm lines, and locations where contamination was documented in the RI. The remedial alternatives for contaminated sediments are:

- no action;
- institutional controls;
- diversion of flow through dikes and berms followed by excavation of sediments;
- grading of stream bank with restorative revegetation at specific locations;
- removal of sediments at Linde; and
- dikes and berms, grading, and revegetation.

No action. Under this alternative no remedial actions will be conducted at the site and status quo will be maintained.

Institutional control. This alternative consists of implementing land use restrictions, site security where applicable, and environmental monitoring of surface water and sediments. Areas of Rattlesnake Creek and the wetlands area at Linde where contaminated sediments are located could be cordoned off by a fence to prevent direct contact with the contamination. Warning signs could be posted notifying the public of the potential hazards. The portion of the creek and wetlands where contamination is located could be restricted for future use. Environmental monitoring would be conducted by collecting samples of sediments and surface water. The sampling results would show if contamination in the sediments is migrating downstream and being transferred to surface water.

Diversion of flow through dikes and berms followed by excavation of sediments. The removal of sediments from Rattlesnake Creek could result in significant environmental impacts; therefore, excavation, if required, should focus on areas of contamination. Dikes and berms can be constructed at appropriate locations to divert surface water flow until excavation of sediments is complete. Construction of dikes and berms is straightforward, and is easily implemented. Since dikes and berms would only be interim measures, materials of construction and techniques of construction would be such that the diversion structures can be completed easily and quickly.

Grading of embankment along with revegetation at specific locations. A potential concern due to the presence of contaminated sediments in Rattlesnake Creek is the gradual erosion of the sediments along the embankment and migration downstream. Erosion control measures can be implemented by grading the creek bank at appropriate locations and revegetating the graded area to hold the sediments together.

Removal of sediments at Linde. The removal of contaminated sediments within storm lines, sumps, and wetlands at Linde includes vacuuming sediments contained within storm lines and sumps. Excavation of contaminated wetland sediments would entail using conventional earth moving equipment. The contaminated sediments would be disposed as discussed for "accessible" soils.

Dikes and berms, grading, and revegetation. This alternative is essentially a combination of surface water controls needed to access contaminated sediments in order to minimize the migration of contaminants into surface water bodies.

4.3.4 Buildings and Structures

Remediation of buildings and structures at Linde should be coordinated to cause minimal disruption of current activities. The alternatives developed cover a range of options that can be used to remediate buildings and structures including:

- no action;
- institutional controls;
- surface encapsulation of contamination on surface of buildings and structures;

- physical and/or chemical decontamination followed by surface restoration;

- physical and/or chemical decontamination followed by demolition, volume reduction, and subsequent disposal of building materials; and

- demolition, volume reduction, and subsequent disposal of building materials.

No Action. This alternative consists of performing no remedial actions and maintaining a status quo at the site. Periodic monitoring of contaminated areas through collection and analysis of samples is incorporated in this alternative.

Institutional controls. This alternative would consist of implementing site security, where applicable, posting of signs indicating potential for exposure, where appropriate, and continued monitoring of air for external gamma radiation from the contaminated surfaces of buildings and structures. Adequate security already exists at Linde and in particular at the buildings where the surfaces are contaminated, such that the general public is not impacted. Some signs have been posted at buildings where the surfaces are believed to be contaminated. Restriction on future development would be incorporated into the property deed to limit land use should the Linde property be decommissioned.

Surface encapsulation of contamination on surfaces of buildings and structures. This alternative involves using an appropriate material such as resin or paint to seal the contaminants on the surfaces. This alternative would not reduce exposure to external gamma radiation.

Physical or chemical decontamination procedures followed by surface restoration. This alternative involves the use of a combination of physical and/or chemical decontamination procedures to remove the contamination from the surfaces to acceptable levels. Physical decontamination procedures can include scrubbing, scraping, scabbling, sanding, grinding, pelletized carbon dioxide, or sand blasting. Chemical decontamination procedures can include the use of water, solvents, acids and bases, and complexing agents to dissolve contaminants present on the surface. After decontamination is complete, the surfaces would be restored to the original condition, and the buildings released for unrestricted use. Waste streams that would be generated from the decontamination operations would have to be collected and treated to remove radionuclide contaminants.

Physical or chemical decontamination followed by demolition, volume reduction, and disposal. This alternative involves decontaminating the surfaces of the buildings and structures prior to demolition. It is expected that, since the decontamination would reduce contamination to levels acceptable for release of the material for unrestricted use; the building debris can be reduced in volume and transported to a permitted solid waste landfill for disposal.

Demolition, volume reduction, and subsequent disposal of building materials. This alternative involves the demolition of buildings and structures without decontamination being performed on the surfaces. It is expected that, in at least some portion of the demolished debris, the overall activity levels would be non-detectable. Following volume reduction, it is expected that this material can be transported to a permitted landfill for disposal. The remainder of the building debris that does have detectable levels of radionuclides would have to be addressed along with the contaminated soils. For the purpose of costing remedial alternatives, the worst case of disposal option, considering the material to be radiologically contaminated, was assumed.

4.4 SCREENING OF ALTERNATIVES FOR EFFECTIVENESS, IMPLEMENTABILITY, AND COST

The media-specific remedial alternatives developed in Section 4.3 were screened on criteria of effectiveness, implementability, and cost. The objective of this screening step was to eliminate from further consideration any alternatives that did not meet the evaluation criteria and to reduce the number of alternatives requiring detailed analysis. The screening process was done on a general basis and with limited effort (relative to the detailed analysis).

The scope of this screening effort depends on the number of alternatives that are initially developed, which itself partially depends on the complexity of the site and/or the number of available technologies. The end result of the screening step is to define a range of alternatives to be evaluated in more detail and to provide decision-makers with a range of suitable options from which to choose.

Alternatives developed during the initial stage already provide a broad range of remedial options. These alternative remedial technologies were evaluated based on the following criteria: effectiveness, implementability, and cost.

Effectiveness

Each alternative was judged for its ability to effectively protect public health and the environment by reducing the toxicity, mobility, or volume of contaminants. Short-term protection involves reducing existing risks to the community and workers during implementation of remedial actions. The ability of an alternative to meet cleanup guidelines was evaluated. The time required for the remedial alternative to achieve the desired result was also considered, including the potential length of exposure to which the local public may be subjected. The long-term protectiveness criterion addresses the magnitude of residual risk and the long-term reliability associated with the alternatives. The alternatives were also evaluated for their effectiveness in preventing further exposure to residual contamination.

Implementability

Each alternative was evaluated in terms of implementability including technical feasibility, administrative feasibility, and availability of necessary remedial materials, equipment, and work force. The assessment of short-term technical feasibility considered the ability to construct the given technology and the short-term reliability of the technology. Long-term technical feasibility factors considered include the ease of undertaking additional remedial action if necessary, of monitoring the effectiveness of the given remedy, and of operation and maintenance. Administrative feasibility for implementing a given technology was evaluated by reviewing the ability to obtain approvals from other agencies, the likelihood of favorable community response, and the need to coordinate with other agencies.

The extent to which a given technology was judged implementable also depended on the availability of treatment and disposal services and capacities, and on the availability of the necessary equipment and specialties.

Cost

The final criterion for the screening of alternatives was the relative cost of the remedy. At this stage, detailed cost estimates are not developed because specific design parameters are not known. Costs at this screening stage are discussed only qualitatively.

4.4.1 "Accessible" Soils

Based on the applicable remedial actions listed in Section 4.3.1 and on previous discussions, the alternatives developed for source media for the Tonawanda site are:

- no action,
- institutional controls;
- containment;
- excavation and disposal; and
- excavation, treatment, and disposal.

Specific disposal options would be paired with the developed sitewide alternatives. Disposal options will be discussed in detail in Section 5.2.

Preliminary information on the effectiveness, implementability, and cost of each of the developed remedial units alternatives is given in the following sections.

Alternative 1: **No action.** This no-action alternative is included for evaluation in accordance with CERCLA requirements and NEPA values and includes environmental monitoring. This alternative is not effective in protecting human health and the environment in areas where contamination is considered above acceptable levels, but it should be easy to implement and involves minimal cost (O&M only).

Alternative 2: **Institutional Controls.** Actions taken to reduce potential exposures include site security and fencing which has already been implemented, therefore it involves minimal cost. Imposition of deed restrictions not currently in place would make this alternative more effective.

Alternative 3: **Containment.** This alternative involves capping accessible contaminated soils. The areas to be capped would be the accessible primary source areas—Ashland 1 and 2 and the waste piles at Seaway and Linde. Other primary source areas are either under buildings, paved areas, refuse or railroad tracks, and are thus considered contained. Environmental monitoring and the statutory-required 5-year review to determine whether the remedy was still protective of human health and the environment would be required. This alternative is effective in eliminating some pathways of exposure to contaminants and, to some extent, the mobility of contaminants, and is thus considered protective of human health and the environment. Overall, it is easy to implement and relatively low in cost (both capital and O&M).

Alternative 4: **Excavation and disposal.** This alternative involves excavation of all "accessible" surface and subsurface soils contaminated above DOE guidelines for residual soil contamination. This would include complete excavation of all contaminated soils at Ashland 1 and 2. Contaminated soils on Linde, not under Building 30, would be removed. The waste storage piles at Linde and Seaway would be removed and soils under the pile would be excavated. Removal of "accessible" contaminated soils would be effective in protecting human health and environment. This would be a time-consuming task; expensive, but considered implementable. Capital costs of excavation and disposal of excavated soils and solid waste are expected to be moderate whereas O&M costs are expected to be low. Time to complete this action at the entire site could be a significant consideration.

Alternative 5: **Excavation, treatment, and disposal.** This alternative is similar to Alternative 4, but includes treatment of contaminated soils. Treatment would be performed onsite at Ashland 2. This action is expected to pose implementation issues in addition to those described under Alternative 4 because of additional material handling. Commercial suppliers of the treatment technologies are available. The time to implement this alternative is a consideration and would be longer than for Alternative 4. The cost of this alternative is expected to be higher than that for Alternative 4; the volume of contaminated soil to be disposed of would be reduced, but the cost of treatment is significant.

4.4.2 "Access-Restricted" Soils

The applicable remedial actions listed in Section 4.3.2 are limited, and the alternatives developed for "access-restricted" soils for the Tonawanda site are:

- no action and
- institutional controls.

Alternative 1: **No action**. This alternative is necessary to comply with CERCLA requirements and NEPA values. This alternative does not achieve remedial action objectives. It is easy to implement and involves minimal cost.

Alternative 2: **Institutional controls**. This alternative of providing site security, fencing, and signs has already been implemented to a large extent; therefore, cost is negligible. This alternative is effective in reducing exposures to the public.

Should the access-restricted soils become accessible either through the actions of DOE or others, they can be remediated as accessible soils.

4.4.3 Contaminated Sediments

Based on the applicable remedial actions listed in Section 4.3.3 and on the previous discussions, the alternatives developed for contaminated sediments for the Tonawanda site are:

- no action,
- institutional controls,
- diversion of flow with dikes and berms followed by excavation of sediments,
- grading of stream bank with restoration of wetlands and revegetation at specific locations,
- removal of sediments at Linde, and
- dikes and berms, grading, and revegetation.

Alternative 1: **No action**. This alternative is included for consideration in accordance with CERCLA requirements and NEPA values. This alternative does not achieve remedial action objectives. It is easy to implement and involves minimal cost.

Alternative 2: **Institutional controls.** This alternative of providing site security, fencing, and signs has been implemented to a large extent; therefore, cost is negligible. This alternative is effective in isolating the contaminants of concern from the public.

Alternative 3: **Diversion of flow with dikes and berms.** This alternative is an effective, low cost solution to redirect surface water flows in order to isolate the contaminants to be removed. It would be easily implementable at Rattlesnake Creek and drainage ditches.

Alternative 4: **Grading and revegetation.** This alternative is an effective, low cost method to minimize contaminant migration into surface water bodies and wetlands. This alternative would be easily implemented at Rattlesnake Creek and drainage ditches.

Alternative 5: **Removal of sediments at Linde.** This alternative entails cleaning all contaminated sediments from the sumps and stormwater lines as well as excavation of contaminated sediments from within the wetlands. This alternative is readily implementable and cost effective to remove all contaminated sediments at Linde.

Alternative 6: **Dikes and berms, grading and revegetation.** This alternative is a combination of Alternatives 3 and 4. These surface water controls are a cost-effective and easily implementable means to prevent further migration of contaminants.

4.4.4 Buildings and Structures

Based on the applicable remedial actions listed in Section 4.3.3 and on the previous discussions, the alternatives developed for buildings and structures for the Tonawanda site are:

- no action;
- containment;
- partial demolition and disposal;
- complete demolition and disposal;
- decontamination; and
- decontamination, partial demolition, and disposal.

Alternative 1: **No action.** This alternative is included for consideration in accordance with CERCLA requirements and NEPA values and includes environmental monitoring. This alternative is not effective in protecting human health and the environment in areas where contamination is considered above acceptable levels, but it should be easy to implement on DOE-owned properties and involves minimal cost (O&M only). Institutional controls (site security, locks, and signs) are currently in place at the four buildings at Linde to restrict access; therefore, these buildings do not require an alternative for remedial action.

Alternative 2: **Containment**. Containment is effective in reducing direct contact and the mobility of the contaminants in the short term. However, surface sealing and barriers are ineffective in reducing the potential for long-term direct contact and contaminant mobility, due to the natural degradation of the sealant with age, likely cracking of the surface material, and difficulty in maintaining the impermeable barriers over time. Effective in mitigating fugitive emissions resulting from demolition activities, this alternative is relatively easy to implement and has low capital and O&M costs.

Alternative 3: **Partial demolition and disposal**. Partial demolition is effective in protecting human health and the environment by reducing direct contact and the mobility of the contaminants for the areas or portions of the buildings and structures demolished and disposed. This alternative would involve the removal of only those parts of buildings and structures with levels of contamination above DOE guidelines. Buildings 14, 31, and 38 would be completely demolished to gain accessibility to contaminated soil. This alternative is moderate to high in capital and low in O&M costs. Implementation of this alternative would be somewhat difficult due to ongoing Linde Plant operations.

Alternative 4: **Complete demolition and disposal**. This alternative is effective in reducing direct contact and the mobility of the contaminants by complete demolition and removal of the contaminants for all of the contaminated buildings and structures. This alternative would involve the complete demolition of buildings with levels of contamination above DOE surface contamination guidelines. This alternative is high in capital and low in O&M cost. Implementation of this alternative would be difficult due to ongoing Linde Plant operations.

Alternative 5: **Decontamination**. Decontamination procedures remove the contaminants from the surface of the material through physical and chemical procedures. This alternative is effective in protecting human health and the environment by reducing direct contact and the mobility of the contaminants. This alternative would involve the decontamination of buildings and structures at the Linde property with levels of contamination above DOE guidelines. Depending on the method of decontamination chosen and the type of surface material, potentially all of the contamination may not be removed from the surface. Buildings 14, 31, and 38 would be completely demolished to gain accessibility to contaminated soil. This alternative is moderate to low in capital and low in O&M cost. Implementation of this alternative would be difficult due to ongoing Linde Plant operations.

Alternative 6: **Decontamination, partial demolition, and disposal**. This alternative is effective in reducing direct contact and the mobility of the contaminants by removal of surface contaminants by decontamination, and partial demolition of buildings and structures where decontamination is impractical or not completely successful. This alternative would involve the decontamination and partial demolition of buildings and structures associated with active plant operations at the Linde property with levels of contamination above DOE guidelines. Buildings 14, 31, and 38 would be completely demolished to gain access to contaminated soil. This alternative is moderate in capital and low in O&M cost. Implementation of this alternative would be difficult due to ongoing Linde Plant operations.

4.5 SCREENING OF ALTERNATIVES FOR APPLICABILITY

In this section alternatives are screened for applicability to the four remedial units. An alternative may be screened out for a remedial unit on the basis of effectiveness, implementability, or cost. The screening is usually performed on a general basis because the information required to fully evaluate the alternatives is not complete at this point in the process. The desired result of screening is to provide a range of alternatives, consistent with the NCP, to be evaluated in more detail. Based on information documented in Section 4.4 on the effectiveness, implementability, and cost of each alternative, the alternatives that are retained have been deemed effective in meeting remedial action objectives. The screening of alternatives follows in Sections 4.5.1 through 4.5.5 and a summary is provided for each remedial unit in Tables 4-1 to 4-4. The no-action alternative has been retained for each remedial unit based on CERCLA requirements and NEPA values.

4.5.1 "Accessible" Soils

Alternative 5, which includes excavation, treatment, and disposal was eliminated at this time. Immobilizing radionuclides by treatment such as vitrification before final disposal at a secure facility would not add to the overall protectiveness and would be very costly. The only exception to that argument would be if beneficial reuse of the vitrified soils would be available and disposal would not be necessary. Vitrification's major limitation is that it is energy intensive and, thus, may be more expensive compared to other remedial technologies. A second major limitation is the potential for some contaminants, both organic and inorganic, to volatize which requires off-gas treatment. Since vitrification has not been demonstrated at full scale, production treatability studies would be required. No action, containment, and excavation and disposal alternatives have been retained for detailed analyses. Institutional controls will be retained as a component to the containment and excavation alternatives. Retaining institutional controls as a separate alternative for "accessible" soils would not produce new information to base a decision upon because these controls are in effect now.

Table 4-1. Initial Screening of Remedial Unit-Specific Alternatives for "Accessible" Soils

Alternative	Retained	Effectiveness	Implementability	Cost
1. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented.	Negligible cost; monitoring only.
2. Institutional Controls	Yes[a]	Not effective in removing source of contamination.	Already implemented to a large extent.	Low capital; low O&M [b].
3. Containment	Yes	Not effective in removing source of contamination and, thereby, principal threat.	Implementable.	Low capital; low O&M.
4. Excavation, Institutional Controls and Disposal	Yes	Effective due to removal of source of contamination.	Implementable.	Moderate capital; low O&M.
5. Excavation, Institutional Controls, Treatment and Disposal	No	Effective due to removal of source of contamination.	Implementable; treatment process performance could affect implementability. Vitrified waste requires disposal in a secure facility.	High capital; low O&M.

[a] Retained only as part of containment and excavation alternatives
[b] O&M = operation and maintenance

Table 4-2. Initial Screening of Remedial Unit-Specific Alternatives for "Access-Restricted" Soils

Alternative	Retained	Effectiveness	Implementability	Cost
1. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented.	Negligible cost; monitoring only.
2. Institutional Controls	Yes[a]	Not effective in removing source of contamination and, thereby, principal threat.	Already implemented. Retained as components to other media-specific alternatives.	Low capital; low O&M [b].

[a] Retained only as part of other media-specific alternatives
[b] O&M = operation and maintenance

Table 4-3. Initial Screening of Remedial Unit-Specific Alternatives for Contaminated Sediments

Alternative	Retained	Effectiveness	Implementability	Cost
1. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented. Institutional controls in place.	Negligible cost; monitoring only.
2. Institutional Controls	Yes[a]	Not effective in removing source of contamination.	Implementable.	Low capital; low O&M [b].
3. Dikes and Berms	No	Minimizes contact between surface water and contaminants. Effective only in combination with other alternatives.	Already implemented. Retained as component to other media-specific alternatives.	Moderate capital; low O&M.
4. Grading and Revegetation	No	Minimizes migration of contaminants; effective only in combination with other alternatives.	Implementable.	Low capital; low O&M.
5. Complete Removal and Disposal	Yes	Effective due to removal of source of contamination.	Implementable; removal of difficult-to-access wetland sediments could affect implementability. Restoration of wetland areas required.	High capital; low O&M.
6. Dikes and Berms, Grading and Revegetation	Yes	Effective to isolate contaminated sediments within drainage ditches and Rattlesnake Creek.	Implementable.	Moderate capital; low O&M.

[a] Retained because these controls currently in place
[b] O&M = operation and maintenance

Table 4-4. Initial Screening of Remedial Unit-Specific Alternatives for Buildings and Structures

Alternative	Retained	Effectiveness	Implementability	Cost
1. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented.	Negligible cost; monitoring only.
2. Complete Demolition and Disposal	Yes	Effective in removing source of contamination.	Difficult to implement due to demolition of operating facility.	High capital; low O&M [a].
3. Partial Demolition and Disposal	No	Effective in removing source of contamination.	Implementable; access to buildings due to operating facility may be difficult.	Moderate capital; moderate O&M.
4. Decontamination	No	Effective in removing majority of contamination.	Implementable; access to buildings due to operating facility may be difficult.	Moderate capital; moderate O&M.
5. Decontamination, Partial Demolition, and Disposal	Yes	Effective in removing source of contamination.	Implementable; access to buildings due to operating facility may be difficult.	Moderate capital; low O&M.
6. Containment and Institutional Controls	Yes	Not effective in removing source of contamination.	Implementable.	Low capital; high O&M.

[a] O&M = operation and maintenance.

4.5.2 "Access-Restricted" Soils

Institutional controls such as site security, posting signs, and fencing are currently implemented at Linde and Seaway, the two properties containing "access-restricted" soils. Therefore, evaluating institutional controls as a separate alternative to be implemented would not generate additional analyses for decision makers. Institutional controls would be retained for detailed analysis as components to other media-specific alternatives. Environmental monitoring currently being performed would be considered as part of the no-action alternative (Alternative 1).

4.5.3 Contaminated Sediments

The alternative of institutional controls (Alternative 2, site security, fencing, and signs) to control access by the public to the contaminated areas of Rattlesnake Creek and Linde would be considered because these controls are currently in place. Alternative 6, diverting flow through dikes and berms to access contaminated sediments and grading embankments along with restoring of wetlands and vegetation at surface water and wetland locations has been retained for further evaluation. All individual surface water controls, Alternative 3, dikes and berms, and Alternative 4, grading and revegetation, comprise Alternative 6 and, therefore, would not be retained for individual detailed analyses. Activities to remove contaminated sediments from within the wetland and storm lines and sumps at Linde have been retained for further evaluation (Alternative 5).

4.5.4 Buildings and Structures

Alternative 3, partial demolition and disposal, and Alternative 4, decontamination, are both part of Alternative 5 and, therefore, will not be retained as individual alternatives. Alternative 2, complete demolition and disposal, was retained for detailed analyses. The extent of contamination documented at present indicates that complete demolition of buildings currently not in use is warranted. Alternative 6, containment, was retained for detailed analyses. Containment would be effective in isolating the source of contamination on a short-term basis.

4.5.5 Disposal Options

All disposal options retained after initial screening in Section 3 are retained for detailed evaluation. These are: onsite disposal; a new in-state FUSRAP-dedicated facility; an out-of-state FUSRAP-dedicated facility located in the eastern or western United States; an existing out-of-state DOE-owned facility; an existing out-of-state commercial facility; and beneficial reuse. A description of these options is provided in Section 5.2.1.3. The disposal options to be combined with the remedial unit alternatives into sitewide alternatives are as follows:

- onsite disposal;
- in-state FUSRAP-dedicated facility;
- out-of-state FUSRAP-dedicated (eastern U.S.) facility;
- out-of-state FUSRAP-dedicated (western U.S.) facility;
- out-of-state DOE-owned facility;
- out-of-state commercial facility; and
- beneficial reuse.

4.6 ASSEMBLY OF SELECTED SITEWIDE ALTERNATIVES

Following this preliminary screening process, the alternatives that remained for each environmental medium of concern were organized into sitewide alternatives. The remedial unit-specific alternatives retained for accessible soils, access-restricted soils, contaminated sediments, and buildings and structures were assembled into sitewide alternatives based upon the objective of each alternative (i.e., total removal, partial removal, and containment). To properly evaluate the overall magnitude of environmental, public health, and socioeconomic impacts in the detailed analysis section, development of sitewide alternatives was necessary.

Sitewide alternatives were assembled to cover a range of options that address each of the environmental media of concern for the Tonawanda site. The alternatives offer a wide range of media-specific options. These options address, to different degrees, the risks posed by the site. Table 4-5 presents a discussion of each sitewide alternative developed. Table 4-6 presents a summary of the components for the sitewide alternatives. These six remedial alternatives will be analyzed in detail in Section 5 of this report.

Table 4-5. Summary of Selected Sitewide Alternatives

Alternative No. 1 - No Action • This alternative consists of performing no remedial actions and maintaining a "status quo" at the site. Limited site access and fencing would continue to minimize direct contact of contaminants with the public but would not be extended or necessarily maintained. Periodic monitoring of contaminant levels by collecting and analyzing samples is incorporated in this alternative.
Alternative No. 2 - Complete Excavation and Offsite Disposal/Reuse • This alternative includes excavation activities to remove all radioactive soil at the site including all "access-restricted" soils at Linde and Seaway. Contaminated buildings and structures would be completely demolished. Surface water from Rattlesnake Creek would be diverted to remove radioactive sediments and the associated wetlands would be reconstructed. All contaminated soil, sediments, and demolition waste would be disposed at an offsite licensed land encapsulation facility. Groundwater would continue to be monitored. Clean backfill would be used to restore all excavated areas.
Alternative No. 3 - Complete Excavation and Onsite Disposal • Same activities as described in Alternative No. 2 except for construction of an onsite designed land encapsulation facility at Ashland 1, Ashland 2, or Seaway for the disposal of all excavated soils and sediments. Demolition debris from the buildings and structures at Linde would be reduced before disposal at the onsite landfill. Clean backfill would be used to restore all excavated areas.
Alternative No. 4 - Partial Excavation and Offsite Disposal/Reuse • This alternative includes excavation activities to remove all accessible radioactive soil contamination at the site. "Access-restricted" soils at Seaway and Linde would be contained where necessary. All other activities would be similar to Alternative No. 2 except those for buildings and structures at Linde, which would include demolition of Buildings 14, 31, and 38 and subsequent volume reduction activities. Building 30 at Linde would be decontaminated. Soils underneath Building 30 would be remediated when it is demolished by others.
Alternative No. 5 - Partial Excavation and Onsite Disposal • Same as Alternative No. 4 except for construction of an onsite designed land encapsulation facility at Ashland 1, Ashland 2 or Seaway.
Alternative No. 6 - Containment • This alternative includes capping all accessible soils and maintaining the existing "containment" of all "access-restricted" soils at Linde and Seaway. Surface sealants would be applied and institutional controls would continue for all Linde structures. Surface water would be diverted from Rattlesnake Creek to remove radioactive sediments and associated wetlands would be reconstructed. Sediments removed would be incorporated into the capped area at Ashland 2. Groundwater would continue to be monitored.

Table 4-6. Summary of Components of Sitewide Alternatives

Alternative 1 - No Action
• Monitor groundwater, surface water, and ambient air (30 years minimum)
Alternative 2 - Complete Excavation and Offsite Disposal
• Spray sealants on all buildings at Linde
• Demolish all buildings at Linde
• Reduce volume of waste with hammer mill and dispose of demolition debris offsite
• Clean storm lines and sumps at Linde and dispose of sediments offsite
• Construct earthen dikes to divert flow of Rattlesnake Creek
• Remove sediments from Rattlesnake Creek, drainage ditches, and wetlands, and dispose of sediments offsite
• Restore creek, drainage ditches, and wetlands
• Remove railroad spur, pavement, and concrete slabs at Linde to access, remove, and dispose of soils offsite
• Excavate and dispose contaminated soils from Ashland 1, Seaway, and Ashland 2 offsite
• Haul clean backfill to restore site
• Restore site with pavement (Linde), loam, and seed
• Monitor groundwater, surface water, and ambient air (5 years minimum)
Alternative 3 - Complete Excavation and Onsite Disposal
• Same activities as described in Alternative 2
• Construct onsite landfill at Ashland 1, Ashland 2, or Seaway
• Operate and maintain onsite landfill (30 years minimum to a maximum of 1000 years)
• Monitor groundwater, surface water, and ambient air (30 years minimum)

Table 4-6. (continued)

Alternative 4 - Partial Excavation and Offsite Disposal/Reuse
• Spray sealants on Buildings 14, 31, and 38 at Linde
• Demolish Buildings 14, 31, and 38 and dispose demolition debris offsite
• Perform physical and chemical decontamination of Building 30 at Linde
• Clean storm lines and sumps at Linde and dispose of sediments offsite
• Construct earthen dikes to divert flow of Rattlesnake Creek
• Remove sediments from Rattlesnake Creek, drainage ditches, and wetlands, and dispose of sediments offsite
• Restore creek, drainage ditches, and wetlands
• Remove waste piles at Linde and Seaway and soils in vicinity of railroad spur at Linde; dispose of contaminated soils offsite
• Completely excavate contaminated soils at Ashland 1 and 2 and dispose of soils offsite
• Haul clean backfill to restore site
• Restore site with loam and seed
• Monitor groundwater, surface water, and ambient air at Linde and Seaway (30 years minimum)
• Maintain institutional controls over site and groundwater use at Linde and Seaway (30 years minimum)
• Remove and dispose of contaminated soils under Building 30 at future date, when building is demolished by others
Alternative 5 - Partial Excavation and Onsite Disposal
• Same activities as described in Alternative 4
• Construct onsite landfill at Ashland 1, Ashland 2, or Seaway
• Operate and maintain onsite landfill (30 years minimum to a maximum of 1000 years)
• Monitor groundwater, surface water, and ambient air (30 years minimum)
• Institutional controls over site and groundwater use (30 years minimum)

Table 4-6. (continued)

<u>**Alternative 6 - Containment**</u>

- Spray sealants on all buildings at Linde
- Clean storm lines and sumps at Linde and dispose sediments offsite
- Construct earthen dikes to divert flow of Rattlesnake Creek
- Remove sediments from Rattlesnake Creek, drainage ditches, and wetlands; incorporate sediments into capped areas of Ashland 2
- Restore creek, drainage ditches, and wetlands
- Cap soils in vicinity of railroad spur at Linde
- Cap waste piles at Linde and Seaway with multi-media cover
- Haul materials for capping contaminated soils
- Place and grade soils on areas to be capped at Ashland 1 and 2
- Cap contaminated soils with multi-media cover
- Restore site with loam and seed
- Operate and maintain capped areas (30 years minimum)
- Monitor groundwater, surface water, and ambient air (30 years minimum)
- Institutional controls over site and groundwater use (30 years minimum)

5. DETAILED ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

The detailed analysis of alternatives follows the development and screening of alternatives and provides the basis for identifying a preferred alternative. This section analyzes and evaluates the suitable alternatives developed and screened in Section 4. Section 5.2 provides the detailed description of alternatives. In Section 5.3, the alternatives capable of addressing the contamination are evaluated in detail based on the integration of CERCLA criteria with NEPA values (see Table 5-1). The detailed analysis consists of defining each alternative with respect to the contaminated media, the technologies to be used, and performance requirements associated with those technologies, and an assessment and summary profile of each alternative against the evaluation criteria.

The statutory requirements (EPA 1988a) that guide the evaluation of remedial alternatives in an FS are that a remedial action:

- protect human health and the environment;
- attain ARARs or define criteria for invoking a waiver;
- be cost effective; and
- use permanent solutions to the maximum extent.

EPA has established nine evaluation criteria to address these statutory requirements for CERCLA. Section 5.3 presents an evaluation of each potential remedial action alternative based on the nine criteria, which are listed and explained below:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- short-term effectiveness;
- reduction of mobility, toxicity, or volume through treatment;
- implementability;
- cost;

Table 5-1. Integration of NEPA Values with CERCLA Evaluation Criteria
Overall Protection of Human Health and the Environment
Compliance with ARARs
Long-Term Effectiveness and Permanence
irreversible and irretrievable commitment of resources
Short-Term Effectiveness
direct and indirect environmental impacts and their significance (environmental impacts)
geology and soils
water quality
air quality
ecological resources
biota
threatened and endangered species
wetlands
archaeological, cultural, and historic resources
land use and recreational/aesthetic resources
socioeconomic and institutional issues
community well-being
institutional considerations
public services
economic and demographic resources
local transportation impacts
noise impacts
unavoidable adverse impacts
mitigative measures
short-term uses and long-term productivity
cumulative impacts
Reduction of Toxicity, Mobility, and Volume through Treatment
Implementability
Cost
Community Acceptance*
State Acceptance*

* After public comment/input

- state or support agency acceptance; and,
- community acceptance.

The overall protection of human health and the environment each alternative affords is evaluated on the extent to which it reduces the risk of exposure to contaminants from potential exposure pathways through engineering or institutional controls. Each alternative is also examined for its potential of creating any unacceptable short-term or cross-media impacts.

The ARARs identified and screened for relevance to the remedial actions are presented in Appendix F. A table identifying ARARs significant to individual alternatives or requiring waivers is presented in Appendix F, Table F-4.

Long-term effectiveness and permanence of the alternatives are evaluated on the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste after response objectives have been met over the long term. Alternatives that afford the highest degrees of long-term effectiveness and permanence result in little or no contaminated waste remaining at the site, making long-term maintenance and monitoring unnecessary and minimizing the need for institutional controls.

Evaluation of alternatives for short-term effectiveness takes into account protection of workers and the community during the remedial action, environmental impacts from implementing the action, and the time required to achieve cleanup goals.

The statutory preference is to select a remedial action that employs treatment to reduce the toxicity, mobility, or volume of hazardous substances. However, treatment technologies were screened out in Section 4 due to the limiting characteristics of the onsite soils and the waste material. Soils at the Tonawanda site are predominantly fine grained soils (clays), which are not suitable for volume reduction or immobilization treatment technologies. Treatment technologies reviewed would not reduce the toxicity (radioactivity) of radionuclides. The mobility of the radionuclides could be reduced, but since the waste is still toxic, the immobilized waste would still require disposal at a secure facility. Since radionuclides tend to adhere to fine grained particles and the waste characteristics consist predominantly of silts and clays, volume reduction technologies would not be effective. In addition, treatment technologies for radionuclides are an emerging technology and have not been demonstrated to be effective at full scale production for all soil types.

The analysis of implementability deals with the technical and administrative feasibility of implementing the alternatives as well as the availability of necessary equipment and services. This criterion includes such items as the ability to construct and operate components of the alternatives; the ability to obtain services, capacities, equipment, and specialists; the ability to monitor the performance and effectiveness of technologies; and the ability to obtain necessary approvals from other agencies.

The costs presented are based on a variety of information including quotes from suppliers, generic unit costs, vendor information, conventional cost estimating guides, and prior experience (EPA 1988a). The feasibility study-level cost estimates shown have been prepared from the information available at the time of the estimate for guidance in project evaluation and implementation. The actual costs of the project would depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, implementation schedule, and other variables. A significant uncertainty that would affect the cost is the actual volume of contaminated soil. Most of these uncertainties would affect all of the costs similarly. A sensitivity cost analysis, presented in Appendix G, describes potential cost analysis impacts based on the variation of certain factors.

The preferred alternative should be acceptable to state and support agencies. Also, the concerns of the community should be considered in presenting alternatives that would be acceptable to the community. An initial discussion about possible impacts to community well-being are presented in each alternative. These two criteria would be evaluated following comments on the draft FS/PP-EIS received during the public comment period and would be addressed in the final FS/PP-EIS prior to the finalization of the ROD.

Section 5.3 also evaluates the environmental consequences of an action, including the following issues not always emphasized in environmental evaluations under CERCLA:

- direct and indirect environmental impacts and their significance;
- unavoidable adverse impacts;
- mitigative measures;
- short-term uses and long-term productivity;
- cumulative impacts; and
- irreversible and irretrievable commitment of resources.

Direct impacts are those effects caused by the action and occurring at the same time and place. Indirect impacts are those caused by the action that occur later in time or farther removed in distance, but that are still reasonably foreseeable. Indirect impacts may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Other categories of NEPA impacts that are evaluated include ecological (such as the effects on natural resources and on the components, structures, and functions of effected ecosystems), aesthetic, historic, cultural, economic, social, and human health effects. Effects also discussed are those actions which may have both beneficial and detrimental effects, even if on balance the effect may be beneficial.

Unavoidable adverse impacts under NEPA include any effects from the proposed action that cannot be avoided should the proposal be implemented. Mitigation is indicated if the adverse impact could be reduced to any degree.

Mitigative actions were considered, where applicable, concerning:

- avoiding the impact altogether by not taking a certain action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact over time by preservation and maintenance operations during the term of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

The discussion of short-term uses and long-term productivity evaluates the short-term benefits of the alternatives in relation to the commitment of natural resources. Adverse impacts to the environment were considered short-term if the project area can be returned to pre-project uses when the project is ended.

Discussion of cumulative impacts includes the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action, regardless of what agency or person undertakes such other action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Discussions of irreversible and irretrievable commitment of resources include the permanent loss of resources caused by implementation of the alternatives. Those resources were identified that could be committed for long periods of time but that could be restored in the future if the hazardous material is removed.

DOE, as a matter of policy, integrates NEPA values into the procedural and documentation requirements of CERCLA. Therefore the evaluation of alternatives for remediation is conducted using this approach. The NEPA discussions have been grouped under the criterion of "short-term effectiveness." Many of the environmental issues addressed under this criterion may have impacts at the site beyond the short term (the period of implementation of the alternative); however, in the interest of avoiding repetition of issues and facilitating review of the document for NEPA purposes, these issues are presented under "short-term effectiveness," and the definition of that criterion is expanded to include these issues. An exception is the

NEPA discussion on "irreversible and irretrievable commitment of resources" which is addressed under the CERCLA criterion, "long-term effectiveness and permanence."

In Section 5.4, a summary of criterion-specific evaluations of each sitewide remedial action alternative from Section 5.3 is presented. Both CERCLA and NEPA require a comparative evaluation of alternatives, which is presented in Section 5.5.

5.2 DETAILED DESCRIPTIONS OF REMEDIAL ACTION SITEWIDE ALTERNATIVES

This section describes in detail the sitewide remedial action alternatives that were developed from the initial screening. General actions which are common to several alternatives (e.g., excavation, transportation, and disposal) are described in Section 5.2.1. Descriptions of these general actions are not repeated in the detailed descriptions in Section 5.2.2; however, their applicability or limitations for a particular remedial unit are discussed as appropriate. Finally, Section 5.2.2 presents the descriptions of sitewide alternatives.

5.2.1 General Actions

5.2.1.1 Excavation

Contaminated soil is excavated with conventional earth-moving equipment (e.g., hoes, bulldozers, and front-end loaders). The type of equipment to be used is determined by the size of the area to be remediated, the area available to set up the equipment, the required bucket size for efficient removal of the soil, and the capability for moving the contaminated soil to a facility for treatment or disposal. Dump trucks and dump trailers can haul excavated soil. At Linde, manual excavation would be employed where lack of space makes use of conventional equipment infeasible.

The term "hoe" applies to any excavating machine of the power-shovel type (e.g., hoe, backhoe, back shovel, or pull shovel). Hoes are used primarily to excavate below the natural surface of the ground on which they rest and are most suited to excavating trenches and pits and to general grading work that requires precise control of excavation depth. They are superior to drag lines for close-range work and for loading excavated material into dump trucks.

Bulldozers are versatile machines used on projects such as moving earth for distances up to 91.4 m (300 ft), spreading earth fill, backfilling trenches and pits, clearing sites of debris, and pushing debris into loading areas. Bulldozer blades are mounted perpendicular to the direction of travel while angle dozer blades are set at some other angle to the direction of travel, so the former blades push earth forward while the latter blades push earth forward and to one side.

Front-end loaders, also called tractor shovels, are used extensively in construction to handle and load bulk material such as soil, rocks, and rubble into dump trucks, to move earth forward for short distances, and to excavate. The two basic types of front-end loader are crawler tractor mounted and wheel tractor mounted; they may be further classified based on their capacity.

Dump trucks and trailers serve only as hauling units for soil, rock, aggregate, and other material. Because of their speed on suitable roads, they provide high earth-moving capacity at relatively low hauling cost. They also provide a high degree of flexibility, as the number of trucks in service may easily be increased or decreased to modify the total hauling capacity of a fleet.

Bulldozers or front-end loaders can remove relatively shallow and wide areas of contaminated soil. Contaminated surface soils that cover smaller areas may be removed using this equipment or digging equipment such as backhoes. Generally effective to a depth of 0.3 to 0.6 m (1 to 2 ft), front-end loaders can scoop surface soils either into a temporary pile that can then be loaded in dump trucks or some other similar container for transport, or directly into the transport container. If soil removal must go below a foot or two, hoes generally are more applicable due to their greater depth-handling capability.

Access to subsurface soils would occur with digging equipment such as hoes or backhoes. In addition to determining the optimum bucket size for efficient removal of subsurface soil, the depth of excavation must be taken into account because there is a physical limitation on the length of hydraulic arms. Contaminated soil in certain locations, (e.g., next to buildings or culverts) can be accessed with backhoes using smaller buckets or with smaller earth removal equipment. In some cases, it may be necessary to reroute drainage culverts to gain access to soils under them, or to use smaller equipment, possibly even shovels, to remove soil manually.

If subsurface soils are contaminated over a large area in some of the remedial units, it would be necessary to combine surface soil removal with further subsurface excavation. The uppermost several feet of contaminated soil could be removed with bulldozers or other surface soil removal equipment, and the more limited deeper areas of contaminated soils could be accessed with digging equipment.

5.2.1.2 Transportation

Either bulk waste or containerized waste may be transported. Shipment of bulk contaminated soil may be by rail car or truck; some disposal facilities are known to have rail access and facilities for offloading rail cars. For the purpose of evaluating the in-state and out-of-state disposal facilities, it would be assumed that rail cars would be used to transport materials out of state, whereas trucks would be used to transport the materials within the State of New York.

Semi-tractor trailer trucks, both flatbed and enclosed, are commonly used to transport containerized waste and would be appropriate for these excavated soils. If the receiving facility can accept bulk contaminated soil, transportation by covered dump truck could be used instead. If the excavated soils must be transported across the country, rail transportation for either the bulk or containerized soil is a viable option.

The containers would be manifested according to applicable requirements for shipment of radioactive waste materials. As required, predesignated routes would be traveled and an emergency response program would be developed for accidents. Upon arriving at the disposal facility, the containers would be removed from the truck or rail car for disposal. The transportation of radioactively contaminated materials would strictly comply with all applicable state and federal regulations.

Material that does not exceed 2000 pCi/g of total radioactivity is not classified as radioactive by the U.S. Department of Transportation (DOT). Therefore, it may be possible to ship untreated bulk soil from the Tonawanda site as nonradioactive waste under DOT regulations, contingent upon disposal facility waste acceptance criteria. Placarding trucks as radioactive materials would still be a good practice.

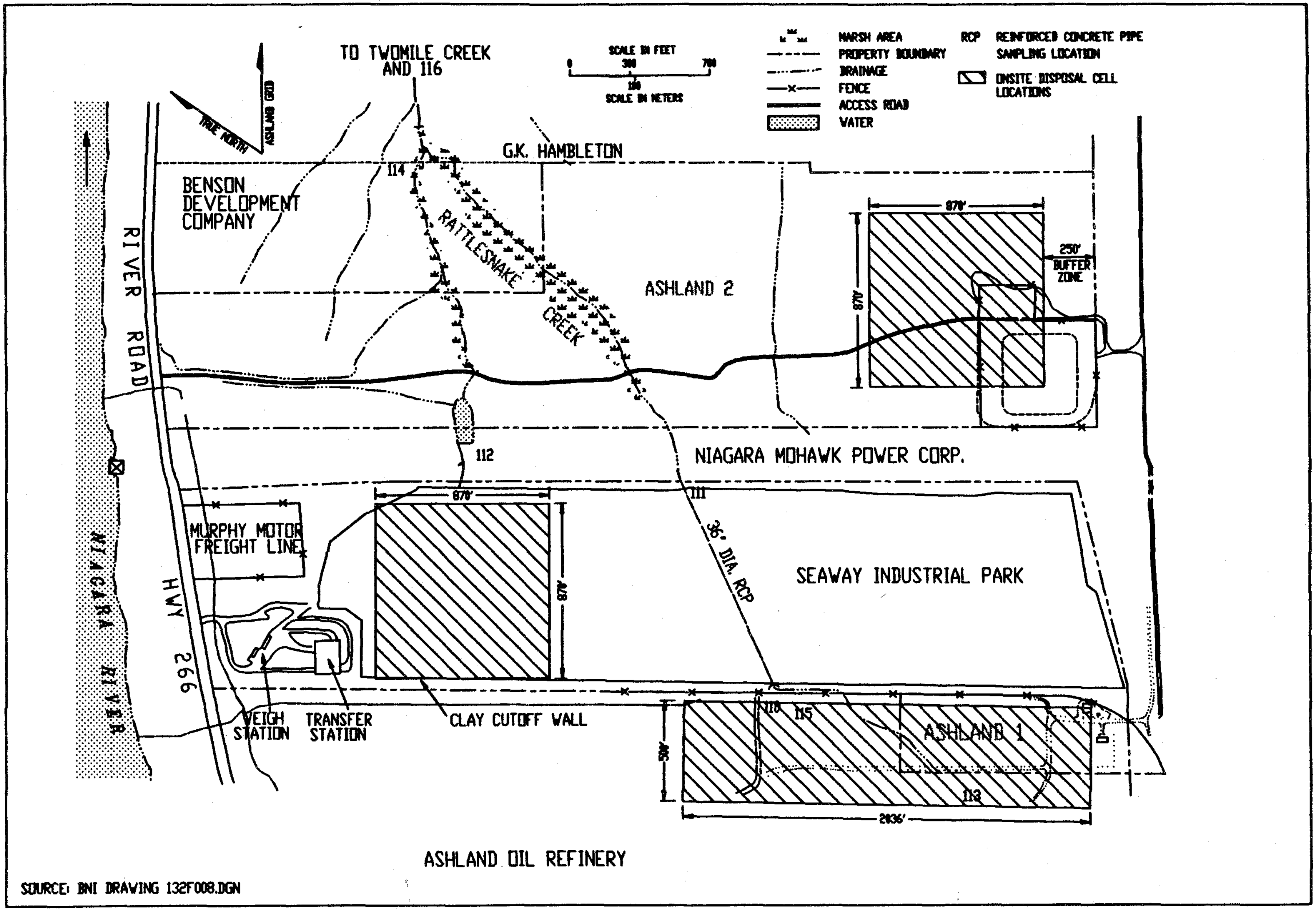
All vehicles used to transport excavated soil would be inspected before use and surveyed for radioactive contamination following transport. Decontamination would be performed as appropriate.

5.2.1.3 Description of Disposal Options

The disposal options for the contaminated materials include onsite or offsite disposal. Offsite disposal options include: a new facility dedicated to FUSRAP waste within the State of New York; a new National East or National West facility dedicated to FUSRAP waste; existing DOE disposal facilities; existing commercial disposal facilities; or beneficial reuse.

Onsite Disposal

This option involves the design and construction of a new encapsulated disposal facility. A new encapsulated disposal facility would follow DOE's conceptual design for an encapsulated, aboveground facility for FUSRAP waste (BNI 1989) and use all natural materials with a projected life of 200 to 1000 years. Design capacity (for complete excavation alternatives) would be for an estimated 282,100 m^3 (369,000 yd^3). Figure 5-1 indicates the three potential locations with the estimated configurations and sizes for the onsite disposal cell located on Ashland 1, Seaway, or Ashland 2 properties. (The three potential locations, configurations, and sizes are intended only to show the feasibility of onsite disposal. The actual location and configuration within each of these options would be determined, in part, based on final engineering design considerations.) Figure 5-2 indicates a typical section of the waste containment structure.



SOURCE: BNI DRAWING 132F008.DGN

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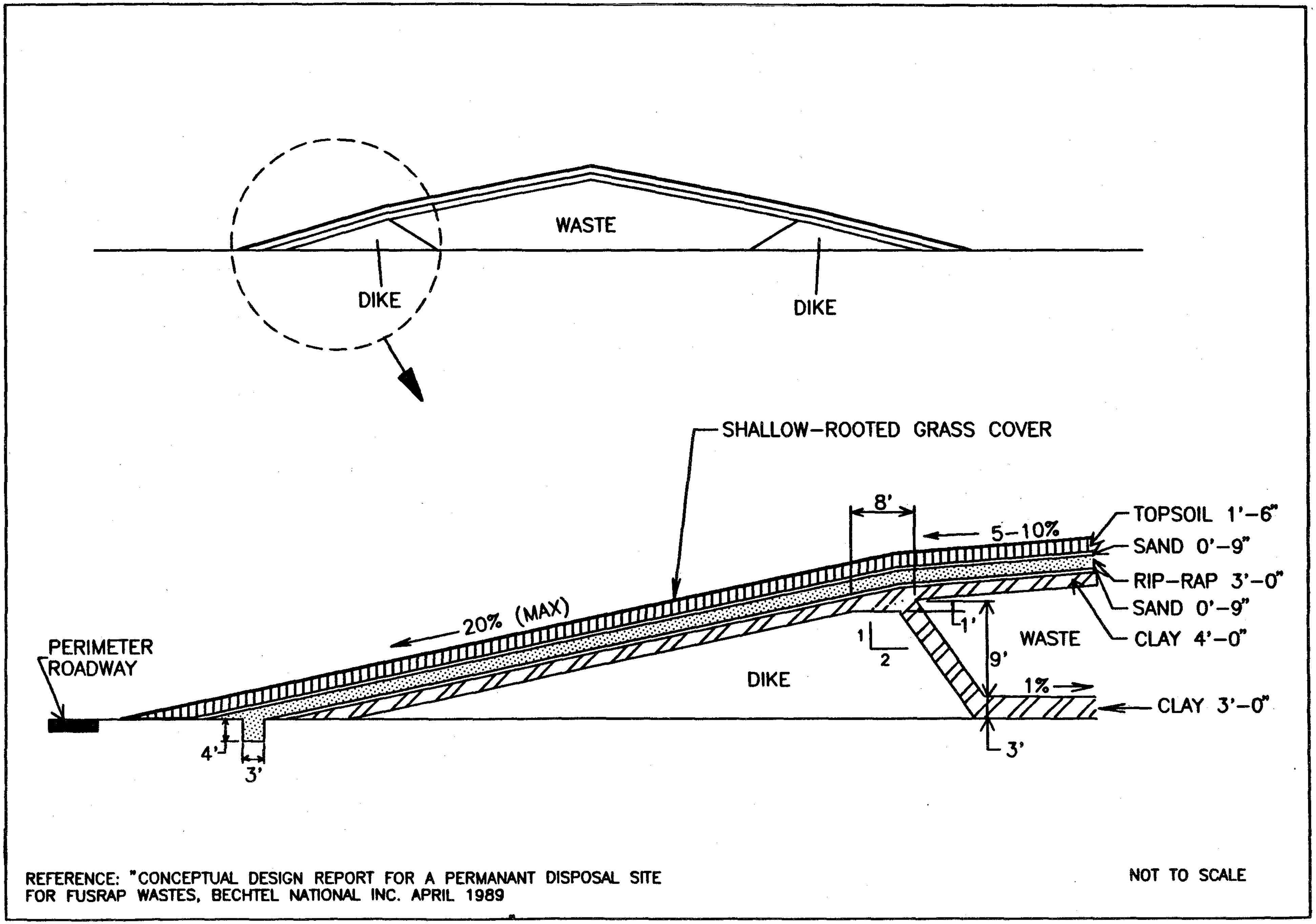
Figure 5-1. Conceptual Design of Onsite Disposal Cell Options



SAIC 677-315 FIG5-2

Figure 5-2. Typical Section of Waste Containment Structure

The onsite disposal facility would be dedicated to FUSRAP waste and be designed and constructed as an above-grade engineered structure. A 1989 conceptual design report (BNI 1989) bases design on an above-grade disposal facility. Using an above-grade waste containment structure minimizes the possibility of groundwater migration into the facility and maximizes the groundwater separation distance.

Site characterization data, particularly that related to waste mobility and environmental transport mechanisms, would have to be evaluated in a pre-operational performance assessment to ascertain whether the combination of engineered disposal technology and site characteristics provides the level of protection necessary for safe and effective operation of a disposal facility.

Offsite Disposal - New York FUSRAP-Dedicated Facility

Disposal at a newly constructed facility within the State of New York is a viable option contingent on the identification of an appropriate disposal site. The disposal site would be sited in accordance with criteria comparable to the protectiveness of human health and safety requirements (performance standards) previously used to site by-product and low-level waste disposal facilities, using a siting methodology similar to that used to identify potential sites for the low-level radioactive waste disposal facilities in New York. The environmental and geologic setting for a specific disposal cell will determine the level of engineering required for the disposal cell to meet performance standards. Some characteristics of a location, such as topography and amount of rainfall, affect the probability of a release. Other characteristics, such as downgradient groundwater wells, adjacent farmland or nearby endangered species, influence the potential for damage that could occur in the event of a release. Site characteristics that could adversely affect performance of the disposal facility are typically mitigated through the site-specific engineering design.

Offsite disposal at the in-state New York facility would be constrained by the difficulties associated with siting such a facility. Extensive characterization of several sites would be required to support siting requirements (including receipt of public input). The siting and development of such a facility would be a very protracted activity, which means that the waste would remain onsite under essentially current conditions for approximately ten years. However, because of the extensive site-suitability studies conducted prior to siting, the new facility would likely have even more favorable conditions (e.g., thicker clay, lower hydraulic conductivity, more favorable geology, deeper groundwater table, and/or higher sorption capabilities) than the onsite facility.

The in-state FUSRAP-dedicated option involves the design and construction of a new encapsulated disposal cell, similar to the onsite disposal facility, to be constructed on land owned or acquired by DOE, somewhere within the State of New York. Design capacity would be for an estimated 382,100 m^3 (499,800 yd^3). This facility would be capable of receipt and disposal of all waste from FUSRAP sites in New York. It has been preliminarily determined that a facility based on the conceptual design for an encapsulated above-ground disposal cell for the above capacity would require approximately 23.5 acres (SAIC 1993b). A buffer and support facility zone could increase this to approximately 25 acres. Regional settings within the state were evaluated for a New York low-level radioactive waste disposal facility in the late 1980s, by the New York State Low-Level Radioactive Waste Commission and Roy F. Weston, Inc., using the siting criteria in the New York Compilation of Rules and Regulations, Title 6, Part 382 (NYDEC 1987) (i.e., geology, hydrology, seismicity, population, land use, minerals, and exploitable resources, etc.). Five potential sites, identified in two counties within 200 miles of the Tonawanda site, were found adequate to initiate field studies (New York State Low-Level Radioactive Waste Siting Commission 1989). DOE would conduct a similar siting study to propose an actual location for a new DOE facility. Transport of waste would be by truck using existing routes; an assumed hauling distance of 200 miles was used for costing purposes. Potential borrow material sources that can meet DOE's estimated demands have been identified in Niagara and Erie Counties.

Offsite Disposal - New National East FUSRAP-dedicated Facility

A new disposal facility dedicated to the disposal of FUSRAP waste would be constructed on land owned or acquired by DOE in the eastern United States. The location would be central to the three parts of the region where the bulk of FUSRAP waste is located: northern New York, northern New Jersey, and near St Louis, Missouri.

Disposal at a newly constructed facility in the eastern United States is a viable option contingent on the identification of an appropriate disposal site. The disposal facility would be sited in accordance with criteria comparable to the protectiveness of human health and safety requirements (performance standards) previously used to site by-product and low-level radioactive waste disposal facilities, using a methodology similar to that used to identify potential low-level radioactive waste disposal sites in New York. The environmental and geologic setting for a specific disposal cell will determine the level of engineering required for the disposal cell to meet performance standards. Some characteristics of a location, such as topography and amount of rainfall affect the probability of a release. Other characteristics, such as downgradient groundwater wells, adjacent farmland or nearby endangered species, influence the potential for damage the could occur in the event of a release. Site characteristics that could adversely affect performance of the disposal facility are typically mitigated through the site-specific engineering design.

Offsite disposal at this facility would be constrained by the difficulties associated with siting such a facility. Extensive characterization of several sites would be required to support siting requirements (including receipt of public input). The siting and development of such a facility would be a very protracted activity, which means that waste would remain onsite under essentially current conditions for approximately ten years. However, because of the extensive site-suitability studies conducted prior to siting, the new facility would likely have even more favorable conditions (e.g., thicker clay, lower hydraulic conductivity, more favorable geology, deeper groundwater table, and/or higher sorption capabilities) than the onsite facility.

The National East FUSRAP-dedicated option involves the design and construction of a new encapsulated disposal cell, similar to the onsite disposal facility, to be constructed on land owned or acquired by DOE, somewhere within the eastern United States. Design capacity would be for an estimated 1,990,000 m^3 (2,600,000 yd^3). This facility would be capable of receipt and disposal of all waste from FUSRAP sites. Based on preliminary calculations (SAIC 1993b), it has been determined that a facility based on the conceptual design for an encapsulated above-ground disposal cell for the above capacity would require approximately 117 acres (SAIC 1993b). A buffer and support facility zone could increase this to approximately 125 acres. Regional settings within the State of New York were evaluated for a New York low-level radioactive waste disposal facility in the late 1980s, by the New York State Low-Level Radioactive Waste Commission and Roy F. Weston, Inc., using the siting criteria in the New York Compilation of Rules and Regulations, Title 6, Part 382 (NYDEC 1987) (i.e., geology, hydrology, seismicity, population, land use, minerals, and exploitable resources, etc.). Five potential sites were found adequate to initiate field studies (New York State Low-Level Radioactive Waste Siting Commission 1989). Other low-level radioactive waste disposal compacts have identified potential disposal sites using similar methodologies (i.e., the Southeastern Compact identified two sites in North Carolina and the Midwestern Compact identified a site in Illinois), but an actual location for the DOE facility has not been identified at this time. Transport of waste would be by rail; an assumed hauling distance of 500 miles was used for costing purposes. Implementation of this alternative would not be constrained by the availability of resources or supplies beyond those expected to be available near the disposal location.

A preliminary comparison of this disposal option with the evaluation criteria found in CERCLA has been performed and it has been determined that this option is implementable (SAIC 1993b).

Offsite Disposal - New National West FUSRAP-dedicated Facility

A new disposal facility dedicated to the disposal of FUSRAP waste would be constructed on land owned or acquired by DOE in the western United States. Disposal at a newly constructed facility in the western United States is a viable option contingent on the identification of an appropriate disposal site. The disposal facility would be sited in accordance with criteria comparable to the protectiveness of human health and safety requirements (performance standards) previously used to site by-product and low-level radioactive waste disposal facilities, using a methodology similar to that used to identify potential low-level radioactive waste disposal sites in the East. The environmental and geologic setting for a specific disposal cell will determine the level of engineering required for the disposal cell to meet performance standards. Some characteristics of a location, such as seismicity and flooding, affect the probability of a release. Other characteristics, such as downgradient groundwater wells, adjacent farmland or nearby endangered species, influence the potential for damage the could occur in the event of a release. Site characteristics that could adversely affect performance of the disposal facility are typically mitigated through the site-specific engineering design.

Offsite disposal at this facility would be constrained by the difficulties associated with siting such a facility. Extensive characterization of several sites would be required to support siting requirements (including receipt of public input). The siting and development of such a facility would be a very protracted activity, which means that waste would remain onsite under essentially current conditions for approximately ten years. However, because of the extensive site-suitability studies conducted prior to siting, the new facility would likely have even more favorable conditions (e.g., less rainfall, lower hydraulic conductivity, more favorable geology, deeper groundwater table, and/or higher sorption capabilities) than the onsite facility.

The National West FUSRAP-dedicated option involves the design and construction of a new encapsulated disposal cell, similar to the onsite disposal facility, to be constructed on land owned or acquired by DOE, somewhere within the western United States. Design capacity would be for an estimated 1,990,000 m^3 (2,600,000 yd^3). This facility would be capable of receipt and disposal of all waste from FUSRAP sites. Based on preliminary calculations (SAIC 1993b), it has been determined that a facility based on the conceptual design for an encapsulated above-ground disposal cell for the above capacity would require approximately 117 acres (SAIC 1993b). A buffer and support facility zone could increase this to approximately 125 acres. Regional settings within the western U.S. have been evaluated by states, using site selection methodologies similar that employed in the East, for low-level radioactive waste disposal facilities. Potential locations for low-level waste disposal facilities have been identified by the States of California and Texas. Disposal facilities for by-product and low-level waste have also been sited in Colorado, Utah, and Nevada. An actual location for the DOE facility has not been identified at this time. Transport of waste would be by rail; an assumed hauling distance of 2800 miles was used for costing purposes. Implementation of this alternative would not be constrained by the availability of resources or supplies beyond those expected to be available near the disposal location.

A preliminary comparison of this disposal option with the evaluation criteria found in CERCLA has been performed and it has been determined that this option is implementable (SAIC 1993b).

Offsite Disposal - Existing DOE-owned Facility

This option involves disposal at an existing DOE disposal facility. Two DOE facilities accept waste from offsite generators for disposal: the Hanford Reservation and the Nevada Test Site. Some other DOE sites provide disposal facilities for wastes generated onsite, but do not accept waste generated offsite.

The waste acceptance criteria for the Hanford site do not contain any specific prohibitions that would preclude accepting Tonawanda site wastes. There are extensive waste certification requirements for the site, including administrative requirements for receiving approval through the appropriate DOE offices of offsite waste on the Hanford Reservation.

The Nevada Test Site radioactive waste disposal operation has been designated for wastes generated through DOE Defense Program operations. The site has no specific restrictions against radium-contaminated waste and can accept shipments of contaminated waste in containerized or bulk form. In addition, extensive certification and preshipment approval requirements are specified in the waste acceptance criteria. Provided that the excavated soils from the Tonawanda site are determined to be Defense Program waste or a waiver can obtained from this requirement, the Nevada Test Site would then be a viable disposal option, but will not be analyzed further in this FS/PP-EIS.

There are no delays expected with the use of existing DOE facilities. The present agreement with the Hanford site includes approval for wastes from some FUSRAP facilities, but not the New York sites, therefore, an agreement would have to be negotiated for acceptance of the Tonawanda waste.

Offsite Disposal - Existing Commercial Facilities

Chapter III of DOE Order 5820.2A specifies that waste generated through DOE operations should be disposed of at a DOE facility unless an exemption is justified. Therefore, properly permitted commercial disposal facilities may be used for the wastes under DOE Order 5820.2A. The Tonawanda wastes would be regulated under the byproduct material definition of the Atomic Energy Act [Chapter 2, Section 11e(2)]. The only commercial facility currently pursuing a by-product material license is the Envirocare of Utah facility.

The Envirocare facility was specifically designed for disposal of low-activity, high-volume remediation wastes, and was authorized for disposal of either bulk or containerized naturally occurring radioactive material, including radium and thorium. The radioactive material license issued by the State of Utah limits the specific activity of the waste to 2000 pCi/g Ra-226 and 680 pCi/g Th-232. However, the State of Utah has not sought an agreement with NRC granting approval for licensing of waste produced through extraction or concentration of thorium. Because this authority does not reside with the state, 11e(2) byproduct material (i.e., thorium extraction waste such as that generated at the Tonawanda site) has not been included in Envirocare's radioactive material license. An application has been submitted by Envirocare to NRC requesting approval for disposal of 11e(2) material. The completed application was accepted for review by NRC on June 4, 1991. The licensing and environmental review process is estimated to be completed during 1994. Until the license is granted by NRC, this disposal facility would not be available for Tonawanda waste. However, because the site is expected to receive approval within a reasonable time with respect to waste generation activities at the Tonawanda site, it will be retained for the detailed evaluation.

Offsite Disposal - Beneficial Reuse

An investigation of standard specifications for various types of construction project fill material for the State of New York was undertaken to determine if the contaminated soils and sediments from the Tonawanda properties might be acceptable for use. In all cases, the maximum acceptable percentage of fine materials (clay and silt) is 15% (New York State Department of Transportation 1990). The grain size distributions and boring log descriptions of contaminated soil samples from the Tonawanda properties indicate that the contaminated soils are predominantly clays and silts, and therefore unacceptable for use on highways and on similar projects. The possibility remains for the contaminated soils to be used as fill or cover at disposal sites.

This option would involve the potential use of excavated contaminated soils as fill material during construction of roads, highways, and new airport runways. Only new construction would be appropriate for such dispersal to comply with 40 CFR 192. Additionally, contaminated soils could be used as fill at certain types of disposal facilities, such as the Seaway landfill, should the closure of this facility require large quantities of fill material to attain responsible closure grades. It would be necessary to demonstrate that groundwater quality would not be impacted. The potential for slight, temporary increase of risk to the community (and to workers) due to particulate emissions during application of soil would be controlled through the use of dust control technologies (e.g., water or foam sprays). The potential benefit of reuse is that radiation dose to individuals would be controlled by limiting land use, eliminating the ingestion pathway, and avoiding most of the direct radiation pathway.

The potential remains for the material to be reused in a beneficial manner, but the uses are limited to use as fill at licensed disposal sites. Should an acceptable reuse option be identified in the future, it could be substituted for offsite disposal. In this case, a supplement to this FS/PP-EIS would be issued to evaluate impacts of the specific reuse option.

5.2.2 Description of Sitewide Alternatives

In this section, the six sitewide alternatives developed for the Tonawanda site are described. Detailed descriptions of those actions in Sections 5.2.1 are referenced.

5.2.2.1 Alternative 1 — No Action

The no-action alternative is considered in accordance with CERCLA requirements and NEPA values, and provides a baseline for comparison with other alternatives. Under this alternative, no action is taken to implement remedial activities. Periodic monitoring of contaminant levels in appropriate media is continued.

Fencing and signs currently in existence would be left in place but would not receive maintenance or repairs. Site security at the Tonawanda site would continue indefinitely under the no-action scenario.

5.2.2.2 Alternative 2 — Complete Excavation and Offsite Disposal

Complete excavation involves removing all soils contaminated above DOE guidelines for residual radioactivity. At Linde, contaminated buildings would be demolished. The railroad spur, concrete floors, and pavement would be removed to gain access to contaminated soils beneath these structures. A large hoe, a small backhoe, and/or front-end loaders would be used to excavate surface and subsurface soils. Before building demolition, spray sealants would be applied to mitigate impacts to ambient air from fugitive dust and particulate emissions. Conventional heavy equipment would be utilized to demolish the four buildings at Linde. Grappling hooks attached to cranes would remove debris and feed the debris directly into volume reduction equipment such as a portable hammer mill with its associated air pollution control equipment. Processed demolition debris could be fed directly into container trucks for offsite disposal. The buried vault also would be removed at Linde. Drainage to storm drain lines would be prevented during excavation activities to minimize additional impact on the storm sewer system.

Contaminated sediments within Linde storm lines and sumps would be snaked, contaminants removed, and lines cleaned. It is estimated that approximately 670 m (2200 linear ft) of storm lines would require cleaning. Contaminated sediments within the wetlands at the northeast corner of Linde would be removed followed by wetland restoration.

At Ashland 2, surface water of Rattlesnake Creek and its associated drainage ditches within the Niagara-Mohawk easement would be temporarily diverted using dikes to reroute flow as appropriate. Erosion control devices would prevent sediments from migrating offsite. Contaminated sediments from the creek and drainage ditch would be removed using a "clamshell" crane. The disturbed areas of Rattlesnake Creek and the drainage ditches would be reconstructed with native materials. The wetlands associated with Rattlesnake Creek would be restored in all disturbed areas.

At Ashland 1 and 2 and the waste piles at Seaway (Area A) and Linde, contaminated soils could be excavated and removed with conventional earth-moving equipment. Soils at these properties are readily accessible and no obstructions would prohibit removal.

At the Seaway property, the "access-restricted" soils located within and under the refuse would be removed. Utilizing conventional excavation techniques would result in greater short-term impacts especially with regard to landfill gas emissions, odors, and temporary storage of excavated waste. Specifications and details for accessing the contaminated soils within the Seaway landfill can be finalized as part of the remedial design process.

General aspects of offsite disposal are discussed in Section 5.2.1.3. The contaminated soil would be placed into rail cars or trucks for bulk shipment to the disposal facility. Loading facilities would have to be constructed, or existing sidings on Ashland 1 and Linde used, to load material into rail cars. Offsite transportation issues are discussed in Section 5.2.1.2.

Radioactively contaminated solid waste would be placed into containers acceptable for transportation and shipment offsite and would meet the waste acceptance criteria for receipt by the permanent disposal facility. Optional disposal sites are described in Section 5.2.1.3. Solid waste would be transported by enclosed semitrailers or by rail. The trucks or rail cars used to transport contaminated materials would be safety inspected before use. All containers would be checked for surface contamination and decontaminated, if necessary, before being loaded onto the trucks or rail cars. The shipments would be manifested according to the applicable requirements for shipment of radioactive waste materials. As required, predesignated routes would be traveled and an emergency response program would be developed to respond to any accidents. Upon arriving at the disposal facility, the containers would be removed from the trucks or rail cars for disposal. The transportation of radioactively contaminated materials would strictly comply with all applicable state and federal regulations.

5.2.2.3 Alternative 3 — Complete Excavation and Onsite Disposal

This alternative is similar to Alternative 2, except for the disposal option. All activities would be identical to those described in Alternative 2. All radioactive materials would be collected in bulk and trucked to the onsite land encapsulation disposal facility located at any one of the three potential sites, namely Ashland 1, Seaway, or Ashland 2. The property containing the disposal cell would be purchased and maintained by DOE. Construction aspects of the onsite disposal facility are discussed in Section 5.2.2.1. Onsite monitoring of air, surface water, and groundwater would be implemented for the life of the facility.

5.2.2.4 Alternative 4 — Partial Excavation and Offsite Disposal/Reuse

This alternative is similar to Alternative 2 except that contaminated soils under Building 30 at Linde and soils in Areas B and C of Seaway would not be excavated. When Building 30 is abandoned and subsequently demolished, the soils would become accessible for future DOE removal. Because contaminated soils would remain in place, institutional controls and containment, as appropriate, would be necessary to prevent exposure to remaining contaminants. Institutional controls would include access restrictions, deed restrictions, and/or perpetual prohibition of excavation/demolition activities on the site. Physical and chemical methods would be used to selectively decontaminate Building 30. Buildings 14, 31, and 38 would be completely demolished at Linde. Sediments located within the storm drains and sumps at Linde, as well as the waste pile stored at Linde would be removed.

Contaminated sediments within the wetlands at the northeast corner of Linde would be removed and the wetland restored. The accessible soils at Ashland 1 (including Seaway Area D) and Ashland 2 plus the waste pile at Seaway (Area A) would be removed under this excavation scenario. Surface water in Rattlesnake Creek and its associated drainage ditches within the Niagara-Mohawk easement would be diverted using dikes to reroute flow as appropriate. Erosion control devices would be placed to contain sediments to prevent offsite migration. Sediments from the creek and drainage ditch would be removed using a "clamshell" crane. Rattlesnake Creek and the drainage ditches would be reconstructed with similar soils in disturbed areas. The associated wetlands of Rattlesnake Creek would be restored in all disturbed areas. In order to assess contaminant migration, onsite monitoring of air, surface water, and groundwater would be implemented and would continue for as long as the contaminants remain in place.

5.2.2.5 Alternative 5 — Partial Excavation and Onsite Disposal

This alternative is a combination of Alternatives 3 and 4, consisting of partial excavation to remove all soils not described as "access-restricted" in Alternative 4 and onsite disposal activities as described in Alternative 3.

5.2.2.6 Alternative 6 — Containment and Institutional Controls

This action involves the use of an earthen cap to reduce the infiltration of water through the Tonawanda site to the groundwater, reduce surface runoff to offsite waterways, reduce the potential for direct human contact with contaminated surface soils, and minimize the potential for airborne migration of surface contamination to human and ecological receptors.

Containment involves covering the surface of the in-place radioactively contaminated soils at Ashland 1 and Ashland 2, and the waste piles at Seaway and Linde properties, with a low-permeability earthen cover constructed to prevent infiltration of water through the cap. Discrete areas where waste is known to be buried are considered for a low-permeability cap. A low-permeability cap should prove effective in reducing the risk of infiltration of rainwater through the waste and into the groundwater. The cap would consist of a 0.6-m (2-ft) thick layer of clay with a hydraulic conductivity of less than 1×10^{-7} cm/s, and a 0.3-m (1-ft) thick topsoil cover layer. The cover would be graded to promote surface runoff from the capped area, and indigenous vegetation would be planted to stabilize the topsoil cover.

Surface water in Rattlesnake Creek and drainage ditches at Ashland 1 and Ashland 2 would be diverted to access and remove contaminated sediments. Sediments located within the storm drains and sumps at Linde would be removed. The sediments would be incorporated into the capped areas at Ashland 1 and 2.

Radioactively contaminated soils within the commercial landfill at Seaway as well as the contaminated soils located beneath paved areas and buildings and structures at Linde would be left undisturbed.

Radionuclides on the surfaces of buildings and structures would be contained by applying sealants.

Institutional controls currently in place are necessary to limit permissible activities on and access to the Tonawanda site and maintain the integrity of the soil cover or cap. Unrestricted access to any capped area could lead to penetration of the capped areas. These actions include maintenance of the perimeter fence and continued security to prevent entry to the properties. Additional actions may include placing warning signs and establishing perpetual deed restrictions to prohibit intrusive activities on and access to the site. Continuing environmental monitoring to assess contaminant migration is also an institutional control action.

5.3 DETAILED ANALYSIS OF SITEWIDE ALTERNATIVES

This section presents a detailed analysis of the predicted consequences of the six remedial action sitewide alternatives for the Tonawanda site.

5.3.1 Alternative 1 — No Action

Under Alternative 1, the no-action alternative, the annual environmental monitoring program would be continued.

5.3.1.1 Overall Protection of Human Health and the Environment

This alternative would not protect human health and the environment. Potential exposure pathways of direct contact with and ingestion and inhalation of contaminated soils exist and would likely increase over time as current control measures, such as fencing and site security, may be breached, and existing structures (building floor slabs) and paved surface areas deteriorate. Exposure to contaminants and the size of the affected area could increase over time as a result of disturbances by humans and natural processes and the subsequent movement of contaminants by erosion and surface water transport.

5.3.1.2 Compliance with ARARs

Since the site presently does not meet ARARs, taking no action would not correct that deficiency. However, all soils contaminated above DOE guidelines for residual radioactivity would remain onsite. All ARARs related to acceptable levels of residual radioactive contamination would not be met.

5.3.1.3 Long-Term Effectiveness and Permanence

This alternative includes no control for exposure to contaminants and no long-term management measures. All current and potential future risks remain (SAIC 1993). Annual monitoring and a 5-year review are necessary to assess risk to human health and the environment.

Irreversible and Irretrievable Commitment of Resources

The no-action alternative commits a large area of active (Linde and Seaway) and inactive (Ashland 1 and 2) properties to limited use because of baseline risk. The commitment is reversible; the site could be remediated later. Long-term productivity of the site is greatly reduced if no action is taken. No cumulative impacts of this alternative have been identified.

5.3.1.4 Short-Term Effectiveness and Environmental Impacts

Community Protection

Implementation poses no additional health risks to the community or the environment. However, the no-action alternative would not be protective of human health because all contaminated materials remain in place. Potential future and residual excess cancer risk due to radionuclide and chemical contaminants range from 1×10^{-2} to 2×10^{-7}, and 2×10^{-5} to 1×10^{-10}, respectively. A more thorough discussion of human health consequences of the no-action alternative for the Tonawanda site is presented in the BRA.

Worker Protection

Remediation activities would not be required for the no-action alternative and there would be no associated additional worker radiation or chemical exposures.

The no-action alternative would not involve material handling operations and construction activities; therefore, no additional fatality or injury risks would be associated with this alternative. The only occupational risk would be due to ongoing monitoring at the site and is estimated to be 2×10^{-6}.

Transportation

Because the no-action alternative does not include requirements for transporting contaminated materials, no exposure to members of the general population would occur and the possibility of a transportation accident does not exist. The no-action alternative would not result in any risk of injury or death associated with transportation.

Environmental Impacts

— *Geology and Soils*

There would be no additional effects on geology or soils if the no-action alternative is implemented, but approximately 257,500 m^3 (336,800 yd^3) of contaminated soil would remain in place.

— *Water Quality*

Surface water contamination at the Tonawanda site presently results from erosion of contaminated surface soil and existing sediment contamination.

Radioactive contaminant concentrations in surface water are not expected to present a problem at the Tonawanda site. Any exposure to human receptors or the environment would be the result of very low gamma, X-ray, and beta emissions from surface water, as discussed under the CERCLA criterion "long-term effectiveness and permanence."

At present, a potential may exist for contaminant transport through the Linde storm sewer system that drains into Twomile Creek, north of Sheridan Park Lake. Twomile Creek is not, however, a public drinking water source. Contamination of Sheridan Park Lake could also occur from overland flow of runoff from Linde. Offsite contaminant transport from Ashland 2 may also occur via Rattlesnake Creek drainage pathways that flow to Twomile Creek.

— *Air Quality*

There are no effects on air quality at the Tonawanda site from implementation of the no-action alternative.

— *Ecological Resources*

Biota. Implementation of this alternative would have no effects on biotic resources when compared to the baseline ecological risk assessment presented in the BRA. Because contaminants remain in place, resident biota would be subject to continued exposure, with the potential of adversely affecting these biota and any transient fauna that feed on them. The sources of these ecological effects and risks are primarily copper in soils at Linde and Ashland 2 and lead in soils at Ashland 1. These two contaminants have ecological quotients in excess of 100 where a quotient above 1 is of ecological concern. Another chemical with a quotient between 10 and 100 is zinc in soils at Ashland 1 and Ashland 2. These three - Cu, Pb, and Zn - are found in surface water, sediment and soil at the other locations at Tonawanda. Because their quotients are high, adverse effects to plants or wildlife are considered inevitable as a cumulative effect to small sub-population. Impaired health or reduced vigor of an individual organism (plant or animal) are expected to be present, but generally is not considered significant as at the population level.

Threatened and Endangered Species. This action would have no impacts on any federally listed threatened or endangered species. Only occasional transient individuals of three such species (bald eagle, peregrine falcon, and osprey) are known to exist in the project area. No state-listed plant species are known to occur on the site (Cunningham 1992).

Wetlands. Because contaminants remain in place, wetlands biota would be subject to continued exposure, potentially resulting in adverse effects to these biota and any fauna that feed upon them.

— *Archaeological, Cultural, and Historical Resources*

This alternative would affect no archaeological, cultural, or historic resources because none are present on the Tonawanda site.

— *Land Use and Recreational/Aesthetic Resources*

An immediate change in land use is not expected under this alternative. It is assumed that no deed restrictions would be imposed on the properties in the Tonawanda site. Therefore, any future reuse of the site could occur within the regulations of the Town of Tonawanda zoning ordinance. It is expected that the Linde Property would continue to be used for industrial purposes. Future reuse of the Ashland 1, Seaway, and Ashland 2 properties would be hindered by the existence of known contaminated areas on the properties. These properties are vacant and hold development potential, especially being located near the Niagara River. The current and future use of these properties would still expose the public and environment to contamination.

This alternative would hinder future plans to revitalize the waterfront area along the Niagara River in the Town of Tonawanda. Two plans, the *Local Waterfront Revitalization Plan* (New York State Department of State Coastal Management Program 1991) and the *Waterfront Region Master Plan* (Ernst and Young 1992), address future land use plans for the waterfront area. Both documents indicate that a priority in revitalizing the area is remediating radioactive and hazardous waste sites. Therefore, not remediating Ashland 1, Seaway, and Ashland 2 could adversely affect redevelopment of the waterfront area.

— *Socioeconomic and Institutional Issues*

Community Issues. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some residential development near the Ashland 2 property around River Road. Under this alternative, the unremediated properties would create a conflict with the community's development plans for the area which assume cleanup of the contamination.

Institutional Considerations. The no-action alternative would produce impacts on the institutional environment by hindering future redevelopment of the Ashland property for less intensive uses and development of residential property along the waterfront west of the River Road realignment. There would be potential for the continued migration of contaminants into the environment and radiological exposures to the public health to arise if the contamination is left in place in an uncontrolled condition.

Public Services. The no-action alternative would place no demand on public utilities or solid waste facilities; thus, no potential for impact on these public services exists. The no-action alternative could lead to a situation requiring emergency response actions if public access to and use of the site are not strictly controlled. However, assuming a continuation of existing conditions and no soil-disturbing activities on the site, minimal impact on emergency services would be expected.

Economic and Demographic Resources. It is assumed that there would be 0.2 full-time equivalent positions for the Tonawanda site even if no specific action is taken to remediate the properties for approximately 30 years. A survey technician would monitor the contamination at the site. It is assumed that this employee would earn the average wage of $35,000 per year, for a total of $70,000 for 2 years. Total operations and monitoring costs are estimated to be $116,400 per year. Capital expenditures during the first year would be $7500 for purchasing signs for the site. Using the Regional Input-Output Modeling System (RIMS) provided by the U.S. Bureau of Economic Analysis for Erie and Niagara Counties, it is estimated that this activity would generate 0.3 additional jobs in the region.

The assumption that persons new to the area would be required to fill the jobs created by the action provides an upper-bound estimate of the impacts on housing and employment. Under this assumption, there would be no projected increase in households and population.

Local Transportation Impacts. No additional impacts on transportation at the Tonawanda site would be expected from the implementation of the no-action alternative.

Noise Impacts. No additional effects on ambient noise at the Tonawanda site are anticipated from the implementation of the no-action alternative.

Unavoidable Adverse Impacts

Potential exposure pathways of direct contact with and ingestion and inhalation of contaminated soils would exist and would likely increase over time as current control measures, such as fencing and site security, may be breached, and existing structures (building floor slabs) and paved surface areas deteriorate. Exposure to contaminants and the size of the affected area could increase over time as a result of disturbances by humans and natural processes and the subsequent movement of contaminants by erosion and surface water transport.

Mitigative Measures

No mitigative measures are to be implemented because no action would be taken under this alternative.

Short-Term Uses and Long-Term Productivity

Short-term land use would be restricted for contaminated areas under the no-action alternative because of potential for adverse human health and environmental impacts. Long-term productivity in terms of various economically-productive land use options would also be extremely limited because access to and use of the contaminated areas would result in increased potential exposure to the site contamination.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e. water quality, air quality), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas of concern where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.1.5 Reduction in Mobility, Toxicity, or Volume through Treatment

There is no treatment to reduce mobility, toxicity, or volume of contaminated soil. Therefore, there are no consequences of treatment.

5.3.1.6 Implementability

Implementability is not applicable because no action would be taken.

5.3.1.7 Cost

Under the no-action alternative, capital costs are estimated at $7500. Environmental monitoring would take place at an estimated annual O&M cost of $116,400. With a 0% discount rate, the estimated 30-year present worth total for this alternative is $3.6M.

5.3.2 Alternative 2 — Complete Excavation and Offsite Disposal

Alternative 2 involves complete excavation of all accessible and "access-restricted" contaminated soils, demolition of buildings at Linde, and offsite disposal.

Offsite disposal options as described in Section 5.2.1.3 include New York FUSRAP-dedicated facility, National East FUSRAP-dedicated facility, National West FUSRAP-dedicated facility, existing DOE-owned facility, existing commercial facility, and beneficial reuse. Discussions pertaining to disposal site options for each evaluation criterion are presented, as appropriate.

5.3.2.1 Overall Protection of Human Health and the Environment

This alternative is highly protective of human health and the environment. Complete excavation and removal of all radioactively contaminated materials above DOE guidelines eliminates risks to human health and the environment at the site. Pathways of exposure to contaminated materials are eliminated. In addition, actions under this alternative eliminate the potential for migration of contaminants to surface waters or into groundwater. Therefore, with all source contamination removed to DOE residual guidelines, current and future use maximum health risks would be reduced to acceptable levels.

Protection of human health and the environment in the vicinity of disposal sites would be ensured by placing all contaminated material in an engineered disposal cell to minimize the potential for contaminant migration and limit potential exposures and resulting risks to below guideline levels. Siting studies would be conducted to ensure that the combination of engineered disposal technology and site characteristics provide the level of protection necessary for safe, effective, and environmentally sound operation. In addition, all sites would institute and maintain access controls at their facilities to further limit the likelihood of actual exposures occurring. Risk calculations performed at comparable disposal sites have indicated risks resulting from operations and disposal through the 1,000 year life of the site in the 10^{-7} range (DOE 1986).

5.3.2.2 Compliance with ARARs

Under this alternative, all soils contaminated above DOE guidelines for residual radioactivity, as well as commingled with non-radiologic contaminants, would be excavated and removed to an offsite disposal facility. All ARARs related to acceptable levels of residual radioactive contamination would be met at the site. Measures (e.g., moisture control) to reduce the potential for fugitive releases of particulates during excavation, and covering materials during transport, would reduce airborne radioactive contaminants to limits of pertinent regulations. The impact of emissions from diesel and gasoline powered excavation equipment on air quality would be typical of major earth moving projects. Significant deterioration of air quality from these sources is not anticipated; the phasing of excavation and transportation activities would mitigate any associated risks. Demolition and dismantling of buildings and structures, and the subsequent removal and transport activities, would be conducted under controlled conditions. Appropriate measures to reduce the potential for airborne contaminant emissions, such as the application of inert fixant sprays to building surfaces before and during intrusive work, would be implemented to ensure DOE criteria for limits on exposure to airborne contaminants are met.

Radiation exposure standards for occupational workers would be met and confirmed by monitoring during excavation, transport, and disposal operations. OSHA requirements for worker health and safety would be met during these actions. Wastes transported offsite would meet the requirements of the Hazardous Material Transportation Act and relevant DOE Orders regarding packaging, labeling, and placarding. Disposal at an offsite facility would be in accordance with DOE Orders if a DOE disposal facility is used, or with applicable NRC or state regulations on licensing and disposal for a commercial facility. Appendix F lists ARARs for the Tonawanda site. Siting studies and the engineered cell design will combine to assure that all location-, chemical-, and action-specific ARARs are met for any DOE facility constructed offsite.

5.3.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness is achieved at the site because all the contaminated soil and contaminated demolition waste above DOE guidelines are excavated and transported offsite for disposal, thereby reducing residual risk to human health or the environment to acceptable levels (see Table 5-10 and Appendix I). At the completion of the work the thoroughness of the remediation would be verified, and the need for further review or long-term monitoring would be evaluated.

Complete excavation of the contaminated soil and removal of contaminated buildings eliminates the need for long-term management, monitoring, maintenance, and replacement directly associated with these remedial activities. Offsite disposal at a permitted facility places the responsibility for long-term management, monitoring, and O&M with the receiving facility which is in accordance with their licensing requirements. Adequate and reliable controls will be required to ensure no unacceptable exposure or release.

Five offsite disposal options were evaluated: 1) offsite disposal in an in-state land encapsulation cell, 2) permanent disposal at a FUSRAP-dedicated disposal facility located in the eastern U.S., 3) permanent disposal at a FUSRAP-dedicated disposal facility located in the western U.S., 4) offsite disposal at an existing federal facility (i.e., Hanford), and 5) offsite disposal at a licensed disposal facility (i.e., Envirocare).

Should the Hanford site be selected, long-term monitoring and maintenance activities would be conducted to ensure the effectiveness of waste isolation and to provide adequate warning to prevent potential exposures if the disposal cell should fail. Because the Hanford site is located in an arid environment with an average annual precipitation much lower than in New York, the potential for human exposure to contaminated water would be further reduced. However, air quality could be slightly impacted by the wind dispersal of the untreated soil characteristic of the area because of high wind speeds and sparse vegetation (ANL 1992).

Although workers will need to periodically collect air, groundwater, and surface water samples, and to perform other routine monitoring and maintenance activities, exposures to radiological and chemical contaminants would be negligible given that the cell is designed to prevent releases of particulates and radon gases.

The potential for exposures to the public in the vicinity of the Hanford site in the long term would be low, on the basis of current and expected future land use in the area and the design of the disposal cell. The higher permeability of the overburden material compared to the other disposal sites could result in groundwater impacts if the waste were saturated (e.g., by infiltration through cover cracks during heavy storms) and the foundation material of the cell was breached over time.

If the commercial facility were selected, it would be responsible for the monitoring and maintenance activities to ensure effectiveness of waste isolation and to prevent any potential exposures if the disposal cell failed. The Envirocare site is located in an arid environment in which precipitation is much lower than in New York, so the potential for human exposure to surface water or groundwater contaminated by any contribution from the Tonawanda waste would be small. Currently, people do not live near the Envirocare site. If current conditions continue, the potential for public health impacts would be low.

If a FUSRAP West, FUSRAP East, or New York disposal site is selected, potential impacts to the environment should be minimal, although a larger site such as the FUSRAP West or FUSRAP East may present more impacts due to the size of the facility. During the site selection process, activities related to the construction and operation of the facility would be analyzed in a NEPA process and site selection would be performed to eliminate or minimize unacceptable environmental impacts. Long term management, monitoring and O&M programs would be established at any new disposal facility developed to accept FUSRAP waste.

Irreversible and Irretrievable Commitment of Resources

All alternatives include the long-term restricted use of land. The commitment of land to restricted use is theoretically not irreversible since the affected property could be remediated in the future. However, it is assumed that the selected disposal site will remain permanently committed to the disposal cell. If Hanford were chosen, the waste is presumed to be placed in a new disposal cell located at the 200-West Area of the Hanford site in Richland, Washington. If Envirocare were selected, a disposal cell would be designated. Criteria used for selection of a site will result in site characteristics similar to the commercial or Hanford site. For an in-state New York site, approximately 25 acres would be permanently committed. Approximately 125 acres would be permanently committed for a FUSRAP East or West site.

The New York in-state disposal facility would use sand, gravel, clay, and topsoil excavated from an offsite borrow area in the vicinity of the disposal facility to construct the disposal cell. A potential borrow area has not been identified for the in-state disposal facility. Borrow soil will be procured as a commodity at the time of remedial action. To minimize transportation impacts, every effort would be made to locate borrow areas near the site within a 100-mile radius of the in-state disposal facility. Following removal of the borrow material, the commercial operation is expected to comply with all applicable regulations relating to closure and revegetation. At a minimum, it is expected that the area would be reclaimed in accordance with land use plans of the State of New York or the appropriate state agency.

Consumptive uses of geologic resources (e.g., quarried rock, sand, and gravel) and petroleum products (e.g., diesel fuel and gasoline) would be required for the removal, construction, and disposal activities of all the action alternatives. Consideration of adequate supplies of these materials would be made in the siting studies. Additional fuel use would result from the offsite transport of the waste. However, adequate supplies are available without affecting local requirements for these products.

Implementing any of the final action alternatives would not be constrained by the availability of resources beyond those expected to be available near the offsite disposal locations.

5.3.2.4 Short-Term Effectiveness and Environmental Impacts

It may require up to 10 years to implement this alternative which includes obtaining all applicable permits, completion of siting studies to ensure that no significant environmental impacts would occur (i.e., no specific impacts to wetlands, water resources, endangered or protected species, etc.), completion of final design plans, and time required to complete remediation activities depending on the disposal option selected. Estimate to complete work is approximately 3 years, due to adverse weather conditions in the Tonawanda area.

Remedial response objectives are achieved upon receipt of contaminated materials by the permanent disposal facility. Time until action is completed is dependent upon the disposal option chosen as indicated in Table 5-2. Time estimate for each disposal option includes the time required to complete all activities associated with this alternative. Also, DOE budget constraints for the Tonawanda site would be limited to $25M per year, based on program management policy. The annual cap on expenditures for the Tonawanda site could impede the progress of this remediation effort based upon the timeframes proposed depending on the disposal option selected.

Community Protection

Intrusive remedial activities such as soil excavation and building demolition may temporarily increase the potential for fugitive dust production for up to 3 years. The general public could be exposed to contaminants transported in airborne dust. The annual radiological risk to persons is 6×10^{-9}. Keeping contaminated soils moist during excavation, loading, and controlled demolition, in addition to the application of inert fixatives to building surfaces would ensure these potentials are at acceptable levels.

Worker Protection

Occupational hazards for remediation workers during implementation of Alternative 2 are related to the length of time required to complete the action and are calculated based on published risk factors for construction activities in the United States. Risk to workers would be mitigated by the proper use of safety protocols, personal protective clothing and equipment, and restrictions on access to contaminated areas. In addition, all machinery and equipment would be inspected after use, surveyed for radioactive contamination, and decontaminated if necessary. Based on the approximate number of manhours for construction work to complete this action, the occupational risk of worker fatality is 1×10^{-3} (see Appendix I for Human Health Risk Assessment Methodology).

In addition to the nonradiological risks associated with complete excavation and disposal, remediation workers would be exposed to contaminated materials throughout the action.

Table 5-2. Time to Implement Disposal Options

Disposal Option	Time Until Action is Completed
In-state disposal	5-10 years; includes 6 years to site and obtain approval for a new disposal facility
National East	5-10 years; includes 4 years to site and obtain approval
National West	5-10 years; includes 4 years to site and obtain approval
Existing DOE facility	1-3 years; assuming disposal capacity is available at time of implementation
Commercial disposal	1-3 years assuming disposal capacity is available at time of implementation
Beneficial reuse	3-5 years; includes 3 years to obtain approval

Construction/excavation activities may temporarily increase fugitive dust production, allowing inhalation and ingestion of contaminated soil. The health risk to a remediation worker during implementation of the alternative can be estimated based on knowledge of concentration of contaminants in soil, duration of the action, and calculation of exposure dose from inhalation, ingestion, and direct exposure. A worker engaged in excavation activities for 30 h/wk throughout implementation of Alternative 2 potentially could receive a combined radiation dose of 500 mrem from exposure to direct external radiation and from inhalation and ingestion of contaminated soil particles. The associated risk of cancer development in the worker's lifetime is 2×10^{-4}. The probability of a cancer occurring over the course of a worker's lifetime as a result of exposure to chemical carcinogens during a one-year remedial action period is 2×10^{-5}. The noncarcinogenic Hazard Index was estimated as 2.6 (see Appendix I). Health risk would be mitigated through use of protective measures, such as respirators and protective clothing. Respirators provide protection by a factor of 10.

Transportation

Implementation of Alternative 2 requires transportation of substantial quantities of material to a disposal facility.

Transport of radioactively contaminated materials to an offsite disposal facility would comply with all applicable state and federal regulations. As required, predesignated routes would be traveled and an emergency response program would be developed to respond to any accidents. Shipments would be made by truck for in-state or by rail for out-of-state. Radiological risks from routine transportation of contaminated material to an offsite disposal facility are related to direct external gamma radiation; exposures to hazardous chemicals should not occur during normal transportation operations. The greatest potential for radiation exposure exists for the truck or railway crew because of the length of time involved in transport and their proximity to the contaminated material. Of these two potential exposure scenarios, the truck driver would be expected to be at greatest risk, because rail crews traveling with the shipment typically remain a substantial distance from the contaminated material. Because the excavated soil has low level waste characteristics, the gamma exposure rate at 1 m from the truck and train would be below DOE guidelines. In the event of an accidental spill during transport of contaminated material to an offsite disposal facility, it is estimated that risks to anyone involved and/or the public would be on the order of that for an onsite remediation worker (see Section 5.3.2.4 and Appendix I). This is due to the small amount of contaminated material (16 yd^3/truck or 72 yd^3/train car) and the short period of time required to complete the clean-up of the material.

Implementation of this alternative carries with it a risk of physical injury or death as a result of offsite transportation accidents. This risk is not related to transport of radioactive or hazardous chemicals and would be the same as the risk resulting from transport of nonhazardous materials. This risk is calculated based on the distance traveled, the number of round trips estimated, and the probability of a fatal accident per mile traveled, and is present as a cumulative probability of an offsite fatal accident occurring throughout the implementation of the alternative. Methods used to determine the offsite non-radiological transportation risk are summarized in Appendix I. Table 5-3 presents the transportation risk for each of the potential offsite disposal options identified in this alternative. In general, offsite disposal within the state of New York carries with it a higher risk than the other potential disposal options because of the greater number of trips the trucks will be required to make. The transportation risk for the potential offsite disposal options using rail for transport of wastes is directly proportional to distance to the disposal facility.

Environmental Impacts

— *Geology and Soils*

Much of the soil profile on the Linde property has been modified by previous industrial activity (site preparation for building construction, addition of materials for railroad grades, roadbeds, and parking lots). An estimated 2.55 ha (6.3 acres) of the Linde property would be excavated. Excavation would be controlled by proper engineering control measures. The shallow excavation depth [0-3.6 m (0-12 ft)] expected would not impact the underlying geological features. The removal of sediments from sewers and drain lines would not result in any impacts to surrounding soils. If contaminants have escaped through cracks, breaks, or leaking joints in the pipes and drain lines, removal of approximately 670 m (2200 ft) of pipes and drain lines and excavation of any contaminated soils would be necessary. Dust control measures also limit the release of particulate matter during transport and during the application of clean backfill. The extent of disturbance to the soil profile from excavation in these areas would be dependent upon the extent of contaminant migration.

Water erosion of contaminated soils disturbed during excavation would be mitigated by proper erosion controls. This would include the prevention of any contaminants from entering the Linde storm sewer system. The soils in the Ashland 1 property were disturbed when the surface was reconfigured for the siting of petroleum storage tanks. Removal of contaminated soils from about two-thirds of the property [2.6 ha (6.5 acres)] would not cause any additional impacts. Contaminated material within the Seaway property is suspected of being separated from the original soil surface by landfilled waste. Accessible contaminated soils cover about 6 ha (14.9 acres) of the Seaway property. Removal of these soils would not cause any negative impacts to soils left in place. Removal actions on Ashland 2 would involve the excavation of 2.2 ha (5.4 acres) of contaminated soils. Depending on the depth to which soils and sediments would need to be excavated and the character and thickness of the overburden in the area of excavation, the underlying Camillus Shale could be impacted by the creation of a pathway for surface water to reach the shale (Sections 2.1.1.1 and 2.1.1.2). This could result in the creation of dissolution cavities depending on the gypsum content and distribution within the shale (La Sala 1968). Excavation of this extent would be highly unlikely, as overburden on the site averages 15.2 m (50 ft) in depth. All excavated areas are proposed to be backfilled with clean material. Borrow material needed for backfill would be obtained from offsite sources and procured as a commodity in accordance with government procurement regulations in effect at the time of remedial action. Potential borrow material sources that can meet DOE's expected

Table 5-3. Alternative 2 - Complete Excavation and Offsite Disposal
Estimate of Probability of a Fatal Accident Due to Offsite Transportation of Materials

	DISPOSAL OPTIONS				
	NY Disposal Site	FUSRAP East	FUSRAP West	Commercial	Existing DOE Facility
Transport of Waste to Offsite Disposal Site	.55	.03	.19	.14	.17
Transport of Fill Material to Tonawanda	.08	.08	.08	.08	.08
Transport of Asphalt to Tonawanda	.001	.001	.001	.001	.001
Transport of Material for Construction of Offsite Disposal Facility	.11	.11	.11	N/A	N/A
Total Probability of a Fatal Accident	.74	.22	.38	.22	.25

demands have been identified in Niagara and Erie Counties in New York. It is estimated that 17,180 truckloads of clean fill will be required for the restoration of the site.

Should Hanford be chosen as the disposal site, potential construction-related impacts (by soil erosion) would be minimized by implementing standard engineering practices and mitigative measures. Because of the arid conditions at Hanford, the potential for soil erosion from surface runoff is low. However, wind erosion presents a greater concern and mitigative measures such as wetting of soil would be used to minimize potential adverse air quality effects (ANL 1992).

In the absence of an accident, transportation of waste to the Hanford site would have no effect on offsite soil because covered railcars would be used. Contingency plans would be in place to address spills, so if an accident occurred that resulted in the release of contaminated material, the spill area would be cleaned up; thus, no long-term effects are expected.

Earthquakes predicted for the 200-West Area would result in peak ground accelerations of about 0.3g, with a return period of 10,000 years (ANL 1992). Potential seismic risks would be factored into cell design. Implementation of Alternative 2 would not affect the regional geology of the Hanford site or their surrounding areas.

If Envirocare were selected, standard mitigative measures by the commercial operation would be used to reduce the potential for erosion during construction and operation of the disposal cell. Because of the arid conditions at the Envirocare site, the potential for water erosion during disposal cell construction is low. Good engineering practices by the commercial operation would also be used to reduce the potential for water erosion, and mitigative measures would be used as needed. Wind erosion could be more significant, but mitigative measures such as wetting of soil would be used to reduce the potential for wind erosion and minimize adverse air quality effects.

In the absence of an accident, transportation of waste to the Envirocare site would have no effect on offsite soil because covered railcars would be used. Contingency plans would be in place to address spills, so if an accident occurred that resulted in the release of contaminated material, the spill area would be cleaned up; thus, no long-term effects are expected.

Earthquakes predicted for the Envirocare site would result in peak horizontal accelerations in bedrock of 0.31 g, with return periods of more than 10,000 years (ANL 1992). Potential seismic risks would be considered during cell design. Implementation of Alternative 2 would not affect the regional geology of the Envirocare site or surrounding areas.

If one of the hypothetical disposal sites is selected, a detailed environmental impact assessment would be performed as part of the site selection process. Activities related to the cell construction and operation would be designed to eliminate or minimize unacceptable environmental impacts, however a larger site such as the FUSRAP West or FUSRAP East may present more impacts (e.g., disturbance of surface soil, impacts from transport of clean fill and other borrow material) due to the size of the facility.

— *Water Quality*

Complete excavation of contaminated materials would ensure the best long-term improvement of water quality at all remedial units. During removal of sediments within storm lines and sumps at Linde, surface water would be rerouted so that sediments would not be resuspended and deposited at other locations. Surface water diversion activities would also occur at Ashland 2 during the removal of sediments at Rattlesnake Creek and the drainage ditches of the Niagara-Mohawk easement. One-half to one mile of stream would be affected by diversion activities. At all remedial units, erosion control ditches would prevent contaminated soils from entering any surface water body during the removal of contaminated soil.

Activities associated with commercial excavation of borrow soil and construction and use of any related haul road could release sediment and fugitive dust that might reach nearby surface water. As for onsite activities, good engineering practices and mitigative measures would be used to control releases of dust and minimize erosion and transport of sediment from exposed areas. Only small effects on surface water quality are expected outside the borrow area because most runoff would be contained in the excavated area.

Removal of soils for use in cell construction could have effects on the local hydrology of the borrow area; however, no long-term effects on the quality of surface waters would be expected assuming that standard construction mitigation measures are used by the commercial operation to prevent siltation of receiving surface waters.

Potential short-term impacts to water quality at the Hanford site, if selected, are unlikely because precipitation is low and engineering controls would be applied. In the absence of cell failure, no significant long-term impacts are expected on surface water or groundwater quality at the Hanford site under Alternative 2. The disposal cell would not be in a floodplain and would not have significant influence on runoff in the area because the size of the cell would be small relative to the area of the drainage basin in which it would be located and because very little rainfall and runoff occur in the area.

Even if the disposal cell at the Hanford site should fail, the potential for adverse effects on surface water quality would be limited given the arid conditions and distance to surface water and the proposed cell design. The site is located in an arid region and the nearest surface water body, an ephemeral stream, would be more than 3 km (2 mi) from the disposal cell (ANL 1992). The Columbia River is about 8 km (5 mi) north of the 200-West Area. The Yakima River, the nearest downgradient perennial water body for most of the 200-West Area, is about 24 km (15 mi) to the southeast.

The potential effects for indications of problems before impacts occur on groundwater resulting from failure of a disposal cell at the Hanford site were evaluated with a model; the details of the analysis are presented in the Feasibility Study for the Weldon Spring Site (ANL 1992). The results of this analysis indicate that cell failure would have no significant effects on offsite groundwater quality largely due to the extensive overburden (approximately 30 m), assuming the site boundary remains as it is (i.e., the site boundary is a considerable distance from the conceptual cell location). The overburden material in the 200-West Area at the Hanford site is about 30 m (100 ft) thick (Pacific Northwest Laboratory 1991) and has an estimated average saturated hydraulic conductivity of 75 m/d (250 ft/d). Infiltration of leachate from the disposal cell was assumed to occur under saturated conditions, with an average linear groundwater velocity equal to the value of the saturated hydraulic conductivity. Furthermore, this analysis did not include artificial or engineered bottom liners, which would reduce the permeability of the overburden material, thus further limiting potential groundwater impacts.

The disposal cell at the Envirocare site, if chosen, would be located about 45 km (28 mi) from the nearest perennial water body (ANL 1992). Because conditions at the site are arid, construction of a disposal cell at the Envirocare site using good engineering practices would not affect local surface water during the remedial action period.

The contaminated material would be transported in covered railcars, so any adverse effects on surface water or groundwater related to transportation are unlikely except in the event of an accident. If an accidental release occurred, it would be immediately cleaned up in accordance with the contingency plan, to prevent potential movement of contaminated material to any nearby water body.

In the unlikely event the disposal cell should fail, the arid conditions and distance to nearby surface water (45 km [28 mi]) would limit the potential for adverse effects on surface water quality. In addition, inspection and monitoring of the cells would provide an early warning of cell failure and the necessary corrective measures would be taken, further limiting the potential surface water impacts.

The current monitoring well program at the Envirocare site includes sampling of about 10 of 42 wells located around the existing disposal cell. Samples are routinely analyzed for contaminants that are representative of the waste types present in the cell. Envirocare of Utah, Inc. would be expected to conduct similar activities for monitoring the containment effectiveness for the Tonawanda site waste disposed of at the Envirocare site.

The potential effects on groundwater resulting from the potential failure of a disposal cell were evaluated with a conservative model. The details of the analysis are presented in the Weldon Spring Feasibility Study (ANL 1992). The results indicate that cell failure would have no significant effect on offsite groundwater quality at the Envirocare site.

Groundwater would be characterized and the potential effects on groundwater resulting from the failure of a disposal cell at one of the hypothetical disposal sites would be addressed as part of the EIS or EA conducted for siting the cell. It is expected that locations in the eastern United States would require more design features to mitigate potential effects of groundwater on the disposal facility and potential effects to groundwater in the event of a release than locations in the arid western United States.

— *Air Quality*

Ambient air quality in areas accessible to the general public is regulated by both state and federal standards. New York standards are the same as the national ambient air quality standards (Table 5-4 and Appendix F), which address six criteria pollutants: sulfur oxides (as sulfur dioxide), carbon monoxide, ozone, nitrogen dioxide, lead, and particulates as PM-10 (i.e., particles with an aerodynamic mean diameter $\leq 10 \mu m$).

Tonawanda site remedial actions, under this alternative, could result in releases of material to the atmosphere. These materials would be generated by the disturbance of soils from earth-moving activities and vehicular movement (fugitive or uncontrolled emissions) and by internal combustion engines (controlled emissions).

Fugitive dust, assuming no mitigative measures, would form a large percentage of the atmospheric-emissions load. Under this alternative, fugitive dust would arise from:

- disturbance and entrainment of soil material due to excavation and backfilling in contaminated areas, and at borrow and storage sites;
- demolition of buildings and structures at Linde;
- wind-induced entrainment and erosion from exposed surfaces; and
- entrainment of particles due to vehicular activity on haul roads.

At the Tonawanda site, the nature of the fugitive dust would be similar to other materials entrained into the atmosphere by wind and human disturbance of local soils, but radionuclides may also be entrained and dispersed in the fugitive dust from contaminated areas.

The annual average air quality standard for PM-10 is 50 $\mu g/m^3$, as the annual arithmetic mean; this value is based on measured daily concentrations over 3 years or predicted daily concentrations for 1 year. The 24-hour standard for PM-10 is 150 $\mu g/m^3$, with not more than three expected exceedances permitted in any three consecutive years. Based on air quality modeling and analysis performed for similar remedial actions at another site (ANL 1992), the highest annual average particulate concentration predicted for an offsite location during the remedial action period is estimated to be 8.5 $\mu g/m^3$ above background (the background PM-10 concentration is estimated to be 22 $\mu g/m^3$ for the Tonawanda area). This concentration is primarily associated with construction and excavation activities and related road traffic. In general, particulate emissions that could result from the remedial activities at the Tonawanda site are expected to be relatively low and are not expected to impact human health or the environment.

The second potential source of atmospheric contamination arises from emissions from internal combustion engines associated with equipment operation at the Tonawanda site, borrow,

Table 5-4. New York State and Federal Ambient Air Quality Standards for Criteria Pollutants

New York State Standards						Corresponding Federal Standards (NAAQS)[a]					
Pollutant[b]	Averaging Period	Level	Conc.	Units	Statistic[c]	Conc.	Primary Unit[d]	Statistic	Conc.	Secondary Units	Statistic
Sulfur Dioxide	12 consecutive months	All	0.03	ppm	Arithmetic Mean (A.M.)	80	$\mu g/m^3$	A.M.			
	24-hr	All	0.14[e]	ppm	Maximum[c]	365	$\mu g/m^3$	Maximum[d]			
	3-hr	All	0.50[f]	ppm	Maximum				1300	$\mu g/m^3$	Maximum
Carbon Monoxide	8-hr	All	9	ppm	Maximum	10	$\mu g/m^3$	Maximum			
	1-hr	All	35	ppm	Maximum	40	$\mu g/m^3$	Maximum			
Ozone	1-hr	All[g]	0.08	ppm	Maximum	235	$\mu g/m^3$	Maximum	235	$\mu g/m^3$	Maximum
Hydrocarbons[h] (non-methane)	3-hr (6-9 a.m.)	All	0.24	ppm	Maximum						
Nitrogen Dioxide	12 consecutive months	All	0.05	ppm	A.M.	100	$\mu g/m^3$	A.M.	100	$\mu g/m^3$	A.M.
Lead	3 consecutive months	All[i]				1.5	$\mu g/m^3$	Maximum	1.5	$\mu g/m^3$	Maximum
Inhalable Particulates (PM10)	12 consecutive months	All[j]				50	$\mu g/m^3$	A.M.	50	$\mu g/m^3$	A.M.
	24-hr	All				150	$\mu g/m^3$	Maximum	150	$\mu g/m^3$	Maximum
Total[k] Suspended Particulates	12 consecutive months	IV	75	$\mu g/m^3$	Geometric Mean (G.M.)						
		III	65	$\mu g/m^3$							
		II	55	$\mu g/m^3$							
		I	45	$\mu g/m^3$							
	24-hr	All	250	$\mu g/m^3$	Maximum	260	$\mu g/m^3$	Maximum	150	$\mu g/m^3$	Maximum

Table 5-4 (continued)

[a] National Ambient Air Quality Standards.

[b] New York also has standards for beryllium, fluorides, hydrogen sulfide, and settleable particulates (dustfall). Ambient monitoring for these pollutants is not currently conducted.

[c] All maximum values are concentrations not to be exceeded more than once per calendar year. (Federal Ozone Standard not to be exceeded more than 3 days in 3 calendar years).

[d] Gaseous concentrations for Federal standards are corrected to a reference temperature of 25°C and to a reference pressure of 760 mm of mercury.

[e] Also during any 12 consecutive months 99% of the values shall not exceed 0.10 ppm.

[f] Also during any 12 consecutive months 99% of the values shall not exceed 0.25 ppm.

[g] Existing New York standard for ozone of 0.08 ppm not yet officially revised via regulatory process to coincide with the Federal standard of 0.12 ppm which is currently being applied to determine compliance status.

[h] Ambient monitoring for non-methane hydrocarbons is not currently conducted.

[i] Federal standard for lead not yet officially adopted by New York but is currently being applied to determine compliance status.

[j] New Federal standard for PM 10 not yet officially adopted by New York but is currently being applied to determine compliance status.

[k] New York also has 30-,60-, and 90-day standards in Part 257 of New York Codes, Rules, and Regulations.

Source: NYSDEC 1991a.

and storage sites. Emissions from internal combustion engines include: CO, NO_x measured as NO_2, hydrocarbons, SO_x measured as SO_2, and TSP. The amounts and composition of emissions (**Table 5-5**) are functions of equipment type (e.g., truck, loader, or dozer), type of fuel consumed (diesel or gasoline), and the time expended by each piece of equipment in supporting a remedial action.

The exhaust emissions from heavy equipment would not be expected to significantly impact air quality, and nonparticulate pollutants are not expected to occur at high levels (ANL 1992).

Impacts on offsite air quality during disposal cell construction and operation activities for any of the offsite disposal alternatives are expected to be negligible. Control measures to mitigate potential air quality impacts are presented in the mitigative measures section following this discussion. Such measures would minimize potential impacts to workers and other onsite personnel from fugitive dust emissions related to disposal cell construction and operation. In the unlikely event a significant air release did occur, no risk would be presented to the public given the distance to the nearest residence. Long-term impacts to air quality are considered to be negligible after the waste is placed in a disposal cell.

— *Ecological Resources*

Biota. The limited terrestrial (Section 2.1.5.1) biota that occur on the Linde property would be impacted by building demolition and excavation on this property. About 2.5 ha (6.3 acres) of the Linde property contains contaminated material. Building demolition would eliminate nesting habitat for several of the avian species adapted to or tolerant of urban habitats, such as the European starling, pigeon, and house sparrow. (Killdeer, nighthawks, and possibly other ground-nesting species that often utilize flat, graveled roofs could also be impacted.) Building removal would possibly eliminate cover/habitat for some rodent species. Individual animals currently inhabiting the property would most likely be displaced. Similar consequences would result from the elimination of the parking lots and landscaped areas. However, future wildlife inhabiting the site (depending upon future land use) would not be exposed to any contaminants of MED origin.

Biotic resources (Section 2.1.5.1) would be impacted by the removal of existing vegetation from about two-thirds [2.6 ha (6.5 acres)] of the Ashland 1 property. Likewise, any aquatic biota (Section 2.1.5.2) (composed of invertebrates) of the ditches draining the property would be heavily impacted during excavation activities. These populations could be expected to be quickly replaced by colonization of whatever open drainage system would be constructed after remediation. Excavation of the 6 ha (15 acres) of contaminated areas within the Seaway property would remove the existing vegetation (Section 2.1.5.1). However, similar vegetation could be readily reestablished.

The most extensive impacts to biota would occur during the removal of soils and sediments from the Ashland 2 property. Four areas of wetland and riparian vegetation (Section

Table 5-5. Emission Factors for Heavy-Duty, Diesel-Powered Construction Equipment Used at a Representative Remedial Action Site

Equipment	Emission Factor (g/h)				
	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides	Particulates	Sulfur Oxides
Air Compressor	190	70	1000	65	65
Backhoe	250	85	1100	80	80
Concrete Truck	610	200	3500	120	210
Dozer	180	50	660	50	60
Generator	190	70	1000	65	65
Grader	100	25	480	30	40
Loader	250	85	1100	80	80
Paver	190	70	1000	65	65
Roller	85	25	470	25	30
Hydro-Axe	190	70	1000	65	65
Dump Truck	610	200	3500	120	210
Chipping Machine	190	70	1000	65	65

Source: EPA 1977a.

2.1.5.3) totaling 0.52 ha (1.3 acres) would be destroyed with the resulting loss of habitat to animals inhabiting the property. Areas not directly impacted by excavation activities but proximal to them would be affected by noise, airborne pollutants (equipment exhaust), and other impacts associated with construction activities. This could involve an area of about 11.3 ha (28 acres) because of the linear nature of the contaminated areas along the streams. Vertebrate wildlife species are generally most affected by these types of impacts. Noise and human activity often disrupt normal wildlife behaviors. The degree of these impacts characteristically decreases with increasing distance from the source. Aquatic resources within Rattlesnake Creek, discussed in Section 2.1.5.2, would be totally eliminated by the diversion of water from the stream channel and the subsequent removal of soil and sediments from an estimated 200 m (610 ft) of the streambed. Impacts of this severity would occur only in the section of the creek being excavated. Stream functions upstream of this area would be impacted only by possible changes in flow resulting from the creek being diverted. However, downstream biologic functions could be affected by such factors as reduced dissolved oxygen, reduced primary production (photosynthesis), or reduced nutrient inputs resulting from this section of creek being routed through a pipe during remedial activities. These reductions likely would not create significant adverse impacts since such reductions would take place in less than 9% of the total length of the creek. In addition, 50 m (165 ft) of streambed of the unnamed tributary to the west would be excavated.

Impacts to biota at the commercial borrow soil location(s) used to supply borrow for site remediation activities cannot be assessed since this commodity will be procured from a presently unknown source within Niagara or Erie Counties at the time of remedial action.

Concerning the possible Hanford disposal option, the construction and operation of a disposal cell would permanently disturb approximately 12 ha (30 acres) of land through noise, human activity, and dust associated with construction of the disposal cell, and result in the permanent loss of vegetation and potential wildlife habitat at the 200-West Area of the Hanford site. However, no unacceptable ecological risks are expected because little undisturbed vegetation or wildlife habitat currently exists at the 200-West Area (ANL 1992) and the vegetation and wildlife habitats that would be permanently disturbed under Alternative 2 would represent no more than 0.008 percent of the total wildlife habitat present at the Hanford site.

At Envirocare, some wildlife in the vicinity of the site could be temporarily affected by noise, human activity, and fugitive dust associated with construction of the disposal cell, transport of the waste to the site, and placement of the waste into the cell. Potential impacts from fugitive dust emissions would be minimized through the implementation of dust control measures during construction and transportation activities. Because of the limited biota present in the area due to ongoing waste management activities and natural conditions, few impacts to local biota are expected, and any impacts would be temporary (ANL 1992).

Impacts to biota at the hypothetical disposal sites will be evaluated prior to site selection as part of the siting process. Once a site is selected, actions associated with the disposal cell construction and operation would be implemented in such a way as to minimize or eliminate any impacts to local biota.

Threatened and Endangered Species. No onsite impacts to any federally-listed species have been identified as resulting from the implementation of this alternative. A rare plant survey conducted during August 1992 indicates that no New York State-listed plant species occur on the site (Cunningham 1992).

For Hanford, the USFWS (Gloman 1991) has identified the federal endangered bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*), as well as several federal candidate species, as possibly occurring in the 200-West Area. Several species of plants and animals under consideration for formal listing by the federal government and the State of Washington also occur at the Hanford site. Except for the loggerhead shrike (C2), none of the listed or candidate species, or their critical habitats, are known to occur at or use the 200-West Area (Pacific Northwest Laboratory 1991). Thus, the long-term loss of vegetation and wildlife habitat that would result under the alternative using Hanford disposal is not expected to significantly affect any of these species or their critical habitats. Construction of a disposal cell at the Hanford site could result in the permanent loss of about 12 ha (30 acres) of potential foraging and nesting habitat for the loggerhead shrike. Loss of this habitat is not expected to adversely affect this species because the amount that could be lost represents less than 1 percent of the undisturbed habitat present at the Hanford site and additional large tracts of equivalent plant communities exist in the vicinity of the Hanford site (DOE 1987, 1992b).

The disposal cell design envisioned for use for the disposal of FUSRAP waste was developed to minimize potential environmental and health impacts related to foreseeable potential failure modes. However, if the breach were to occur in the containment and no corrective measures were taken, some contaminants could be released and subsequent exposures of local vegetation and wildlife could occur. The extent of potential habitat contamination and exposure of biota would depend on the nature and magnitude of cell failure, the extent of contaminant dispersal following cell failure, and the implementation of response measures. Considering the long-term monitoring and maintenance activities that will be incorporated in the operation and maintenance of the disposal cell, corrective actions would be taken in a timely manner eliminating any long-term impacts to the local vegetation and wildlife.

For Envirocare, no federal listed species, state listed species, or critical habitats are known to occur at the Envirocare site (Fairchild 1991; Johnson 1991). However, the USFWS (Johnson 1991) has identified the federal endangered bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*) as possibly occurring in the area. Because of the distances from the Envirocare site to the bald eagle wintering areas and the peregrine falcon hack sites, no impacts are expected from cell construction and waste placement activities. Although the bald eagle may forage in the vicinity of the site during winter months, the current and continued human activity at the Envirocare site likely preclude the use of the immediate surroundings by this bird. Considering, however, the short-term duration of cell construction activities, and limited nature of potential exposures during occasional foraging, no impacts to the bald eagle are anticipated. A biological assessment has been prepared and submitted to the USFWS for concurrence (ANL 1992).

Cell construction and maintenance at the Envirocare site would result in the permanent loss of approximately 12 ha (30 acres) of semidesert shrubland, assuming that the area requirements would be the same as at the Tonawanda site for the same volume of waste. The plant community at the disposal cell location (primarily shadscale-gray molly) would be permanently lost, and wildlife using this area would be impacted or permanently displaced. None of the vegetation, habitats, or wildlife that would be affected are unique so implementation of Alternative 2 would not be expected to significantly affect the ecosystem of the area. In addition, no impacts to aquatic resources are expected because of the absence of surface water (DOE 1984) and state listed species (Fairchild 1991) (ANL 1992).

Various natural failure modes were considered during the development of the disposal cell envisioned for encapsulating FUSRAP waste. Should failure of the disposal cell occur, however, in the absence of corrective measures, release of some contaminants and subsequent exposure and local vegetation and wildlife could result. The extent of habitat contaminant and exposure of biota would depend on the nature and magnitude of the cell failure, the extent of contaminant dispersal following cell failure, and the implementation of response measures. Because of the absence of aquatic habitats and state listed species in the area, no impacts to these resources are expected. Also, because of the distances to the peregrine falcon hack sites and the bald eagle wintering areas (from 24 to 88 km [15 to 55 mi]), no impacts to these areas would be expected. Little or no impact to foraging habitat for the bald eagle and peregrine falcon is anticipated at the Envirocare site, and exposure of these species to contaminants via food chain transfer is not considered likely (ANL 1992).

Impacts to threatened and endangered species at the hypothetical disposal sites will be evaluated prior to site selection during the siting process. Every attempt would be made not to locate the disposal sites in an area where threatened and endangered species are known to exist. Once a site is selected, actions associated with disposal cell construction will be conducted in a manner to minimize or prevent any adverse impacts.

Wetlands. Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (Figure 2-7) would impact approximately 0.32 ha (0.80 acres) of the associated wetland area (Figure 2-19). Removal of contaminated material from Rattlesnake Creek would be performed during the dry season to minimize the need for dikes and berms. Contaminated soils and sediments would then be removed from an estimated 200 m (610 ft) of the streambed and low lying areas. An additional 50 m (165 ft) of streambed of the unnamed tributary to the west of Rattlesnake Creek would also be excavated. The estimated volume of this material is 8352 cubic yards. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek low lying areas and the associated wetland area. The excavation of contaminated sediments in these areas would result in the loss of the affected wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions. Remedial actions that require soil removal within the Rattlesnake Creek low lying area could temporarily affect the storage volume, but they would be scheduled during dry periods (July - November) when the potential for flooding is low. Over the long term, the flood storage volumes would not be affected because the area that would be disturbed is small and the area would be restored to its original contours upon completion of remedial activities. No significant impoundment, diversion, or other modification of floodwaters would result.

Impacts to floodplains and wetlands at the hypothetical disposal sites will be evaluated prior to site selection. Every attempt would be made to choose sites where floodplains and wetlands are not impacted. If floodplains or wetlands are involved, then floodplain or wetland assessments will be performed in compliance with 10 CFR 1022. Locations in the western United States could be expected to require little or no design features to mitigate possible impacts from or to floodplains or wetlands.

— *Archaeological, Cultural, and Historical Resources*

This alternative would affect no archaeological, cultural, or historic resources on the Tonawanda site because none is present (Appendix D).

For Hanford, construction of a disposal cell in the 200-West Area of the Hanford site would not adversely affect significant archaeological sites or cultural resources at that location. A literature/file review and several field surveys (pedestrian walkovers) were conducted in the 200-West Area during 1988; about 15 percent of the area (2.59 km^2) was sampled (Chatters and Cadoret 1990). Three isolated artifacts and two historic archaeological sites were recorded; in addition, historic White Bluffs Road traverses the center of the 200-West Area (Chatters and Cadoret 1990, Figure 5). Although the isolated artifacts and sites are not significant cultural resources, White Bluffs Road appears to meet eligibility criteria for the *National Register of Historic Places* (36 CFR 60.4) (Chatters and Cadoret 1990). A disposal cell would not be constructed on or near this historic road. However, it might be necessary to undertake a field survey of low to moderate intensity (e.g., transect intervals of 50 to 100 m) of any previously unsurveyed and undisturbed affected areas prior to disposal cell construction (ANL 1992).

All archaeological remains encountered during such a survey would be evaluated for eligibility to the *National Register* in consultation with the Washington SHPO; sites determined to be eligible would require mitigation of unavoidable adverse effects (ANL 1992).

The 200-West Area is located within 10 km (6 mi) of several landforms, including Gable Mountain and Gable Butte, that have religious significance to local Native American people (Relander 1956; Chatters 1989). If Alternative 2 were selected and Hanford chosen as the disposal option, the affected Native Americans would be consulted with regard to any potential impacts to these and other areas of religious significance (as required by the American Indian Religious Freedom Act).

For Envirocare, removal of waste to the site would have no adverse effects on archaeological sites or cultural resources, including historic structures listed on or eligible for the *National Register of Historic Places*. An archaeological field survey of the Envirocare site was carried out during August 1981 (DOE 1984). Except for several isolated fragments of glass (undated remains of the historic period), no artifacts were encountered. No buildings or structures of historic significance occur in the affected areas.

Disposal cells at other sites would not be constructed on or near these types of resources, thus no impacts are anticipated.

— *Land Use and Recreational/Aesthetic Resources*

Current land uses would continue but would be impacted in the short-term while remediation occurs. Short-term impacts include the inconvenience and cost of removing contaminated materials, additional trucks using roads to move the contaminated material to a location for transporting the contaminated material to an offsite disposal facility, and temporary inconveniences associated with diverting Rattlesnake Creek and restoring wetlands. The Linde property is likely to be used for industrial purposes in the future. This alternative would allow for any future reuse of the Ashland 1, Seaway, and Ashland 2 properties that conform to the regulations stated in the current Town of Tonawanda zoning ordinance.

This alternative would also remove constraints associated with the existence of radioactive wastes in revitalizing the waterfront area along the Niagara River in the Town of Tonawanda. Two draft plans, the *Local Waterfront Revitalization Program* (New York State Department of State Coastal Management Program 1991) and the *Waterfront Region Master Plan* (Ernst and Young 1992), note that removing radioactive and hazardous wastes sites is a priority to help encourage development of the waterfront area.

Disposal of the Tonawanda waste at the Hanford site would have no significant effects on land use in the vicinity of that site. The Hanford site is owned and operated by the federal government for the production of nuclear material, research, and waste management, so the use of the area for waste disposal would be consistent with existing and planned future land-use patterns.

Since Envirocare is an existing disposal site, no significant effects will occur on land use in the site vicinity.

Siting of other disposal sites would consider land use and minimize impact accordingly. It is expected that a facility sited in the western United States would have minimal impacts due to the larger, more abundant areas of less dense population.

— *Socioeconomic and Institutional Issues*

<u>Community Issues</u>. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some

residential development near the Ashland 2 property around River Road. This alternative would not conflict with the community's plans since all contamination on properties involved with the development of River Road would be removed.

During the short term, or approximately 3 years with 24 work months (8 months/year), temporary social impacts due to cleanup operations (e.g., demolition of buildings, truck traffic, and noise) should be expected in the form of annoyance, inconvenience, and/or disruption of activities. DOE would coordinate with officials of the Town of Tonawanda and the Holmes School to minimize disruptions to the extent possible. Coordination between DOE and management of Linde Center and BFI would be undertaken to make adjustments that would minimize impacts on operations and workers during remediation activities.

Institutional Considerations. Implementation of Alternative 2 would be likely to eliminate the potential for institutional impacts since it removes constraints to land uses being considered for waterfront development. While impacts on the local institutional environment are avoided by the offsite disposal option, institutional impacts could be experienced at the selected disposal site and/or along transportation routes. These impacts would be addressed in a separate EIS or EA.

This alternative could result in short-term commitment of local institutional resources for such purposes as traffic control and emergency preparedness. Remedial activities may coincide with some waterfront development activities such as the River Road realignment. Coordination and consultation between DOE and local officials would be undertaken to keep the local community and state updated on progress of the remedial action and to avoid unnecessary inconveniences to local residents, businesses, and resources.

Public Services. Public utilities in the area are adequate to accommodate the remedial activities expected under this alternative. The anticipated population growth is not sufficient to strain existing service capabilities. Although local and state-wide emergency services appear to be adequate to deal with an incident or accident involving low-level radioactive materials, advance coordination and consultation with Town of Tonawanda emergency responders and the New York State Department of Health would enhance emergency response capabilities in the event of an emergency during remediation or transportation.

Economic and Demographic Resources. It is assumed that Alternative 2 would require the employment of 27.3 workers for 3 years. There are assumed to be 14.3 full-time equivalent (FTE) construction workers, 5.3 FTEs in the radiological crew, 7.6 FTEs handling administrative tasks, and 0.1 FTEs allocated to sampling and monitoring. The construction workers are assumed to be paid $43,000 per year; all other labor categories are assumed to average $35,000 per year. The dollar value of payrolls directly attributable to the construction effort would be $1.1M. The local (Tonawanda area) operation and maintenance (O&M) costs are estimated to be $139,650 for the three years during site remediation. It is estimated that total capital costs of Alternative 2 in the three years of remediation would be $93M, of which 33% is estimated to be spent in the local area. The balance of the expenditures are expected to go to contractors based outside the local area. It is estimated that Alternative 2 would result in an additional 37.7 jobs, for a total employment impact of 65 (see Appendix H).

The 1989 value for total personnel employed in Erie and Niagara Counties was 625,889; therefore, expected employment accounts for 0.01% of total employment in the region. The employment impact is such a small share of the total in the region that it can be accommodated through normal growth in employment. For example, total employment in Erie and Niagara Counties grew at an average annual compound growth rate of 2.4% between 1985 and 1989.

It is anticipated that much of the employment taking place during the remediation under Alternative 2 would utilize resources already available in the region and that there would not be a large impact on housing and population. In order to estimate the upper bound on impacts to housing and population, calculations were made assuming that employment would be filled by persons new to the region. Under this assumption, it is estimated that the number of households associated with the employment would be 49 (less than 0.02% of the total number of households). The estimated upper bound on population affected by the action is estimated to be 118 (less than 0.01% of the total population in the two-county region). Since the possible impacts are so small relative to the total region, this action would not have a substantial impact on economic and demographic resources.

There would not be substantial impacts to employment, population, or households in the Tonawanda area for the different offsite disposal options being considered. The transportation company selected to conduct the transfer of contaminated material to an offsite location is assumed not to employ personnel from Erie and Niagara Counties; contract truck (or rail) transportation crews are not often located in an area requiring short-term transportation services for a particular origin and destination.

Local Transportation Impacts. For this alternative, the main transportation impacts would be an increase in average daily traffic volumes and potential road deterioration along affected routes at the Tonawanda site and surrounding area. The level of significance would depend primarily on site-specific characteristics such as the volume of material to be removed or brought in for fill and the routes to disposal sites, landfills, and borrow sites.

Transportation of an estimated 2,850 m^3 (3,730 yd^3) of replacement pavement to Linde would require 233 loads. Transportation of a computed 210,190 m^3 (274,900 yd^3) of clean fill, clay, and loam material, from a borrow site to the Tonawanda site, would require 17,180 loads.

For the duration of the remedial activities, the increase in average daily traffic volumes would be a potential inconvenience for other vehicles (personal and commercial) on the affected routes and on connecting roads, especially if the number of truck trips is high relative to pre-action traffic volumes. Delays in deliveries and in work trips could affect local industrial and commercial operations. Commercial operations could suffer temporarily reduced sales while customers avoid the area because of traffic delays.

Transportation of contaminated material to an offsite disposal facility is discussed in Sections 5.2.1.4 and 5.3.2.4. Loading of contaminated material for truck transport would take place within Linde and within Ashland 1, Seaway, and Ashland 2. Contaminated material would be loaded into bulk rail cars for transport by rail at Linde or Ashland 1. This would eliminate the need for additional transportation of contaminated material to a central staging area on the Tonawanda site.

Other potential impacts related to transportation include increased noise, fugitive dust, and internal combustion engine emissions. These impacts are discussed in separate sections.

Noise Impacts. Activities of earth-moving, demolition, construction, and transportation equipment at the Tonawanda site would result in the generation of noise. Typical sound levels generated by the types of equipment that may be used for the remedial activities are presented in Table 5-6. In general, the sound waves from the actions would be of the intermittent or impulse type as opposed to the steady-state type of sound generation. Receptor populations include wildlife, as well as humans, in the vicinity of the Tonawanda site.

Representative activities associated with the remedial actions at the Tonawanda site properties could result in equivalent sound emissions of 85-88 dB for a receptor 15.2 m (50 ft) from the site of operations, for the duration of the project. The closest sensitive receptor to Linde is Holmes Elementary School, which is located approximately one quarter mile away. The closest residences are located approximately one half mile away to the north and east of Linde. A hospital is also located approximately one half mile away to the east of Linde. As stated previously in section 2.1.7.5, the background ambient noise level for Linde and the surrounding area is estimated to be around 60 dB (L_{dn}). During the remedial activities at Linde, ambient noise levels at Holmes School, nearby residences, and the hospital would increase to about 65-68 dB (L_{dn}). The nearest residences to the Ashland 1, Seaway, and Ashland 2 properties are located approximately one mile east in the City of Tonawanda. Due to hemispherical divergence, noise levels generated during remedial activities would approach background levels at the closest residences and thus no noise impacts are anticipated.

Equivalent sound-pressure levels of 85-88 dB, for remedial activities at the Tonawanda site properties are not expected to exceed the OSHA standard for an 8-hour workday average of 90 dB, nor will anticipated noise levels from individual pieces of equipment (Table 5-6) exceed OSHA standards for short-term exposure.

Table 5-7 presents a summary of the effects of noise on people. Based on this table and the estimated increase by 6-8 dB, for sensitive receptors closest to Linde, it is expected that approximately 15% of these people will experience increased annoyance for the duration of the remedial activities.

In summary, noise levels associated with this alternative would occur during normal working hours and would be temporary (approximately 100 work weeks over a 3-year period).

Table 5-6. Typical Sound Pressure Levels for Equipment Used at a Representative Remedial Site

Equipment	Maximum Sound Level at 50 ft [dB(A)]
Air Compressor	81
Backhoe	85
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	87
Generator	78
Grader	85
Jack Hammer	88
Loader	79
Paver	89
Pneumatic Tool	85
Pump	76
Roller	74
Saw	78
Scraper	88
Shovel	82
Truck	88

Source: EPA (1974b).

Table 5-7. Effects of Noise on People[a] (Residential Land Uses Only)

Day-Night Average Sound Level, in Decibels	Hearing Loss	Speech Interference		Annoyance[b]	Average Community Reaction[d]	General Community Attitude Towards Area
	Qualitative Description	Indoor	Outdoor	% of Population Highly Annoyed[c]		
		% Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility			
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise is considered no more important than various other environmental factors.

[a] "Speech Interference" data are drawn from the following tables in EPA Report 550/9-74-004, Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

[b] Depends on attitudes and other factors

[c] The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

[d] Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

Noise impacts may result in short-term annoyances to the public, but would not affect hearing or pose occupational health hazards.

Unavoidable Adverse Impacts

Under this alternative, the unavoidable adverse impacts have been identified above.

Mitigative Measures

— *Air Quality Impact Mitigation*

The entrainment of fugitive dust particles would be reduced by wetting surface materials with water or other chemicals in order to increase the adhesion of surface particles. Regular watering can reduce the dust load from construction sites and storage piles by as much as 40-50% (EPA 1977b). The use of other chemical wetting agents can increase the reduction significantly. Use of wetting agents on the active portions of a site is not as effective because of the frequent disturbance of surface materials by equipment as the action progresses.

Atmospheric entrainment of surface particles would also be reduced by covering storage piles or inactive areas. Cover materials may range from plastic sheets to mulch or established vegetation. The former is most practical for temporary reduction in wind erosion whereas revegetation is preferred for long-term control.

The most practical method for reducing emissions from internal combustion engines is to properly operate and maintain equipment so that maximum work is obtained with as infrequent operation of equipment as possible.

— *Wetlands Impact Mitigation*

Proper engineering controls would be instituted to mitigate potential disturbances to the wetland areas surrounding Rattlesnake Creek and the northeast corner of the Linde property. Appropriate erosion and siltation controls would be used and maintained during the remedial actions. Also, heavy equipment utilized in wetlands would be of the low ground-pressure type (e.g., high floatation tires or specialized tracks), or placed on mats to minimize soil disturbance.

Probably the most critical aspect of any wetland creation or restoration plan is that of hydrology. Because restoration under this alternative is an extension of an existing wetland and proposed conditions are similar to those in the existing wetland, establishing similar grades on suitable soils would be sufficient to create a proper hydrologic setting. Replacement soils would be of similar soil classification and sufficient to support the intended vegetation or provide other functions such as groundwater discharge control or pollution attenuation.

The preferred time of year for reconstruction is site-specific depending on hydrologic factors, breeding of wildlife and fish, logistical constraints (e.g., work in frozen organic soils), optimum times for planting, and downstream concerns. The preferred time for the removal and wetland restoration activities at the Tonawanda site would be from July to October.

Active reintroduction of wetland vegetation is probably not necessary, as natural colonization would usually occur within two or three growing seasons as conditions become suitable. To protect unstabilized soils from eroding until wetland vegetation becomes established, a fast-growing annual grass (e.g., millet) or a perennial grass that is acceptable to include in the plant community would be planted. Also, exposed soil surfaces would be straw-mulched or comparably covered (netted if inundated and potentially subject to flowing water) to minimize erosion during the nongrowing season.

— *Community Issues Impact Mitigation*

A carefully designed public information and community relations program is required to keep community members informed about progress at the site and the reason for any unexpected delays. Institutional mechanisms would be established so that frequent, informal contact with local officials would be maintained to ensure two-way communication. Written agreements among DOE and local officials regarding institutional roles, responsibilities, and schedules for implementing this alternative would be established to ensure expeditious completion of the action.

Short-term impacts created by demolition of buildings and by truck traffic during implementation would be mitigated through coordination with local officials concerning schedules, routes, and local ordinances to prevent inconveniences and annoyance as much as possible (see sections on "Local Transportation" and "Ambient Noise"). Additional compensation may be required to offset local commitment of community resources for such purposes as traffic control, sanitation services, and enforcement of ordinances. Additional data on community issues would be incorporated throughout remedial action.

— *Local Transportation Impacts Mitigation*

Transportation impacts would be minimized by utilizing the most appropriate haul routes and trip times to reduce traffic congestion, accident potential, and road deterioration. Scheduling of vehicle movements during off-peak traffic hours and provision of turning lanes and other safety measures would also reduce impacts. All local ordinances regarding weight and speed limits would be obeyed, or appropriate waivers or temporary permits acquired.

— *Noise Impact Mitigation*

Noise impacts would be reduced, when feasible, by: (1) limiting noisy activities to daylight hours, (2) selecting the quietest among alternative equipment pieces, (3) assuring proper maintenance and operation of equipment, and (4) providing enclosures or other barriers if needed.

Short-Term Uses and Long-Term Productivity

Both short-term land use and long-term productivity, in terms of various economically-productive land use options on the site, would be greatly enhanced under this option. Once the contaminated material was removed from the site, any land use under existing zoning codes could be considered. Long-term productivity would be high under this alternative. After the contamination is removed, the land would be available for other uses without the current restrictions governing the MED-related wastes.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e. water quality, air quality), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas of concern where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.2.5 Reduction in Mobility, Toxicity, and Volume Through Treatment

At the site, the mobility, toxicity, and volume of contaminated soil are not reduced through treatment. The volume of building demolition would be reduced through a crushing process.

5.3.2.6 Implementability

The New York FUSRAP disposal facility and the National East and West disposal facilities are implementable options. Excavation, construction, decontamination, demolition, and transportation equipment is commercially available, but requires trained personnel for operation. Borrow sites for backfill and soil cover material have not yet been identified, but are assumed to be available by the time of remedial action implementation. Decontamination and demolition actions at Linde may be difficult to implement due to ongoing plant operations. The implementation of this alternative could be impacted by the requirements for the review and approval of an EIS, design, and construction of a new disposal facility. These requirements could delay the operation of the facility beyond when it would be needed to receive this waste. Waste acceptance and capacity restrictions imposed by the disposal facility would not be expected to become a limiting factor. Documentation to transport and dispose of the contaminated materials is required. Delays in obtaining the necessary approvals for construction and operation of the national disposal facility could impact implementation of this alternative.

Implementability of the existing DOE disposal option may be greatly impacted by the fact that only a few DOE disposal sites are potentially available to accept FUSRAP waste.

Two commercial facilities have applied for a license to accept waste classified as byproduct material. However, the implementability of this alternative could be greatly affected if neither facility receives a license. Also, implementability of this alternative could be affected if the facility that has state requirements against receiving out-of-state waste is the only facility to receive its license.

The beneficial reuse option is implementable, if a qualified use is found, and measures are taken to comply with the cleanup levels specified in 40 CFR 192 regulations.

5.3.2.7 Cost

This alternative includes demolition of buildings, removal of demolition waste, complete excavation of contaminated soil, and offsite transport and disposal of contaminated soil and building debris. The total direct capital cost is $69.7M. Disposal costs are based on the transportation and permanent disposal of 267,900 m^3 (351,000 yd^3) of contaminated waste materials at the New York FUSRAP facility.

Annual Tonawanda area O&M cost for a one-year period to conduct environmental monitoring is estimated to be $139,650. With a 0% discount rate, the present worth cost for this alternative is estimated to be $99.7M assuming disposal at a New York FUSRAP site. Additional costing information pertaining to the various transportation and disposal options is provided in Appendix G.

5.3.3 Alternative 3 — Complete Excavation and Onsite Disposal

Alternative 3 involves complete excavation of the contaminated soils and onsite disposal. Figure 5-1 indicated three possible locations with the estimated configurations and sizes for the onsite disposal cell on Ashland 1, Ashland 2, and Seaway properties. (These three possible locations, configurations, and sizes are intended only to show the feasibility of onsite disposal. The actual location and configuration within each of these options would be determined, in part, based on final engineering design considerations.) Figure 5-2 indicated a typical section of the waste containment structure. Impacts associated with the three possible areas will be discussed for this alternative.

5.3.3.1 Overall Protection of Human Health and the Environment

This alternative would have a high degree of protection of human health and the environment. Complete excavation and removal of all radioactively contaminated materials and commingled inorganic contaminants would result in negligible long-term risk to receptors in the area because exposure to contaminated materials via all pathways would be eliminated. In addition, completion of remedial activities would eliminate the migration of contaminants into surface waters. Risk calculations for the general public under this alternative have indicated risks resulting from remedial actions and risk at the site after remediation are in the 10^{-9} range and disposal through the 1,000 year life of the site in the 10^{-7} range (DOE 1986).

This alternative provides short-term benefits of protection of human health and the environment by the complete removal and onsite disposal of all MED-related source contamination, thereby eliminating all exposure pathways. Furthermore, the short-term benefits are enhanced with increased long-term environmental productivity of a majority of the site. This is because of the potential for virtually unrestricted future site uses (except in the area of the onsite constructed disposal facility). Adverse impacts on the environment would be short-term and mitigated by the elimination of adverse long-term effects on the environment. After remedial response objectives are achieved, the remediated site could be designated for unrestricted use.

5.3.3.2 Compliance with ARARs

Under this alternative, all soils contaminated above DOE guidelines for residual radioactivity at FUSRAP sites would be excavated along with the commingled non-radioactive contaminants contained in the radiologically contaminated soils. All ARARs related to acceptable levels of residual radioactive contamination would be met at the site. If soils are kept moist during excavation, transport, and handling, airborne radioactive contaminants would remain within pertinent regulatory limits. The impact of diesel-powered excavation equipment on air quality is uncertain; the size and number of pieces of equipment used would determine whether air quality significantly deteriorates from this action. Actions under this alternative meet DOE criteria for limits on public exposure to radioactive contaminants. Radiation exposure standards for occupational workers would be met by monitoring during excavation and disposal. In addition, OSHA requirements for worker health and safety would be met during these actions. Transported wastes would meet the requirements of the Hazardous Material Transportation Act and relevant DOE Orders regarding packaging, labeling, and placarding. Disposal at an onsite facility would be in accordance with DOE Orders and State of New York regulations.

5.3.3.3 Long-Term Effectiveness and Permanence

The long-term effectiveness of this alternative is enhanced because all the MED-related contaminated soil is excavated and disposed of onsite, thereby reducing residual radiological risk to 1×10^{-9} for an employee maintaining the site. This plan would require long-term operation and maintenance and monitoring of the onsite disposal facility.

Residual long-term risks associated with this action would be due to maintenance of the contaminated material on the property. The use of an onsite designed land encapsulation facility at Ashland 1, Ashland 2, or Seaway properties would substantially reduce or eliminate any risk of residual contamination (see Appendix I for the Human Health Risk Assessment Methodology).

Complete excavation of contaminated soil eliminates the need for long-term management, monitoring, maintenance, and replacement directly associated with these remedial activities with the exception of the onsite landfill. Utilizing natural materials for construction of the onsite landfill would achieve long-term stability with minimal maintenance during the desired life of 200 to 1,000 years for an engineered waste encapsulation structure (BNI 1989).

Irreversible and Irretrievable Commitment of Resources

Implementing Alternative 3 will result in the permanent commitment of land at the Tonawanda site for waste disposal. This commitment of land for the disposal facility is consistent with current land use at the site. The Tonawanda site is a contaminated industrial complex that contains wastes from past disposal practices.

The disposal cell proper is expected to cover about 17.5 acres, but the total amount of committed land would be larger (e.g., double the waste containment area) because a buffer zone will be established around the cell. No other area of the Tonawanda site would sustain a long-term impact or injury as a result of this alternative. Perpetual care will be taken of the committed land because the waste would retain its low level radioactivity for thousands of years. For example, the cover will be visually inspected, groundwater will be monitored, and the effectiveness of the overall system at the Tonawanda site will be reviewed at least every 5 years.

Consumptive use of geological resources (e.g., quarried rock, sand, and gravel) and petroleum products (e.g., diesel fuel and gasoline) will be required for the removal, construction, and disposal activities. Adequate supplies of these materials are readily available in the Tonawanda area. To minimize transportation impacts, every effort will be made to locate borrow areas near the site. Implementing Alternative 3 is not constrained by the availability of resources or supplies beyond those currently available in the Buffalo, NY area.

5.3.3.4 Short-Term Effectiveness and Environmental Impacts

Estimated time to complete remediation activities is 3 years because of potential weather delays. Remedial response objectives are achieved when the onsite permanent disposal facility receives the contaminated materials. The time required to site, study, design, and construct the onsite disposal facility is expected to take 3-5 years. This time estimate includes the time required to complete all activities associated with this alternative.

Community Protection

Excavation would increase fugitive dust during the remediation action. Annual airborne radiological risk (deaths per year due to cancer) and lifetime risk of cancer induction to the maximally exposed individual would be 6×10^{-9}. The general population would experience a temporary increase in exposure, due to an increase in airborne contaminants from excavation activities. Contaminated soils would be kept moist during excavation and handling to prevent release of radioactively contaminated dust. Dust control methods would limit the release of particulate matter and mitigate the slight short-term increase in potential risk to the community. Potential adverse environmental impacts from erosion of contaminated soils disturbed during excavation would be mitigated by proper drainage controls.

Worker Protection

Risks associated with remediation activities would increase during implementation of the alternative. Onsite construction activities would expose construction workers engaged in work in areas of contamination. Remediation workers would receive a radiation exposure dose based on the type of activity engaged in and the duration of the exposure. The annual radiological exposure dose to a remediation worker engaged in excavation activities during implementation of Alternative 3 would be 500 mrem with an associated risk of 2×10^{-4}. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, and restrictions on access to contaminated areas. In addition, all machinery and equipment would be inspected after use, surveyed for radioactive contamination, and decontaminated if necessary.

The probability of a cancer occurring over the course of a worker's lifetime as a result of exposure to chemical carcinogens during a 1-year remedial action period is 2×10^{-5}. The noncarcinogenic Hazard Index was estimated as 2.6. In addition to radiological risks posed by implementation of the alternative, occupational risks associated with construction and material handling would occur. The total occupational fatality risk associated with construction activities is estimated at 2×10^{-3}.

Transportation

The transportation of radioactively contaminated materials to the onsite disposal facility would strictly comply with all applicable state and federal regulations. As required, predesignated routes would be traveled and an emergency response program developed to respond to any accidents.

Complete excavation and onsite disposal of waste at Tonawanda would limit offsite non-radiological transportation risk to that involved with trucking waste from Linde to the onsite disposal cell, with hauling asphalt and fill material to the site for restoration, and with hauling materials to the site for construction of the disposal cell. The risk (expressed in probability of an offsite fatal accident) for this alternative is estimated to be 0.19. See Appendix I for the methodology used to determine the offsite transportation risk.

Environmental Impacts

— *Geology and Soils*

Impacts from the implementation of this alternative would be similar to those resulting from Alternative 2 with the exception of the development of an onsite disposal facility. This permanent facility is proposed to be located on either the Ashland 1, Seaway, or Ashland 2 properties. The proposed disposal cell on Ashland 1 might be long and narrow [119 m (390 ft) x 1069 m (3506 ft)] and require an area of 12.7 ha (31.4 acres). The alternative disposal cell on Ashland 2 or Seaway might be 165 m (870 ft) square and cover an area of only 7 ha (17.4 acres). The impacts to soils from the development of such a facility would be those associated with the construction activities. The potential would exist for contamination of underlying soils if the facility's containment measures fail. Potential adverse environmental impacts from erosion of contaminated soils disturbed during excavation would be mitigated by proper drainage controls. No additional impacts would be expected to result from siting a disposal cell on the Seaway property, an active solid waste disposal facility.

Borrow material needed for backfill would be obtained from offsite sources and procured as a commodity in accordance with government procurement regulations in effect at the time of remedial action. Potential borrow material sources that can meet DOE's expected demands have been identified in Niagara and Erie Counties in New York. It is estimated that 17,180 truckloads of clean fill will be required for the restoration of the site and 22,920 truckloads of borrow material (backfill, sand, clay, gravel, etc.) would be required to construct, operate, and close the onsite disposal facility.

— *Water Quality*

Impacts to surface water quality for sitewide Alternative 3 would be the same as those listed for sitewide Alternative 2. The onsite disposal location would, like the offsite disposal location, be designed and sited in compliance with all applicable laws and regulations concerning surface water standards. Therefore, no degradation of surface water quality is expected at the onsite disposal location.

— *Air Quality*

The impact to air quality at the Tonawanda site and vicinity would be similar to that of Alternative 2. Remedial activities would produce fugitive dust and internal combustion engine emissions, which would result in releases of material to the atmosphere. The construction of an onsite designed land encapsulation facility would contribute additional releases of material. Airborne emissions that would result from remedial activities are expected to be relatively low and significant impacts to human health or the environment would not be anticipated.

— *Ecological Resources*

Biota. Impacts from the implementation of this alternative would parallel those resulting from Alternative 2 with the exception of the development of an onsite disposal area. The area selected (Ashland 1, Seaway, or Ashland 2 properties) for disposal cell placement would greatly influence potential impacts. The Ashland 1 site would remove 12.7 ha (31.4 acres) of poor wildlife habitat with little vegetation. The use of Ashland 2 would involve the use of only 7 ha (17.4 acres) of land, but Ashland 2 supports diverse vegetation that provides good wildlife habitat. Biotic resources would be effectively eliminated from the facility site during construction and operation. Post-closure objectives would direct the selection of post-closure treatment and maintenance activities. The treatment and maintenance activities actually implemented after closure would dictate what plant species/communities might develop on the site. Revegetation with native grasses is a likely requirement under New York State regulations, while shallow-rooted vegetation would be necessary to avoid plant root penetration of the proposed multi-media cap. The resulting habitat would, in turn, influence what wildlife might inhabit or utilize the site after closure. Because the Seaway property is an active solid waste disposal facility, no additional impacts would occur from its use for an onsite disposal cell.

Threatened and Endangered Species. No impacts to any federally or state-listed plant or animal species have been identified as resulting from the implementation of this alternative.

Wetlands. Impacts to the low lying and wetland areas along Rattlesnake Creek and the northeast corner of the Linde property would be the same as those of Alternative 2. Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (Figure 2-7) would impact approximately 0.32 ha (0.80 acres) of the associated low lying and wetland area. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek wetland area. The removal would also result in the loss of the affected area's and wetlands' hydrogeologic, hydrologic, soil, and biological characteristics. Construction of an onsite disposal facility at the potential Ashland 2 site would potentially eliminate the 0.09 ha (0.24 acre) Wetland H identified on Figure 2-9. No wetlands would be involved at the potential sites at Ashland 1 and Seaway properties. If any wetlands are eliminated, new wetlands would be created to replace those eliminated. There are no anticipated impacts from flooding on the site because the site is located above the 500 year flood elevation.

— *Archaeological, Cultural, and Historical Resources*

This alternative would affect no archaeological, cultural, or historic resources because none is present on the Tonawanda site.

— *Land Use and Recreational/Aesthetic Resources*

Current land uses would continue but would be impacted in the short-term while remediation occurs. Short-term impacts to land use include the inconvenience and cost of removing contaminated materials, additional trucks using roads to transport the contaminated material to an onsite disposal site, and temporary inconveniences and aesthetic impacts associated with diverting Rattlesnake Creek and restoring wetlands. The Linde property is likely to be used for industrial purposes in the future. This alternative would allow for any future reuse of the Ashland 1, Seaway, and Ashland 2 properties that conform to the regulations stated in the current Town of Tonawanda zoning ordinance.

This alternative, however, would have implications for two draft revitalization plans (New York State Department of State Coastal Management Program 1991; Ernst and Young

1992) for the waterfront area. Each plan notes that a priority in revitalizing the area is the remediation of radioactive and hazardous waste sites. The *Local Waterfront Revitalization Program* specifically states that the development of a disposal site on the Ashland property would result in a variety of negative impacts similar to those caused by any BFI expansion (New York State Department of State Coastal Management Program 1991). In general, the plans call for residential areas and commercial businesses to be located near the waterfront and River Road with light industries in the back half of the planning area. The actual location of the encapsulation facility would determine the impact to the revitalization plans. For example, if the encapsulation facility is placed in the south portions (away from River Road) of Ashland 2, then future developments could be hindered from occurring in that area. However, if the encapsulation facility is placed at Ashland 1 in an area away from other potential industrial developments or within the confines of Seaway, then the impacts would not be as great.

DOE would have to purchase, at fair market value, or receive a land donation of a portion or all of the Ashland or Seaway properties to construct an onsite land encapsulation facility. A zoning variance and a building permit from the Town of Tonawanda could be required for building the land encapsulation facility. The land used for the land encapsulation facility could not be reused in the future unless it is remediated, and no property taxes would be paid because the federal government is not required to pay property taxes on lands it owns.

— *Socioeconomic and Institutional Issues*

Community Issues. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some residential development near the Ashland 2 property around River Road. This alternative would conflict with the community's plans if the disposal facility is located on the Ashland 2 property. Location of the facility on the Ashland 1 or Seaway property would not conflict with the community's future development plan.

Short-term impacts on community well-being would occur in the form of annoyance, inconvenience, and disruption of activities during demolition and transportation activities. DOE would coordinate with local officials of the Town and Holmes School to minimize disruptions to the extent possible. Coordination between DOE and the management of Linde Center and BFI would minimize impacts on operations and workers during remediation activities.

Institutional Considerations. If acquisition of property at Ashland or Seaway is required for construction of a land encapsulation facility, the Town of Tonawanda would experience loss of revenues from property tax for which compensation may be expected.

This alternative may result in short-term commitment of local institutional resources for such purposes as traffic control and emergency preparedness. Remedial activities may coincide with some waterfront development activities such as the River Road realignment. Coordination and consultation between DOE and local officials would be undertaken to keep the local community and the State updated on progress of the remedial action and to avoid unnecessary inconveniences to local residents, businesses, and resources.

Public Services. Public utilities in the area are adequate to accommodate the construction and operation of an onsite disposal facility. Population growth anticipated under this alternative is not sufficient to create a strain on services. Emergency services in the area are adequate to respond to an incident or accident involving radioactive materials. DOE would coordinate with the New York State Department of Health, Erie County, and the Town of Tonawanda to ensure that emergency response channels and facilities are appropriate for the maximum credible emergency that may occur on the site.

Economic and Demographic Resources. It is assumed that Alternative 3 would require 31.7 full-time equivalent positions for each of the three years of remediation. Assuming that 13 construction workers would earn $43,000 per year and the other 18.7 employees would earn $35,000 per year, the annual dollar value of payrolls directly attributable to the cleanup effort would be $1.2M per year. Total capital costs are estimated to be $70.2M, which will be spent over three years. Annual O&M costs would be $339,450/year for the first three years, $199,800/year thereafter. Using the RIMS II model to calculate the indirect employment resulting from these expenditures (see Appendix H), it is estimated that Alternative 3 would result in an additional 71.9 jobs, for a total employment impact of 103.6 in each of the three years of remediation activity.

The 1989 value for total personnel employed in Erie and Niagara Counties was 625,889; therefore, expected employment accounts for 0.02% of total employment in the region. The employment impact is such a small share of the total in the region that it can be accommodated through normal growth in employment. For example, total employment in Erie and Niagara Counties grew at an average annual compound growth rate of 2.4% between 1985 and 1989.

It is anticipated that much of the employment taking place during the remediation under Alternative 3 would utilize resources already available in the region and that there would not be a large impact on housing and population. In order to estimate the upper bound on impacts to housing and population, calculations were made assuming that employment would be filled by persons new to the region. Under this assumption, it is estimated that the number of households associated with the employment would be 77 (less than 0.02% of the total number of households). The estimated upper bound on population affected by the action is estimated to be 186 (less than 0.02% of the total population in the two-county region). Since the possible impacts are so small relative to the total region, this action would not have a substantial impact on economic and demographic resources.

It is estimated that there would be continued monitoring of the onsite disposal area for 30 years after the complete excavation of the properties in the third year. This activity would require 0.2 workers for sampling and lab analysis. It is estimated that this employment would result in annual payrolls estimated to be $7,000. An additional $192,800 is expected to be required for annual O&M activities, of which 0.5% is assumed to be spent with industries based within the region. Using these assumptions, there is expected to be indirect employment of 0.1 workers, with no associated growth in households or population.

Local Transportation Impacts. The impacts on transportation would be similar to those for Alternative 2, mainly an increase in average daily traffic volumes and potential road deterioration.

Transportation of approximately 61,270 m^3 (80,130 yd^3) of contaminated material from Linde to the onsite disposal facility at Seaway or Ashland would require 5,008 loads. Transportation of approximately 2,850 m^3 (3,730 yd^3) of replacement pavement to Linde would require 233 loads. Transportation of a computed 509,600 m^3 (666,500 yd^3) of fill, clay, and loam material, from a borrow site to the Tonawanda site for site restoration and construction of the disposal facility, would require 40,101 loads.

Noise Impacts. Ambient noise impacts at the Tonawanda site would be similar to those for Alternative 2. Sound waves would be of the intermittent or impulse type as opposed to the steady-state type of sound generation. Receptor populations include wildlife, as well as humans, in the vicinity of the Tonawanda site. Noise levels generated during remedial activities would not affect hearing or pose any occupational health hazards. The closest sensitive receptors to Linde could experience an increase of 6-8 dB above background L_{dn} for the duration of remedial activities (approximately 100 work weeks over a period of 3 years). Approximately 15% of the affected population would experience increased annoyance. Noise levels generated at the Ashland-Seaway properties would approach background levels at the closest residences; thus, no noise impacts are anticipated.

Unavoidable Adverse Impacts

Under this alternative, the unavoidable adverse impacts have been identified above.

Mitigative Measures

— *Air Quality Impact Mitigation*

Mitigative measures for air quality would be the same as those for Alternative 2. Water or other chemical wetting agents and cover materials would be used to reduce atmospheric entrainment of fugitive dust particles. Equipment would be properly operated and maintained to minimize air quality impacts.

— *Wetlands Impact Mitigation*

Mitigative measures for the Tonawanda site wetlands would be the same as those for Alternative 2. Proper engineering controls would be instituted to mitigate potential disturbances to the surrounding area and restore the wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions.

— *Community Issues Impact Mitigation*

Community issues associated with the onsite disposal component of this alternative may be mitigated through frequent formal and informal communication with affected residents and local officials. Financial compensation to the Town of Tonawanda would be necessary if property acquisition is required for construction of a land encapsulation facility. Close coordination and formal agreements with local officials would help to mitigate potential institutional conflicts associated with permitting and land acquisition. Additional compensation and coordination may be required for loss of property taxes, or to offset local commitment of community resources for such purposes as traffic control, sanitation services, enforcement of ordinances, and local monitoring of onsite disposal. Additional data on community issues would be incorporated throughout remedial action.

— *Local Transportation Impact Mitigation*

Transportation impacts would be minimized by utilizing the most appropriate haul routes and trip times to reduce traffic congestion, accident potential, and road deterioration. Scheduling of vehicle movements during off-peak traffic hours and provision of turning lanes and other safety measures also would reduce impacts. All local ordinances regarding weight and speed limits would be obeyed, or appropriate waivers or temporary permits acquired.

— *Noise Impact Mitigation*

Noise impacts would be reduced by: (1) limiting noisy activities to daylight hours, (2) selecting the quietest among alternative equipment pieces, (3) assuring proper maintenance and operation of equipment, and (4) providing enclosures or other barriers if needed.

Short-Term Uses and Long-Term Productivity

This alternative provides short-term benefits of protection of human health and the environment by the complete removal and onsite disposal of all source contamination, thereby eliminating all exposure pathways. Furthermore, the short-term benefits are coupled with increased long-term environmental productivity of a majority of the site because of the potential for virtually unrestricted future site uses (except in the area of the onsite constructed disposal facility). Adverse impacts would not be significant and would be short-term, mitigated by the elimination of adverse long-term effects on environmental productivity. After remedial response objectives are achieved, the remediated site could be designated for unrestricted use.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e., water quality, air quality), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas of concern where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.3.5 Reduction in Mobility, Toxicity, and Volume Through Treatment

Mobility, toxicity, or volume of contaminated soil is not reduced through treatment. The mobility of contaminants is eliminated once the contaminants are encapsulated in an onsite landfill.

5.3.3.6 Implementability

This alternative is implementable. Permits to construct and dispose of the excavated soil onsite are required. The excavation equipment is available commercially, but requires trained personnel for operation.

5.3.3.7 Cost

This alternative includes the complete excavation of contaminated soil, demolition and removal of contaminated buildings, and onsite disposal. The total direct capital cost is estimated to be $45.5M.

Annual O&M cost is estimated to be $339,000/year for the first three years and $199,800/year thereafter. With a 0% discount rate, the 30-year present worth cost for this alternative is estimated to be $74.9M. Additional costing information is provided in Appendix G.

5.3.4 Alternative 4 — Partial Excavation and Offsite Disposal

Alternative 4 involves excavation of the accessible contaminated soils, institutional controls, and containment activities for "access-restricted" soils, demolition of Buildings 14, 31, and 38, decontamination of Building 30, and offsite disposal.

All offsite disposal options, as described in Section 5.2.1.3 and analyzed in Section 5.3.2 under the complete excavation and offsite disposal alternative, are also considered as disposal options for Alternative 4. Discussions pertaining to disposal site options and potential impacts at the disposal site are presented, as necessary. Where potential impacts are assumed to be similar to these relating to the complete excavation alternative, a reference is made to the earlier discussion.

5.3.4.1 Overall Protection of Human Health and the Environment

This alternative is moderately protective of human health and the environment. Most of the contaminated soil would be removed; however, soils thought to be contaminated, based on elevated gamma readings in that area, would remain under Building 30 at Linde (until the soil becomes accessible) and under refuse at the Seaway landfill. Restricting access to Building 30 at Linde and maintaining the cap at the Seaway landfill would prevent potential exposure at least over the short term. Implementation of this alternative greatly reduces the probability of exposure and level of potential exposure. In addition, actions under this alternative significantly reduce the migration of contaminants to surface waters or into groundwater at the Ashland 1 and 2 properties.

This alternative provides some short-term benefits of protection of human health and the environment by reducing exposures, but results in reduced long-term productivity of the site, specifically at Linde and the Seaway landfill, because of restricted future use. No cumulative impacts for this alternative have been identified.

5.3.4.2 Compliance with ARARs

Partial excavation would leave difficult-to-access soils that are above DOE guidelines for residual radioactivity in place.. The contaminated soils left in place would not be expected to exceed pertinent regulations concerning elevation of gamma levels at the perimeter of a radioactively contaminated facility, based on compliance at the site in its current state (BNI 1991). Regulations under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) call for control measures to be effective for at least 200 years and up to 1000 years. Decontamination and demolition of the buildings at Linde would completely remove radioactive contaminants. Monitoring requirements under UMTRCA would be met by continuing annual environmental monitoring. This alternative does not meet DOE guidelines for residual radioactivity for sites released for unrestricted use. Subsurface levels of thorium and its decay products in "access-restricted" areas would remain above the guideline of 15 pCi/g. Restricted access keeps exposures to radioactive contaminants to the public within limits of DOE guidelines.

Regulatory requirements for excavation and transport of contaminated soil and for worker safety and health would be met as for Alternative 3.

5.3.4.3 Long-Term Effectiveness and Permanence

The residual risk to human health and the environment results from approximately 4,130 m^3 (5,400 yd^3) of contaminated soil that remains untreated and unexcavated at Linde (until the soils become accessible) plus the 19,800 m^3 (25,900 yd^3) of contaminated soil buried within the Seaway landfill in Areas B and C. Removal of all accessible radioactively contaminated soil would substantially reduce the residual risk at this site. Because contaminated materials are buried under the landfill, exposure pathways are eliminated and exposure is negligible (see Appendix I for the Human Health Risk Assessment Methodology).

Because contaminated soils remain in place onsite, a review would be required at least every 5 years to ensure that the remedy continues to adequately protect human health and the environment. Long-term monitoring and controls would also be required.

Excavation of accessible contaminated soils would reduce but not eliminate the need for long-term management, monitoring, maintenance, and replacement directly associated with these remedial activities. Remaining or residual contaminants require long-term management and possible future remedial actions. Potential problems could arise if the existing civil features are modified or demolished; however, there is a moderate degree of confidence that institutional controls including site access restrictions can adequately handle these potential problems.

Offsite disposal at a permitted facility places the responsibility of long-term management, monitoring, and O&M with the receiving facility which, because of licensing requirements, is expected to have adequate and reliable controls.

Discussions of the long-term effectiveness and permanence related to the disposal site options for this alternative are equivalent to those presented for Alternative 2, the only difference being a smaller quantity of waste to be disposed of at the facility.

Irreversible and Irretrievable Commitment of Resources

Soils thought to be contaminated, based on elevated gamma readings, would remain under Building 30 at Linde. The use of these soils would then be restricted. However, in the future, once Building 30 is removed, the contamination would be removed. All disposal options under this alternative require a long-term commitment of land for the disposal cell.

5.3.4.4 Short-Term Effectiveness and Environmental Impacts

The time required to implement this alternative is similar to that for Alternative 2, in that completion time for remediation activities would be approximately 3 years and, depending on the disposal option selected, up to 10 years of lead time may be required to site, obtain permits, and design the disposal facility.

Community Protection

The factors producing short-term health risks resulting from implementation of this alternative are the same as those described in Alternative 2. The risk associated with each activity would be altered by the length of time required to complete the action. Annual airborne radiological risk (deaths per year due to cancer) and risk to the maximally exposed individual would be 5×10^{-9}.

Worker Protection

A remediation worker engaged in excavation during implementation of the alternative may receive a radiological exposure dose of 38 mrem. The potential risk of development of cancer during the lifetime of the worker, as a result of that exposure, is 3×10^{-5}. The probability of a cancer occurring over the course of a worker's lifetime as a result of exposure to chemical carcinogens during a 1 year remedial action period is 2×10^{-5}. The noncarcinogenic Hazard Index was estimated as 2.6. The potential occupational risk associated with construction type work during this alternative is calculated as 2 non-fatal injuries and 2×10^{-3} fatal injuries. Risk to workers would be mitigated through proper use of safety protocols, personal protective clothing and equipment, and restrictions on access to contaminated areas.

Transportation

Implementation of this alternative carries with it a risk of physical injury or death as a result of offsite transportation accidents. This risk is not related to transport of radioactive or hazardous chemicals and would be the same as the risk resulting from transport of nonhazardous materials. This risk is calculated based on the distance traveled, the number of round trips estimated and the probability of a fatal accident per mile traveled, and is present as a cumulative probability of an offsite fatal accident occurring throughout the implementation of the alternative. Methods used to determine the offsite non-radiological transportation risk are summarized in Appendix I. Table 5-8 presents the transportation risk for each of the potential offsite disposal options identified in this alternative. In general, offsite disposal within the state of New York carries with it a higher risk than the other potential disposal options because of the greater number of trips the trucks will be required to make. The transportation risk for the potential offsite disposal options using rail for transport of wastes is directly proportional to distance to the disposal facility.

Environmental Impacts

— *Geology and Soils*

The only impacts to soils on the Linde property resulting from the implementation of the alternative of partial excavation would occur during the removal of sediments from the 0.32 ha (0.8 acre) area in the northeast corner of the Linde property. Some erosion could occur during the removal of the waste pile, potentially resulting in sediment deposition on unpaved soils. The placement and size of the waste pile would allow for nearly complete containment and control of unwanted material transport. Because only partial excavation would be performed, some contaminated soils would remain in place.

Minimal impacts would occur to soils on the Ashland 1 and Seaway properties from the limited scope of this alternative. Only contaminated soils accessible from the surface would be excavated and moved offsite. The Ashland 2 property would still be subject to remedial activities over fairly large areas (Rattlesnake Creek, drainage ditches, and wetlands) because of

Table 5-8. Alternative 4 - Partial Excavation and Offsite Disposal
Estimate of Probability of a Fatal Accident Due to Offsite Transportation of Materials

	DISPOSAL OPTIONS				
	NY Disposal Site	FUSRAP East	FUSRAP West	Commercial	Existing DOE Facility
Transport of Waste to Offsite Disposal Site	.50	.03	.17	.13	.17
Transport of Fill Material to Tonawanda	.08	.08	.08	.08	.08
Transport of Asphalt to Tonawanda	.001	.001	.001	.001	.001
Transport of Material for Construction of Offsite Disposal Facility	.10	.10	.10	N/A	N/A
Total Probability of a Fatal Accident	.68	.21	.35	.21	.25

the extent of contamination. Actual excavation would occur on four areas of Ashland 2, with a total area of 0.52 ha (1.3 acres). Potential impacts to the geology and soils on Ashland 2 remain much the same as those that would occur within Alternative 2. As at Linde, some contaminated soils would be left in place.

Potential impacts to geology and soils at the selected disposal facility would be equivalent to those discussed under Alternative 2.

— *Water Quality*

Partial excavation would involve only those contaminated materials that directly threaten human health and the environment. As in sitewide Alternatives 2 and 3, water quality is expected to improve as a result of this alternative. However, because less material is being moved and handled in this alternative as opposed to Alternatives 2 and 3, there is less potential for short-term degradation of water quality. Monitoring of water quality would ensure long-term protection of this resource.

Potential impacts to water quality at the selected disposal facility would be equivalent to those discussed under Alternative 2.

— *Air Quality*

The impact to air quality at the Tonawanda site and vicinity and at the selected disposal facility would be similar to that of Alternative 2. Remedial activities would produce fugitive dust and internal combustion engine emissions which would result in releases of material to the atmosphere. These emissions are expected to be relatively low and significant impacts to human health or the environment would not be anticipated.

— *Ecological Resources*

Biota. The most extensive impacts to biota at the Tonawanda site would occur during the removal of soils and sediments from the Ashland 2 property. Four areas, totaling 0.52 ha (1.3 acres), of wetland and riparian vegetation would be destroyed with the resulting loss of habitat to animals inhabiting this property. Areas not directly impacted by excavation activities would probably be affected by noise, airborne pollutants, and other impacts associated with remedial activities. This area is estimated to be 11.3 ha (28 acres). Aquatic resources within Rattlesnake Creek and its un-named tributary would be severely impacted if not totally eliminated by the diversion of water from the stream channel and the subsequent removal of soil and sediments from the streambed. Gradual recovery of aquatic communities could be expected to occur after cessation of remedial activities.

Potential impacts to biota at the various disposal sites considered would be equivalent to those discussed in Alternative 2.

Threatened and Endangered Species. No impacts to any state or federally-listed species at the Tonawanda site have been identified as resulting from the implementation of this alternative. Potential impacts at the disposal facilities are presented in the discussion of Alternative 2.

Wetlands. Impacts to the low lying and wetland areas along Rattlesnake Creek and the northeast corner of the Linde property would be the same as that of Alternative 2. Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (Figure 2-7) would impact approximately 0.32 ha (0.80 acre) of the associated area. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek wetland area. The removal would also result in the loss of the affected low lying areas' and wetlands' hydrogeologic, hydrologic, soil, and biological characteristics.

— *Archaeological, Cultural, and Historical Resources*

This alternative would not affect archaeological, cultural, or historic resources because none is present on the Tonawanda site. Potential impacts related to the disposal sites considered for the Tonawanda waste are presented in the discussion of Alternative 2.

— *Land Use and Recreational/Aesthetic Resources*

Short-term impacts to land uses include the inconvenience and cost of removing contaminated materials, additional trucks using roads to move the contaminated material to a location for transportation to an offsite disposal facility, and temporary inconveniences and aesthetic impacts associated with diverting Rattlesnake Creek and restoring wetlands.

This alternative would allow for any future reuse of the Ashland 1 and 2 properties that conform to the regulations stated in the current Town of Tonawanda zoning ordinance. Because the properties at Linde and Seaway would still have inaccessible soils, a deed restriction would be necessary to ensure that future reuse of properties does not pose a health risk. This alternative would partially remove constraints associated with the existence of radioactive wastes in revitalizing the waterfront area along the Niagara River in the Town of Tonawanda. Two plans, the *Local Waterfront Revitalization Program* (New York State Department of State Coastal Management Program 1991) and the *Waterfront Region Master Plan* (Ernst and Young 1992), note that removing radioactive and hazardous wastes sites is a priority to help encourage development of the waterfront area. Partial excavation with offsite disposal would possibly alleviate concerns some developers may have about developing certain areas. The Seaway property (Areas B and C) and portions of the Linde property are the only areas that would not be excavated. Because the Seaway property is a landfill, leaving that area unexcavated may not have a significant impact on redevelopment plans.

Land use at the selected disposal site will be dedicated to the long-term encapsulation of the Tonawanda waste.

— *Socioeconomic and Institutional Issues*

Community Issues. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some residential development near the Ashland 2 property around River Road. This alternative would not conflict with the community's plans since all contamination on properties involved with the development of River Road would be removed.

Short-term impacts in the form of annoyance, inconvenience, and disruption of activities would occur during demolition and transportation activities. Coordination with local officials of the Town and the Holmes School would be undertaken to minimize disruption to the extent possible. DOE would coordinate with the management of Linde Center and BFI to minimize impacts on operations and workers.

Public Services. Public utilities in the area are adequate to accommodate remedial activities associated with this alternative. Population growth would not be anticipated to create a strain on public services. Emergency services in the area are adequate to respond to an incident or accident involving radioactive materials. DOE would coordinate with the New York State Department of Health and the Town of Tonawanda to ensure that communication channels and emergency facilities are appropriate for any emergency that may occur on the site.

Economic and Demographic Resources. It is assumed that Alternative 4 would require the employment of 32.2 workers for the three years of active remediation. Assuming that 20.6 construction workers would earn $43,000 per year and the remaining full-time equivalent employees would earn $35,000 per year, the dollar value of payrolls directly attributable to the cleanup effort would be $1.3M. Capital costs expended in the Tonawanda area are estimated at $6.0M per year; total annual O&M expenditures in the Tonawanda area are estimated at $139,650 for three years. Using the RIMS II model to calculate the indirect employment resulting for these expenditures (see Appendix H), it is estimated that Alternative 4 would result in an additional 31.2 jobs, for a total employment impact of 63.4 jobs. The 1989 value for total personnel employed in Erie and Niagara Counties was 625,889; therefore, expected employment is estimated to account for 0.01% of total employment in the region. The employment impact is such a small share of the total in the region that it can be accommodated through normal growth in employment. For example, total employment in Erie and Niagara Counties grew at an average annual compound growth rate of 2.4% between 1985 and 1989.

It is anticipated that much of the employment taking place during the remediation under Alternative 4 would utilize resources already available in the region and that there would not be a large impact on housing and population. In order to estimate the upper bound on impacts to housing and population, calculations were made assuming that employment would be filled by persons new to the region. Under this assumption, it is estimated that the number of households associated with the employment would be 47. The estimated upper bound on population affected by the action is estimated to be 113. Since the upper bound of possible impacts is so small relative to the total region, this action would not have a substantial impact on economic and demographic resources.

It is estimated that there would be continued monitoring of the Tonawanda site for 30 years after the partial excavation of the properties. This activity would require 0.3 person for sampling and lab analysis. It is estimated that this employment would result in payrolls estimated to be $10,500. An additional $129,150 is expected to be required for operations and maintenance activities, of which 0.5% is assumed to be spent with industries based within the region. Using these assumptions, there is expected to be indirect employment of 0.2 person, with no associated growth in households or in population.

There would not be substantial impacts to employment, population, or households in the Tonawanda area for the different offsite disposal options being considered. The transportation company selected to conduct the transfer of contaminated material to an offsite location is assumed not to employ personnel from Erie and Niagara Counties; contract truck (or rail) transportation crews are not often located in an area requiring short-term transportation services for a particular origin and destination. A separate EIS, upon which the selection of a specific offsite disposal site would be made, would include estimates of the cost of handling radioactive materials at the chosen site.

Local Transportation Impacts. The impacts on transportation would be similar to those for Alternative 2, mainly an increase in average daily traffic volumes and potential road deterioration.

Transportation of an estimated 2,850 m^3 (3,730 yd^3) of replacement pavement and concrete slabs to Linde would require 233 loads. Transportation of an estimated 210,200 m^3 (274,900 yd^3) of clean fill and loam material, from a borrow site to the Tonawanda site, would require 17,180 loads.

Transportation of contaminated material to an offsite disposal facility is discussed in Sections 5.2.1.4 and 5.3.2.4. Loading of contaminated material into shipping containers for truck transport would take place within Linde, Ashland 1, Seaway, and Ashland 2. Loading of contaminated material into bulk rail cars for transport by rail would take place at Linde or Ashland 1. This eliminates the need for additional transportation of contaminated material to a central staging area on the Tonawanda site.

— *Noise Impacts*

Noise impacts at the Tonawanda site would be similar to those for Alternative 2. Sound waves would be of the intermittent or impulse type as opposed to the steady-state type of sound generation. Receptor populations include wildlife, as well as humans, in the vicinity of the Tonawanda site. Noise levels generated during remedial activities would not affect hearing or pose any occupational health hazards. The closest sensitive receptors to Linde would experience an increase of 6-8 dB above background L_{dn} for the duration of remedial activities (approximately 100 work weeks). Approximately 15% of the affected population would experience increased annoyance. Noise levels generated at the Ashland-Seaway properties would approach background levels at the closest residences; thus, no noise impacts are anticipated.

Unavoidable Adverse Impacts

Under this alternative, the unavoidable adverse impacts have been identified above.

Mitigative Measures

— *Air Quality Impact Mitigation*

Mitigative measures for air quality would be the same as those for Alternative 2. Water or other chemical wetting agents and cover materials would be used to reduce atmospheric entrainment of fugitive dust particles. Equipment would be properly operated and maintained to minimize associated air quality impacts.

— *Wetlands Impact Mitigation*

Mitigative measures for the Tonawanda site wetlands would be the same as those of Alternative 2. Proper engineering controls would be instituted to mitigate potential disturbances to the surrounding area and restore the wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions.

— *Community Issues Impact Mitigation*

Community issues would be mitigated by implementation of a well-planned public information and community relations program, that maintains frequent informal and formal contact with affected residents and officials. Community members should have access to complete, balanced information about the components of the action and how containment would be achieved for inaccessible soils through technological and institutional controls. Formal institutional agreements may be required to ensure timely completion of the alternative. Short-term impacts of demolition and transportation activities would be mitigated through coordination and consultation with local officials concerning hours of operation, routes, and local ordinances. Additional compensation may be required to offset local commitment of community resources for such purposes as traffic control, sanitation services, and enforcement of ordinances. Additional data on community issues will be incorporated throughout remedial action.

— *Local Transportation Impact Mitigation*

Transportation impacts would be minimized by utilizing the most appropriate haul routes and trip times to reduce traffic congestion, accident potential, and road deterioration. Scheduling of vehicular movements during off-peak traffic hours and provision of turning lanes and other safety measures would also reduce impacts. All local ordinances regarding weight and speed limits would be obeyed, or appropriate waivers or temporary permits acquired.

— *Noise Impact Mitigation*

Noise impacts would be reduced by: (1) limiting noisy activities to daylight hours, (2) selecting the quietest among alternative pieces of equipment, (3) assuring proper maintenance and operation of equipment, and (4) providing enclosures or other barriers if needed.

Short-Term Uses and Long-Term Productivity

Restricting access to certain areas at Linde would prevent potential exposure to contaminants at least over the short-term. Implementation of this alternative greatly reduces the probability of exposure and level of potential exposure. In addition, actions under this alternative significantly reduce the migration of contaminants to surface waters or into groundwater at Ashland 1 and 2. This alternative provides some short-term benefits of protection of human health and the environment by reducing exposures, but results in reduced long-term productivity of the site because of restricted future use.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e., water quality, air quality), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas of concern where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.4.5 Reduction in Mobility, Toxicity, and Volume Through Treatment

As for all alternatives, mobility, toxicity, or volume of contaminated soil is not reduced through treatment.

5.3.4.6 Implementability

This alternative is implementable and represents the most commonly used method for handling radioactive waste. It would probably be the fastest to implement. Waste acceptance and capacity restrictions imposed by the offsite disposal facility are the only limiting factors. Documentation to transport and dispose of the excavated soil and building debris is required.

5.3.4.7 Cost

This alternative includes excavation and bulk removal of accessible contaminated soils and offsite disposal. Disposal costs are based on the transportation (by truck) and permanent disposal of 257,260 m^3 (336,470 yd^3) of contaminated waste materials at the New York FUSRAP facility. Rail transportation would be used if an out-of-state facility is selected as the disposal option. Costs associated with the other disposal options for this alternative are presented in Appendix G.

The total capital cost for this alternative is estimated to be \$73M. Annual O&M cost associated with environmental monitoring at the Tonawanda site for three 1-year periods is estimated to be \$139,650. With a 0% discount rate, the 30-year present worth cost for this alternative is an estimated \$79.4M. Additional costing information pertaining to the various transportation and disposal options is provided in Appendix G.

5.3.5 Alternative 5 — Partial Excavation and Onsite Disposal

Alternative 5 involves excavation of accessible contaminated soils and onsite disposal. Figure 5-1 indicated three possible locations with the estimated configurations and sizes for the onsite disposal cell on Ashland 1, Ashland 2, and Seaway properties. (These three possible locations, configurations, and sizes are intended only to show the feasibility of onsite disposal. The actual location and configuration within each of these options would be determined, in part, based on final engineering design considerations.) Figure 5-2 indicated a typical section of the waste containment structure. Impacts associated with the three possible areas will be discussed for this alternative.

5.3.5.1 Overall Protection of Human Health and the Environment

This alternative would be moderately protective of human health and the environment. Most (over 90%) of the contaminated soil would be removed. The level of potential exposure would be reduced by implementing this alternative. In addition, actions under this alternative would significantly reduce the migration of contaminants to surface waters or into groundwater.

5.3.5.2 Compliance with ARARs

Partial excavation leaves in place difficult-to-access soils that are above DOE guidelines for residual radioactivity. The contaminated soils left in place would not be expected to exceed pertinent regulations concerning acceptable levels. Regulations under UMTRCA call for control measures to be effective for up to 1000 years and at least for 200 years. This alternative would not meet DOE guidelines for residual radioactivity for sites released for unrestricted use. Subsurface levels of thorium and its daughter products would, in "access-restricted" locations, remain above the guideline of 15 pCi/g. Restricted access to Linde and Seaway would keep exposures to radioactive contaminants to the public within limits of DOE guidelines.

If soils are kept moist during excavation of accessible soils, airborne radioactive contaminants would remain within pertinent regulatory limits. Radiation exposure standards for occupational workers would be met by monitoring during excavation, treatment, and disposal. In addition, OSHA requirements for worker health and safety would be met during these actions.

5.3.5.3 Long-Term Effectiveness and Permanence

Residual risk to human health results from the inaccessible contaminated soils that remain unexcavated at the site and the risk associated with disposal and maintenance of accessible soils onsite. Because unexcavated contaminated materials are buried under the landfill, exposure pathways from this source are eliminated. Containment of all accessible contaminated soils in the potential onsite encapsulation facility at Ashland 1, Seaway, or Ashland 2 would protect human health provided the facility remained intact and controlled. Residual risk to an employee monitoring the site is $<1 \times 10^{-9}$. (See Appendix I for Human Health Risk Assessment Methodology.)

Because contaminated soils remain in place and untreated on the site, access controls would be necessary to minimize exposure. In addition, long-term monitoring of appropriate media plus a review at least every 5 years would be required to ensure that the remedy continues to adequately protect human health and the environment.

Excavation of the accessible contaminated soils would reduce, but not eliminate the need for long-term management, monitoring, maintenance, and replacement directly associated with these remedial activities. Remaining or residual contaminants would require long-term management and possible future remedial actions. Problems could arise when the existing building overlying the remaining contaminated area at Linde is modified or demolished or if excavation of the Seaway Landfill should occur; however, there is a moderate degree of confidence that institutional controls can adequately handle these potential problems. Onsite disposal at a permitted facility places the responsibility of long-term management, monitoring, and O&M with the onsite facility owner, DOE, which is expected to have adequate and reliable controls.

Irreversible and Irretrievable Commitment of Resources

Implementing Alternative 5 will result in the permanent commitment of land at the Tonawanda site for waste disposal. This commitment of land for the disposal facility is consistent with current land use at the site. The Tonawanda site is a contaminated industrial complex that contains wastes from past disposal practices.

The disposal cell proper is expected to cover about 17.5 acres, but the total amount of committed land would be larger because a buffer zone will be established around the cell. No other area of the Tonawanda site would sustain a long-term impact or injury as a result of this alternative. Perpetual care will be taken of the committed land because the waste would retain its low level radioactivity for thousands of years. For example, the cover will be visually inspected, groundwater will be monitored, and the effectiveness of the overall system at the Tonawanda site will be reviewed at least every 5 years.

Consumptive use of geological resources (e.g., quarried rock, sand, and gravel) and petroleum products (e.g., diesel fuel and gasoline) will be required for the removal, construction, and disposal activities. Adequate supplies of these materials are readily available in the Tonawanda area. To minimize transportation impacts, every effort will be made to locate borrow areas near the site. Implementing Alternative 5 is not constrained by the availability of resources or supplies beyond those currently available in the Buffalo, NY area.

5.3.5.4 Short-Term Effectiveness and Environmental Impacts

Excavation, bulk removal, and onsite disposal would be completed in approximately 3 years. However, to site, study, design, and construct the onsite disposal facility may take 3-5 years to implement. This time estimate includes the time required to implement all activities associated with this alternative. Remedial response objectives would be achieved upon receipt of contaminated materials by the permanent disposal facility.

Community Protection

Activities for this alternative could temporarily increase fugitive dust. Annual airborne radiological risk (deaths per year due to cancer) and risk to the maximally exposed individual would be 5×10^{-9}. Contaminated soils would be kept moist during excavation and handling in order to prevent release of radioactively contaminated dust. Dust control measures would also limit the release of particulate matter during transport and application of clean backfill. These measures would mitigate the slight potential for an increase in risk to the community.

Worker Protection

Short-term health risks to remediation workers arising from implementation of this alternative would be based on the same principles described in Alternative 4. The only variation would be due to the time required to complete the action. Worker dose and occupational risks are the same as calculated for Alternative 4. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, and restrictions on access to contaminated areas. In addition, all machinery and equipment would be inspected after use, surveyed for radioactive contamination, and decontaminated if necessary.

A remediation worker engaged in excavation during implementation of the alternative may receive a radiological exposure dose of 500 mrem. The potential risk of development of cancer during the lifetime of the worker, as a result of that exposure, is 2×10^{-4}. The probability of a cancer occurring over the course of a worker's lifetime as a result of exposure to chemical carcinogens during a 1-year remedial action period is 2×10^{-5}. The noncarcinogenic Hazard Index was estimated as 2.6. The occupational risk associated with construction type work during this alternative is estimated as 2×10^{-3} fatal injuries.

Transportation

Transport of radioactively contaminated materials to the onsite disposal facility would strictly comply with all applicable state and federal regulations. As required, predesignated routes would be traveled and an emergency response program would be developed to respond to any accidents. (See Appendix I for the Human Health Risk Assessment Methodology.)

Partial excavation and onsite disposal of waste at Tonawanda would limit offsite non-radiological transportation risk to that involved with trucking waste from Linde to the onsite disposal cell, with hauling asphalt and fill material to the site for restoration, and with hauling materials to the site for construction of the disposal cell. The risk (expressed in probability of an offsite fatal accident) for this alternative is estimated to be 0.18. See Appendix I for the methodology used to determine the offsite transportation risks.

Environmental Impacts

— *Geology and Soils*

Impacts of this alternative would be the same as those of Alternative 4 except for the impact that would occur during the construction of an onsite disposal facility. The facility would not be as large as that needed under Alternative 3 because of the smaller volume of material produced by partial excavation. A disposal cell on Ashland 1 would cover 11 ha (27.2 acres), while a cell sited within Ashland 2 would require an estimated 6.3 ha (15.5 acres). This would, in turn, reduce the area required for the disposal facility. The potential would exist for contamination of underlying soils in the event of loss of integrity of the facility's containment device. Erosion of contaminated soils disturbed during excavation could cause adverse environmental impacts, but these would be mitigated by proper erosion controls. No additional impacts would result from siting a disposal cell on the Seaway property. It is estimated that 17,180 truckloads of clean fill will be required for restoration of the site and 21,683 truckloads of borrow material (backfill, sand, clay, gravel, etc.) will be required to construct, operate, and close an onsite disposal facility under this alternative.

— *Water Quality*

Impacts on surface water quality for sitewide Alternative 5 would be the same as those listed for sitewide Alternative 4. The onsite disposal location would, like the offsite disposal location, be designed and sited in compliance with all applicable laws and regulations concerning surface water standards. Therefore, no degradation of surface water quality is expected at the onsite disposal location.

— *Air Quality*

The impact on air quality at the Tonawanda site and vicinity would be similar to that of Alternative 2. Remedial activities would produce fugitive dust and internal combustion engine emissions which would result in the release of material to the atmosphere. The construction of an onsite designed land encapsulation facility would contribute additional releases of material. Airborne emissions that would result from remedial activities are expected to be relatively low and significant impacts to human health or the environment would not be anticipated.

— *Ecological Resources*

Biota. Except for the development of the onsite disposal area, the impacts would be the same as those discussed for Alternative 4. The impacts associated with the development of an onsite disposal facility in Alternative 3 would also result from this alternative, except that the facility would not be as large because of the smaller volume of material produced by partial excavation. The estimated size of a disposal cell on Ashland 2 is 11 ha (27.2 acres), and 6.3 ha (15.5 acres) on Ashland 2. This would reduce the area impacted by construction and operation of the facility.

Threatened and Endangered Species. No impacts to any state or federally-listed species have been identified as resulting from the implementation of this alternative.

Wetlands. Impacts to the low lying and wetland areas along Rattlesnake Creek and the northeast corner of the Linde property would be the same as those of Alternative 2. Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (Figure 2-7) would impact approximately 0.32 ha (0.80 acres) of the associated area. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek wetland area. The removal would also result in the loss of the affected low lying areas' and wetlands' hydrogeologic, hydrologic, soil, and biological characteristics. Construction of an onsite disposal facility at Ashland 2 would potentially eliminate the 0.09 ha (0.24 acres) Wetland H identified on Figure 2-9. No wetlands would be involved at the possible Ashland 1 and Seaway properties. There are no anticipated impacts from flooding on the site because the site is located above the 500 year flood elevation.

— *Archaeological, Cultural and Historical Resources*

This alternative would not affect archaeological, cultural, or historic resources because none is present on the Tonawanda site.

— *Land Use and Recreational/Aesthetic Resources*

Short-term impacts to land use include the inconvenience and cost of removing contaminated material, additional trucks using roads to transport the contaminated material to an onsite land encapsulation facility, and temporary inconveniences and aesthetic impacts associated with diverting Rattlesnake Creek and restoring wetlands.

This alternative would allow for any future reuse of the Ashland 1 and 2 properties (not utilized for the onsite cell) that conforms to the regulations stated in the current Town of

Tonawanda zoning ordinance. The properties of Linde and Seaway would still have inaccessible soils, so a deed restriction would be necessary to assure future reuse of properties does not pose a health risk. Land uses at Linde and Seaway are expected to continue into the future.

This alternative, however, would have implications to two draft revitalization plans (New York State Department of State Coastal Management Program 1991; Ernst and Young 1992) for the waterfront area. Each plan notes that a priority in revitalizing the area is the remediation of radioactive and hazardous waste sites. This alternative would not achieve the desired full remediation. The *Local Waterfront Revitalization Program* specifically states that the development of a disposal site on the Ashland property would result in a variety of negative impacts similar to those caused by any BFI expansion (New York State Department of State Coastal Management Program 1991). In general, the plans call for residential areas and commercial businesses to be located near the waterfront and River Road with light industries in the back half of the planning area.

DOE may have to purchase, at fair market value, or to receive a land donation of a portion or all of the Ashland 1 or 2 or Seaway properties to construct an onsite land encapsulation facility. A zoning variance and a building permit from the Town of Tonawanda could be required for building the land encapsulation facility. The land used for the land encapsulation facility could not be reused in the future unless it is remediated, and no property taxes would be paid because the federal government is not required to pay property taxes on lands it owns.

— *Socioeconomic and Institutional Issues*

Community Issues. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some residential development near the Ashland 2 property around River Road. This alternative would conflict with the community's plans if the disposal facility is located on Ashland 2 property. Location of the facility on Ashland 1 or Seaway property would not conflict with the community's future development plan.

Demolition of structures and truck traffic would create short-term impacts in the form of annoyance, inconvenience, and disruption of activities in nearby residential areas and businesses. DOE would coordinate with local officials of the Town and the Holmes School to minimize disruptions to the extent possible. Also, coordination between DOE and management of Linde Center and BFI would minimize impacts on workers and operations.

Institutional Considerations. If acquisition of property at Ashland 2 or Seaway is required for construction of a land encapsulation facility, the Town of Tonawanda would experience loss of revenues from property tax. Remedial activities may coincide with some waterfront development activities such as the River Road realignment. Coordination and consultation between DOE and local officials would be undertaken to keep the local community and State updated on progress of the remedial action and to avoid unnecessary inconveniences to local residents, businesses, and resources.

Public Services. Public utilities in the area are adequate to accommodate remedial activities and the construction and operation of an onsite disposal facility. Emergency services in the area are adequate to respond to an incident or accident involving radioactive materials. DOE would coordinate with the New York State Department of Health and the Town of Tonawanda to ensure that emergency response channels and facilities are appropriate for the maximum credible emergency that may occur on the site.

Economic and Demographic Resources. It is assumed that Alternative 5 would require the employment of 50.8 workers for the first three years of remediation. Assuming that 33.8 constructions workers would earn $43,000 per year and the other 17 employees would earn $35,000 per year, the annual dollar value of payrolls directly attributable to the cleanup effort would be $2.0M. Capital costs are estimated to be $17.3M per year; annual O&M expenses are estimated at $340,000/year for the first three years, $200,000/year thereafter. Using the RIMS II model to calculate the indirect employment resulting for these expenditures (see Appendix H), it is estimated that Alternative 5 would result in an additional 67.8 jobs in the first year of activity, for a total employment impact of 113.6 jobs. The 1989 value for total personnel employed in Erie and Niagara Counties was 625,889; therefore, expected employment is estimated to account for 0.02% of total employment in the region. The employment impact is such a small share of the total in the region that it can be accommodated through normal growth in employment. For example, total employment in Erie and Niagara Counties grew at an average annual compound growth rate of 2.4% between 1985 and 1989.

It is anticipated that much of the employment taking place during the three years of remediation under Alternative 5 would utilize resources already available in the region and that there would not be a large impact on housing and population. In order to estimate the upper bound on impacts to housing and population, calculations were made assuming that employment would be filled by persons new to the region. Under this assumption, it is estimated that the number of households associated with the employment would be 89. The estimated upper bound on population affected by the action is estimated to be 215. Since the upper bound of possible impacts is so small relative to the total region, this action would not have a substantial impact on economic and demographic resources.

It is estimated that there would be continued monitoring of the Tonawanda site for 30 years after the partial excavation of the properties. This activity would require 0.3 workers for sampling and lab analysis. It is estimated that this employment would result in payrolls of $10,500. An additional $189,300 is expected to be required for operations and maintenance activities associated with the disposal cell, of which 0.5% is assumed to be spent with industries based within the region. The balance of the expenditures are expected to go to contractors based outside the local area. Using these assumptions, there is expected to be indirect employment of 0.5 workers, with no associated growth in households or population.

<u>Local Transportation Impacts</u>. The impacts on transportation would be similar to those for Alternative 2, mainly an increase in average daily traffic volumes and potential road deterioration.

Transportation of an estimated 2,850 m^3 (3,730 yd^3) of replacement pavement to Linde would require 233 loads. Transportation of approximately 55,900 m^3 (73,110 yd^3) of contaminated material from Linde to the potential onsite disposal facility at Ashland 1, Seaway, or Ashland 2 would require 4,569 loads. Transportation of a computed 493,000 m^3 (644,800 yd^3) of clean fill and loam material, from a borrow site to the Tonawanda site for site restoration and construction of the disposal facility, would require 38,863 loads.

<u>Noise Impacts</u>. Noise impacts at the Tonawanda site would be similar to those for Alternative 2. Sound waves would be of the intermittent or impulse type as opposed to the steady-state type of sound generation. Receptor populations include wildlife, as well as humans, in the vicinity of the Tonawanda site. Noise levels generated during remedial activities would not affect hearing or pose any occupational health hazards. The closest sensitive receptors to Linde would experience an increase of 6-8 dB above background L_{dn} for the duration of remedial activities (approximately 100 work weeks over a 3-5 year period). Approximately 15% of the affected population would experience increased annoyance. Noise levels generated at the Ashland-Seaway properties would approach background levels at the closest residences; thus, no noise impacts are anticipated.

Unavoidable Adverse Impacts

Under this alternative, the unavoidable adverse impacts have been identified above.

Mitigative Measures

— *Air Quality Impact Mitigation*

Mitigative measures for air quality would be the same as those for Alternative 2. Water or other chemical wetting agents and cover materials would be used to reduce atmospheric entrainment of fugitive dust particles. Equipment would be properly operated and maintained so that maximum work is obtained with as infrequent operation of equipment as possible.

— *Wetlands Impact Mitigation*

Mitigative measures for the Tonawanda site wetlands would be the same as those for Alternative 2. Proper engineering controls would be instituted to mitigate potential disturbances to the surrounding area and restore the wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions.

— *Community Issues Impact Mitigation*

Community issues would be mitigated by a well-planned public information and community relations program to ensure that community members are well-informed about the various steps in the alternative and progress being made toward completion of the action. Short-term impacts associated with demolition and transportation activities may be mitigated through coordination with local officials on hours of operation, routes, and local ordinances. Any financial losses to the Town of Tonawanda incurred due to property acquisition for the land encapsulation facility would be appropriately compensated. Additional compensation may be required to offset local commitment of community resources for such purposes as traffic control, sanitation services, enforcement of ordinances, or local monitoring of the onsite disposal facility. Additional data on community concerns would be incorporated throughout the FS-EIS process.

— *Local Transportation Impact Mitigation*

Transportation impacts would be minimized by utilizing the most appropriate haul routes and trip times to reduce traffic congestion, accident potential, and road deterioration. Scheduling of vehicle movements during off-peak traffic hours and provision of turning lanes and other safety measures would also reduce impacts. All local ordinances regarding weight and speed limits would be obeyed, or appropriate waivers or temporary permits acquired.

— *Noise Impact Mitigation*

Noise impacts would be reduced by: (1) limiting noisy activities to daylight hours, (2) selecting the quietest among alternative pieces of equipment, (3) assuring proper maintenance and operation of equipment, and (4) providing enclosures or other barriers if needed.

Short-Term Uses and Long-Term Productivity

Restricting access to certain areas at Linde where contamination remains in place would prevent potential exposure to contaminants at least over the short term. Implementation of this alternative greatly reduces the probability of exposure and level of potential exposure. In addition, actions under this alternative significantly reduce the migration of contaminants to surface waters or into groundwater at Ashland 1 and 2. This alternative provides some short-term benefits of protection of human health and the environment by reducing exposures but results in reduced long-term productivity of the site because of restricted future use.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e., water quality, air quality, etc.), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.5.5 Reduction in Mobility, Toxicity, and Volume Through Treatment

No treatment is applied to reduce mobility, toxicity, or volume of contaminants.

5.3.5.6 Implementability

This alternative is implementable. The required excavation equipment is available commercially to construct onsite disposal facilities which would be designed to accept untreated low-level radioactive waste. Permits to store, transport, and dispose of the excavated soil onsite may be required.

5.3.5.7 Cost

This alternative includes partial excavation of contaminated soil and onsite disposal. The total capital cost is estimated to be $52M.

Annual O&M cost is estimated to be $340,000/year for the first three years, $200,000/year thereafter. With a 0% discount rate, the 30-year present worth cost is estimated to be $58.6M.

5.3.6 Alternative 6 — Containment and Institutional Controls

Alternative 6, a containment response action, involves capping the contaminated soil areas at Ashland 1 and 2 and the waste piles at Linde and Seaway. The "access-restricted" soils at Linde and Seaway would be left in place. Approximately 39 m^3 (50 yds^3) of contaminated sediments within the storm lines and sumps would be removed at Linde. Approximately 126 m^3 (165 yd^3) of contaminated sediments within the wetlands at the northeast corner of Linde would be removed and the wetlands restored. Surface water would be diverted at Rattlesnake Creek and associated drainage ditches to access and remove contaminated sediments. Disturbed wetland areas would be restored. Sediments removed would be incorporated into the capped areas. Surface sealants would be sprayed on all buildings at Linde to contain radioactive surface contamination.

5.3.6.1 Overall Protection of Human Health and the Environment

This alternative would be somewhat protective of human health and the environment. Covering the contaminated areas would reduce the risk to human health by minimizing exposure pathways of direct contact with and ingestion or inhalation of contaminated particles. The soil cover and surface sealants would minimize the mobility of contaminants to groundwater, surface water, and air. Institutional controls, including access restrictions, would further minimize potential human exposure through the above mentioned pathways.

5.3.6.2 Compliance with ARARs

This alternative controls exposure to contaminated soil and solid waste by a combination of (a) capping contaminated soil areas, (b) sealing contaminated building surface areas, and (c) restricting access to the site. Landfill closure requirements do not apply to this alternative because the actions do not involve disposal of RCRA hazardous waste; however, certain landfill closure requirements would be followed to ensure that no rainwater infiltrates the contaminated soils. Applicable regulations for airborne radioactive contaminant levels would be met.

Certain regulations under UMTRCA are considered ARARs for the Tonawanda site. The UMTRCA regulations call for control measures to be effective for at least 200 years and up to 1,000 years. Buildings that would remain in place are not expected to be effective for surface containment for 200 years. Thus, Alternative 6 does not meet this ARAR and a waiver would be required. Monitoring requirements of UMTRCA are met by the current annual monitoring. This alternative does not meet DOE guidelines for residual radioactivity for sites released for unrestricted use; therefore, a waiver or imposition of supplemental standard would be required. Subsurface levels of thorium and its decay products would remain above the guideline of 15 pCi/g. Covering contaminated surfaces and restricting access would keep exposures to the public within limits of DOE guidelines.

5.3.6.3 Long-Term Effectiveness and Permanence

The entire volume of contaminated soil and contaminated buildings remains in place, including the waste piles at Linde and Seaway. The contaminated soils are, however, covered so that pathways of exposure are blocked and, therefore, residual risks are reduced. Because the contaminated soil would remain onsite and in place, long-term monitoring, maintenance, and control are required for this alternative. In addition, a review would be conducted at least every 5 years to ensure that the remedy continues to adequately protect human health and the environment.

Containment in the form of a cap for the soil contaminants or surface sealants for buildings is effective in reducing the risk of exposure to contaminants by eliminating the exposure pathway and should remain completely effective for a long period of time. Institutional control measures are intended to ensure that the integrity of the containment layer is maintained. However, despite institutional controls to help ensure the integrity of the cap or seal, human activities, such as construction on the site, could breach the integrity of the cap or seal. In addition, natural forces such as wind and rain could eventually erode the cover or surface seals and expose the contaminants. Although these events are unlikely in the near future, long-term maintenance and possible replacement would be required for the cap/covering to remain effective. Repairs could be instituted relatively easily. The magnitude of the risk associated with replacement of the cap or seal is potentially greater than the risk associated with the first time installation because of the potential for disturbing covered contaminant material. This alternative would maintain a moderate degree of long-term effectiveness and permanence.

Long-term residual risk associated with implementation of the containment alternative would be associated with contaminated materials remaining at the site. Residual radiological risk to an employee monitoring the site is estimated to be $<1 \times 10^{-9}$. Containment would be effective in reducing the risk of exposure by eliminating the exposure pathway. Ongoing institutional control measures would ensure that the integrity of the containment layer is maintained.

Irreversible and Irretrievable Commitment of Resources

This alternative would commit an area the size of the restricted area in Alternative 1 to limited use for an extended period of time (>200 years). This commitment could be withdrawn later if conditions warranted that the waste needed to be moved to another location offsite.

5.3.6.4 Short-Term Effectiveness and Environmental Impacts

Implementation would not increase significant adverse environmental impacts. Estimated time to complete the remedial activities is 16 weeks (approximately 4 months). The time required to permit and prepare final design plans is estimated to be 2 years. Short-term remedial response objectives are achieved upon completion of actions.

Community Protection

Containment and institutional controls reduce the potential for direct human contact with contaminated surface soils and contaminated surfaces in buildings and minimize contaminant migration to the air and to surface waters. Fugitive dust production would temporarily increase during transportation and application of backfill soil, but contaminated soils would remain undisturbed. Annual airborne radiological risk (deaths per year due to cancer) and risk to the maximally exposed individual would be 1×10^{-10}. Spray sealants would be applied to all building surfaces to minimize fugitive dust production. The particulate emissions would be controlled with dust control technologies (e.g., water or foam sprays). Workers would require protection against dermal contact with and inhalation of contaminated dust.

Containment in the form of a cap for the soil contaminants or surface sealants for buildings is effective in reducing the risk of exposure to contaminants by eliminating the exposure pathway. Institutional control measures are intended to ensure that the integrity of the containment layer is maintained. However, construction on the site could breach the integrity of the cap or seal. This alternative would maintain a moderate degree of short-term effectiveness and permanence.

Worker Protection

The nonradiological hazards associated with implementation of this alternative would be similar to those encountered in any large earth-moving project. These activities could potentially result in accidents causing injury to workers. An estimation of the risk associated with these activities would be based on the number of labor-hours required for construction activities, including site development, capping and removal of radioactive sediments from Rattlesnake Creek. The occupational risk of worker fatality is 3×10^{-4}.

Occupational radiation doses to workers involved in implementation of Alternative 6 were determined using the information described in Appendix I. Exposure doses would be due to direct exposure to gamma radiation from contaminated soil and doses from inhalation and ingestion of airborne contaminated particulates during construction activities. The maximally-exposed individual is assumed to be a worker involved in excavation activities which require the placement of an earthen cover or a multilayer cap on top of contaminated areas. Because Alternative 6 does not require excavation of contaminated wastes, the effective dose and the associated risk would be less than similar alternatives requiring excavation. The carcinogenic and noncarcinogenic Hazard Indices resulting from implementation of this alternative are similarly less than the estimates for the other alternatives. (See Appendix I for the Human Health Risk Assessment Methodology.)

Transportation

Capping of waste at Tonawanda would limit offsite non-radiological transportation risk to that involved with hauling materials to the site for construction of the cap. The risk (expressed in probability of an offsite fatal accident) for this alternative is estimated to be 0.04. See Appendix I for the methodology used to assess the offsite transportation risk.

Environmental Impacts

— *Geology and Soils*

Containment methodologies for this alternative would require the removal of sediments from Rattlesnake Creek and associated drainage ditches and wetlands, creating some disturbance of the soil profile in these areas. The total area estimated for excavation is 0.52 ha (1.3 acres). As the creek would most likely be diverted for excavation of its streambed sediments and low lying area soils, a temporary change in creek grade should not affect soils on either upstream or downstream properties. Ponding of water in excavated areas could be expected and would have to be dealt with during excavation and restoration. The physical characteristics of the diversion channel, including its grade, should be designed and constructed to minimize any problems that might be created. Geologic impacts would not be anticipated unless excavation allows water entry into the underlying shale. Material removed during this activity would be incorporated into the capped areas on the Ashland 2 property. All contaminated sediments would, therefore, remain on the property, with some slight potential for future release or migration.

— *Water Quality*

Under Alternative 6, surface water would be continually monitored to ensure there is no degradation of water quality from any runoff from storage sites on the Tonawanda site. The storage sites would be designed and sited in compliance with all applicable laws and regulations concerning surface water standards. Therefore, no degradation of surface water quality is expected to result from containment.

— *Air Quality*

The impact to air quality at the Tonawanda site and vicinity would be similar to that of Alternative 2. Remedial activities would produce fugitive dust and internal combustion engine emissions which would result in releases of material to the atmosphere. These emissions are expected to be relatively low and significant impacts to human health or the environment would not be anticipated.

— *Ecological Resources*

Biota. The capping of the soils on the Linde property would eliminate all vegetation currently growing on those portions of the site. An estimated 0.52 ha (1.3 acres) of vegetation would be destroyed during the removal of sediments from the Ashland 2 property, resulting in a loss of habitat to animals inhabiting the property. Complete loss of biotic resources would also occur in the area selected for placement and capping of soils and sediments removed from the Linde and Ashland 2 properties. Areas not directly impacted by excavation activities would be affected to a slight degree by various impacts associated with remedial activities. This area could approach 11.3 ha (28 acres) in size. Aquatic resources within Rattlesnake Creek would be severely impacted if not totally eliminated by the diversion of water from the stream channel and the subsequent removal of sediments from an estimated 200 m (610 ft) of the streambed. A gradual recovery of these communities could be expected after remedial activities are concluded.

Threatened and Endangered Species. No impacts to any state or federally-listed species have been identified as resulting from the implementation of this alternative.

Wetlands. Impacts to the low lying and wetland areas along Rattlesnake Creek and the northeast corner of the Linde property would be the same as those of Alternative 2. Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (Figure 2-7) would impact approximately 0.32 ha (0.80 acres) of the associated areas. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek Wetland area. The removal would also result in the loss of the affected area's and wetlands' hydrogeologic, hydrologic, soil, and biological characteristics.

— *Archaeological, Cultural, and Historical Resources*

This alternative would not affect archaeological, cultural, or historic resources because none are present on the Tonawanda site.

— *Land Use and Recreational/Aesthetic Resources*

Short-term impacts include diverting Rattlesnake Creek, then removing radioactive sediments and including the contaminated material in the capped area of Ashland 2. Another short-term impact involves the inconvenience of placing the capping onsite. The removal of sediments and the capping would temporarily impact the aesthetics of the area, but vegetation would eventually come back. The installation of slurry walls and in situ grouting for horizontal barriers for groundwater would also be a short-term impact.

Deed restrictions would be placed on all involved properties, limiting future reuse. This alternative, however, would have implications to two draft revitalization plans (New York State Department of State Coastal Management Program 1991; Ernst and Young 1992) for the waterfront area. Each plan notes that a priority in revitalizing the area is the remediation of radioactive and hazardous waste sites. Capping the sites and placing institutional controls would limit the type and amount of future development. Adjustments would have to be made to the proposed land use sections of the plans in order to avoid the capped areas. The knowledge that there would be capped radioactive areas may also hinder future development plans for the area.

— *Socioeconomic and Institutional Issues*

Community Issues. The Town of Tonawanda has developed plans to revitalize the River Road area bordering the Ashland 1, Seaway, and Ashland 2 properties (Ernst and Young 1992). Plans call for commercial and light industrial development of most of the properties with some residential development near the Ashland 2 property around River Road. Containment of the waste would involve leaving most of the waste on the properties involved in the River Road development plans, thereby creating a conflict with the community's plans.

Institutional Considerations. This alternative would result in adverse impacts on the institutional environment if capped areas are perceived as too close to the proposed residential area west of the realigned River Road. This alternative would hinder waterfront redevelopment efforts, which are a primary institutional issue, and possibly generate renewed institutional conflict.

Public Services. Public utilities in the area are adequate to accommodate remedial activities required for this alternative. Emergency services in the area are adequate to respond to an incident or accident involving radioactive materials. DOE would coordinate with the New

York State Department of Health, Erie County, and the Town of Tonawanda to ensure that emergency response channels and facilities are appropriate for the maximum credible emergency that may occur on the site.

Economic and Demographic Resources. It is assumed that Alternative 6 would require the employment of 13.2 full-time equivalent workers in the first year. Expenditures for O&M activities would require 0.5 sampling lab technicians. The dollar value of payrolls directly attributable to the cleanup effort would be $513,200. Total capital expenditures are estimated to be $10.1M; O&M expenses are estimated to be $214,650. Using the RIMS II model to calculate the indirect employment resulting from these expenditures (see Appendix H), it is estimated that Alternative 6 would result in an additional 28.5 jobs, for a total employment impact of 41.7 jobs. The 1989 value for total personnel employed in Erie and Niagara Counties was 625,889; therefore, expected employment is estimated to account for 0.01% of total employment in the region. The employment impact is such a small share of the total in the region that it can be accommodated through normal growth in employment. For example, total employment in Erie and Niagara Counties grew at an average annual compound growth rate of 2.4% between 1985 and 1989.

It is anticipated that much of the employment taking place during the remediation under Alternative 6 would utilize resources already available in the region and that there would not be a large impact on housing and population. In order to estimate the upper bound on impacts to housing and population, calculations were made assuming that employment would be filled by persons new to the region. Under this assumption, it is estimated that the number of households associated with the employment would be 31. The estimated upper bound on population affected by the action is estimated to be 75. Since the upper bound of possible impacts is so small relative to the total region, this action would not have a substantial impact on economic and demographic resources.

It is estimated that there would be continued monitoring of the Tonawanda site for 30 years after the implementation of containment at each of the properties. This activity would require 0.5 workers for sampling and lab analysis. It is estimated that this employment would result in payrolls of $17,500. An additional $197,150 is expected to be required for operations and maintenance activities, of which 0.5% is assumed to be spent with industries based within the region. The balance of the expenditures are expected to go to contractors based outside the local area. Using these assumptions, there is expected to be indirect employment of 0.3 workers, with the associated growth in households estimated to be one and the increase in population estimated at two.

Local Transportation Impacts. The impacts on transportation would be similar to those for Alternative 2, mainly an increase in average daily traffic volumes and potential road deterioration.

Transportation of a computed 99,750 m^3 (130,460 yd^3) of clean fill, clay, and loam material, from a borrow site to the Tonawanda site, would require 8,153 loads.

Noise Impacts. Noise impacts at the Tonawanda site would be similar to those for Alternative 2. Sound waves would be of the intermittent or impulse type as opposed to the steady-state type of sound generation. Receptor populations include wildlife, as well as humans, in the vicinity of the Tonawanda site. Noise levels generated during remedial activities would not affect hearing nor pose any occupational health hazards. The closest sensitive receptors to Linde would experience an increase of 6-8 dB above background L_{dn} for the duration of remedial activities (approximately 32 work weeks). Approximately 15% of the affected population would experience increased annoyance. Noise levels generated at the Ashland-Seaway properties would approach background levels at the closest residences; thus, no noise impacts are anticipated.

Unavoidable Adverse Impacts

Under this alternative, the unavoidable adverse impacts have been identified above.

Mitigative Measures

— *Air Quality Impact Mitigation*

Mitigative measures for air quality would be the same as those for Alternative 2. Water or other chemical wetting agents and cover materials would be used to reduce atmospheric entrainment of fugitive dust particles. Equipment would be properly operated and maintained to minimize associated impacts on air quality.

— *Wetlands Impact Mitigation*

Mitigative measures for the Tonawanda site wetlands would be the same as those for Alternative 2. Proper engineering controls would be instituted to mitigate potential disturbances to the surrounding area and restore the wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions.

— *Community Issues Impact Mitigation*

Mitigative measures required for this alternative require a well-planned community relations and public information program to keep community members informed and to address public concerns about long-term health risks. Coordination and formal agreements with local officials may be necessary to mitigate institutional impacts associated with restrictions on land uses.

— *Local Transportation Impact Mitigation*

Transportation impacts would be minimized by utilizing the most appropriate haul routes and trip times to reduce traffic congestion, accident potential, and road deterioration. Scheduling of vehicle movements during off-peak traffic hours and provision of turning lanes and other safety measures would also reduce impacts. All local ordinances regarding weight and speed limits would be obeyed or appropriate waivers or temporary permits acquired.

— *Noise Impact Mitigation*

Noise impacts would be reduced by: (1) limiting noisy activities to daylight hours, (2) selecting the quietest among alternative pieces of equipment, (3) properly maintaining and operating equipment, and (4) providing enclosures or other barriers if needed.

Short-Term Uses and Long-Term Productivity

Restricting access to areas where contamination remains in place would prevent potential exposure to contaminants. In addition, actions under this alternative significantly reduce the migration of contaminants to surface waters or into groundwater. This alternative provides the benefits of protection of human health and the environment by reducing exposures, but results in reduced long-term productivity of the site because of restricted future use.

Cumulative Impacts

It has been determined that there are no significant cumulative impacts to the environment that would occur if this alternative were implemented. Both short-term and long-term effects were considered with respect to their additive contribution to the total impacts that would occur simultaneously with other non-FUSRAP related activities. Possible effects from all areas of investigation (i.e., water quality, air quality), as documented in this section, indicate that potential impacts from this alternative are low enough so that the total additive contribution on a local and regional basis would be minor. This is based on the fact that in areas of concern where this alternative would have an effect, the general level of environmental quality, as documented in Section 2, is considered relatively good, and capable of absorbing with little effect the minor impacts associated with this alternative.

5.3.6.5 Reduction in Mobility, Toxicity, and Volume Through Treatment

Mobility, toxicity, and volume of contaminated soils are not reduced through treatment.

5.3.6.6 Implementability

This alternative is considered implementable. The response actions used, soil covering and capping, are technologies well known for their ease of application and high reliability when properly maintained. Institutional controls such as signs, fences, deed restrictions are also easily implemented. The required equipment and materials are readily available commercially. No special permits are required to construct the containment layer.

5.3.6.7 Cost

This alternative includes the installation and maintenance of containment remedial actions along with implementation and maintenance of institutional controls. The total direct cost is $6.7M. Annual O&M costs are estimated to be $214,650. With a 0% discount rate, the 30-year present worth cost for this alternative is estimated at $16.8M. Additional costing information is provided in Appendix G.

5.4 SUMMARY OF INDIVIDUAL ANALYSIS

Table 5-9 summarizes the impacts associated with each of the alternatives. The information is presented by CERCLA criteria and NEPA environmental consequences in the same sequence as the discussion in Section 5.3 to allow the reader to refer back to the full discussion when necessary. The table allows the reader to quickly formulate a concise description of the expected impacts of the project. It does not contain any of the rationale or data found in Section 5.3 that were used in the analysis of the assessment. Impacts were quantified where possible, and secondary impacts were identified where they occurred.

5.5 COMPARATIVE ANALYSIS OF SITEWIDE ALTERNATIVES

5.5.1 Introduction

The purpose of the comparative analysis is to compare the alternatives with each other considering the CERCLA criteria and the NEPA consequences used in the detailed assessment. This procedure is in contrast with the individual examinations, which analyzed each alternative separately and gave little consideration to interrelationships among them. The comparative analysis identifies items that can be evaluated by decision-makers in the final selection. Overall protection and compliance with ARARs are threshold determinants in that they must be met by an alternative for it to be eligible for selection. Next, short-and long-term effectiveness; reduction of toxicity, mobility, and volume; ease of implementation; and costs receive consideration. The NEPA consequences are evaluated with equal consideration.

5.5.2 Overall Protection of Human Health and the Environment

The alternatives involving complete excavation of contaminated soil and removal of contaminated building material, specifically Alternatives 2 and 3, provide the greatest degree of protection because the contaminated materials are removed from the site and permanently isolated in a disposal facility. All potential exposure pathways are minimized by these alternatives, including direct contact with contaminated soil and building materials as well as pathways related to the potential environmental release scenarios. Complete excavation and demolition would remove all contamination above the DOE guidelines. Risk to workers is involved with implementing these alternatives because the associated work involves intrusive

Table 5-9. Summary of Detailed Analysis of Sitewide Alternatives

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
OVERALL PROTECTION						
• Human Health	Not protective	Increased worker exposure; long-term protection almost complete.	Increased worker exposure; long-term protection almost complete.	Increased worker exposure; long-term protection almost complete.	Increased worker exposure; long-term protection almost complete.	Limited worker exposure; decrease long-term in health risk.
• Environment	Not protective	Increased short-term threat to environment; long-term benefits.	Increased short-term threat to environment; long-term benefits.	Increased short-term threat to environment; long-term benefits.	Increased short-term threat to environment; long-term benefits.	Decreased short-term environmental risk. Limited long-term benefits.
COMPLIANCE WITH ARARs						
• Chemical-specific	Not compliant	Compliant	Compliant	Compliant	Compliant	Compliant
• Action-specific	N/A[a]	Compliant	Compliant	Compliant	Compliant	Compliant
• Location-specific	N/A	Compliant	Compliant	Compliant	Compliant	Compliant
• Other	N/A					
• Risk Objectives	Not compliant	Compliant	Compliant	Not compliant without imposing supplemental standards	Not compliant without imposing supplemental standards	Not compliant without imposing supplemental standards

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
LONG-TERM EFFECTIVENESS AND PERMANENCE						
• Magnitude of Remaining Risk	Same as BRA	Below guidelines	Greatly lowered	Lowered	Lowered	Lowered
• Adequacy of Controls	Limited	Adequate	Adequate	Limited	Limited	Limited
• Reliability of Controls	Limited	Reliable	Reliable	Reliable	Reliable	Limited
• Long Term Management at Tonawanda	Necessary	Not necessary	Necessary	Necessary	Necessary	Necessary
• Irreversible and Irretrievable Commitment of Resources	Commitment of land in area of contamination; land use highly restricted.	None	Commitment of land for disposal facility; commitment could later be withdrawn if other actions were taken.	Commitment of contaminated land under refuse; commitment could later be withdrawn if other actions were taken.	Commitment of contaminated land under refuse and disposal facility; commitment could also be withdrawn if other actions were taken.	Commitment of land in area of contamination; land use highly restricted.
SHORT-TERM EFFECTIVENESS AND ENVIRONMENTAL IMPACTS						
• Protection of Community	Not protective	Protective with controls	Protective with controls	Protective with controls	Protective with controls	Short-term protection only
• Protection of Workers	N/A	Protective with controls	Protective with controls	Protective with controls	Protective with controls	Protective with controls
• Time to Reach Objectives	N/A	3-10 years; includes final design plans, permitting and time to complete work (3 years)	3-5 years; includes final design plans, permitting and time to complete work (3 years)	3-10 years; includes final design plans, permitting and time to complete work (2 years)	3-5 years; includes final design plans, permitting and time to complete work (2 years)	2 years; includes final design plans, permitting and time to complete work (4 months)

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
• Health Risk	Not protective of human health; source contamination remains. Health risks equivalent to baseline risks.	Highly protective of human health by completely removing the source contamination from the site. Short-term risks associated with remediation activities.	Highly protective of human health by reducing exposure to source contamination. Short-term risks associated with remediation activities.	Moderately protective of human health by reducing residual risk. Short-term risks associated with remediation activities.	Moderately protective of health by containment of accessible contaminated soils. Short-term health risks associated with remediation activities.	Moderately protective of human health since contaminated materials remain at the site but are covered. Short-term health risks associated with remediation activities.
• Environmental Impacts						
- Geology and Soils	No additional impacts above baseline; contaminated soils remain in place.	Short-term soil disturbance during excavation and replacement of soil.	Short-term soil disturbance during excavation and replacement of soil.	Short-term soil disturbance during excavation and replacement of soil.	Short-term soil disturbance during excavation and replacement of soil.	Short-term soil disturbance during excavation and replacement of soil; incorporation of removed soil into areas receiving cap; capping activities.
- Water Quality	No additional impacts above baseline; surface and groundwater remain contaminated; long-term monitoring required.	Short-term minor impacts during excavation; long-term improvement in surface and groundwater.	Short-term minor impacts during excavation; long-term improvements in surface and groundwater.	Short-term minor impacts during excavation; long-term improvement in surface and groundwater; low potential for contamination of groundwater.	Short-term minor impacts during excavation; long-term improvement in surface and groundwater; low potential for contamination of groundwater.	Short-term minor impacts during excavation; long-term improvement in surface and groundwater; long-term monitoring required.

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
- Air Quality	No additional impacts above baseline	Short-term increase in atmospheric emissions	Short-term increase in atmospheric emissions	Short-term increase in atmospheric emissions	Short-term increase in atmospheric emissions	Short-term increase in atmospheric emissions
- Ecological Resources						
Terrestrial biota	No additional impacts; continued exposure of biota to contaminants.	Temporary loss of habitats; long-term improvement resulting from removal of contaminants.	Temporary loss of habitats; permanent loss of habitat in area of the onsite encapsulation cell.	Temporary loss of some habitats; long-term improvement of many areas resulting from removal of contaminants.	Temporary loss of some habitats; permanent loss of habitat in area of the encapsulation cell.	Temporary loss of some habitats; permanent loss of habitat in capped areas.
Aquatic biota	No additional impacts; continued exposure of biota to contaminants.	Temporary loss of habitat; no further exposure after reestablishment.	Temporary loss of habitat; no further exposure after reestablishment.	Temporary loss of habitat; no further exposure after reestablishment.	Temporary loss of habitat; no further exposure after reestablishment.	Temporary loss of habitat; no further exposure after reestablishment.
Threatened and Endangered Species	Potential exposure of transients to contaminants	No impacts	No impacts	No impacts	No impacts	No impacts
Wetlands	No additional impacts; contaminants remain in place.	Temporary loss of wetland characteristics and functions	Temporary loss of wetland characteristics and functions	Temporary loss of wetland characteristics and functions	Temporary loss of wetland characteristics and functions	Temporary loss of wetland characteristics and functions
- Archeological, Cultural, and Historical Resources	No impact	No impact	No impact	No impact	No impact	No impact

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
- Land Use and Recreational/Aesthetic Resources	No abatement of future reuse constraints; property owner liability.	Abatement of future reuse constraints.	Partial abatement of future reuse constraints; encapsulation impact to property taxes and surrounding property reuse.	Partial abatement of future reuse constraints; deed restrictions.	Partial abatement of future reuse constraints; deed restrictions; encapsulation impact to property taxes and surrounding property reuse.	Minimal abatement of future reuse constraints; deed restrictions.
- Socioeconomic and Institutional Issues						
Community Issues	Long-term continuation of current trend of impacts; inadequate to address local issues and concerns.	Abatement of trend of impacts; adequate to address local concerns and issues.	Change in distribution of impacts; eliminate source of uncertainty at remediated properties; create impacts due to onsite disposal. Conflict with community's development plan if located on Ashland 2. Does not present a conflict if located on Ashland 1 or Seaway.	Reduction in trend of existing impact; dependent upon public judgment of risk reduction.	Inadequate to reduce the trend of existing impacts; create impacts due to onsite disposal. Conflict with community's development plan if located on Ashland 2. Does not present a conflict if located on Ashland 1 or Seaway.	Inadequate to reduce the trend of existing impacts.
Public Services	Low potential for impact on emergency response services. No impact on utilities.	Short-term pressure on emergency response services; low impact on utilities.	Short-term pressure on emergency response services; low impact on utilities.	Short-term pressure on emergency response services; low impact on utilities.	Short-term pressure on emergency response services; low impact on utilities.	Short-term pressure on emergency response services; low impact on utilities.

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
Economic & Demographic Resources	No impact	Short-term pressure on temporary housing resources; upper bound housing need of 118 units	Short-term pressure on temporary housing resources; upper bound housing need of 186 units	Short-term pressure on temporary housing resources; upper bound housing need of 113 units	Short-term pressure on temporary housing resources; upper bound housing need of 215 units	Low impact; short-term upper bound housing needs of 75 units
Local Transportation Impacts	No impact	Short-term impact on traffic volume; road deterioration.	Short-term impact on traffic volume; road deterioration.	Short-term impact on traffic volume; road deterioration	Short term impact on traffic volume; road deterioration.	Short-term impact on traffic volume; road deterioration.
Noise Levels	No impact	Short-term impact on public due to annoyance during implementation.	Short-term impact on public due to annoyance during implementation.	Short-term impact on public due to annoyance during implementation.	Short-term impact on public due to annoyance during implementation.	Short-term impact on public due to annoyance during implementation.
• Unavoidable Adverse Impacts	Potential exposure to contaminants over time by direct contact and ingestion and inhalation; possible increase in exposure to contaminants over time due to human disturbance and natural processes.	None	None	None	None	None
• Short-term Uses and Long-term Productivity	Long-term restriction of land use.	Long-term productivity highest. Commitment of land for disposal facility.	Commitment of land for disposal facility; long-term productivity high for unrestricted area.	Commitment of land under refuse; long-term productivity high for unrestricted area; long-term productivity unrestricted.	Commitment of land under refuse and disposal facility; long-term productivity high for unrestricted area.	Long-term restriction of land use.

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
• Cumulative Impacts	Impacts to mental health, social structure, and community image from uncertainty about health risks from multiple contaminated sites in community/region.	No long-term cumulative impacts.	Minor impacts on community well-being from multiple waste sites in community/region.	Moderate impacts to community well-being from waste remaining on site and multiple waste sites in community/region.	Moderate impacts to community well-being from waste remaining on site and multiple waste sites in community/region.	Impacts to mental health, social structure, and community image from uncertainty about health risks from multiple contaminated sites in community/ region.
<u>REDUCTION OF TOXICITY, MOBILITY, OR VOLUME (T, M, or V) THROUGH TREATMENT</u>						
• Treatment Process Used	None	None	None	None	None	None
• Amount Destroyed or Treated	None	None	None	None	None	None
• Reduction of T, M or V	None	None	None	None	None	None
• Irreversibility	N/A	N/A	N/A	N/A	N/A	N/A
• Type and Quantity of Residuals	N/A	Waste in offsite landfill	Waste in onsite landfill	Waste in offsite disposal facility; portion of waste remains onsite	Waste in offsite disposal facility; portion of waste remains onsite	Waste remains onsite

Table 5-9. (continued)

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 COMPLETE EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 3 COMPLETE EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 4 PARTIAL EXCAVATION OFFSITE DISPOSAL	ALTERNATIVE 5 PARTIAL EXCAVATION ONSITE DISPOSAL	ALTERNATIVE 6 CONTAINMENT
IMPLEMENTABILITY						
• Technical Feasibility	N/A	Feasible; transportation problems	Feasible	Feasible; transportation problems	Feasible	Feasible
• Reliability	N/A	Reliable	Reliable	Reliable	Reliable	Long-term; reliability of cap questioned
• Ease of Expansion/Modification	N/A	No problem	No problem	No problem	No problem	No problem
• Monitoring	Long-term	Long-term at disposal facility	Long-term	Long-term	Long-term	Long-term
• Approvals & Permits	N/A	Approval from disposal facility	Approval and permits for encapsulation cell, if required.	Approval from disposal facility	Approval and permits for encapsulation cell, if required	Approval for cap required
• Availability of Offsite Disposal Services	N/A	Available	N/A	Available	N/A	N/A
• Availability of Services and Equipment	N/A	Available	Available	Available	Available	Available
COST						
• Present Worth 0% Discount	\$3.6M[b]	\$99.7M[b,c]	\$76.8M[b]	\$79.4M[b,c]	\$58.6M[b]	\$16.8M[b]

[a] Not applicable
[b] Million
[c] Assuming a New York FUSRAP site

activities for handling and moving all contaminated materials at the Tonawanda site. These risks can be minimized through the use of safety procedures and protective equipment.

Alternatives 4 and 5, which involve partial excavation of contaminated soil and selective demolition and decontamination of buildings at Linde, provide the next best level of protection but do not eliminate all potential contaminant exposure pathways. Some contaminated soils (less than 3% of the total) would temporarily remain under Building 30 and the contaminated soils in Areas B and C at Seaway (less than 8% of the total) would remain under the refuse at the landfill. Risk to workers is involved with implementing these alternatives because of the amounts of contaminated materials that must be handled and moved; however, these risks would be minimized through the use of protective equipment and safety procedures. As with Alternatives 2 and 3, the contaminated material would be placed in a protective engineered cell for ultimate disposal.

Alternative 6 provides protection by reducing or eliminating certain exposure pathways and preventing access through the use of institutional controls. This alternative has a higher degree of protection than current site conditions, but less than excavation alternatives. Alternative 1 provides no increased protection over the current site conditions and would not be protective of human health and the environment. These alternatives offer a low degree of risk to workers during implementation because they are less intrusive than the other alternatives.

All alternatives except Alternative 1 are considered to provide overall protection to human health and the environment.

5.5.3 Compliance With ARARs

Alternatives 2 and 3 meet ARARs because all soil with contamination exceeding the DOE guidelines would be excavated and permanently isolated in a disposal facility. The other alternatives, all of which involve leaving some contaminated soil in place, would not comply with restrictions on residual concentrations in soil without the application of supplemental standards under 40 CFR 192.21. Partial excavation Alternatives 4 and 5 entail leaving 19,000 m^3 (25,900 yd^3) of contaminated soil in place (less than 8% of the total) that is contaminated above the DOE residual contamination limits. However, the unexcavated soil is considered inaccessible, so supplemental standards under 40 CFR 192.21 would be invoked. In this case, the alternative would comply with ARARs. Similarly, Alternative 6 would rely on the application of supplemental standards to be compliant. Alternative 1 is noncompliant with ARARs because all contaminated waste remains onsite with no additional protection provided.

5.5.4 Long-Term Effectiveness and Permanence

Estimates of human health risks after remediation indicate the long-term effectiveness of an alternative. The degree to which human health risks due to exposure to contaminated media are reduced from the existing risk depends on the degree of remediation the alternative provides.

Alternatives 2 and 3 have the highest degree of long-term effectiveness and permanence because all contaminated soils and building materials and structures are excavated and removed from the site, eliminating residual risk, and placed in an engineered disposal cell.

Alternatives 4 and 5, while protective of human health and the environment in the short term, are dependent on long term access and use restrictions at the Seaway landfill to ensure that access to contaminated soils does not become possible in the future. It is assumed that the Seaway landfill will remain as a use restricted property due to the large quantity of waste buried at the site and the need to protect the facility's clay cap. Therefore, Alternatives 4 and 5 have a high degree of effectiveness, eliminating residual risk by eliminating all exposure pathways, but only a moderate degree of permanence.

Alternative 6, containment, has a high degree of effectiveness but relies on long term management to ensure that exposure pathways remain blocked. The magnitude of residual risk and exposures to human health and the environment is directly related to the adequacy and reliability of the clay cap and institutional controls. Therefore, Alternative 6 is assumed to have a moderate degree of long term effectiveness and permanence.

For Alternatives 2, 3, 4, 5, and 6, risk calculated for a worker involved in maintenance activities at any disposal cell or capped areas for a period of 25 years is equivalent to the general public's health risk during remediation which is 6×10^{-9}.

Alternative 1, no action, has low long-term effectiveness because the post-implementation remedial risks equal those now at the site.

5.5.4.1 Irreversible and Irretrievable Commitment of Resources

Alternatives 2 and 3, complete excavation, would be the alternatives requiring no long-term restriction on land use once the alternatives are implemented, except for the land committed for the disposal cell. Alternatives 4 and 5, partial excavation, would have a moderate commitment of restricted land use, due to the commitment of land for the disposal cell, and the land where residual waste remains (Seaway landfill). Alternatives 6 and 1, containment and no action, would have a major commitment of restricted land use. However, in all cases the commitment of resources is reversible.

5.5.5 Short-Term Effectiveness and Environmental Impacts

Short-term effectiveness is measured with respect to protection of community and workers as well as short-term environmental impacts during remedial actions and time until remedial action objectives are achieved. An increase in the complexity of an alternative typically results in a decrease in short-term effectiveness because of increased handling and processing. The increased handling and processing activities associated with the more complex alternatives result in increased exposures to human health and the environment from the contaminants of concern. Alternative 1, no action, is the most effective in protecting the community and workers and controlling impacts during implementation since no actions that could create impacts are undertaken. Alternative 1 requires the shortest time to implement. The short-term effectiveness of the other alternatives ranks in the following order: Alternative 6 (containment), Alternative 5 (partial excavation and onsite disposal), Alternative 4 (partial excavation and offsite disposal), Alternative 3 (complete excavation and onsite disposal), and Alternative 2 (complete excavation and offsite disposal).

Alternative 6 has a high degree of short-term effectiveness because it requires little handling or movement of the contaminated soils or building materials. Once the sediments are removed from the drainage ditches and Rattlesnake Creek and incorporated into the areas to be capped, an initial layer of fill material would be deposited onto the contaminated materials. This initial layer would isolate the source material from the workers. Dust would be generated by the earth-moving aspects of the alternative and would have to be controlled. Building materials contaminated with radionuclides would not be disturbed but sealed in place. This alternative is highly effective in minimizing impacts to the community, workers, and the environment because it involves minimal disturbance of the radioactive contaminants. Alternative 6 requires 4 months to complete all remediation activities.

Alternatives 4 and 5 offer a moderate degree of short-term effectiveness because the accessible contaminated soils are excavated and removed. Selective demolition and decontamination of the buildings at Linde would result in exposures to the workers and the environment. Onsite disposal (Alternative 5) results in a slightly lower degree of effectiveness because the contaminated materials are handled twice in order to place the waste in the onsite disposal facility. This alternative results in short-term impacts to workers and the environment due to increased fugitive emissions and erosional migration of contaminated particles from extensive activities. However, if proper health and safety measures and engineering controls are adhered to during implementation of this alternative, minimal impacts should be realized. Impacts to the community would result from increased truck traffic as well as noise and diesel emissions resulting from the truck traffic. The time required to implement Alternative 4 (offsite disposal) is entirely dependent upon the disposal option chosen. The time required for Alternative 4 could range from a minimum of 3 years to a maximum of 10 years. The time required to implement Alternative 5 is dependent upon the time required to study, design, and construct the onsite disposal facility. It is projected that it may take 3-5 years to implement this alternative.

Alternatives 2 and 3 have the highest degree of short-term risks. Extensive handling of the waste is required to remove all "access-restricted" soils. All radioactively contaminated buildings at Linde are completely demolished followed by an associated waste reducing process. The activities to excavate refuse at the Seaway landfill in order to remove the radioactive soils would have the greatest impacts to the workers, the community, and the environment due to the offensive landfill gases expected and increased leachate production. Additional time is required to implement these remedial activities. The disposal options would require the same time as determined for Alternatives 4 and 5.

5.5.5.1 Health Risk

— *Long-Term*

Alternative 1, no action, provides a low level of protection of human health, since contaminated materials remain in place at the Tonawanda site. Complete and partial excavation with offsite disposal, i.e., Alternative 2, provides a high level of protection of human health at Tonawanda while Alternatives 3, 4, 5, and 6 provide a moderate level of protection at Tonawanda. At the selected disposal site, long-term human health risk is expected to be low because of the planned controls and containment afforded by the engineered disposal cell.

— *Short-Term*

Alternative 1 poses no additional health risks to the workers or community from implementation activities. Implementation of Alternatives 2 through 6 is associated with moderate short-term risks to human health. Table 5-10 shows quantification for human health risk associated with each alternative. Table 5-11 gives an estimated occupational worker fatality risk for each alternative.

5.5.5.2 Environmental Impacts

— *Geology and Soils*

Alternative 2, complete excavation with offsite disposal, would provide the highest long-term protection of local geologic resources and soils. Under this alternative, all contaminated soils would be removed and replaced with clean backfill and topsoil. Offsite disposal would exclude any potential for the recontamination of local soils with wastes from the Tonawanda site. At the disposal site geology and soils would be protected because of the linings, covers, and monitoring proposed for the disposal cell. However, the disposal facility would present some potential risk in the form of a possible failure of the facility's containment devices. Such failure could result in contamination of local soils.

Alternative 3, complete excavation with onsite disposal, would provide nearly the same high level of long-term protection as Alternative 2 but less than Alternative 5, partial excavation with onsite disposal. However, the onsite disposal facility would present some potential risk in the form of a possible failure of the facility's containment devices. Such a failure could result in recontamination of local soils.

Alternative 4 would provide a moderate level of soil protection through partial excavation and offsite disposal. Some contaminated soils would remain for the short term in place on the Linde and Seaway properties. This remaining contamination would remain in direct contact with soils, leaving a pathway for slow but continued contaminant migration. At the disposal site geology and soils would be protected as explained for Alternative 2.

Table 5-10. Human Health Risk Associated With Each Alternative

Alternative	Remediation Worker		General Public[a]	
	Radiological[b]	Chemical	During Remediation	Residual Risk
1	NA	NA	NA	1×10^{-9} [c]
2	2×10^{-4}	2×10^{-5}	6×10^{-9}	$<1 \times 10^{-9}$
3	2×10^{-4}	2×10^{-5}	6×10^{-9}	$<1 \times 10^{-9}$
4	2×10^{-4}	2×10^{-5}	5×10^{-9}	$<1 \times 10^{-9}$
5	2×10^{-4}	2×10^{-5}	5×10^{-9}	$<1 \times 10^{-9}$
6	2×10^{-4}	2×10^{-5}	1×10^{-10}	$<1 \times 10^{-9}$

NA not applicable

[a] Lifetime fatal cancer risk to a maximally exposed offsite individual exposed to incidental airborne radioparticulates modeled using CAP88PC

[b] Annual risk modeled using RESRAD

[c] Risks to onsite workers estimated to range from 1×10^{-2} to 4×10^{-4} (SAIC 1993)

Table 5-11. Noncontaminant Associated Occupational Worker Fatality Risk[a,b]

Alternative	Construction	Material Processing	Site Monitoring[c]	Total
1	None scheduled	None scheduled	2×10^{-6}	2×10^{-6}
2	5×10^{-4}	6×10^{-4}	6×10^{-6}	1×10^{-3}
3	1×10^{-3}	6×10^{-4}	6×10^{-5}	2×10^{-3}
4	5×10^{-4}	6×10^{-4}	5×10^{-5}	1×10^{-3}
5	1×10^{-3}	6×10^{-4}	6×10^{-5}	2×10^{-3}
6	2×10^{-4}	None scheduled	6×10^{-5}	3×10^{-4}

[a]Based on (ANL 1982):

Activity	Rate of Fatalities per Manhour of Labor
Construction	1.5×10^{-8}
Material Processing	3.3×10^{-8}
Monitoring	2.3×10^{-8}

[b]Typical construction activities include excavation and building demolition.
Typical material processing activities include filling transport boxes, loading flatcars
Typical monitoring activities include radiation monitoring and sampling.

[c]Site monitoring based on years of required continued monitoring.

The partial excavation and onsite disposal facility in Alternative 5 would provide a low to moderate level of protection of local geology and soils. In addition to the contaminants left in place, some potential risk of containment failure would be associated with an onsite disposal facility.

Alternative 6 would provide low protection from the partial excavation and the incorporation of the removed contaminated soils and sediment into the multi-media caps over areas not excavated. Contaminants left in place would remain in direct contact with soils, while contaminants incorporated into the capping structures could be released in the future if the caps were allowed to deteriorate. By contrast, Alternative 1, no action, would provide no protection of soils or geology since contaminated soils would remain in place and would allow currently active migration routes to continue.

— *Water Quality*

Water quality under Alternative 1 is predicted to remain constant for contaminant concentrations for an indefinite period. Alternatives 2 through 6 all address the long-term improvement of surface water on the Tonawanda site. Groundwater quality under all alternatives would remain the same. The isolation of groundwater from the environment and human contact and the isolation between the groundwater and contaminated soils and sediments makes remedial action for this media unnecessary. Alternatives 2 and 3 would provide the most long-term improvement of both surface water and groundwater. Alternatives 4, 5, and 6 would protect human health and the environment but not provide the level of long-term water quality improvement of Alternatives 2 and 3. Alternatives 1 and 6 would require long-term monitoring to ensure no deterioration of water quality. The selected offsite disposal site is expected to have similar and very low impacts because of planning linings, covers, and monitoring. In fact, two potential disposal sites, in the desert are long distances, i.e., many miles, from surface water bodies.

— *Air Quality*

Alternative 1, no action, would provide the highest short-term protection of air quality at the Tonawanda site since no remedial activities would be performed that would release or produce additional particulate and nonparticulate air pollutants.

Alternative 6, containment, provides the next best short-term protection of air quality at the Tonawanda site. Fugitive dust emissions would be primarily due to excavation, loading, transport, placement, and grading of borrow soil on areas to be capped. Smaller amounts of emissions would be generated during the removal and restoration activities for the drainage ditches and wetland areas.

The remaining four action alternatives involve construction and earth-moving activities which would generate fugitive dust that could affect PM-10 concentrations only for the duration of remedial activities. The exhaust emissions from heavy equipment use would not be expected to significantly impact air quality, and nonparticulate pollutants are expected to occur at high levels for short durations. Mitigative measures would be implemented to further reduce the generation of additional particulate and nonparticulate pollutants.

There are additional emissions associated with the offsite transport of excavated materials to the various disposal sites. The longer the distances from Tonawanda the greater the emissions. At the disposal sites, emissions are expected to be similar.

— *Ecological Resources*

Biota. Alternatives 2 and 3 would provide the highest long-term protection of aquatic and terrestrial biotic resources on the Tonawanda site. The complete removal and disposal of contaminants would prevent any future exposure of biota to contamination of MED origin. For both alternatives, some residual risk of future exposure would exist from the possibility of a failure of the disposal facility's containment measures. Offsite disposal sites are expected to require the use of a small and similar amount of habitat.

Alternatives 4 and 5 would provide moderate long-term protection of biota as a result of the partial excavation and disposal of contaminants. Exposure pathways from the remaining contaminants would be limited, as contaminants left in place would not be physically accessible to most biota. For both alternatives, there is an increase in the potential for exposure in the event of a failure of the disposal facility's containment measures. Offsite disposal sites are expected to require the use of a small and similar amount of habitat.

Alternative 6, partial excavation and incorporation of the removed soils and sediments into multi-media caps over areas not excavated, would provide a lower degree of long-term protection to biota. This alternative would result in potential contaminant migration and subsequent exposure routes the contaminants left in place. A potential would exist for future exposure of biota to contaminants released from the caps and underlying material if the caps were allowed to deteriorate.

Alternative 1, no action, would provide no long-term protection of terrestrial habitats since contaminated soils and sediments would remain in place, increasing the potential for contaminant migration and therefore increased exposure of biota.

Threatened and Endangered Species. There are no federally-listed threatened or endangered species and no state-listed threatened species at the Tonawanda site. Therefore, no impacts are possible because of the various alternatives. At the two known disposal sites there are only transients, while a survey will be needed to determine the possible presence of any threatened or endangered species.

Wetlands. Alternatives 2 and 4 would provide the highest long-term protection of wetlands since all contaminated soils and sediments in the affected areas would be removed and the areas would be reconstructed. No significant impoundment, diversion, or other modification of floodwaters would result, and over time, the characteristics and functions of the disturbed wetland areas would become re-established.

Alternatives 3 and 5 would provide a moderate to high degree of long-term protection for wetlands. Contaminated soils and sediments would be removed and the affected areas reconstructed, but there is added risk of contaminant exposure to downstream wetland areas in the event of a leak from the onsite disposal facility.

Alternative 6, containment, provides a low to moderate degree of long-term protection for wetlands because the potential would exist for future exposure to contaminants released from the caps and underlying material, if the caps were allowed to deteriorate.

Alternative 1, no action, would provide low long-term protection of wetland areas since contaminated soils and sediments would remain in place increasing the potential for further contaminant migration and exposure. There are no known wetlands at the two known disposal sites and it is not expected that they will be present at the to-be-defined disposal sites.

— *Archeological, Cultural and Historic Resources*

No alternative would impact archaeological, cultural, or historical resources in the area.

— *Land Use and Recreational/Aesthetic Resources*

Future land use of the Tonawanda site and surrounding properties would partially depend on the remedial action, or lack of it, whichever is chosen. Predictions of future land use must consider several variables such as ownership, zoning, surrounding use, and future land use plans. Alternative 2 would allow for the highest degree of future reuse of the site because the contaminants would be removed and placed offsite. However, the disposal site will be a permanent land use. Alternative 4 would be the second highest alternative since most accessible contaminants would be removed, but deed restrictions would be necessary to ensure that the inaccessible soils would be remediated if uncovered. Both Alternatives 3 and 5 involve an onsite land encapsulation facility. The degree of impact to future land uses would depend on the location of the encapsulation facility. Location of the facility on Ashland 1 or Seaway would not conflict with the community's development plans since those properties are not identified for development. Location of the facility on Ashland 2 could conflict with the community's plans because the property is identified for future development. These alternatives would reduce the amount of property taxes collected by the Town of Tonawanda due to DOE obtaining a portion of or a whole property and creating a visible reminder that the contamination is still contained in the area. Alternative 6 would allow a low degree of future reuse because the contamination would still exist and deed restrictions would be necessary. Alternative 1 would allow the lowest degree of reuse due to the threat to human health and the potential liabilities assumed in future reuse.

— *Socioeconomic and Institutional Issues*

Alternative 2, complete excavation and offsite disposal, would provide the greatest reduction or avoidance of conflict with local development plans and the institutional environment because it would completely remove the contamination from the community, thereby reducing the threat to health and safety. It would eliminate any potential constraints to the Town's plans to restore and develop the waterfront for public use. Alternative 4, partial excavation and offsite disposal, would avoid the construction and operation of a disposal facility and, therefore, avoid conflict with the community's development plans.

For Alternative 3, complete excavation and onsite disposal, the location of the waste disposal facility on Seaway or on the southeast end of Ashland 1 would not conflict with current waterfront development plans, particularly if it is possible to access the site with minimal use of River Road. Siting a waste disposal facility near the area of River Road proposed for development under Alternative 5, partial excavation and onsite disposal, would produce similar conflicts as Alternative 3.

Alternative 6, containment and institutional controls, and Alternative 1, no action, would be least responsive of all the alternatives to community plans. These two alternatives would conflict with waterfront development plans.

There is no discernible difference among the various alternatives with regard to public services, since none of the alternatives would create a strain on public utilities or emergency responders that could not be managed with available resources. Alternatives 2, 3, 4, and 5 appear to be approximately the same in terms of potential for short-term impacts on community well-being in the form of disruptions, annoyances, and inconveniences. Alternatives 1 and 6 pose the least potential for short-term impacts on community well-being, although this advantage does not sufficiently offset the higher potential for long-term impacts on the community under these two alternatives.

There is no distinction among alternatives when evaluated in terms of economic and demographic resources. The impact analysis conducted for economic and demographic resources indicated that the upper-bound increases in employment, populations, and housing were small relative to the size of the area. No impact was greater than 0.1% of 1989 levels, indicating that changes could be accommodated as part of the general growth trends in the area. Depending on how the temporary jobs were filled, there would be a slight possible increase in the need for temporary housing. Alternative 5 is estimated to require an upper-bound increase of 215 temporary housing units, followed by Alternative 3 (186 units), Alternative 2 (118 units), Alternative 4 (113 units), Alternative 6 (75 units) and Alternative 1 (0 units). However, all these requirements should be easily accommodated in the region.

Noise Impacts. Alternative 1, no action, would provide the fewest impacts and provide the highest short-term protection of ambient noise levels at the Tonawanda site since no remedial activities would be performed that would produce additional noise.

Alternative 6, containment, provides the next best short-term protection of ambient noise levels at the Tonawanda site. This is due to fewer activities being conducted that would produce additional noise and the shorter timeframe required to complete the remedial activities.

The remaining four alternatives involve remedial activities that would create additional temporary sources of noise. Equivalent sound-pressure levels that would be generated would not affect hearing or pose occupational health hazards under any of the alternatives. Noise levels that would be generated during remedial activities at the Ashland and Seaway properties would approach background levels at the closest sensitive offsite receptors and no noise impacts would be anticipated. Sensitive receptors closest to Linde would experience an estimated 6-8 dB increase above the background ambient noise levels which could result in increased annoyance for the duration of the remedial activities. At the disposal sites there will be additional and expected 6-8 dB noise increases over background.

5.5.5.3 Unavoidable Adverse Impacts

No unavoidable adverse impacts are expected from any alternative except Alternative 1. Alternative 1 would allow long term risk of exposure to humans and the environment from contaminants remaining onsite.

5.5.5.4 Short-Term Uses and Long-Term Productivity

Alternative 2 would provide the greatest short-term use and long-term productivity of the land at the Tonawanda site. There would be a loss of productivity at the offsite disposal site. If Alternative 2 were implemented, there would be no restriction of land use in Tonawanda, where other alternatives would have varying degrees of restriction. Under alternative 4, current land use of areas under certain structures could continue, and remaining areas would have no restriction. Alternatives 3, 5, and 6 would require restriction of possible land uses over the containment sites and areas where waste is left in place. Alternative 1 would have the most surface area restricted at Tonawanda, and the highest degree of restriction of possible land uses.

5.5.5.5 Cumulative Impacts

There are no long-term cumulative impacts that will result from the Alternative 2. By contrast, Alternatives 1 and 6 have cumulative impacts from the mental health, social structure and community image viewpoints. These possible cumulative impacts are minor for Alternative 3 and judged to be larger for Alternatives 4 and 5 - the partial excavation alternatives. There may be similar cumulative impacts for some of the disposal sites depending on the selected location.

5.5.6 Reduction of Toxicity, Mobility, and Volume Through Treatment

None of the alternatives provides for waste treatment. All treatment technologies were screened in Sections 3 and 4. None of them reduces mobility, toxicity, or volume through treatment, except for the incidental volume reduction as a result of crushing building demolition.

5.5.7 Implementability

In regards to implementability, the alternatives were evaluated with respect to the following:

- ability to construct and operate the technology,
- reliability of the technology,
- ease of undertaking additional remedial actions,
- ability to monitor effectiveness,
- ability to obtain approvals and coordinate with regulatory agencies,
- availability of offsite disposal services and capacity, and
- availability of necessary equipment and specialists.

The degree of difficulty in implementing an alternative increases with the complexity of the remediation activity. The design, engineering, and administrative requirements of Alternative 1, no action, are essentially negligible. Materials required for the components of this alternative are readily available. The remaining alternatives are all technically and administratively feasible. The engineering, design, and administrative requirements increase with the complexity of the alternatives in the following order: Alternative 6, containment; Alternative 5, partial excavation and onsite disposal; Alternative 4, partial excavation and offsite disposal; Alternative 3, complete excavation and onsite disposal; and Alternative 2, complete excavation and offsite disposal. Materials and services for the various alternatives are readily available. The degree of difficulty in implementing these alternatives increases with the amount and type of contaminated soils to be excavated (i.e., "access-restricted" soils), the level of permitting required to construct new disposal facilities, and the distance to the selected disposal facility.

5.5.8 Cost

The comparative analysis of costs compares the differences in capital, O&M, and present worth values. Costs for each alternative have been provided in detail in Appendix G. Itemization of individual components and the sensitivity analysis for each alternative may be found in Appendix G. The costs increase primarily with the amount of contaminated soil to be excavated and the type of disposal facility chosen. The total capital costs for each alternative increase as follows (assuming a New York FUSRAP site for offsite disposal alternatives): Alternatives 1, 6, 5, 3, 4 and 2.

Table 5-12 presents a cost summary for each alternative identifying capital costs, operation and maintenance (O&M) costs, and present worth costs. Each alternative is listed from least expensive to most expensive.

Table 5-12. Tonawanda Site Cost Summary of Alternatives (Thousands)

Alternative #	Alternative Disposal	Capital Cost	Total O&M Cost 0% - 30 year	30 Yr. Present Worth 0% Discount
1	NA	$8	$3,608	$3,615
6	Onsite	$10,096	$6,654	$16,750
5	Onsite	$51,968	$6,613	$58,581
3	Onsite	$70,173	$6,613	$76,786
4	New York	$72,757	$6,613	$79,370
	East	$77,821	$6,613	$86,434
	West	$99,767	$6,613	$106,379
	Commercial	$201,256	$419	$201,675
	DOE	$261,923	$419	$262,342
2	New York	$93,071	$6,613	$99,684
	East	$100,827	$6,613	$107,440
	West	$122,725	$6,613	$129,338
	Commercial	$234,818	$419	$235,237
	DOE	$301,426	$419	$301,845

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APPENDIX A

LIST OF ABBREVIATIONS AND UNITS

LIST OF ABBREVIATIONS AND UNITS

acre ft	acre foot
°C	degrees Celsius (Centigrade)
cfs	cubic feet per second
Ci	curie
Ci/m^3	curies per cubic meter
cm	centimeter
cm/yr	centimeters per year
cm^2	square centimeter
cms	cubic meters per second
Co	cobalt
CO	carbon monoxide
CO_2	carbon dioxide
COH	coefficient of haze
Cr	chromium
dB	decibel
°F	degrees Fahrenheit
ft/mi	feet per mile
ft/s	feet per second
ft/yr	feet per year
ft	foot
ft^3/h	cubic feet per hour
g/km	grams per kilometer
g	gram
gal	gallon
gpd ft	gallons per day per foot
gpm	gallons per minute
ha	hectare
ha m	hectare meter
h	hour
in.	inch
in./h	inches per hour
in./yr	inches per year
in^2	square inch
kg	kilogram
kg/day	kilograms per day
km	kilometer
km/h	kilometers per hour
km^2	square kilometer

L	liter
L/min	liters per minute
lb	pound
lb/day	pounds per day
lb/mi	pounds per mile
L_{dn}	day-night average sound level
L_{eq}	equivalent-continuous sound level
lin ft	linear feet
M	million
MGD	million gallons per day
m	meter
m/km	meters per kilometer
m/s	meters per second
m^2/day	square meters per day
m^2	square meter
m^3	cubic meter
m^3/h	cubic meters per hour
metric tons/yr	metric tons per year
mg/L	milligrams per liter
mg	milligram
mi	mile
mi^2	square mile
$\mu Ci/m^2$	microcuries per square meter
$\mu g/m^3$	micrograms per cubic meter
min	minute
mm	millimeter
mph	miles per hour
mrem	millirem
Ni	nickel
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NX	oxides of nitrogen
O_3	ozone
Pb	lead
pCi	picocurie
pCi/g	picocuries per gram
PM-10	inhalable particulates

LIST OF ABBREVIATIONS AND UNITS (continued)

ppm	parts per million
Ra	radium
Rn	radon
sec	second
SO_2	sulfur dioxide
SO_x	sulfur oxides
Th	thorium
Tl	thallium
TSP	total suspended particulate
tons/yr	tons per year
U	uranium
yd	yard
yd^2	square yard
yd^3	cubic yard
yr	year

APPENDIX B

LIST OF PREPARERS

LIST OF PREPARERS

This FS/PP-EIS has been prepared by DOE with contractual assistance from SAIC. The following SAIC staff members contributed to the preparation of this report.

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Elizabeth Caldwell	Ph.D. Ecology, Univ. of Tennessee; M.S. Radiation Ecology, Colorado St. Univ.; B.S. Medical Technology, California St. Univ.; 14 years of experience in environmental impact assessment, 4 years of experience in environmental impact statement preparation.	Health Risk Evaluation
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APPENDIX C

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DISTRIBUTION LIST

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NOTE: Letters were also mailed out by the FUSRAP Oak Ridge Operations Office announcing the availability of the draft FS/PP-EIS to interested parties who have expressed an interest in the remediation of the Tonawanda site. The letters indicate that copies of the draft FS/PP-EIS can be obtained by contacting the Tonawanda DOE Public Information Center at (716) 871-9660 or the toll free number, 1-800-253-9759.

APPENDIX D

COPIES OF CORRESPONDENCE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

January 30, 1992

Dr. Richard E. Ambrose
Senior Staff Scientist
Science Applications International Corp.
P.O. Box 2501
Oak Ridge, TN 37831

Dear Dr. Ambrose:

This responds to your letter of January 15, 1992, requesting information on the presence of Federally listed or proposed endangered or threatened species in the vicinity of a U.S. Department of Energy cleanup project at the Tonawanda Site located in the Town of Tonawanda, Erie County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required with the U.S. Fish and Wildlife Service (Service). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered. A compilation of Federally listed and proposed endangered and threatened species in New York is enclosed for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under the Fish and Wildlife Coordination Act or other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact:

New York State Department of
Environmental Conservation
Region 9
128 South Street
Olean, NY 14760
(716) 372-0645

New York State Department of
Environmental Conservation
Significant Habitat Unit
Information Services
700 Troy-Schenectady Road
Latham, NY 12110-2400
(518) 783-3932

The National Wetlands Inventory (NWI) map for the Buffalo NW Quadrangle indicates that there may be wetlands in the vicinity of the Linde site. Copies of NWI maps may be obtained through:

CLEARS
Cornell University
464 Hollister Hall
Ithaca, NY 14853
(607) 255-6520

A map indicating the status of wetland mapping in New York State and an order form listing the topographic quadrangles that have been mapped are enclosed for your information. The NWI maps are reasonably accurate but should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes.

Work in certain waters and wetlands of the United States may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without stipulations, or recommend denial of the permit depending upon the potential adverse impacts on fish and wildlife resources associated with project implementation. The need for a Corps permit may be determined by contacting Mr. Paul Leuchner, Chief, Regulatory Branch, U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, NY 14207 (telephone: (716) 879-4321).

If you have any questions regarding this letter, contact Tom McCartney at (607) 753-9334.

Sincerely,

Mark W. Clough
ACTING FOR

Leonard P. Corin
Field Supervisor

Enclosures

cc: NYSDEC, Albany & Olean, NY (Regulatory Affairs)
NYSDEC, Latham, NY
COE, Buffalo, NY
EPA, Chief, Marine and Wetlands Protection Branch, New York, NY

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK

Common Name	Scientific Name	Status	Distribution
FISHES			
Sturgeon, shortnose*	*Acipenser brevirostrum*	E	Hudson River & other Atlantic coastal rivers
REPTILES			
Turtle, green*	*Chelonia mydas*	T	Oceanic summer visitor coastal waters
Turtle, hawksbill*	*Eretmochelys imbricata*	E	Oceanic summer visitor coastal waters
Turtle, leatherback*	*Dermochelys coriacea*	E	Oceanic summer resident coastal waters
Turtle, loggerhead*	*Caretta caretta*	T	Oceanic summer resident coastal waters
Turtle, Atlantic ridley*	*Lepidochelys kempii*	E	Oceanic summer resident coastal waters
BIRDS			
Eagle, bald	*Haliaeetus leucocephalus*	E	Entire state
Falcon, peregrine	*Falco peregrinus*	E	Entire state - re-establishment to former breeding range in progress
Plover, piping	*Charadrius melodus*	E T	Great Lakes Watershed Remainder of coastal New York
Tern, roseate	*Sterna dougallii dougallii*	E	Southeastern coastal portions of state
MAMMALS			
Bat, Indiana	*Myotis sodalis*	E	Entire state
Cougar, eastern	*Felis concolor cougar*	E	Entire state - probably extinct
Whale, blue*	*Balaenoptera musculus*	E	Oceanic
Whale, finback*	*Balaenoptera physalus*	E	Oceanic
Whale, humpback*	*Megaptera novaeangliae*	E	Oceanic
Whale, right*	*Eubalaena glacialis*	E	Oceanic
Whale, sei*	*Balaenoptera borealis*	E	Oceanic
Whale, sperm*	*Physeter catodon*	E	Oceanic
MOLLUSKS			
Snail, Chittenango ovate amber	*Succinea chittenangoensis*	T	Madison County
Mussel, dwarf wedge	*Alasmidonta heterodon*	E	Orange County - lower Neversink River

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Region 5 - 01/27/92 - 2 pp.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK (Cont'd)

Common Name	Scientific Name	Status	Distribution
BUTTERFLIES			
Butterfly, Karner blue	*Lycaeides melissa samuelis*	PE	Albany, Saratoga, Warren, and Schenectady Counties
PLANTS			
Monkshood, northern wild	*Aconitum noveboracense*	T	Ulster County
Pogonia, small whorled	*Isotria medeoloides*	E	Entire state
Swamp pink	*Helonias bullata*	T	Staten Island - presumed extirpated
Gerardia, sandplain	*Agalinis acuta*	E	Nassau and Suffolk Counties
Fern, American hart's-tongue	*Phyllitis scolopendrium* var. *americana*	T	Onondaga and Madison Counties
Orchid, eastern prairie fringed	*Platanthera leucophea*	T	Not relocated in New York
Bulrush, northeastern	*Scirpus ancistrochaetus*	E	Not relocated in New York
Roseroot, Leedy's	*Sedum integrifolium* ssp. *Leedyi*	PT	West shore of Seneca Lake

E=endangered T=threatened P=proposed

Region 5 - 01/27/92 - 2

RECREATION · HISTORIC PRESERVATION
OFFICE OF PARKS
NEW YORK STATE
Orin Lehman
Commissioner

New York State Office of Parks, Recreation and Historic Preservation
The Governor Nelson A. Rockefeller Empire State Plaza
Agency Building 1, Albany, New York 12238-0001

February 7, 1992

Mr. Richard E. Ambrose, PhD
Senior Staff Scientist
Science Applications International Corporation
P.O. Box 2501
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

Dear Mr. Ambrose:

Re: DOE
FUSRAP
Tonawanda, Erie County
92PR0187

Thank you for requesting the comments of the State Historic Preservation Office (SHPO) concerning the property referenced above. The information which you submitted has been reviewed in accordance with Section 106 of the National Historic Preservation Act of 1966 and the relevant implementing regulations.

Based upon this review, it is the SHPO's opinion that this project will have No Effect upon cultural resources in or eligible for inclusion in the National Register of Historic Places.

If you have any questions, please call Kevin L. Moody of our Project Review Unit at (518) 474-0479.

Sincerely yours,

Julia S. Stokes
Deputy Commissioner for
Historic Preservation

JSS/KLM:lk
cc: DOE

New York State Department of Environmental Conservation
Wildlife Resources Center
Information Services
700 Troy-Schenectady Road
Latham, New York 12110-2400

Thomas C. Jorling
Commissioner

January 24, 1992

Richard E. Ambrose
Science Applications International Corp.
PO Box 2501, 800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

Dear Mr. Ambrose:

We have reviewed the Significant Habitat Unit and the NY Natural Heritage Program files with respect to your request for biological information concerning the Tonawanda RUSRAP site, as indicated on your map, Town of Tonawanda, Erie County, New York State.

Enclosed is a computer printout covering the area you requested to be reviewed by our staff. The information contained in this report is <u>confidential</u> and may not be released to the public without permission from the Significant Habitat Unit.

Our files are continually growing as new habitats and occurrences of rare species and communities are discovered. In most cases, site-specific or comprehensive surveys for plant and animal occurrences have not been conducted. For these reasons, we can only provide data which have been assembled from our files. We cannot provide a definitive statement on the presence or absence of species, habitats or natural communities. This information should <u>not</u> be substituted for on-site surveys that may be required for environmental assessment.

This response applies only to known occurrences of rare animals, plants and natural communities and/or significant wildlife habitats. You should contact our regional office, Division of Regulatory Affairs, at the address <u>enclosed</u> for information regarding any regulated areas or permits that may be required (e.g., regulated wetlands) under State Law.

If this project is still active one year from now we recommend that you contact us again so that we may update this response.

Sincerely,

Burrell Buffington
Burrell Buffington
Significant Habitat Unit

Encs.
cc: Reg. 9, Wildlife Mgr.
Reg. 9, Fisheries Mgr.

New York Heritage Program is supported in part by The Nature Conservancy

Due to confidentiality, the database
Report mentioned in NYSDEC letter dated
January 24, 1992 has been removed.

APPENDIX E

RESPONSE TO COMMENTS

(Will Be Provided After Public Comment Period)

APPENDIX F

FEDERAL ARARs
AND
NEW YORK STATE STANDARDS AND GUIDELINES

APPENDIX F: FEDERAL ARARs AND NEW YORK STATE STANDARDS AND GUIDELINES

INTRODUCTION

The remediation program for the Tonawanda site must comply with all Federal and State laws that are determined to be potentially applicable or relevant and appropriate (ARAR). The ARARs selected for Tonawanda Feasibility Study, to meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the New York State Environmental Conservation Law, are presented in this Appendix. Table F-1 is a compilation of the action-specific ARARs; Table F-2 is the compilation of location-specific ARARs; Table F-3 summarizes the chemical-specific water quality ARARs; and Table F-4 presents the documentation of ARARs.

FEDERAL DEFINITION OF ARARS UNDER CERCLA SECTION 121

An environmental requirement may be either "applicable" or "relevant and appropriate" but not both. ARARs are identified by answering two inquiries: first, is the regulation applicable; if not, is the regulation both relevant and appropriate.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. An applicable requirement directly and fully addresses an element of the remedial action. It is helpful to look at the jurisdictional prerequisites to determine applicability.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements,d criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is suited to the particular site. A requirement must be both relevant and appropriate to be an ARAR. The origin and objective of each requirement is compared to the specific goals, affected media, involved substances, and similar factors of the specific site. Using best professional judgment, a decision to add the requirement as an ARAR is made if it is both relevant and appropriate.

Site-specific factors are used to identify ARARs, including the characteristics of the remedial action, hazardous substances present, and physical circumstances of the site. These factors are compared to the requirement under evaluation to determine if it is directly applicable or if it is relevant and appropriate. In some cases, only part of a requirement may be found to be relevant and appropriate. A determination that a requirement is relevant and appropriate will result in an ARAR that must be complied with to the same degree as it is applicable.

To-Be-Considereds (TBCs) are non-promulgated advisories or guidance issued by a federal or state government that are not legally binding and do not have the status of potential ARARs. However, as described below, in many circumstances TBCs will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment.

The evaluation of federal ARARs for the Tonawanda Site Feasibility Study follows the guidance provided under CERCLA Section 121. This section added by Congress in SARA in 1986, establishes cleanup standards for remedial actions under Sections 104 and 106 of CERCLA. Remedial standards must attain a general standard of cleanup that assures protection of human health and the environment, must be cost-effective, and must use permanent solutions and alternative treatment technologies or resource recovery technologies to the extent possible. In addition, any remaining material left onsite must meet a level, standard, or concentration limit for the hazardous constituents that is at least that of any applicable or relevant and appropriate requirement under any federal environmental law or a more stringent state environmental statute.

CERCLA Section 121 provides that no federal, state, or local permit shall be required for activities carried out entirely onsite when the activity is selected and carried out in compliance with the cleanup standards required under Section 121. New York State Environmental Conservation Law Section 27-1315, 6NYCRR Part 375 also exempts onsite work from the administrative permitting process but must be in compliance with the substantive technical requirements of the permit.

Location-Specific ARARs

Location-specific ARARs generally restrict the concentration of hazardous substances or the conduct of activities based solely on the particular characteristics or location of a site. Theses restrictions apply to natural site features (e.g., wetlands, floodplains, and sensitive ecosystems) and man-made features (e.g., existing landfills, disposal areas, and places of historical or archaeological significance). Location-specific restrictions that are applicable or relevant and appropriate to the Tonawanda site include:

- National Historic Preservation Act
- Archaeological and Historical Preservation Act
- Historic Sites, Buildings, Objects, and Antiquities Act
- Fish and Wildlife Coordination Act
- Endangered Species Act
- Clean Water Act (CWA) (including Dredge or Fill Requirements - Section 404)
- Floodplain Management/Wetlands Protection
- DOE Compliance with Floodplain/Wetland Review Requirement
- Wilderness Act

- National Wildlife Refuge System
- Scenic River Act

Table F-2 summarizes the general provisions of these restrictions.

Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based limitations controlling action conducted at hazardous waste sites. As remedial alternatives are developed, action-specific ARARs provide a basis for assessing feasibility and effectiveness. A number of general action-specific ARARs apply to any remedial action conducted at a hazardous waste site. These general requirements include:

- Occupational Safety and Health Act (OSHA) Regulations
- Clean Air Act (CAA) Regulations
- Clean Water Act (CWA), as amended
- Safe Drinking Water Act (SDWA)
- Uranium Mill Tailings Radiation Control Act (UMTRCA)
- Hazardous Materials Transportation Act of 1974
- Atomic Energy Act
- DOE Orders
- DOE Guidelines for Residual Radioactivity at FUSRAP Sites (1987)

Table F-1. Potential Action-specific ARARs for the Remediation of the Tonawanda Site

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
OSHA - General Industry Standards	29 *CFR* Part 1910 (1992)	Specifies the 8-hour time-weighted average concentration for various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 *CFR* § 1910.120.	TBC	Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the concentration. Workers performing activities must have completed specific training requirements under 40 *CFR* § 300.150. Has been amended to add new requirements for workers in confined spaces. 58 *FR*4462 (Jan. 14, 1993). The effective date is April 15, 1993.
OSHA - Safety and Health Standards	29 *CFR* Part 1926 (1992)	Specifies the type of safety equipment and procedures to be followed during site remediation.	TBC	All appropriate safety equipment will be onsite, and safety procedures would be followed during onsite activities under 40 *CFR* § 300.150.
OSHA - Recordkeeping, Reporting, and Related Regulations	29 *CFR* Part 1904 (1992)	Outlines the recordkeeping and reporting requirements for an employer under OSHA.	TBC[1]	These requirements apply to all site contractors and subcontractors and must be followed during all site work under 40 *CFR* § 300.150.
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 *CFR* Part 61 (1992)	Designates hazardous air pollutants and sets emission standards.	Applicable	No new source may be operated, modified, or constructed unless these regulations are met.

[1] Not an ARAR because Part 1904 is not promulgated under an environmental statute, but these standards should be considered.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
NESHAP (continued) Discharge of Radioactive Pollutants to Air	40 *CFR* Part 61, Subpart H (1992)	States that airborne emissions shall not cause members of the public to receive doses greater than: 10 mrem/yr effective dose equivalent.[2]	Applicable	Applicable to airborne emissions from DOE facilities. Not applicable to doses caused by radon-220, radon-222, and their respective decay products; facilities regulated under 40 *CFR* § 190, 191, or 192; and low-energy accelerators and users of sealed radiation sources.
Discharge of Asbestos to Air	40 *CFR* Part 61, Subpart M (1992)	Establishes standards for demolition and renovation: applicability, notification requirements and procedures for asbestos emission control.	Applicable	Applicable if asbestos is present in buildings to be decontaminated or demolished.
Discharge of Radon to Air from DOE Facilities	40 *CFR* Part 61, Subpart Q (1992)	Establishes emission standard for radon from DOE facilities: <20 pCi/m 2/sec of radon-222 as averaged for the source Exempted from source reporting requirements under 40 *CFR* § 61.10	Applicable	Gernal application

[2]Not applicable if site has been designated by the Secretary of Energy under Title 1 of the Uranium Mill Tailings Radiation Control Act of 1978.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
NESHAP (continued) Discharge of Radon from Uranium Mill Tailings	40 *CFR* Part 61, Subpart T (1992)	Limits radon emissions effluent from uranium mill disposal: Requires testing and reporting after pile is covered Criteria provide implementation measurements Exempted from reporting under 40 *CFR* § 61.10	Relevant & Appropriate	Relevant and appropriate since site contains material sufficiently similar to uranium mill tailings.
Air Quality Standards	40 *CFR* § 50 (1992) 40 *CFR* § 52 (1992)	Establishes National Primary and Secondary Ambient Air Quality Standards. State Implementation Plans (SIPs)	Applicable	May be applicable or relevant and appropriate if excavation equipment exhaust and fugitive dust contribute significantly to air quality ranking for region.
National Pollutant Discharge Elimination System (NPDES)	40 *CFR* Parts 122-125 (1992)	Requires permits for the discharge of pollutants from any point source into waters of the United States. The Act defines a point source as any discernible conveyance from which pollutants are or may be discharged. Effluent limitations must protect beneficial uses of water.	Applicable	Remedial actions which would discharge a pollutant into surface waters would enter into the NPDES regulatory framework. A permit is not required for onsite CERCLA response actions, but the substantive requirements would apply. Offsite discharges would require a permit. In response to a 1992 case, deadlines have been specified for the issuance of NPDES permits in areas having a population of 100,000 or more. 57 *FR* 60444 (Dec. 18, 1992). NY operates the PDES program in the state.
Water Quality Standards Regulation	40 *CFR* Part 131 (1992)	Provides chemical-specific numeric criteria for toxic pollutants in waters of certain use classifications for states that have not fully complied with the requirements of the Clean Water Act.	Applicable	

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Discharge of Radioactive Pollutants to Surface Waters	40 *CFR* § 440.32(b) (1992)	Sets concentration limits for pollutants discharged from mines as liquid effluent: ≤10 pCi/L of dissolved radium-226 in any one day or <3 pCi/L of dissolved radium-226 averaged over 30 consecutive days,[3] <30 pCi/L of total radium-226 in any one day or <10 pCi/L of total radium-226 averaged over 30 consecutive days; and 4 mg/L of uranium in any one day or 2 mg/L of uranium averaged over 30 consecutive days.	Relevant & Appropriate	If any discharge to surface water took place, these standards would be relevant and appropriate.
	40 *CFR* § 440.34(b) (1992)	Prohibits discharge of process wastewater to navigable waters.	Relevant & Appropriate	If any discharge to surface water took place, these standards would be relevant and appropriate.
National Primary Drinking Water Regulations	40 CFR Part 141 (1992)	Establishes MCLs for contaminants in water.	Applicable	
Licensing of Exports of Certain Alpha-Emitting Radionuclides and Byproduct materials	10 *CFR* Part 110 (proposed)	Application, reporting, and recordkeeping requirements for exports and imports of nuclear equipment and material.	TBC	Licenses would be required for exports of byproduct materials and some alpha-emitting radionuclides. Site may have to meet substantive requirements.
Price-Anderson Amendments Act of 1988 to the Atomic Energy Act	DOE Orders related to Nuclear Safety	DOE Orders related to nuclear safety are enforceable against most DOE contractors, subcontractors, and vendors.	TBC	May be applicable, once promulgated.

[3] A curie, or Ci, is the amount of radioactive material that produces 37 billion nuclear disintegrations per second. A picocurie, or pCi, is equal to 1 x 10^{-12} curies.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Hazardous Materials Transportation Regulations	49 *CFR* Part 171 (1992)	Definitions of hazardous materials, wastes, substances, reportable quantities, etc.	Applicable	Must be used to determine applicability of specific hazardous materials or waste transportation requirements, regardless of destination.
	49 *CFR* Part 172 (1992)	Provides information and requirements addressing shipping paper descriptions, marking and labeling of packages, placarding of vehicles, and requirements for emergency response information.	Applicable	Parts 172 and 173 were amended by final rule to give regulatory relief for materials being shipped at elevated temperatures. 58 *FR* 3343 (Jan. 8, 1993).
	49 *CFR* Part 172, Subpart G	Emergency response information for use in the mitigation of accidents involving hazardous materials and wastes.	Applicable	Must include at a minimum: (1) the basic description and technical name of the hazardous material; (2) immediate hazards to health; (3) risks of fire or explosion; (4) immediate precautions to be taken in the event of an accident or incident; (5) immediate methods for handling fires; (6) initial methods for handling spills or leaks in the absence of fire; and (7) preliminary first aid measures.
	49 *CFR* Part 173 (1992)	Shippers--General requirements for shipments and packaging	Applicable	

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Hazardous Materials Transportation Regulations (continued)	49 *CFR* Part 173 Subpart I (1992)	Radioactive Materials.	Applicable	This section provides definitions specific to the radioactive materials transportation regulations in Subpart I. These definitions are of substantial significance for determining transportation ARARS for the Tonawanda site. The DOT definition of "Radioactive material" is any material having a specific activity greater than 0.002 microcuries per gram, which is equivalent to 2,000 pCi/g. This minimum specific activity number includes all U, Ra, and Th daughter products. Radionuclides that surpass minimum A_2 quantity (and allowable specific activity) requirements are DOT regulated low specific activity (LSA) materials. Note: The NRC [10 *CFR* § 20.3(a)(13)] defines radioactive material as any such material whether or not subject to licensing control by the Commission.
	49 *CFR* Part 174 (1992)	Carriage by rail.	Applicable	Subpart K governs rail shipment of radioactive wastes.
	49 *CFR* Part 177, Subpart A (1992)	Carriage by public highway. General Information and Regulations.	Applicable	Provides specific requirements for highway shipments of radioactive materials.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
URANIUM MILL TAILINGS RADIATION CONTROL ACT (UMTRCA)	42 U.S.C. § 2022 (1992, as amended)	Control residual radioactive material at processing or depository sites and during site restoration.	Relevant & Appropriate	In the absence of other standards, may be relevant to establish clean-up standards.
Control of Uranium or Thorium Mill Tailings	40 C.F.R. § 192.02(a) (1991)	Design control measures to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case for at least 200 years.	Relevant & Appropriate	Relevant if inactive uranium processing took place on the sites designated for remedial action.
	40 C.F.R. § 192.02(b) (1991)	Design control measures to ensure that releases of Rn-222 from residual radioactive material to the atmosphere will not exceed an average (applied over the entire surface of the disposal site and over at least a one-year period) release rate of 20 pCi/m^2/sec or increase the average annual concentration of Rn-222 in the atmosphere at or above any location outside the disposal site by more than 0.5 pCi/L.	Relevant & Appropriate	Relevant and Appropriate only if the facility is a disposal site.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
UMTRCA (continued) Clean-up of Radioactively Contaminated Land	40 C.F.R. §§ 192.12(a), 192.32(b)(2), and 192.41 (1991)	Determine above - background concentration of Rn-226. If the above-background concentration of Rn-226 in land averaged over any area of 100 square meters is: <5 pCi/g, no further clean-up is needed; between 5 and 15 pCi/g, a decision concerning the need for further clean-up should be made based on the volume and depth of the contamination, as well as other site-specific characteristics (further guidance from EPA's Office of Radiation Programs should be sought in these cases); or >15 pCi/g, the contamination should be removed.	Relevant & Appropriate	Relevant and Appropriate in the absence of other clean-up standards.
Clean-up of Radioactively Contaminated Buildings	40 C.F.R. § 192.12(b)(1) (1991)	Achieve an annual average radon decay product concentration (including background) of less than 0.02WL[4] in any occupied or habitable building. The radon decay product concentration shall not exceed 0.03WL.	Relevant & Appropriate	Relevant and Appropriate if no other standards are available regarding certain inactive uranium processing sites designated for remedial action under Title I of UMTRCA.

[4] A working level, or WL, means any combination of short-lived radon decay products (through polonium-214) in one liter of air that will result in the emission of alpha particles with a total energy of 130 billion electron volts. An activity concentration of 10 picocuries per liter of radon-222 in equilibrium with its daughters corresponds approximately to 1 WL.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
UMTRCA (continued) Protection of Groundwater from Radioactive Contamination	40 C.F.R. § 192.32(a) (1991)	Before closure, processing areas shall meet the following criteria: 40 C.F.R. 264.221 for surface impoundment design requirements 40 C.F.R. 264.92 for groundwater protection standards: Rn-226 or Rn-228 <5 pCi/L Gross alpha (excluding radon & uranium) <15 pCi/L Monitoring program required within 1 year 40 C.F.R. 190 and 40 C.F.R. 440 for uranium byproduct materials Federal Radiation Protection Guidance implies as low as reasonably achievable (ALARA) as well	Relevant & Appropriate	Relevant only if there is any discharge to groundwater and no other standards are available.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
UMTRCA (continued) Protection of Groundwater from Radioactive Contamination (continued)	40 C.F.R. §§ 192.32(a)(2) and 192.41 (1991)	Manage uranium mill tailings to conform to the groundwater protection standard in 40 C.F.R. § 264.92, except that for the purpose of this standard: molybdenum, uranium, and thorium are added to the list of hazardous constituents referenced in 40 C.F.R. § 264.93; radioactivity concentration limits for radium and gross alpha particle[5] activity are added to Table 1 of 40 C.F.R. § 264.94; and detection monitoring programs required under § 264.98 to establish the standards required under § 264.92 shall be completed within one year of promulgation.	Relevant & Appropriate	Relevant to commercial and thorium processing sites in the absence of other standards.
	40 C.F.R. §§ 192.32(b)(1)(i), and 192.41 (1991)	Design disposal areas to be effective for up to 1,000 years to the extent reasonably achievable, and in any case for at least 200 years.	Relevant & Appropriate	Relevant in the absence of other standards.
	40 C.F.R. §§ 192.32(b)(1)(ii), and 192.41 (1991)	Design disposal areas to ensure that releases of Rn-222 from residual radioactive material to the atmosphere will not exceed an average (applied over the entire surface of the disposal site and over at least a one-year period) release rate of 20 $pCi/m^2/sec$.	Relevant & Appropriate	Relevant in the absence of other standards.

[5] Gross alpha particle activity means the total radioactivity due to all alpha particle emitters, excluding (for the purposes of 40 CFR Section 141.15) radon and uranium.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
UMTRCA (continued) Closure of Uranium and Thorium Mill Tailings Sites	40 C.F.R. § 192.32(b) (1991)	Disposal areas shall comply with the closure performance standard in 40 C.F.R. § 261.111 with respect to non-radiological hazards.	Relevant & Appropriate	Relevant to commercial and thorium processing sites in the absence of other standards.
Corrective Action of Radioactively Contaminated Groundwater	40 C.F.R. § 192.33 (1991)	Develop a corrective action program as specified in 40 C.F.R. § 264.100 and put it into operation as soon as is practicable, in no event later than 18 months after a finding of exceedance.	Relevant & Appropriate	Relevant to commercial and thorium processing sites in the absence of other standards. Whether groundwater at Tonawanda site is radioactively contaminated is not known.
	1992	Classify, package, mark, label, placard, ship, and transport hazardous materials, including radioactive materials, in accordance with established regulations.		Applicable to remediation activities involving the transportation of hazardous or radiological waste.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
<u>DOE Orders:</u>				
Radiation Protection of the Public and the Environment	DOE Order 5400.5	General	TBC	This order is now a proposed rule to be codified at 10 *CFR* Part 834 (58 *FR*16268, Mar. 25, 1993).
	§ 8	Identifies other applicable orders.		
	Chapter I	Addresses methods of evaluations and goals.		
	Chapter II	Specifies applicable criteria for protection of the public (e.g., 100 mrem/yr for DOE operations for all pathways).		
	Chapter III	Provides guidance for implementation of the requirements in Chapters I and II as related to the inhalation and ingestion of radionuclides.		
	Chapter IV	Establishes residual radioactive materials criteria for the site and operations.		
Radiation Protection for Occupational Workers	DOE Order 5480.11	General	TBC	
	§ 6	Identifies other applicable orders.		
	§ 9.a	Mandates implementation of ALARA.		
	§ 9.b	Specifies radiation exposure standards for occupational workers.		

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
DOE Orders (continued) Radiation Protection for Occupational Workers (continued)	§ 9.c and 9.p	Addresses the method for authorizing planned special exposures and exposures associated with emergency recovery activities.		
	§ 9.d	Specifies the exposure limitations for minors and students.		
	§ 9.e	Specifies the exposure limitations for the public entering the Controlled Area.		
	§§ 9.f and 9.h	Specifies the criteria to be used to assess exposure as a whole (combining various types of exposure data).		
	§ 9.g	Addresses monitoring requirements to assure exposures are below limits and ALARA, and to provide verification and documentation.		
	§ 9.i	Specifies controls and limitations on the removal of material from the Controlled Area.		
	§ 9.j	Specifies design goals for engineered systems.		
	§ 9.k	Specifies labeling and posting requirements.		
	§ 9.l	Specifies access control requirements.		
	§ 9.m and 9.n	Specifies minimum recordkeeping requirements.		
	§ 9.o	Specifies minimum training requirements.		

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
DOE Orders (continued) Radiation Protection for Occupational Workers (continued)	§ 9.q	Addresses the requirements for nuclear accident dosimetry.		Not anticipated to be necessary
	§ 9.r	Specifies the requirements for a contractor internal audit program.		
Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes	DOE Order 5480.3	Specifies requirements for the labeling and packaging of these substances in addition to 49 *CFR*.	TBC	
Environmental Protection, Safety, and Health Protection Standards	DOE Order 5480.4	Specifies other applicable regulations, standards, requirements, and guidance.	TBC	
Department of Energy Laboratory Accreditation Program for Personnel Dosimetry	DOE Order 5480.15	Specifies criteria for radiation dosimetry programs.	TBC	

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
DOE Orders (continued) Radioactive Waste Management	DOE Order 5820.2A	Establishes the criteria for the required radioactive waste activities associated with a DOE operation, including action to minimize and stabilize waste.	TBC	
	Chapter III	Addresses the management, treatment, and disposal of low-level radioactive waste (mill tailings and waste generated under 40 *CFR* 192 addressed in Chapter IV).		
	Chapter IV	Specifies criteria (40 *CFR* 192) for the disposal of waste (uranium tailings) from this site.		
	Chapter V	Establishes criteria for the decommissioning of radioactively contaminated facilities.		
	Chapter VI	Establishes the requirements for a waste management plan at DOE operations.		
<u>Executive Orders</u> Protection & Enhancement of Environmental Quality	Executive Order No. 11514 (Mar. 5, 1970)	Requires monitoring, developing procedures to allow public information, share information with other states and agencies, and comply with CEQ regulations.	TBC	Purpose is to require federal agencies to follow mandate of NEPA. Not promulgated.
The Administration of the CAA and CWA with Respect to Federal Contracts, Grants or Loans	Executive Order 10.11738 (Sept. 10, 1973)	Prohibits federal agencies from entering into contracts with firms which have been convicted of an offense of the CAA or CWA.	TBC	EPA keeps a list of firms with convictions. Limited exemptions are available. Not promulgated.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Executive Orders (continued) Federal Compliance with Pollution Control Standards	Executive Order No. 12088 (Oct. 13, 1978)	Requires federal agencies to comply with federal pollution prevention laws.	TBC	Also establishes conflict resolution procedures to resolve differences between agencies. Not promulgated.
Superfund Implementation	Executive Order No. 12580 (Jan. 23, 1987)	Implements National Contingency Plan and delegates presidential authority to various agencies.	TBC	Secretary of Energy is named as one of the federal trustees for natural resources. Not promulgated.
DOE Guidelines for Residual Radioactivity at FUSRAP Sites (1987)	Project Document Control Center, BNI, Oak Ridge, TN, E-03195 (Rev. 2, March 1987)	Establishes criteria for residual radioactive material in soil and other media.	TBC	Program-specific guidance, but not formally promulgated.
Radon/Radon Progeny Measurement Proficiency Program	EPA-520/1-87-001	EPA criteria program to qualify individuals to complete radon/radon progeny measurements.	TBC	Guidance document for radon measurement.
Determining Applicable Emission Standards	N.Y. COMP. CODES R. & REGS. tit. 6, § 212.4 (BNA)	Establishes emission standards where air contaminants from two or more devices or contrivances are emitted to the outdoor atmosphere through a single emission point.	Applicable	A process emission source, subject to the Federal new source performance standards in 40 C.F.R. Part 60, the national emission standards for hazardous air pollutants in 40 C.F.R. Part 61, or to PCB disposal criteria in 40 C.F.R. Part 761, satisfies the requirements of this Part if the source owner can demonstrate that the source is in compliance with the respective Federal regulation.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Opacity of Emissions Limited	N.Y. COMP. CODES R. & REGS. tit. 6, § 212.5 (BNA)	Establishes limitations for opacity of emissions. Commissioner may accept for an emission source an equivalent opacity standard exceeding the opacity standard of subdivision (a) if the source owner can demonstrate through acceptable tests for such source compliance with all applicable emission requirements other than the opacity standard and that the source and any associated emission control equipment is being operated and maintained in a manner acceptable to the commissioner.	Applicable	An equivalent opacity standard will only be granted where reasonably available control technology (RACT) has been used. In any event, the source owner or operator will not cause or allow emissions to exceed the equivalent opacity.
Open Fires	N.Y. COMP. CODES R. & REGS. tit. 6, § 215.2 (BNA)	Unless permitted by Section 215.3, no person shall burn, cause, suffer, allow or permit the burning in an open fire: • garbage; • refuse at a refuse disposal area; • rubbish for salvage; • rubbish generated by industrial or commercial activities for onsite disposal; • rubbish generated by land clearing or demolition for the erection of any structure.	Applicable	May be applicable to remediation activities.
Restricted Burning	N.Y. COMP. CODES R. & REGS. tit. 6, § 215.3 (BNA)	Restricted burning. Burning in an open fire, provided it is not contrary to other law, will be permitted.	Applicable	Permitted permit holder operates within constraints of a valid permit.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Emissions from Motor Vehicles Propelled by Gasoline Engine	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 217-1 (BNA)	Gasoline powered motor vehicle(s) subject to an exhaust emission test will not be operated in such a manner that it emits carbon monoxide (CO) or hydrocarbons (HC) in the exhaust in excess of the standards below or that has a combined CO and carbon dioxide emission less than 6.0 percent when measured using the test procedure specified in the DMVs "Emissions Inspection Procedure" document. **Vehicle Model Year** / **CO Limit** / **HC Limit** Light / Heavy / (%) / (PPM) 1974+ / 1969+ / 7.0 / 800 — / 1970-73 / 6.0 / 700 — / 1974-78 / 4.5 / 600 1975-78 / 1979+ / 3.0 / 300 1979-80 / — / 2.5 / 300 1981+ / — / 1.2 / 220	Applicable	May be applicable to excavation equipment used in remediation activities.
Vehicles Propelled by Diesel Engines	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 217-3 (BNA)	Vehicle(s) propelled by diesel engines shall not be operated in such a manner that exhaust emission of a shade of blue, black, or grey equal to or greater than Number 1 on the Ringelmann chart or equivalent standard acceptable to the Commission is produced for a continuous period of more than five seconds when the vehicle is in motion. Do not allow a bus or truck to idle for more than five consecutive minutes when the vehicle is not in motion, except as otherwise permitted by section 218.3.	Applicable	May be applicable to excavation equipment used in remediation activities.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Application for Specific Permits	N.Y. COMP. CODES R. & REGS. tit. 6, § 621.4 (BNA)	Application for specific permits. Includes additional information to be furnished, in order for the application to be determined complete, and schedules of fees.	Applicable	Applicable to permits sought under the Environmental Conservation Law (ECL) article 19 and 6 N.Y. COMP. CODES R. & REGS. Parts 201, 203 and 215--Air Pollution Control.
Application for Permit Renewals or Modifications	N.Y. COMP. CODES R. & REGS. tit. 6, § 621.13 (BNA)	Applications to renew or modify permits must be submitted to the regional permit administrator. Such application shall provide information supporting the action sought, shall include payment of any fees, and, if for a modification, shall include a statement of necessity or reasons for modification.	Applicable	Applications for renewals must be submitted no less than 30 calendar days with the exception for Standard Pollutant Discharge Elimination System (SPDES), hazardous waste manufacturing facility (HWMF), air pollution control (APC), or solid waste manufacturing facility (SWMF) permits which must be submitted no less than 180 calendar days prior to permit expiration.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
<u>NEW YORK:</u>				
New York Ambient Air Quality Standard - Air Quality Classification System	N.Y. COMP. CODES R. & REGS. tit. 6, Part 256 (BNA)	Air Quality Classification System. Describes the four general levels of social and economic development and pollution potentials that exist in the State of New York. The land uses associated with the classification levels assigned to the geographical areas of the state are detailed below: Level I - Predominantly used for timber, agricultural crops, dairy farming, or recreation. Habitation and industry sparse. Level II - Predominantly single and two family residences, small farms, and limited commercial services and industrial development. Level III - Densely populated, primarily commercial office buildings, department stores, and light industries in small and medium metropolitan complexes, or suburban areas of limited commercial and industrial development near large metropolitan complexes. Level IV - Densely populated, primarily commercial office buildings, department stores, and industries in large metropolitan complexes, or areas of heavy industry.	Applicable	Air quality standards for the Tonawanda site will be set by Part 257 and the appropriate level assigned to the site.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York Ambient Air Quality Standards - General Application	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-1.3 (BNA)	Emissions in a classified area shall be controlled to the extent required by the Commissioner to be compatible with standards established in other areas. Ambient air concentrations shall be determined in accordance with the procedures and techniques as specified in the standard or in accordance with other methods or techniques acceptable to the commissioner. The Commissioner may publish acceptable methods from time to time.	Applicable	
Compliance	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-1.4 (BNA)	Prohibits the emission of contaminants from an emission source which alone or in combination with emissions from other sources cause contravention of air quality standards. Prohibits the emissions of odorous, toxic, or deleterious substance in concentrations or of such duration that will affect human health or well-being, or unreasonably interfere with the enjoyment of property or unreasonably and adversely affect plant or animal life.	Applicable	Applies to remediation activities that include a controlled air emission source. May be applicable or relevant and appropriate if excavation equipment exhaust and fugitive dust contribute significantly to air quality ranking for region.
Air Quality Standards - Particulates	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-3 (BNA)	Sets forth measurement techniques, sampling frequencies, 24-hour, annual, 30-day, 60-day and 90-day standards for suspended particulates, and 12-month standard for settleable particulates (dustfall).	Applicable	

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Air Quality Standards - Particulates (continued)	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-3.3 (BNA)	Establishes the following standards for suspended particulates: • For any 24- hour period the average concentration shall not exceed 250 $\mu g/m^3$ more than once a year. • During any 12 consecutive months, the geometric mean of the 24-hour average concentrations shall not exceed: Level I - 45$\mu g/m^3$ Level II - 55$\mu g/m^3$ Level III - 65$\mu g/m^3$ Level IV - 75$\mu g/m^3$ • During any 30 consecutive days, the arithmetic mean of the 24-hour average concentrations at any location shall not exceed: Level I - 80$\mu g/m^3$ Level II - 100$\mu g/m^3$ Level III - 115$\mu g/m^3$ Level IV - 135$\mu g/m^3$ • During any 60 consecutive days, the arithmetic mean of the 24-hour average concentrations at any location shall not exceed: Level I - 70$\mu g/m^3$ Level II - 85$\mu g/m^3$ Level III - 95$\mu g/m^3$ Level IV - 115$\mu g/m^3$		

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Air Quality Standards - Particulates (continued)	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-3.3 (BNA) (continued)	• During any 90 consecutive days, the arithmetic mean of the 24-hour average concentrations at any location shall not exceed: Level I - 65μg/m^3 Level II - 80μg/m^3 Level III - 90μg/m^3 Level IV - 105μg/m^3 Standards described for 30, 60, and 90 consecutive days are intended for enforcement purpose. Monitoring will be performed only as required.		
Standard for Settleable Particulates	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-3.4 (BNA)	Settleable particulates (dustfall) standards. • During any 12 consecutive months, 50 percent of the values of the 30-day average concentrations shall not exceed: Level I - 0.30mg/cm^2/mo Level II - 0.30mg/cm^2/mo Level III - 0.40mg/cm^2/mo Level IV - 0.60mg/cm^2/mo During any 12 consecutive months, 84 percent of the values of the 30-day average concentrates shall not exceed: Level I - 0.45 mg/cm^2/mo Level II - 0.45 mg/cm^2/mo Level III - 0.60 mg/cm^2/mo Level IV - 0.90 mg/cm^2/mo	Applicable	

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92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Air Quality Standard - Carbon Monoxide Standard	N.Y. COMP. CODES R. & REGS. tit. 6, § 257-4.3 (BNA)	Establishes the following carbon monoxide standards: • For an 8-hour period, the average concentration of carbon monoxide shall not exceed 9 ppm[4] more than once in any 12 consecutive months; • For a 1-hour period, the average concentration of carbon monoxide shall not exceed 35 ppm[5] more than once in any 12 consecutive months.	Applicable	Applicable to all levels identified in § 256.
Air Quality Standard - Photochemical Oxidants	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-5 (BNA)	Establishes the following photochemical oxidants standards: • In any one hour period, the average concentration of photochemical oxidant shall not exceed 0.08 ppm[6] more than once in any 12 consecutive months.	Applicable	Applicable to all levels identified in Part 256. An equivalent method for measurement may be approved by the commissioner.
Air Quality Standard - Hydrocarbons (Non-Methane)	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-6 (BNA)	Establishes the following hydrocarbons (Non-Methane)standard: • During the three hour period from 6 to 9 a.m., the average non-methane hydrocarbon concentration must not exceed 0.24 ppm[7] more than once in any 12 consecutive months.	Applicable	Applicable to all levels identified in Part 256. Other methods of measurement may be approved by the commissioner.

[4] Corresponds to Federal Standard of 10 mg/m^3 (at temperature of 25°C and pressure of 760 mm of mercury).

[5] Corresponds to Federal Standard of 160 μg/m^3 (at temperature of 25°C and pressure of 760 mm of mercury).

[6] Corresponds to Federal Standard of 160 μg/m^3 (at temperature of 25°C and pressure of 760 mm of mercury).

[7] Corresponds to Federal Standard of 40 mg/m^3 (at temperature of 25°C and pressure of 760 mm mercury).

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Air Quality Standard - Nitrogen Dioxide	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-7 (BNA)	Establishes the following nitrogen dioxide standards: • During any 12 consecutive months, the annual average of the 24-hour concentrations, shall not exceed 0.05 ppm (100μg/m^3).	Applicable	Applicable to all levels identified in Part 256. Concentration may be determined by method specified or an equivalent method approved by the commissioner.
Air Quality Standard - Fluoride	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-8 (BNA)	Establishes the following fluoride standards: • Total fluorides, ppm, dry weight basis (as F), in and on forage for consumption by grazing ruminants. Average concentration shall be less than the following for all levels: -For growing season (not to exceed 6 consecutive months)--40 ppm -For any 60-day period--60 ppm -For any 30-day period--80 ppm • Gaseous fluorides in air (ppm of air) as F--all levels (25 degrees Centigrade, 760mm Hg) -12-hour averages to be less than 4.5 ppb (3.7 μg/m^3) -24-hour averages to be less than 3.5 ppb (2.85 μg/m^3) -1 week average to be less than 2.0 ppb (1.65 μg/m^3) -1 month averages to be less than 1.0 ppb (0.8 μg/m^3)	Applicable	Applicable to all levels identified in Part 256.
Air Quality Standards - Beryllium	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-9 (BNA)	Requires that during any month, the average concentration of beryllium shall not exceed 0.01 μg/m^3.	Applicable	Identifies measurement methodology.
Air Quality Standards - Hydrogen Sulfide	N.Y. COMP. CODES R. & REGS. tit. 6, Subpart 257-10 (BNA)	Establishes the standard that in any 1-hour period, the average concentration of hydrogen sulfide shall not exceed 0.01 ppm (14 μg/m^3).	Applicable	Applicable to all levels identified in Part 256. Identifies measurement methodology.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York Waste Transport Permit Regulations	N.Y. COMP. CODES R. & REGS. tit. 6, § 364.1 (BNA)	The collection, transport, and delivery of regulated waste, originating or terminating at a location within New York, will be governed in accordance with Part 364.	Applicable	Applicable if site's wastes fall into regulated categories.
Permit Requirements	N.Y. COMP. CODES R. & REGS. tit. 6, § 364.2 (BNA)	Without a valid permit regulated waste will not be: • collected or removed from its point of origin, generation, or occurrence; • transported; • delivered to any TSD facility or otherwise disposed or relinquished; • landspread septage; or • landspread sewage sludge.	Applicable	Although a permit is not required, the substantive provisions of the regulation must be met if site's wastes fall into regulated categories.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Permitting Standards	N.Y. COMP. CODES R. & REGS. tit. 6, § 364.4 (BNA)	A decision to issue or deny a permit for the transport of a regulated waste is based on: • Status of receiving facility: Receiving facility must be authorized to accept such waste, must operate under an active department issued order on consent, provide proof of authorization to operate if facility is outside the jurisdiction of New York, or if facility is not required by the state to be licensed, permitted, or certified to operate. • Compliance status of receiving facility. • Compliance history and reliability of applicant. Waste transporter permit may be denied, revoked, suspended, or modified based on the unsuitability of the applicant (under provisions of Environmental Conservation Law § 27-0913). Waste transporter permits may be denied, revoked, suspended, or modified if the receiving facility has been determined to have violated any law, rule, or regulation or permit condition related to the operation of its TSD facility.	Applicable	Applicable to waste transporters of regulated waste from the Tonawanda site associated with remedial actions.
Vehicle/Operation Requirements	N.Y. COMP. CODES R. & REGS. tit. 6, § 364.6 (BNA)	Governs conditions under which regulated wastes may be transported.	Applicable	Applicable to transport of regulated waste from the Tonawanda site during remedial activities.

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92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Hazardous and Low-level Radioactive Waste Manifest Systems	N.Y. COMP. CODES R. & REGS. tit. 6, §§ 364.7-8 (BNA)	Transporters of hazardous and low-level radioactive waste shall comply with applicable waste manifest systems (Part 372).	Applicable	Applicable to transporters of hazardous waste, if wastes generated are regulated wastes.
New York Rules on Hazardous Waste Program Fees Fees Related to Clean-up, Remediation, or Corrective Action	N.Y. COMP. CODES R. & REGS. tit. 6, § 483.4 (BNA)	Generator fees shall not be payable for waste resulting from services which are provided: • under contract with the department, EPA, or a court order related to the clean-up or remediation of a hazardous material or hazardous waste spill, discharge, or surficial clean-up, pursuant to ECL or a removal action pursuant to CERCLA; • under contract for or with approval of department for clean-up and removal of petroleum spill or discharge; • under the order of a court, the Department of Health, EPA, or CERCLA related to an inactive hazardous waste disposal site; • voluntarily and without expectation of monetary compensation in accordance with subdivision 1 of ECL § 27-1321; or • under permit or order requiring corrective action pursuant to title 9 of ECL article 27 or RCRA.	Applicable	Applicable to the clean-up, remediation, or corrective action associated with the Tonawanda site if hazardous waste is generated during remediation. DOE's position is that as a federal agency they are exempt from user fees.
Waste Transporter Program Fees	N.Y. COMP. CODES R. & REGS. tit. 6, Part 484 (BNA)	Fee schedules.	Applicable	Applicable if wastes to be transported are included in the regulation.

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92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York Identification and Listing of Hazardous Wastes Regulations	N.Y. COMP. CODES R. & REGS. tit. 6, § 371.3 (BNA) Appendix 23	Lists regulated hazardous waste. Each hazardous waste is assigned an EPA Hazardous Waste Number which must be used in complying with the notification requirements of § 3010 of RCRA or certain recordkeeping and reporting requirements under §§ of this Title. Lists hazardous constituents.	Applicable	Applicable if site's wastes are listed hazardous wastes.
New York Hazardous Waste Manifest System Regulations	N.Y. COMP. CODES R. & REGS. tit. 6, § 372.2 (BNA)	General standards and specific manifest requirements for generators of hazardous waste.	Applicable	Applicable if Tonawanda site meets the criteria of a generator of hazardous materials as defined in N.Y. COMP. CODES R. & REGS. tit. 6, § 372.1 (d).
New York Water Classifications and Quality Standards	N.Y. COMP. CODES R. & REGS. tit. 6, Part 701 (BNA) N.Y. COMP. CODES R. & REGS. tit. 6, Part 702 (BNA) N.Y. COMP. CODES R. & REGS. tit. 6, Part 703 (BNA)	Lists classifications of surface waters and groundwaters. Sets forth procedures for deriving standards and guidance values for implementing the control of toxic and deleterious substances. Surface water and groundwater quality standards and groundwater effluent standards.	Applicable	Do not violate or exceed the established MCL or specific levels established for principal organic contaminants. Substances belonging to the principal organic contaminant classes and for which there is no specific MCL, the standard or guidance value shall be 5 μ/L or a less stringent value as determined by the Commissioner of the N.Y. State Department of Health. Substances that do not have an applicable health (water source) standard in Section 703.5 and that the Department determines may pose a threat to human health if discharged into the waters of the state shall be determined by the requirements of Section 702.15. Does not incorporate federal standards.
Implementation of SPDES Program in New York	N.Y. COMP. CODES R. & REGS. tit. 6, §§ 750-758 (BNA)	Regulates permitted releases into waters of the state.	Applicable	

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92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York Water Pollution Control Regulations - Use and Protection of Waters	N.Y. COMP. CODES R. & REGS. tit. 6, § 608.4 (BNA)	Regulates excavation or fill in any of the navigable waters of the state or in adjacent marshes, estuaries, tidal marshes, and wetlands.	Applicable	Applicable if the remedial activities for the Tonawanda site require excavation from or placing fill in any of the navigable waters of the state or in marshes, estuaries, tidal marshes, and wetlands.
NEW YORK FRESHWATER WETLANDS ACT	N.Y. ENVTL. CONSERV. LAW art. 24 (BNA)	Regulates the use and development of wetlands.	Applicable	May be applicable if the remedial alternative involves draining or dredging.
NEW YORK ENVIRONMENTAL CONSERVATION LAW - Water Pollution Control	N.Y. ENVTL. CONSERV. LAW art. 17 (BNA)	Do not discard organic or inorganic matter into waters during remedial activities without first obtaining an SPDES permit.	Applicable	
Permit for Outlet Point Source and for Disposal System Required	N.Y. ENVTL. CONSERV. LAW § 17-0701 (BNA)	Regulates point sources for the discharge of sewage, industrial waste or other wastes or effluents into the waters of the state of New York.	Applicable	§ 17-0105.2. "Waters" or "waters of the state" shall be construed to include lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic ocean within the territorial limits of the state of New York and all other bodies of surface or underground water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or affect a junction with natural surface or underground waters), which are wholly or partially within or border in the state or within its jurisdiction.
NEW YORK ENVIRONMENTAL CONSERVATION LAW	N.Y. ENVTL. CONSERV. LAW art. 37 (BNA)	Governs the storage or release to the environment of substances hazardous or acutely hazardous substances to public health, safety, or the environment.	Applicable	
Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste	N.Y. COMP. CODES R. & REGS., tit. 6, § 371.2 (BNA)	Classification of Hazardous Waste.	Applicable	Applies to transportation and all other hazardous waste management practices in the State of New York. Applicable if hazardous waste is generated during remediation.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York State Hazardous Waste Manifest System Regulations	N.Y. COMP. CODES R. & REGS., tit. 6, § 372.1 (BNA)	Establishes standards for generators and transporters of hazardous waste on the manifest system and recordkeeping requirements.	Applicable	All Tonawanda site waste shipments must be properly manifested, in accordance with applicable New York State and federal requirements. Applicable if hazardous waste is generated during remediation.
	N.Y. COMP. CODES R. & REGS., tit. 6, § 372.1 (BNA) (continued)	Regulates hazardous waste transportation manifesting and manifest recordkeeping requirements. Also includes spill response and reporting requirements.	Applicable	Applicable to transporters if hazardous waste is transported during remediation.
Shipments by Rail or Water	N.Y. COMP. CODES R. & REGS., tit. 6, § 372.7 (BNA)	Outlines shipping documentation requirements for bulk rail and water shipments.	Applicable	Applicable if either of these modes is selected for Tonawanda site waste shipments, if generated wastes are hazardous.
	Appendix 30	Instructions for the Uniform Hazardous Waste Manifest	Applicable	Supplements EPA manifest requirements, if generated wastes are hazardous.
New York Solid Waste Management Facilities Rules	N.Y. COMP. CODES R. & REGS., tit. 6, Part 360 (BNA)	Regulate Solid waste management facilities, other than hazardous waste management facilities subject to Part 373 or 374 of this Title [6], and facilities managing radioactive (NARM) waste, and low-level radioactive waste subject to Parts 380, 382 and 383 of this Title [6], located wholly within the State of New York.	TBC	See next entry for proposed amendment.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Proposed Revisions/Enhancements to New York State's Solid Waste Management Regulations	N.Y. COMP. CODES R. & REGS., tit. 6, Part 360 (360-1 NYSDEC Draft, 10/92) (Proposed)	Regulates solid waste management facilities and facilities managing radioactive materials, naturally-occurring and accelerator-produced radioactive (NARM) waste, and low-level radioactive waste that are subject to [Part] Parts 380, 382 and 383 of this Title. All solid waste other than low-level radioactive waste and NARM waste as defined in Part 382 of this Title which is required to be disposed of at a land disposal facility subject to regulation under Parts 382 and 383 of this Title and other than hazardous waste as defined in Part 371 which is required to be managed at a facility subject to regulation under Part 373 or 374 of this Title must be transferred, processed, recovered, stored, reclaimed or disposed of in a manner consistent with this Part. However, the management of nonhazardous solid waste in a portion of a facility that also handles hazardous waste is subject to the requirements of Part 373 of this Title unless exempted under that Part. Any facility [permitted] authorized under Part 373, 374, [or] 382, or 383 of this Title [or having interim status under Part 373] is not regulated under this Part.	TBC	§ 360-1.2(a)(1) "Solid waste" . . . does not include source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923) except as may be provided by existing agreements between the State of New York and the government of the United States. § 360-1.2(b)[145]152 "Solid waste management facility" means any facility employed beyond the initial solid waste collection process and managing solid waste, including but not limited to: storage areas or facilities; transfer stations; rail-haul or barge-haul facilities; landfills; disposal facilities; solid waste incinerators; refuse-derived fuel processing facilities; pyrolysis facilities; C&D debris processing facilities; [landspreading] land application facilities; composting facilities; surface impoundments . . . and includes all contiguous land and structures, other appurtenances, and improvements on the land used for the proposed management or disposal of solid waste.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
New York Hazardous Waste Management System Regulations - General	N.Y. COMP. CODES R. & REGS., tit. 6, Part 370 (BNA)	Provides definitions of terms and general standards applicable to Parts 370 through 374, and 376 of this Title [6].	TBC	Definitions for solid and hazardous waste given in section 371.1: "Solid waste" is any discarded material not excluded under § 371.1(e)(1); § 371.1(e)(1)(iv) states that radioactive materials which are source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, are not solid wastes. § 371.1(d) states that a "hazardous waste" is a solid waste that is not excluded under paragraph (e)(2), and exhibits any of the characteristics of hazardous waste identified in section 371.3: ignitability, corrosivity, reactivity, or toxicity; a solid waste that is listed in and not excluded from section 371.4; or a mixture of solid waste and hazardous waste that is listed in section 371.4 solely because it exhibits one or more of the characteristics of hazardous waste identified in section 371.3.
New York Rules for Inactive Hazardous Waste Disposal Sites - Hazardous Waste Disposal Site Remedial Program	N.Y. COMP. CODES R. & REGS., tit. 6 Part 375 (BNA)	Applies to development and implementation of programs under the authority of, ECL art. 27, tit. 13.	Applicable	Incorporates the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300, by reference. Effective 5/30/92.
Ambient Water Quality Standards and Guidance Values (9/90)	NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1	Provides standards/guidance values for ambient concentrations of toxic and nonconventional pollutants in surface and groundwater used by NYSDEC in SPDES permitting.	TBC	Consider if remedial action requires obtaining an SPDES Permit.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

Table F-1. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Applicable or Relevant and Appropriate	Comment
Underground Injection/Recirculation - Groundwater Remediation Sites (5/87)	NYSDEC TOGS 2.2.3	Provides guidance to SPDES permitting where groundwater remediation is proposed.	TBC	To Be Considered if remedial action requires obtaining an SPDES Permit.
Primary and Principal Aquifer Determinations (5/87)	NYSDEC TOGS 2.1.3	Provides guidance on determining water supply aquifers in upstate New York.	TBC	
New York Environmental Quality Review Regulations	N.Y. COMP. CODES R. & REGS. tit. 6, Part 617 (BNA)	Implements provisions of State Environmental Quality Review Act (SEQR)	TBC	§ 617.16 Actions involving a federal agency. When draft and final EIS has been prepared under NEPA, an agency shall have no obligation to prepare an additional EIS under this part. Where a finding of no significant impact (FNSI) or other written threshold determination that the action will not require a Federal impact statement has been made under NEPA, that determination does not automatically constitute compliance with SEQR. In the case of an action involving a Federal agency for which either a Federal FNSI or a Federal draft and final EIS has been prepared, except where otherwise required by law, a final decision by a Federal agency shall not be controlling on any State or local agency decision on the action.

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR considerations.

92-048P/102793

Table F-2. Potential Location-Specific ARARs for the Remediation of the Tonawanda Site

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
National Historic Preservation Act	16 USC § 470 (1992, as amended) 40 *CFR* § 6.301(b) (1992) 36 *CFR* § 800 (1992)	Requires Federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP).	Applicable
Archeological and Historical Preservation Act	16 USC § 469 (1992, as amended) 40 *CFR* § 6.301(c) (1992)	Establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.	Applicable
Historic Sites, Buildings, Objects, and Antiquities Act	16 USC §§ 461-469 (1992, as amended) 40 *CFR* § 6.301(a) (1992)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on each landmark.	Applicable
Fish and Wildlife Coordination Act	16 USC §§ 661-668ee (1992, as amended) 40 *CFR* § 6.302(g) (1992)	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.	Applicable
Dredge or Fill Requirements (§ 404)	40 *CFR* Parts 230 and 231 (1992) 33 *CFR* §§ 320-330 (1992)	Requires permits for discharge of dredged or fill material into waters of the United States, including wetlands. General regulatory policies on permitting.	May be applicable
Floodplain Management/ Wetlands Protection	Executive Order No. 11988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	TBC

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR consideration.

92-048P/102793

Table F-2. (continued)

Regulation, Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Floodplain Management/ Wetlands Protection (continued)	Executive Order No. 11990 40 *CFR* § 6.302(b) Appendix A (1992)	Requires Federal agencies to evaluate the potential effects of actions on wetlands and to avoid undertaking, to maximum extent possible, actions negatively impacting wetlands. Procedures on floodplain management and wetlands protection.	TBC Applicable
DOE Compliance with Floodplain/Wetland Review Requirement	10 *CFR* 1022 (1992)	Implements Executive Orders 11988 and 11990	May be applicable

NOTE: The most current version/amendment of the cited regulation, standard, requirement, criteria, or limitation in effect will be used for ARAR consideration.

92-048P/102793

Table F-3. Water Quality ARARs and Drinking Water Health Advisories Chemicals in Groundwater and Surface Water, Tonawanda Site, New York

Chemical	State Drinking Water MCLs (μg/L)	MCLs(a) (μg/L)	P.MCLs(a) (μg/L)	MCLGs(b) (μg/L)	P.MCLGs(b) (μg/L)	FWQC-HH(c) Human Health: Adjusted for Drinking Water Only (μg/L)	FWQC-A(c) Freshwater Acute Value: Aquatic Life (μg\L)	FWQC-C(c) Freshwater Chronic Value: Aquatic Life (μg/L)	Federal Drinking Water Health Advisories			
									One-Day 10 KG(k) (μg/L)	Ten-Day 10 KG(k) (μg/L)	Longer-Term 70-KG(m) (μg/L)	Lifetime Health Advisory (μg/L)
INORGANICS												
Aluminum			0.05-0.2 e									
Arsenic	50	50		50 d								
Barium	100	2000	5000	2000								2000
Boron									4000	900	3000	600
Cadmium	10	5	5 d	5	5 d	10	3.9	1.1	43	43	20	5
Chromium (III)	50					179000	1700	210				
Chromium (VI)	50	50	100 d		100 d	50	16	11	1000	1000	800	100
Copper		1300 d		1300 d		1000 g	18	12				
Iron		300 e						1000				
Lead	50	5	5	0 d		50950	82	3.2			20 μg/day	
Manganese		50 e										
Nickel		100		100		15.4	1400	160	1000	1000	600	100
Nickel		0.1 mg/L t		0.1 mg/L t								
Potassium												
Selenium	10	50	50 d	50	50 d	10	280	35				
Zinc		5000 e				5000 g	120	110	4000	4000	9000	2000
ORGANICS												
Benzene		5		0		0.67 f	5300		200	200		
Bis(2-Ethylhex)phthlate			4 p		0 p	21000	400	360				

Table F-3. (continued)

Chemical	State Drinking Water MCLs (µg/L)	MCLs(a) (µg/L)	P.MCLs(a) (µg/L)	MCLGs(b) (µg/L)	P.MCLGs(b) (µg/L)	FWQC-HH(c) Human Health: Adjusted for Drinking Water Only (µg/L)	FWQC-A(c) Freshwater Acute Value: Aquatic Life (µg\L)	FWQC-C(c) Freshwater Chronic Value: Aquatic Life (µg/L)	Federal Drinking Water Health Advisories			
									One-Day 10 KG(k) (µg/L)	Ten-Day 10 KG(k) (µg/L)	Longer-Term 70-KG(m) (µg/L)	Lifetime Health Advisory (µg/L)
Chlorobenzene			100 d		100 d	488	250	50	4000	4000	7000	100
1,2-Dichlorobenzene		600	600 d	600	600 d	470	1120	763	9000	9000	30000	600
trans-1,2-Dichloroethylene		100	100 d	100	100 d		11600		20000	2000	6000	100
1,2-Dichloroethylene			5 d		0 d		23000	5700		90		
Toluene		1000	1000 d	1000	1000 d	15000	17500		20000	2000	7000	1000
Trichloethene		5		0		2.8 f	45000	21900				
Vinyl chloride		2		0		2 f			3000	3000	50	
PESTICIDES/PCBs												
Arochlor 1254*		0.5	0 d,n	0	3 d,n	>0.0126 f	2	0.014				
4,4'-DDT						>0.0012 f	1.1	0.001				
Endosulfan I						138	0.22	0.056				

Table F-3. (continued)

Chemical	State Drinking Water MCLs (μg/L)	MCLs(a) (μg/L)	P.MCLs(a) (μg/L)	MCLGs(b) (μg/L)	P.MCLGs(b) (μg/L)	FWQC-HH(c) Human Health: Adjusted for Drinking Water Only (μg/L)	FWQC-A(c) Freshwater Acute Value: Aquatic Life (μg\L)	FWQC-C(c) Freshwater Chronic Value: Aquatic Life (μg/L)	Federal Drinking Water Health Advisories			
									One-Day 10 KG(k) (μg/L)	Ten-Day 10 KG(k) (μg/L)	Longer-Term 70-KG(m) (μg/L)	Lifetime Health Advisory (μg/L)
RADIONUCLIDES												
Beta particles and photon activity (formerly man-made radionuclides)		4 mrem/yr r	4 mrem ede/yr s	0	0							
Gross alpha particle activity		15 pCi/L	15 pCi/L	0	0							
Radium-226/228		5 pCi/L	20 pCi/L	0	0							
Radon-222			300 pCi/L	0	0							
Uranium			20 μg/L	0	0							
All other man-made radionuclides		4 mrem/yr										

* Values entered for unspecified PCB congeners
a. Maximum Containment Levels established under the Safe Drinking Water Act. (Referenced in Fact Sheet: Drinking Water Regulations under the Safe Drinking Water Act, May 1990, unless otherwise specified.)
b. Maximum Containment Level Goals established under the Safe Drinking Water Act. (Referenced in Fact Sheet: Drinking Water Regulations under the Safe Drinking Water Act, May 1990, unless otherwise specified.)
c. Federal Ambient Water Quality Criteria (FWQC) for human health and aquatic life established under the Clean Water Act.
d. Proposed MCL or MCLG. Proposed in Federal Register Vol. 56, No. 20, Wednesday, January 30, 1991.
e. Secondary Maximum Containment Level (SMCL) established under the Safe Drinking Water Act - not an ARAR.
f. FWQC - HH for human health corresponding to the 10-6 risk level.
g. Criterion established based on taste and odor effects organoleptic), not human health effects.
h. Maximum Containment Level for total trihalomethanes: the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
i. FWQC - HH for halomethanes as a class of compounds corresponding to the 10-6 risk level. Methylene chloride (dichloromethane) is a member of this class and this group.
j. Federal drinking Water Health Advisories are not ARARs but values to be considered (TBC) in evaluating the significance of observed levels of contamination in drinking water supplies. Information obtained for USEPA (1986, 1987 1,b,c).
k. Drinking Water Health Advisory for a 10 kg child. Taken from Drinking Water Regulations and Health Advisories, April 1991.
m. Drinking Water Health Advisory for a 70 kg adult. Taken from Drinking Water Regulations and Health Advisories, April 1991.
n. Proposed for PCBs as docachlorobiphenyl.
p. Proposed July 25, 1990.
q. USEPA has proposed two MCLs based upon PQLs of five times the MDL.
r. Any organ or whole body.
s. Effective dose equivalent.
t. EPA: Final MCL or MCLG. 57 Fed. Reg. 31776, Friday, July 17, 1992.

Table F-4. Documentation of ARARs

Action Specific	Alternative 1 No Action	Alternative 2 Complete Excavation/Offsite Disposal	Alternative 3 Complete Excavation/Onsite Disposal	Alternative 4 Partial Excavation/Offsite Disposal	Alternative 5 Partial Excavation/Onsite Disposal	Alternative 6 Containment
UMTRCA Disposal Cell Design	—	Disposal cell design will comply.	Disposal cell design will comply.	Disposal cell design will comply.	Disposal cell design will comply.	—
CWA, Section 404	—	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.
Floodplain/Wetland	—	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.	Permits will be obtained for dredging activities.
DOE Compliance with Floodplain/Wetland Review Requirements	—	Notifications will be made for floodplain/wetland activities.	Notifications will be made for floodplain/wetland activities.	Notifications will be made for floodplain/wetland activities.	Notifications will be made for floodplain/wetland activities.	Notifications will be made for floodplain/ wetland activities.
N.Y. Solid Waste Regulations (Part 360)	—	—	Waiver required to allow onsite disposal of rad. materials if Seaway selected.	—	Waiver required to allow onsite disposal of rad. materials if Seaway selected.	—
DOE 5400.5 (also UMTRCA) 5 pCi/g - 15 pCi/g Uranium 50 pCi/g	Will not comply	Will comply through complete excavation.	Will comply through complete excavation.	Supplemental standards will be required for all contaminated soils left in place.	Supplemental standards will be required for all contaminated soils left in place.	Supplemental standards will be required for all contaminated soils left in place.
NESHAP	—	Will comply during excavation activities through engineering controls.	Will comply during excavation activities through engineering controls.	Will comply during excavation activities through engineering controls.	Will comply during excavation activities through engineering controls.	Will comply during excavation activities through engineering controls.

APPENDIX G

TONAWANDA SITE FS/PP-EIS COST ANALYSIS INFORMATION

APPENDIX G

TONAWANDA SITE FS/PP-EIS COST ANALYSIS INFORMATION

This appendix provides backup information for the cost analysis portion of this document. General cost assumptions and information is provided in Sections G.1 through G.7. Direct capital and O&M cost estimates for each alternative are provided in Table G-1 through G-41. The 30-year present worth costs (using 0, 5 and 10%) are also presented in these tables and form the basis of a sensitivity analysis. The cost estimates are expected to provide an accuracy of +50% to -30% and are prepared using data available from the RI.

Costs for additional studies such as a detailed environmental impact assessment for a new offsite disposal facility have not been included in these estimates. A modest allocation for legal costs, siting studies, and the inventory of environmental impacts has been included in indirect costs under engineering design and contingency allowances. However, the actual costs for these activities could increase significantly due to the present uncertainty in the respective scopes of services required. The cost estimates in this appendix are based on the remedial action construction activities alone and do not incorporate additional studies or delays. These cost estimates are appropriate only for this feasibility study analysis of alternatives. They should not be extended to other applications. In addition, the actual realized costs for remedial activities at some facilities have been shown to be higher, in some cases, than the calculated cost estimates from available construction cost estimating guides such as Means.

GENERAL COST INFORMATION

Unit and activity prices have been derived from contractors, equipment suppliers, service providers, and from industry standard cost estimating guides. In the majority of instances, unit material, labor, and equipment prices including contractor's overhead and profit have been derived from Means Heavy Construction Cost Data, 1992.

G.1 EXCAVATION AND BACKFILLING

Excavation and backfilling costs include, respectively, the costs of excavating and stockpiling contaminated soils. Costs for restoring properties to their pre-remedial action condition are presented within the direct cost tables under the heading, Site Restoration. Costs are based on equipment and labor usage rates obtained from Means (1992) for the estimated volumes of contaminated soil. No operating and maintenance costs are associated with excavation and backfilling. Eight radiation technicians are assumed to be used at each remediation property and a foreman is assumed to be on the project for the entire duration.

The estimated cost of excavation activities in radiologically-contaminated areas have been modified by a factor of 2.5 (increase in labor and equipment). Excavation activities at the

Seaway landfill (Areas B and C) have been modified by a factor of 1.5 (increase in labor and equipment).

Certain construction activities can run concurrently resulting in an overall shortened project duration. Conversely, weather-related delays can extend the duration of construction activities. Therefore, for estimating purposes the construction durations for site development, building and services, and excavation/backfill are assumed cumulative.

It is assumed that backhoes and front end loaders are used for excavating at the site. Spreading and compaction of backfill is assumed to be at the same production rate as excavation. Dump trucks are assumed to haul backfill soil from borrow areas at the same rate as that of the excavation activity. Material cost estimates do not include equipment decontamination activities.

Additional assumptions are as follows:

- Percent to account for over-excavation = 20, (included in BNI volume estimates).
- Percent swell of excavated soil = 30.
- Volume of backfill soil is assumed to be equal to volume of excavated soil (includes volume of removed pavement) + volume of excavated wetland sediment - volume of asphalt to be replaced.
- Weight of soil = 120 lbs. per ft^3.
- For the partial excavation alternatives (4 and 5), soil will not be removed from below Building 30 (until the building is vacated and demolished by Linde) nor from Areas B and C of Seaway. Building 30 will be decontaminated to allow on-going operations until the decision is made to vacate and demolish the structure.
- Dump truck capacity = 9.5 yd^3 for 12 yd^3 trucks (onsite movements); 16 yd^3 for 20 yd^3 trucks (offsite movements).
- In-place containment cap (Alternative 6) utilizes 2 ft clay and 1 ft topsoil.
- Work week composed of 5, 8-hr days or 40 hours/week. There are 35 work weeks/year (8 months).
- Construction crew rates based on hourly rate with overhead and profit (O&P).
- Equipment rates based on monthly rental rates plus hourly fuel and maintenance cost.
- Material cost based on bare costs plus O&P.

G.2 DISPOSAL

Disposal costs include all construction costs related to the disposal cell construction or disposal fees for the generated waste materials. Offsite disposal costs are evaluated for six options, which include: 1) new in-state FUSRAP facility, 2) new out-of-state eastern FUSRAP national facility, 3) new out-of-state western FUSRAP national facility, 4) existing DOE facility, 5) commercial facility, and 6) beneficial re-use. Disposal fees are evaluated for an offsite facility generally conforming to the design concept of the onsite facilities. Disposal fees for FUSRAP facilities do not take into account any fees which may result due to delays.

The new FUSRAP (onsite or offsite) facility is assumed to be a land encapsulation type facility. The bottom of the facility will be lined with a 0.9 m (3 ft) thick layer of low permeability clay. Compacted soil dikes around the perimeter of the disposal area will serve as the side walls of the containment area. The dikes will be a minimum of 2.5 m (8 ft) wide at the top and would have 2:1 slopes on the interior side. Ramps will be constructed over the dikes to allow truck access to the disposal cells. These ramps will be removed as the cells are filled with material.

After the facility is filled, a .9 m (3 ft) cap of compacted low permeability clay will be added to seal the waste from infiltration. A 23 cm (9 in) layer of sand will be placed over the clay to provide a drainage layer for infiltrating water as well as a cushion between the clay and the riprap above. The riprap layer will be 0.9 m (3 ft) thick over the sand layer to serve as a barrier to human intrusion and to prevent plant root disturbance of the clay layer. The surface of the riprap layer will be filled with rock spoil and sand to provide a base for the cover layers. The cover layers will be placed over the riprap beginning with a 23 cm (9 in) sand transition filter layer between the riprap and topsoil. A 46 cm (18 in.) layer of fine grained, medium permeability topsoil will inhibit water infiltration, enhance runoff, support grass growth, prevent radical temperature changes to the layers below, and be self- healing with respect to drought related cracks. A shallow-rooted grass will be seeded in the topsoil to minimize erosion damage to the cover and enhance evapotranspiration of water that does infiltrate the topsoil.

Office space will be provided near the entrance to the facility for administrative personnel during the construction and closure of the site. A maintenance trailer will be required for: maintenance shop; laundry facility for protective clothing; shower/dressing room; health physics lab; and equipment storage. An enclosed equipment decontamination facility sized to accommodate equipment as large as dump trucks would be used to decontaminate equipment contaminated by operations. The site will require a gravel road around the disposal facility to provide maintenance monitoring and inspection access. Security lighting will be installed to illuminate the roadway.

Assumptions specific to the FUSRAP-dedicated disposal facilities include:

General

- All waste material will be brought in from offsite by dump truck (in the case of onsite or in-state facilities) or rail transport.
- All replacement soil and placed waste are assumed to be 95% compacted.
- Costs for cell construction materials (sand, clay, loam, and gravel) are based on in-place compacted volumes.

Site Development and Bottom Liner Construction

- Clay is used for bottom liner construction
- Trailers are used for office space and maintenance facility
- Water treatment facility cost is $100,000 for decon water treatment
- Decontamination facility cost is $60,000
- Front-end loader and backhoe will perform support roles to bulldozer and trucks
- Monitoring wells are assumed to be installed for $3,000 each
- National facility land and in-state land is assumed to cost $10,000/acre
- Pressure transducer network for waste monitoring is assumed to cost $150,000

Waste Emplacement

- Waste cell capacities for complete excavation Alternatives 2 and 3 are approximately 369,000 yd^3.
- Waste cell capacities for partial removal are approximately 336,000 yd^3.
- Construction costs associated with cell components have been increased by a factor of 1.5 (labor and equipment) to cover impacts associated with the handling of radiological waste.
- Costs associated with placing and compacting radiologically-contaminated soils in the cell have been developed by increasing general construction costs by a

factor of 2.5 (labor and equipment) to cover impacts related to the radiological waste.

The costs for constructing, operating, and closing FUSRAP-dedicated engineered waste disposal cells were estimated for the onsite alternatives. Costs to construct and operate cells within the state of New York and outside the state at a national east or west site are assumed to be comparable on a dollar per volume basis. The cost for the onsite cell was broken down to a cost per cubic yard and is used for the cell costs (disposal cost) for the offsite alternatives as presented in Table G-8a for complete excavation and G-22a for partial excavation alternatives. The same tables contain disposal costs for other disposal options evaluated for radioactively contaminated soil. The full range of disposal options considered includes:

- Onsite disposal, new FUSRAP facility
- In-state disposal, new FUSRAP facility
- New National East FUSRAP facility
- New National West FUSRAP facility
- Existing DOE facility
- Existing commercial facility
- Beneficial re-use

It is currently assumed that a user can be identified for beneficial re-use with no disposal fee for the Tonawanda site; further information is pending. There is no additional cost presentation relating to the beneficial reuse option due to the lack of information on potential reuse options at this time.

G.3 TRANSPORTATION

Rail transport has been assumed for all disposal alternatives outside the state of New York. Out-of-state disposal alternatives include national FUSRAP-dedicated facilities east and west, commercial disposal, and disposal at an existing DOE facility. The in-state FUSRAP-dedicated facility is assumed to be within 200 miles of the Tonawanda site and dump trucks would be used for transport. Transportation fees for beneficial re-use are assumed to be the same for the in-state FUSRAP facility.

Onsite disposal will use dump trucks to transport the soil from the excavation site to the disposal facility. This transport cost is included in the cost for site remediation.

Costs for bulk rail transportation of contaminated waste by gondola to the western facilities (FUSRAP National West and commercial), based on vendor quotes, range from $6,835 to $8,275 per rail car (72 yd^3). Costs for bulk transportation to the FUSRAP national east facility by gondola were calculated based on vendor quotes to be $4,860 per rail car. In-state disposal of the waste material is assumed to be within 200 miles of the Tonawanda site with transport by 20 yd^3 dump truck (hauling 16 yd^3) at an estimated $800 per load. The unit costs for transportation can be found in Table G-8a and G-22a.

It is assumed that 3 people (1 equipment operator and 2 laborers) are needed for loading contaminated soils into dump trucks or rail cars for transport offsite. This activity is assumed to run concurrently with the excavation/backfill activities; therefore, in certain alternatives loading crews may be doubled or tripled to keep pace.

In the case of the existing DOE facility (Hanford), bulk transportation by barge has also been considered. Barges pulled by tugboats would travel on the Great Lake system to the St. Lawrence Seaway; south through the Panama Canal, then north and up the Columbia River to Richland, Washington. Each barge would carry 8,000 cubic yards per trip, make about 3 round trips per year, and be towed by a 4,000 hp tug. Material movement would be interrupted during winter months due to icing of the Great Lakes. These cost estimates are presented in Tables G-8a and G-22a.

G.4 ENVIRONMENTAL MONITORING

Costs for environmental monitoring are based on continuation of the present program, if applicable, or on establishing a program. The bi-annual monitoring program would include air, groundwater, surface water, and sediment sampling at designated locations at the remediation sites, and the same program without continued sediment sampling at the engineered disposal cell.

G.5 INDIRECT CAPITAL COSTS

Engineering costs are estimated at 25% of direct capital costs (less transportation costs for offsite alternatives). Conventional engineering services can range up to a maximum of about 15% of capital costs. Therefore, a modest allotment for additional project development services such as legal services, siting studies, basic permitting, and environmental impact evaluation has been incorporated. However, the actual cost for site permitting and licensing could escalate substantially due to the great uncertainty in the respective scope of services and time requirement necessary.

Contingency allowances are estimated at 25% of direct capital costs (less transportation costs for offsite disposal options).

Technical and administrative personnel were assumed to be 1 to 2% of the total capital costs to conduct site construction and operation and maintenance services. The duration of these services is assumed to coincide with the governing construction or operation activity.

G.6 O&M COSTS

Except as noted in the following discussion, annual O&M activities are proposed and cost estimates presented for each year over a thirty year period (as well as during the initial year of remediation, year 0) for all alternatives. The exception to this case is Alternative 2, complete excavation and off site disposal, should either the commercial facility or the existing DOE facility be selected for the disposal site. In these cases the O&M activities relating to the engineered disposal cell will be the responsibility of the receiving facility, and presumably funding for the O&M is included in each facility's disposal charges. In all other cases involving the establishment of a disposal cell, onsite or offsite, an O&M program is proposed.

The O&M costs developed for the no action alternative are limited to bi-annual environmental monitoring for the four Tonawanda properties. Two rounds of sampling per year including 10 sediment samples, 20 air samples, and 20 water samples per round are proposed.

The O&M costs for the containment alternative includes the same sampling activities and includes a $50,000 annual cap maintenance and monitoring well replacement component ($9,000 for well replacements and $41,000 for cap maintenance).

O&M costs for the remaining four alternatives include costs for monitoring the four properties (Site) over the three year construction period and, except as noted above, an O&M program for the disposal cell (Cell). The O&M program for the cell includes $30,000 for the maintenance of the cell, $9,000 for the replacement of monitoring wells and $11,000 for other equipment and property replacement.

Long term O&M activities (beyond year 30) have not been included in the cost estimates. It should be noted that the annual O&M costs could be fully funded from the interest generated by a fund established for the perpetual care of the disposal cell. The annual cost of cell O&M has been estimated to be approximately $200,000. Assuming a real annual rate of return of 3%, a fund of $6.7 million could fund a $200,000 annual program without depleting the fund, therefore establishing a perpetual fund.

G.7 SENSITIVITY ANALYSIS

The sensitivity to changes to different components of each alternative on the total estimated costs (30 year present worth) for each alternative have been calculated and are presented in a summary table for each alternative. The sensitivity to the present worth of each alternative assuming 0%, 5% and 10% discount factors, are presented for each alternative as part of the sensitivity analysis. These discount rates were used based on DOE direction (0%) and EPA guidance on cost estimating for remedial actions. The 0% discount rate was used as the baseline case and the cost estimates presented in the FS text reflect this assumption.

In general, the sensitivity analysis based on differing discount rates does not impact the results of the comparative analysis because the long term monitoring requirements for all alternatives are comparable, and the assumed discount rate would impact the total estimated costs of the alternatives equally. The exception to this involves the comparison between alternatives requiring the inclusion of long term monitoring and maintenance costs in the 30 year present worth costs to the situation of complete excavation and disposal at a facility where the long term O&M responsibility is placed on the facility operators (such as the example sites at Envirocare and Hanford). Presumably, the long term O&M for the disposal cell will be funded through the disposal fee charged at the time of disposal. Because the actual O&M for the disposal cell for FUSRAP waste will require O&M for many years beyond the 30 year period presented, the total cost of the O&M becomes a very large number assuming a 0% discount rate.

To form a realistic basis for comparing the costs related to these two situations (O&M included in the disposal fee vs. O&M costs continually incurred by DOE) a value can be calculated and applied to the 30th year of O&M costs to compensate. As indicated in the discussion of long term O&M, the O&M costs can be funded through a fund established for the perpetual care of the disposal facility. The size of the fund for a $200,000 annual program, as estimated above, would be $6.7 million. To establish a common ground to compare these two cases, the reader could add this $6.7 million to the total cost of alternatives requiring the establishment of a FUSRAP disposal cell, and compare this figure to the commerical and DOE disposal options presented.

For example, the estimated 30 year present worth costs for complete excavation and disposal at a commercial facility is $235,237,000. The estimated 30 year present worth cost for complete excavation and onsite disposal is $76,786,000. To compare these two figures, taking into account long-term (after year 30) monitoring costs, the commercial facility figure would not change but the onsite figure must be adjusted. By adding $6,700,000 to the total based on 30 years of O&M, $83,486,000 results and can be used to compare to the $235,237,000 for the commercial facility.

For the alternatives requiring 30-year O&M programs, the impact of differing O&M annual costs (-30% and +50%) on the total 30 year present worth is presented. No comparative differences result because each alternative will be impacted similarly. For the two offsite disposal alternatives, the highest estimated cost based on using the DOE facility (Hanford) is also presented to illustrate the range of total 30 year present worth costs for the alternatives.

The two onsite disposal options include a presentation of the impact of an increase of the Direct Capital Costs associated with each alternative.

For Alternative 1, the 30 year present worth costs for the alternative vary from a low of $1,221,000 (based on a 10% discount rate) to a high of $5,420,000 (assuming an increase of +50% on O&M). The baseline 30 year present worth cost is $3,616,000.

For Alternative 2, the 30 year present worth costs range from a low of $85,623,000 (based on a 10% discount rate) to a high of $299,990,000 assuming the use of the DOE disposal facility. The base line 30 year present worth cost, assuming the use of a New York FUSRAP site, is estimated at $97,828,000.

For Alternative 3, the 30 year present worth costs range from a low of $66,440,000 (assuming a 10% discount rate) to a high of $94,330,000 (assuming a 25% increase in direct costs). The baseline 30 year present worth cost is estimated at $76,786,000.

For Alternative 4, the 30 year present worth costs range from $68,796,000 (assuming a 10% discount rate) to a high of $262,343,000 (assuming the use of Hanford). The baseline 30 year present worth cost for this alternative assumes the use of a New York state FUSRAP site and is estimated to be $79,370,000.

For Alternative 5, the 30 year present worth costs range from a low of $49,843,000 (assuming a 10% discount rate) to a high of $71,573,000 (assuming an increase of +25% in direct capital costs). The baseline 30 year present worth costs for this alternative are estimated to be $58,581,000.

For Alternative 6, the 30 year present worth costs range from a low of $12,344,000 (assuming a 10% discount rate) to a high of $20,080,000 (assuming a 50% increase in direct capital costs). The baseline 30 year present worth cost estimate for Alternative 6 is $16,752,000.

Table G-1 Alternative 1: No Action
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$0		0
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
5.Relocation costs			
Subtotal	$0		
6. Disposal costs			
Subtotal	$0		
Total direct costs	$0		
INDIRECT CAPITAL COSTS			
1. Engineering and design	$6,000	Sampling plan development	0
2. Contingency allowance	$1,500	25% of Engineering Design & Direct Costs	0
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$0		
TOTAL INDIRECT COSTS	$7,500		0
TOTAL CAPITAL COSTS	$7,500		0

Form A

Date: 6/6/93

Table G-2 Alternative: 1 No Action
Basis of Cost Estimate

Cost Component:

1. Rome Waste Reducer, 1992
2. Waterfront Study, 1992
3. Means Site Work Cost Data, 1991, 10th Edition
4. Means Heavy Construction Cost Data, 1992,
5. Tonawanda Volume Calculation Package, December, 1992
6. Tonawanda Alternative 1 Calculation Package, December, 1992

Date: 6/6/93

Form C

Table G-3 Alternative 1: No Action
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr)/inspection	2/year	0-30
b. Sampling	$16,000	(160 hrs x $50 hr)/round	2/year	0-30
c.				
2. Maintenance: Materials and Labor	$0			
3. Auxiliary:				
4. Purchased Service				
a. Analytical	$74,100	10 sediment samples/round x $495/sample (metals & isotopic analysis)	2/year	0-30
b.		20 air samples/round x $250 /sample (gamma radiation)	2/year	0-30
c.		20 water samples/round x $1,355/sample Semi-vols & isotopic analysis)	2/year	0-30
5. Administration	$23,275	25% of 1-4	Annually	0-30
6. Insurance, Taxes Licenses a. b. c.	$0	N/A	Annually	0-30
7. Maintenance: Reserve and Contingency costs	$0	N/A	Annually	0-30
TOTAL O & M	$116,375			

Form D
Date: 6/6/93

Table G-4 Alternative 1: No Action
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	8															
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
3. Annual Expenditures, x (sum of lines 1 and 2)	124	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	124	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Present Worth ($1000)
1. Capital Cost																
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	
3. Annual Expenditures, x (sum of lines 1 and 2)	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
5. Present Worth (product of lines 3 and 4)	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	$ 3616

Date: 6/6/93

Form E

Table G-4 Alternative 1: No Action
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	8															
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
3. Annual Expenditures, x (sum of lines 1 and 2)	124	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	124	111	106	101	96	91	87	83	79	75	71	68	65	62	59	56

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Present Worth ($1000)
1. Capital Cost																
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	
3. Annual Expenditures, x (sum of lines 1 and 2)	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	53	51	48	43	44	42	40	38	36	34	33	31	30	28	27	$ 1910

Date: 6/6/93

Form F

Table G-4 Alternative 1: No Action
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	8															
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
3. Annual Expenditures, x (sum of lines 1 and 2)	124	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	124	106	96	87	80	72	66	60	54	49	45	41	37	34	31	28

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost																
2. O & M Costs	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	
3. Annual Expenditures, x (sum of lines 1 and 2)	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	Total Present
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	25	23	21	19	17	16	14	13	12	11	10	9	8	7	7	$ 1221

Date: 6/6/93

Form G

Table G-5 Alternative 1: No Action
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC FS Guidance Document, DOE
O & M Costs Sampling, Analysis, Inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling and inspection frequency from semi-annual to quarterly or annual after first year

Form H
Date: 6/6/93

Table G-6 Alternative 1: No Action

Summary of Sensitivity Analysis

Cost Factor	Baseline 0% Discount Rate	Sensitivity Factor Examined/Resulted 5% Discount Rate	10% Discount Rate	-30% in Total O&M	+50% in Total O&M	
Total Capital Costs ($) (x1000) year 0	7.50	7.50	7.50	7.50	7.50	
Present Worth ($) Total O & M $ (x1000)	3,608	1,902	1,213	2,526	5,412	
Total Present Worth $ (x1000)	3,616	1,910	1,221	2,534	5,420	

Form I

Date: 6/6/93

Table G-7 Alternative 2:
Complete Excavation and Offsite Disposal
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$985,153	Site Preparation	0,1,2
	$21,618,504	Site Remediation	0,1,2
	$6,504,328	Site Restoration	0,1,2
Subtotal	$29,107,985		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
5.Relocation costs			
Subtotal	$0		
6. Transportation and Disposal costs	$40,543,064	Trans. and Disp. *	0,1,2
Subtotal	$40,543,064		0,1,2
Total direct costs	$69,651,049		
INDIRECT CAPITAL COSTS		25% of Total direct	
1. Engineering and design	$11,710,012	costs-transportation	0,1,2
2. Contingency allowance	$11,710,012	25% of Total direct costs-transportation	0,1,2
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$0		
TOTAL INDIRECT COSTS	$23,420,024		
TOTAL CAPITAL COSTS	$93,071,073		

NOTE: * Assumes New York FUSRAP Site

Date: 10/15/93

Table G-8 Alternative 2:

Complete Excavation and Offsite Disposal

Basis of Direct Capital Cost Estimate

Cost Item: Direct Construction Costs — Cost Component: Equipment, Labor & Materials

Basis: Excavation of accessible & access restricted soils, demolition of buildings & offsite disposal.

Description	Quantity	Unit Price	Total Costs
1. SITE PREPARATION			
a. Decon & water treat Facilities	2	$110,000 ea	$220,000
b. Silt Fence	21,070 lf	$1.10 lf	$23,177
c. Clean Storm Sewers/Sumps	3,200 lf	$5.00 lf	$16,000
d. Remove / Install RR Spur	1,250 lf	$33.00 lf	$41,250
e. Remove Pavement	22,394 sy	$3.67 sy	$82,186
f. Remove Concrete Slabs	4,647 cy	$125 cy	$580,875
g. Divert / Restore / Creek / Ditches	800 lf	$10.00 lf	$8,000
h. Mob/demob (for 1,2&3)	3 yr	4555 yr	$13,665
2. SITE REMEDIATION			
a. Spray Application Sealants	625,275 sf	$0.85 sf	$531,484
b. Building Demolition	383,400 cf	$2.80 cf	$1,073,520
c. Waste Reducer	10 days	$3,000.00 day	$30,000
d. Excavate Sediments	10,022 cy	$50.00 cy	$501,100
e. Excavate Soils	326,728 cy	$25.00 cy	$8,168,200
f. Water Tank Spray	12 mos	$3,000.00 mo	$36,000
g. Radiation Technicians (8)	525 days	$1,568.00 day	$823,200
h. Seaway Excavation / Refill	510,000 cy	$20.50	$10,455,000
3. SITE RESTORATION			
a. Clean Fill	274,878 cy	$21.00 cy	$5,772,438
b. Loam	12,212 cy	$26.86 cy	$328,014
c. Hydroseeding	659,476 sf	0.041 sf	$27,039
d. Wetland Restoration	1.3 ac	$6,600.00 ac	$8,580
e. Pavement	22,394 sy	$7.28 sy	$163,028
f. 2' Clay Cap @ Seaway	8,923 cy	$23 cy	$205,229
4. OFF-SITE DISPOSAL **			
a. Transportation	456,220 cy *	$50.00 cy	$22,811,000
b. Disposal Cost	369,418 cy	$48.00 cy	$17,732,064
TOTAL DIRECT COSTS			$69,651,049

Notes:

(*) Includes expansion factor of 30%

(**) Assumes New York FUSRAP Site

Form B

Date: 10/15/93

Table G-8a Alternative 2:
Complete Excavation and Offsite Disposal
Basis of Direct Capital Cost Estimate

Cost Item: Direct Construction Costs — Cost Component: Equipment, Labor & Materials

Basis: Offiste and transportation disposal costs

Alternative - Disposal facility	Quantity	Unit Price	Total Costs
A. FUSRAP-New York			
a. Transportation	456,220 cy *	$50 cy	22,811,000
b. Disposal Costs	369,418 cy	$48 cy	$17,732,064
Subtotal			$40,543,064
Total Capital Costs			$93,071,074
B. FUSRAP- East			
a. Transportation	456,220 cy *	$67 cy	$30,566,740
b. Disposal Costs	369,418 cy	$48 cy	$17,732,064
Subtotal			$48,298,804
Total Capital Cost			$100,826,814
C. FUSRAP - West			
a. Transportation	456,220 cy *	$115 cy	$52,465,300
b. Disposal Costs	369,418 cy	$48 cy	$17,732,064
Subtotal			$70,197,364
Total Capital Cost			$122,725,374
D. DOE - Hanford			
1. Rail Transport			
a. Transportation	456,220 cy *	$115 cy	$52,465,300
b. Disposal Cost(2)	456,220 cy *	$300 cy	$136,866,000
Subtotal			$189,331,300
Total Capital Cost			$301,426,278
2. Barge Transport			
a. Transportation	456,220 cy *	$245	$111,773,900
b. Disposal Cost	456,220 cy *	$300	$136,866,000
Subtotal			$248,639,900
			$360,734,878
E. Commercial			
a. Transportation	456,220 cy*	$95	$43,340,900
b. Disposal Costs	456,220 cy*	$216	$98,543,520
Subtotal			$141,884,420
Total Capital Cost			$234,818,158
F. Beneficial Reuse (1)			
a. Transportation	456,220 cy*	$50 cy	$22,811,000

Notes:

(1) Assume end-user provides transportation and material provided free of cost.

(2) Per DOE

* Quantity includes an expansion factor of 30%

Form X

Date: 10/15/93

Table G-9 Alternative 2:
Complete Excavation and Offsite Disposal
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0,1,2
b. Sampling(Site)	$16,000	(160 hrs x $50 hr) / round	2/year	0,1,2
c. Cell inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0-30
d Sampling(Cell)	$16,000	(160 hrs x $50 hr) / round	2/year	0-30
2. Maintenance: Materials and Labor (Cell)	$50,000	Cover maint., well replacement	Annual	0-30
3. Auxiliary:	$0			
4. Purchased Service				
a. Analytical(Site)	$74,100	10 sediment samples / round x $495/sample (metals & isotopes analysis) 20 air samples/round x $250 /sample (gamma) 20 water samples/round x $1,355 /sample (chem)	2/year	0,1,2
b. Analytical(Cell)	$64,200	20 air samples/round 20 water samples/round	2/year	0-30
5. Admin. (Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
6. Insurance, Taxes Licenses				
a.				
b.				
7. Maintenance:				
Res.and Cont.(Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
TOTAL (Site)	$139,650			0,1,2
TOTAL (Cell)	$199,800			0-30

Note: "Cell" Items not included for DOE or Commercial disposal options

Form D

Date: 10/15/93

Table G-10 Alternative: 2
Complete Excavation and Offsite Disposal
Basis of Cost Estimate

Calculation/Source:

1. Rome Waste Reducer, 1992
2. Means Site Work Cost Data 1991, 10th Edition
3. Means Heavy Construction Cost Data, 1992, 6th Annual Edition
4. Tonawanda Volume Calculation Package, December, 1992
5. Tonawanda Alternative 2 Calculation Package, December, 1992
6. BNI, Correspondence between Paul Huber and Mushtaq Khan, April 30, 1993
7. BNI, Correspondence between C. R. Hickey and Mushtaq Khan, May 28, 1993

Date: 10/15/93

Form C

Table G-11 Alternative 2:
Complete Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	31024	31024	31024	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	31363	31363	31363	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	31363	31363	31363	200	200	200	200	200	200	200	200	200	200	200	200	200

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	$99,684

Date: 10/15/93

Form E

Table G-11 Alternative 2:
Complete Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	31024	31024	31024	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	31363	31363	31363	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	31363	29858	28446	173	164	157	149	142	135	129	123	117	111	106	101	96

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	92	87	83	74	75	72	68	65	62	59	56	54	51	49	46	$92,362

Date: 10/15/93

Form F

Table G-11 Alternative 2:
Complete Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	31024	31024	31024	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	31363	31363	31363	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	31363	28509	25906	150	137	124	113	103	93	85	77	70	64	58	53	48

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	
5. Present Worth (product of lines 3 and 4)	44	40	36	33	30	27	25	22	20	18	17	15	14	13	11	$87,315

Date: 10/15/93

Form G

Table G-12 Alternative 2:
Complete Excavation and Offsite Disposal
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC, DOE
O & M Costs sampling, analysis and inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling & inspection frequency from semi-annual to quarterly or annual after first year
Disposal site option	Existing DOE facility	Calculated estimate	DOE

Form H
Date: 10/15/93

Table G-13 Alternative 2:
Complete Excavation and Offsite Disposal

Summary of Sensitivity Analysis

Cost Factor	Baseline	Sensitivity Factor Examined/Resulted				
	0% Discount Rate	5% Discount Rate	10% Discount Rate	-30% in Total O & M	+50% in Total O & M	High end disposal site DOE
Capital Costs ($) (x1000)	93,071	88,697	84,850	93,071	93,071	301,426
Present Worth ($) Total O & M $ (x1000)	6,613	3,665	2,465	4,629	9,920	419
Total Present Worth $ (x1000)	99,684	92,362	87,315	97,700	102,991	301,845

Form I
Date: 10/15/93

Table G-14 Alternative 3:
Complete Excavation and Onsite Disposal
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$995,059	Site Preparation	0,1,2
	$21,618,504	Site Remediation	0,1,2
	$6,504,328	Site Restoration	0,1,2
Subtotal	$29,117,891		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development	$17,664,337	On-site Cell	0,1,2
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$17,664,337		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
5.Relocation costs			
Subtotal	$0		
6. Disposal costs			
Subtotal	$0		
Total direct costs	$46,782,228		0,1,2
INDIRECT CAPITAL COSTS			
1. Engineering and design	$11,695,557	25% of direct costs	0,1,2
2. Contingency allowance	$11,695,557	25% of direct costs	0,1,2
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$23,391,114		
TOTAL INDIRECT COSTS	$23,391,114		
TOTAL CAPITAL COSTS	$70,173,342		

Form A

Date: 9/1/93

Table G-15 Alternative 3:
Complete Excavation and Onsite Disposal
Basis of Direct Cost Estimate

Cost Item: Direct Construction Costs — Cost Component: Equipment, Labor & Materials

Basis: Excavation of accessible & access restricted soils, demolition of buildings & onsite disposal.

Description	Quantity	Unit Price	Total Costs
1. SITE PREPARATION			
a. Decon & water treat Facilities	2 ea	$110,000 ea	$220,000
b. Silt Fence	21,070 lf	$1.10 lf	$23,177
c. Clean Storm Sewers/Sumps	3,200 lf	$5.00 lf	$16,000
d. Remove / Install RR Spur	1,250 lf	$33.00 lf	$41,250
e. Remove Pavement	22,394 sy	$3.67 sy	$82,186
f. Remove Concrete Slabs	4,647 cy	$125 cy	$580,875
g. Divert / Restore / Creek / Ditches	800 lf	$10.00 lf	$8,000
h. Mob/demob (for 1,2&3)	3 yr	$7,857 yr	$23,571
2. SITE REMEDIATION			
a. Spray Application Sealants	625,275 sf	$0.85 sf	$531,484
b. Building Demolition	383,400 cf	$2.80 cf	$1,073,520
c. Waste Reducer	10 days	$3,000.00 day	$30,000
d. Excavate Sediments	10,022 cy	$50.00 cy	$501,100
e. Excavate Soils	326,728 cy	$25.00 cy	$8,168,200
f. Water Tank Spray	12 mos	$3,000.00 mo	$36,000
g. Radiation Technicians (8)	525 days	$1,568.00 day	$823,200
h. Seaway Excavation / Refill	510,000 cy	$20.50	$10,455,000
3. SITE RESTORATION			
a. Clean Fill	274,878 cy	$21.00 cy	$5,772,438
b. Loam	12,212 cy	$26.86 cy	$328,014
c. Hydroseeding	659,476 sf	$0.041 sf	$27,039
d. Wetland Restoration	1.3 ac	$6,600 ac	$8,580
e. Pavement	22,394 sy	$7.28 sy	$163,028
f. 2' Clay Cap @ Seaway	8,923 cy	$23 cy	$205,229
4. ON-SITE DISPOSAL CELL			
a. Land Acquisition & Clearing	26 ac	$12,375 ac	$321,750
b. Clean Fill, Backfill & Compact 1ft	28,033 cy	$22.91 cy	$642,236
c. Monitoring wells & Transducers	1 net	$210,000 net	$210,000
d. Sand (washed)	44,529 cy	$29.15 cy	$1,298,020
e. Rip Rap	90,609 cy	$36.95 cy	$3,348,003
f. Loam	46,791 cy	$32.35 cy	$1,513,689
g. Hydroseeding	1,132,560 sf	$0.041 sf	$46,435
h. Clay	173,057 cy	$23.83 cy	$4,123,948
i. Gravel for Dike	36,635 cy	$18.18 cy	$666,024
j. Place / Compact Waste	369,418 cy	$12.60 cy	$4,654,667
k. Mob/demob	3 yr	$5,455 yr	$16,365
l. Radiation Technicians (8)	525 days	$1,568 day	$823,200
TOTAL DIRECT COSTS			$46,782,228

Notes:

Form B
Date: 9/1/93

Table G-16 Alternative 3:
Complete Excavation and Onsite Disposal
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0,1,2
b. Sampling(Site)	$16,000	(160 hrs x $50 hr) / round	2/year	0,1,2
c. Cell inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0-30
d Sampling(Cell)	$16,000	(160 hrs x $50 hr) / round	2/year	0-30
2. Maintenance: Materials and Labor (Cell)	$50,000	Cap maint., well replacement	Annual	0-30
3. Auxiliary:	$0			
4. Purchased Service				
a. Analytical(Site)	$74,100	10 sediment samples / round x $495/sample (metals & isotopes analysis)	2/year	0,1,2
		20 air samples/round x $250 /sample (gamma)	2/year	0,1,2
		20 water samples/round x $1,355 /sample (chem)	2/year	0,1,2
b. Analytical (Cell)	$64,200	20 air samples/round	2/year	0-30
		20 water samples/round	2/year	0-30
5. Admin.(Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
6. Insurance, Taxes Licenses				
a. ________				
b. ________				
7. Maintenance:				
Res.and Cont.(Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
TOTAL (Site)	$139,650			0,1,2
TOTAL (Cell)	$199,800			0-30

Form D

Date: 9/1/93

Table G-17 Alternative: 3
Complete Excavation and Onsite Disposal
Basis of Capital Cost Estimate

Calculation/Source:

1. Rome Waste reducer, 1992
2. Waterfront Study, 1992
3. Means Heavy Construction Cost Data, 1992, 6th Annual Edition
4. Tonawanda Volume Calculation Package, December, 199
5. Tonawanda Alternative 3 Calculation Package, December, 1992
6. Means Site Work Cost Data 1991, 10th Edition
7. BNI, Correspondence between Paul Huber and Mushtaq Khan, April 30, 1993

Date: 9/1/93

Form C

Table G-18 Alternative 3:
Complete Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	23391	23391	23391	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	23731	23731	23731	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	23731	23731	23731	200	200	200	200	200	200	200	200	200	200	200	200	200

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
5. Present Worth (product of lines 3 and 4)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	$76,786

Date: 9/1/93

Form E

Table G-18 Alternative 3:
Complete Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	23391	23391	23391	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	23731	23731	23731	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	23731	22592	21524	173	164	157	149	142	135	129	123	117	111	106	101	96

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	92	87	83	74	75	72	68	65	62	59	56	54	51	49	46	$70,541

Date: 9/1/93

Form F

Table G-18 Alternative 3:
Complete Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	23391	23391	23391	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	23731	23731	23731	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	23731	21571	19602	150	137	124	113	103	93	85	77	70	64	58	53	48

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	44	40	36	33	30	27	25	22	20	18	17	15	14	13	11	$66,440

Date: 9/1/93

Form G

Table G-19 Alternative 3:
Complete Excavation and Onsite Disposal
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC, DOE
O & M Costs sampling, analysis and inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling & inspection frequency from semi-annual to quarterly or annual after first year
Direct Capital Costs	Variability of costs for excavation	+25%	Change in overall costs for construction activities

Form H
Date: 9/1/93

Table G-20 Alternative 3:
Complete Excavation and Onsite Disposal

Summary of Sensitivity Analysis

Cost Factor	Baseline 0% Discount Rate	Sensitivity Factor Examined/Resulted 5% Discount Rate	10% Discount Rate	-30% in Total O & M	+50% in Total O & M	+25% Total Direct Costs
Capital Costs ($) (x1000)	70,173	66,875	63,975	70,173	70,173	87,717
Present Worth ($) Total O & M $ (x1000)	6,613	3,665	2,465	4,629	9,920	6,613
Total Present Worth $ (x1000)	76,786	70,540	66,440	74,802	80,093	94,330

Form I
Date: 9/1/93

Table G-21 Alternative 4:
Partial Excavation and Offsite Disposal
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$687,763	Site Preparation	0,1,2
	$11,112,504	Site Remediation	0,1,2
	$6,299,099	Site Restoration	0,1,2
Subtotal	$18,099,366		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
Subtotal	$0		
6. Transportation and Disposal costs	$37,330,873	Trans. & Disp. *	0,1,2
Subtotal	$37,330,873		0,1,2
Total direct costs	$55,430,239		
INDIRECT CAPITAL COSTS		25% of Total direct	
1. Engineering and design	$8,663,435	costs-transportation	0,1,2
2. Contingency allowance	$8,663,435	25% of Total direct costs-transportation	0,1,2
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$0		
TOTAL INDIRECT COSTS	$17,326,870		
TOTAL CAPITAL COSTS	$72,757,109		

Note: * Assumes New York FUSRAP Site.

Form A

Date: 10/15/93

Table G-22 Alternative 4:
Partial Excavation and Offsite Disposal
Basis of Direct Capital Cost Estimate

Cost Item: Direct Construction Costs — Cost Component: Equipment, Labor & Materials

Basis: Excavation of accessible soils, selective demolition and decontamination and offsite disposal

Description	Quantity	Unit Price	Total Costs
1. SITE PREPARATION			
a. Decon & Water Treat. Facilities	2	$110,000 ea	$220,000
b. Silt Fence	21,070 lf	$1.10 lf	$23,177
c. Clean Storm Sewers/Sumps	3,200 lf	$5.00 lf	$16,000
d. Remove / Install RR Spur	1,250 lf	$33.00 lf	$41,250
e. Remove Pavement	22,394 sy	$3.67 sy	$82,186
f. Remove Concrete Slabs	2,277 cy	$125 cy	$284,625
g. Divert / Restore / Creek / Ditches	800 lf	$10.00 lf	$8,000
h. Mob/demob (for 1,2&3)	3 yr	$4,175 yr	$12,525
2. SITE REMEDIATION			
a. Spray Application Sealants	399,675 sf	$0.85 sf	$339,724
b. Building Demolition	237,600 cf	$2.80 cf	$665,280
c. Waste Reducer	5 days	$3,000.00 day	$15,000
d. Excavate Sediments	10,022 cy	$50.00 cy	$501,100
e. Excavate Soils	326,728 cy	$25.00 cy	$8,168,200
f. Water Tank Spray	12 mos	$3,000.00 mo	$36,000
g. Radiation Technicians (8)	525 days	$1,568.00 day	$823,200
h. Building Decon. (Bldg 30)	225,600 sf	$2.50	$564,000
3. SITE RESTORATION			
a. Clean Fill	274,878 cy	$21.00 cy	$5,772,438
b. Loam	12,212 cy	$26.86 cy	$328,014
c. Hydroseeding	659,476 sf	0.041 sf	$27,039
d. Wetland Restoration	1.3 ac	$6,600.00 ac	$8,580
e. Pavement	22,394 sy	$7.28 sy	$163,028
4. OFF-SITE DISPOSAL			
a. Transportation **	415,530 cy *	$50.00 cy	$20,776,500
b. Disposal Cost **	336,471 cy	$49.20 cy	$16,554,373
TOTAL DIRECT COSTS			$55,430,239

Notes:

(*) Quanitity includes an expansion factor of 30%

(**) Assumes New York FUSRAP Site

Form B

Date: 10/15/93

Table G-22a Alternative 4:
Partial Excavation and Offsite Disposal
Basis of Direct Capital Cost Estimate

Cost Item: Direct Construction Costs — Cost Component: Equipment, Labor & Materials

Basis: Excavation of accessible & access restricted soils, demolition of buildings & offsite disposal.

Alternative - Disposal facility	Quantity	Unit Price	Total Costs
A. FUSRAP-New York			
a. Transportation	415,530 cy *	$50 cy	20,776,500
b. Disposal Costs	336,471 cy	$49.20 cy	$16,554,373
Subtotal			$37,330,873
Total Capital Costs			$72,757,109
B. FUSRAP- East			
a. Transportation	415,530 cy *	$67 cy	$27,840,510
b. Disposal Costs	336,471 cy	$49.20 cy	$16,554,373
Subtotal			$44,394,883
Total Capital Cost			$79,821,119
C. FUSRAP - West			
a. Transportation	415,530 cy *	$115 cy	$47,785,950
b. Disposal Costs	336,471 cy	$49.20 cy	$16,554,373
Subtotal			$64,340,323
Total Capital Cost			$99,766,559
D. DOE - Hanford			
1. Rail Transport			
a. Transportation	415,530 cy *	$115 cy	$47,785,950
b. Disposal Cost	415,530 cy *	$300 cy	$124,659,000
Subtotal			$172,444,950
Total Capital Cost			$261,923,499
2. Barge Transport			
a. Transportation	415,530 cy *	$245	$101,804,850
b. Disposal Cost	415,530 cy *	$300	$124,659,000
Subtotal			$226,463,850
Total Capital Cost			$315,942,399
E. Commercial			
a. Transportation	415,530 cy*	$95	$39,475,350
b. Disposal Costs	415,530 cy*	$216	$89,754,480
Subtotal			$129,229,830
Total Capital Cost			$201,256,119
F. Beneficial Reuse (1)			
a. Transportation	415,530 cy*	$50 cy	$20,776,500

(1) Assume end-user provides transportation and material provided free of cost.
* Quantity includes a expansion factor of 30%

Form X
Date: 10/15/93

Table G-23 Alternative 4:

Partial Excavation and Offsite Disposal
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0,1,2
b. Sampling(Site)	$16,000	(160 hrs x $50 hr) / round	2/year	0,1,2
c. Cell inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0-30
d Sampling(Cell)	$16,000	(160 hrs x $50 hr) / round	2/year	0-30
2. Maintenance: Materials and Labor (Cell)	$50,000	Cap maint., well replacement	Annual	0-30
3. Auxiliary:	$0			
4. Purchased Service				
a. Analytical(Site)	$74,100	10 sediment samples / round x $495/sample (metals & isotopes analysis)	2/year	0,1,2
		20 air samples/round x $250 /sample (gamma)	2/year	0,1,2
		20 water samples/round x $1,355 /sample (chem)	2/year	0,1,2
b. Analytical(Cell)	$64,200	20 air samples/round	2/year	0-30
		20 water samples/round	2/year	0-30
5. Admin. (Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
6. Insurance, Taxes Licenses				
a.				
b.				
7. Maintenance:				
Res.and Cont.(Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
TOTAL (Site)	$139,650			0,1,2
TOTAL (Cell)	$199,800			0-30

Note: "Cell" Items not included for DOE or Commercial disposal options

Form D

Date: 10/15/93

Table G-24 Alternative: 4

Partial Excavation and Offsite Disposal

Basis of Capital Cost Estimate

Calculation/Source:

1. Rome Waste reducer, 1992

2. Means Site Work Cost Data, 1991, 10th Edition

3. Means Site Work Cost Data, 1991, 10th Edition

4. Means Heavy Construction Cost Data, 1992

5. Tonawanda Volume Calculation Package, December, 1992

6. Tonawanda Alternative 4 Calculation Package, December, 1992

7. BNI, Correspondence between Paul Huber and Mushtaq Khan, April 30, 1993

8. BNI, Correspondence between C. R. Hickey and Mushtaq Khan, May 28, 1993

Date: 10/15/93

Form C

Table G-25 Alternative 4:
Partial Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	24252	24252	24252	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	24592	24592	24592	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	24592	24592	24592	200	200	200	200	200	200	200	200	200	200	200	200	200

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
5. Present Worth (product of lines 3 and 4)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	$79,370

Date: 10/15/93

Form E

Table G-25 Alternative 4:
Partial Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	24252	24252	24252	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	24592	24592	24592	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	24592	23411	22305	173	164	157	149	142	135	129	123	117	111	106	101	96

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	92	87	83	74	75	72	68	65	62	59	56	54	51	49	46	$73,003

Date: 10/15/93

Form F

Table G-25 Alternative 4:
Partial Excavation and Offsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	24252	24252	24252	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	339	339	339	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	24592	24592	24592	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	24592	22354	20313	150	137	124	113	103	93	85	77	70	64	58	53	48

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	44	40	36	33	30	27	25	22	20	18	17	15	14	13	11	$68,796

Date: 10/15/93

Form G

Table G-26 Alternative 4:
Partial Excavation and Offsite Disposal
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC, DOE
O & M Costs sampling, analysis and inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling & inspection frequency from semi-annual to quarterly or annual after first year
Disposal site option	Existing DOE facility	Calculated estimate	DOE

Form H
Date: 10/15/93

Table G-27 Alternative 4:
Partial Excavation and Offsite Disposal

Summary of Sensitivity Analysis

Cost Factor	Baseline 0% Discount Rate	Sensitivity Factor Examined/Resulted				
		5% Discount Rate	10% Discount Rate	-30% in Total O & M	+50% in Total O & M	High end disposal site DOE
Capital Costs ($) (x1000)	72,757	69,338	66,330	72,757	72,757	261,924
Present Worth ($) Total O & M $ (x1000)	6,613	3,665	2,465	4,629	9,920	419
Total Present Worth $ (x1000)	79,370	73,003	68,796	77,386	82,677	262,343

Form I
Date: 10/15/93

Table G-28 Alternative 5:
Partial Excavation and Onsite Disposal
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$688,963	Site Preparation	0,1,2
	$11,112,504	Site Remediation	0,1,2
	$6,299,099	Site Restoration	0,1,2
Subtotal	$18,100,566		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development	$16,544,842	On-site Cell	0,1,2
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$16,544,842		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
5.Relocation costs			
Subtotal	$0		
6. Disposal costs			
Subtotal	$0		
Total direct costs	$34,645,408		0,1,2
INDIRECT CAPITAL COSTS			
1. Engineering and design	$8,661,352	25% of direct costs	0,1,2
2. Contingency allowance	$8,661,352	25% of direct costs	0,1,2
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$17,322,704		
TOTAL INDIRECT COSTS	$17,322,704		
TOTAL CAPITAL COSTS	$51,968,112		

Form A

Date: 6/6/93

Table G-29 Alternative 5:

Partial Excavation and Onsite Disposal

Basis of Direct Cost Estimate

Cost Item: Direct Construction Costs

Basis: Excavation of accessible soils, selective demolition and decontamination of buildings & onsite disposal

Cost Component: Equipment, Labor & Materials

Description	Quantity	Unit Price	Total Costs
1. SITE PREPARATION			
a. Decon & Water Treat. Facilities	2	$110,000 ea	$220,000
b. Silt Fence	21,070 lf	$1.10 lf	$23,177
c. Clean Storm Sewers/Sumps	3,200 lf	$5.00 lf	$16,000
d. Remove / Install RR Spur	1,250 lf	$33.00 lf	$41,250
e. Remove Pavement	22,394 sy	$3.67 sy	$82,186
f. Remove Concrete Slabs	2,277 cy	$125 cy	$284,625
g. Divert / Restore / Creek / Ditches	800 lf	$10.00 lf	$8,000
h. Mob/demob (for 1,2&3)	3 yr	$4,575 yr	$13,725
2. SITE REMEDIATION			
a. Spray Application Sealants	399,675 sf	$0.85 sf	$339,724
b. Building Demolition	237,600 cf	$2.80 cf	$665,280
c. Waste Reducer	5 days	$3,000.00 day	$15,000
d. Excavate Sediments	10,022 cy	$50.00 cy	$501,100
e. Excavate Soils	326,728 cy	$25.00 cy	$8,168,200
f. Water Tank Spray	12 mos	$3,000.00 mo	$36,000
g. Radiation Technicians (8)	525 days	$1,568.00 day	$823,200
h. Building Decon. (Bldg 30)	225,600 sf	$2.50	$564,000
3. SITE RESTORATION			
a. Clean Fill	274,878 cy	$21.00 cy	$5,772,438
b. Loam	12,212 cy	$26.86 cy	$328,014
c. Hydroseeding	659,476 sf	0.041 sf	$27,039
d. Wetland Restoration	1.3 ac	$6,600.00 ac	$8,580
e. Pavement	22,394 sy	$7.28 sy	$163,028
4. ON-SITE DISPOSAL CELL			
a. Land Acquisition & Clearing	24 ac	$12,375 ac	$297,000
b. Clean Fill, Backfill & Compact (12 in. thick)	25,230 cy	$22.91 cy	$578,019
c. Monitoring wells & Transducers	1 net	$210,000 net	$210,000
d. Sand (washed)	42,042 cy	$29.15 cy	$1,225,524
e. Rip Rap	85,587 cy	$37 cy	$3,162,440
f. Loam	44,234 cy	$32 cy	$1,430,970
g. Hydroseeding	1,051,810 sf	$0.041 sf	$43,124
h. Clay	162,537 cy	$24 cy	$3,873,257
i. Gravel for Dike	35,501 cy	$18.18 cy	$645,408
j. Place / Compact Waste	336,471 cy	$12.60 cy	$4,239,535
k. Mob/demob	3 yr	$5,455 yr	$16,365
l. Radiation Technicians (8)	525 days	$1,568 day	$823,200
TOTAL DIRECT COSTS			$34,645,408

Form B

Date: 6/6/93

Table G-30 Alternative 5:
Partial Excavation and Onsite Disposal
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0,1,2
b. Sampling(Site)	$16,000	(160 hrs x $50 hr) / round	2/year	0,1,2
c. Cell inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0-30
d Sampling(Cell)	$16,000	(160 hrs x $50 hr) / round	2/year	0-30
2. Maintenance: Materials and Labor (Cell)	$50,000	Cap maint., well replacement	Annual	0-30
3. Auxiliary:	$0			
4. Purchased Service				
a. Analytical(Site)	$74,100	10 sediment samples / round x $495/sample (metals & isotopes analysis)	2/year	0,1,2
		20 air samples/round x $250 /sample (gamma)	2/year	0,1,2
		20 water samples/round x $1,355 /sample (chem)	2/year	0,1,2
b. Analytical(Cell)	$64,200	20 air samples/round	2/year	0-30
		20 water samples/round	2/year	0-30
5. Admin. (Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
6. Insurance, Taxes Licenses				
a. ______				
b. ______				
7. Maintenance:				
Res.and Cont.(Site)	$23,275	25% of Labor and Services	Annually	0,1,2
(Cell)	$33,300	25% of Labor and Services	Annually	0-30
TOTAL (Site)	$139,650			0,1,2
TOTAL (Cell)	$199,800			0-30

Form D

Date: 6/6/93

Table G-31 Alternative: 5
Partial Excavation and Onsite Disposal
Basis of Capital Cost Estimate

Calculation/Source:

1. Rome Waste reducer, 1992
2. Waterfront Region Master Plan, 1992
3. Means Site Work Cost Data 1991, 10th Edition
4. Means Heavy Construction Cost Data, 1992
5. Tonawanda Volume Calculation Package, December, 1992
6. Tonawanda Alternative 5 Calculation Package, December, 1992
7. BNI, Correspondence between Paul Huber and Mushtaq Khan, April 30, 1993

Date: 6/7/93

Form C

Table G-32 Alternative 5:
Partial Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	17323	17323	17323	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	17662	17662	17662	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	17662	17662	17662	200	200	200	200	200	200	200	200	200	200	200	200	200

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Present Worth ($1000)
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
5. Present Worth (product of lines 3 and 4)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	$58,581

Date: 6/6/93

Form E

Table G-32 Alternative 5:
Partial Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	17323	17323	17323	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	17662	17662	17662	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	17662	16814	16020	173	164	157	149	142	135	129	123	117	111	106	101	96

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Present Worth ($1000)
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	92	87	83	74	75	72	68	65	62	59	56	54	51	49	46	$53,191

Date: 6/6/93

Form F

Table G-32 Alternative 5:
Partial Excavation and Onsite Disposal
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	17323	17323	17323	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	340	340	340	200	200	200	200	200	200	200	200	200	200	200	200	200
3. Annual Expenditures, x (sum of lines 1 and 2)	17662	17662	17662	200	200	200	200	200	200	200	200	200	200	200	200	200
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	17662	16055	14589	150	137	124	113	103	93	85	77	70	64	58	53	48

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
3. Annual Expenditures, x (sum of lines 1 and 2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	
5. Present Worth (product of lines 3 and 4)	44	40	36	33	30	27	25	22	20	18	17	15	14	13	11	$49,843

Date: 6/6/93

Form G

Table G-33 Alternative 5:
Partial Excavation and Onsite Disposal
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC, DOE
O & M Costs sampling, analysis and inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling & inspection frequency from semi-annual to quarterly or annual after first year
Direct Capital Costs	Variability of costs for excavation	+25%	Change in overall costs for construction activities

Form H
Date: 6/6/93

Table G-34 Alternative 5:
Partial Excavation and Onsite Disposal

Summary of Sensitivity Analysis

Cost Factor	Baseline 0% Discount Rate	Sensitivity Factor Examined/Resulted 5% Discount Rate	10% Discount Rate	-30% in Total O & M	+50% in Total O & M	+25% Direct Cap Costs
Capital Costs ($) (x1000)	51,968	49,526	47,378	51,968	51,968	64,960
Present Worth ($) Total O & M $ (x1000)	6,613	3,665	2,465	4,629	9,920	6,613
Total Present Worth $ (x1000)	58,581	53,191	49,843	56,597	61,888	71,573

Form I
Date: 6/6/93

Table G-35 Alternative 6: Containment
Capital Costs

Cost Component	Cost Estimate	Basis of Estimate	Year Incurred
DIRECT CAPITAL COSTS			
1. Construction costs	$310,937	Site Preparation	0
	$1,330,984	Site Remediation	0
	$5,088,947	Site Restoration	0
Subtotal	$6,730,868		
2. Equipment costs			
___Installed			
___Purchased			
3. Land and site development			0
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
4.Buildings and services			
a. Equipment			
b. Labor			
c. Materials			
Subtotal	$0		
5.Relocation costs			
Subtotal	$0		
6. Disposal costs			
Subtotal	$0		
Total Direct Costs	$6,730,868		0
INDIRECT CAPITAL COSTS			
1. Engineering and design	$1,682,717	25% of Direct Capital Costs	0
2. Contingency allowance	$1,682,717	25% of Direct Capital Costs	0
3. Other indirect costs			
a. Legal fees			
b. License/permit costs			
c. Start-up and shake-down			
Subtotal	$3,365,434		
TOTAL INDIRECT COSTS	$3,365,434		0
TOTAL CAPITAL COSTS	$10,096,302		0

Form A

Date: 6/6/93

Table G-36 Alternative 6: Containment

Basis of Direct Cost Estimate

Cost Item: Direct Construction Costs

Basis: Capping accessible soils and surface sealing of buildings

Cost Component: Equipment, Labor & Materials

Description	Quantity	Unit Price	Total Costs
1. SITE PREPARATION			
a. Decon & Water Treat. Facilities	2	$110,000 ea	$220,000
b. Silt Fence	21,070 lf	$1.10 lf	$23,177
c. Clean Storm Sewers/Sumps	3,200 lf	$5.00 lf	$16,000
d. Remove / Install RR Spur	1,250 lf	$33.00 lf	$41,250
e. Divert/Restore Creek/Diches	800 lf	$10.00 lf	$8,000
h. Mob/demob (for 1,2&3)	1 yr	$2,510 yr	$2,510
2. SITE REMEDIATION			
a. Spray Application Sealants	625,275 sf	$0.85 sf	$531,484
b. Excavate Sediments	10,022 cy	$50.00 cy	$501,100
c. Water Tank Spray	8 mo	$3,000 mo	$24,000
g. Radiation Technicians (8)	175 days	$1,568.00 day	$274,400
3. SITE RESTORATION			
a. Clear and Grub	12.3 ac	$2,375 ac	$29,213
b. Clay Fill	80,883 cy	$22.55 cy	$1,823,912
c. Clean Fill	10,022 cy	$21.00 cy	$210,462
d. Fluid Flow Mat	1,091,925 sf	$0.40 sf	$436,770
e. Geotextile Fabric	1,091,925 sf	$1.29 sf	$1,408,583
f. Loam (12in depth)	40,440 cy	$27.86 cy	$1,126,658
g. Hydroseeding	1,091,925 sf	$0.041 sf	$44,769
g. Wetland Restoration	1.3 ac	$6,600 ac	$8,580
TOTAL DIRECT COSTS			$6,730,868

Form B

Date: 6/6/93

Table G-37 Alternative 6: Containment
Annual Operating Costs

Cost Component	Estimate ($)	Basis of Estimate	Frequency	Year/ Period
O & M Cost				
1. Operating Labor				
a a. Site inspections	$3,000	(20 hr x $75 hr) / inspection	2/year	0-30
b. Sampling	$16,000	(160 hrs x $50 hr) / round	2/year	0-30
c.				
d				
2. Maintenance: Materials and Labor	$50,000	Cap maint., well replacement	Annual	0-30
3. Auxiliary:	$0			
4. Purchased Service				
a. Analytical	$74,100	10 sediment samples / round x $495/sample (metals & isotopes analysis)	2/year	0-30
		20 air samples/round x $250 /sample (gamma)	2/year	0-30
		20 water samples/round x $1,355 /sample (chem)	2/year	0-30
b.				
5. Administration	$35,775	25% of Labor and Services	Annually	0-30
6. Insurance, Taxes Licenses				
a.				
b.				
7. Maintenance: Reserve and Cont.	$35,775	25% of Labor and Services	Annually	0-30
TOTAL	$214,650			

Form D

Table G-38 Alternative: 6 Containment
Basis of Capital Cost Estimate

Calculation/Source:

1. Rome Waste reducer, 1992
2. Means Site Work Cost Data 1991, 10th Edition
3. Means Heavy Construction Cost Data, 1992
4. Tonawanda Volume Calculation Package, December 1992
5. Tonawanda Alternative 6 Calculation Package, December 1992
6. BNI, Correspondence between Paul Huber and Mushtaq Khan, April 30, 1993

Date: 6/7/93

Form C

Table G-39 Alternative 6:
Containment
Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	10096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
3. Annual Expenditures, x (sum of lines 1 and 2)	10311	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Present Worth (product of lines 3 and 4)	10311	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	
3. Annual Expenditures, x (sum of lines 1 and 2)	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	Total Present
4. Discount Factor (annual discount rate = 0%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	$16,752

Date: 6/6/93

Form E

Table G-39 Alternative 6: Containment Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	10096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
3. Annual Expenditures, x (sum of lines 1 and 2)	10311	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
4. Discount Factor (annual discount rate = 5%)	1.0	0.952	0.907	0.864	0.823	0.784	0.746	0.711	0.677	0.645	0.614	0.585	0.557	0.530	0.505	0.481
5. Present Worth (product of lines 3 and 4)	10311	204	195	186	177	168	160	153	145	138	132	126	120	114	108	103

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	
3. Annual Expenditures, x (sum of lines 1 and 2)	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	Total Present Worth ($1000)
4. Discount Factor (annual discount rate = 5%)	0.458	0.436	0.416	0.369	0.377	0.359	0.342	0.326	0.310	0.295	0.281	0.268	0.255	0.243	0.231	
5. Present Worth (product of lines 3 and 4)	98	94	89	79	81	77	73	70	67	63	60	58	55	52	50	$13,605

Date: 6/6/93

Form F

Table G-39 Alternative 6: Containment Cost Analysis Work Sheet

	Cost/Year Cost Occurs (thousands of dollars)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Capital Costs	10096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
3. Annual Expenditures, x (sum of lines 1 and 2)	10311	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
4. Discount Factor (annual discount rate = 10%)	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.350	0.319	0.290	0.263	0.239
5. Present Worth (product of lines 3 and 4)	10311	195	177	161	147	133	121	110	100	91	83	75	69	62	57	51

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1. Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. O & M Costs	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	
3. Annual Expenditures, x (sum of lines 1 and 2)	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	Total Present
4. Discount Factor (annual discount rate = 10%)	0.218	0.198	0.180	0.164	0.149	0.135	0.123	0.112	0.101	0.092	0.084	0.076	0.069	0.063	0.057	Worth ($1000)
5. Present Worth (product of lines 3 and 4)	47	43	39	35	32	29	26	24	22	20	18	16	15	14	12	$12,334

Date: 6/6/93

Form G

Table G-40 Alternative 6: Containment
Sensitivity Factor

Sensitivity Factor	Justification for Consideration	Range	Justification of Range
Discount Rate	Variability of time value of money	0%, 5%, 10%	NYSDEC, DOE
O & M Costs sampling, analysis and inspections	Variability in the monitoring program is possible	-30% to +50% in total O&M costs	Change in sampling & inspection frequency from semi-annual to quarterly or annual after first year
Direct Capital Costs	Variability of costs for excavation	+25%	Change in overall costs for construction activities

Form H
Date: 6/6/93

Table G-41 Alternative 6:
Containment

Summary of Sensitivity Analysis

Cost Factor	Baseline 0% Discount Rate	Sensitivity Factor Examined/Resulted 5% Discount Rate	10% Discount Rate	-30% in Total O & M	+50% in Total O & M	+25% Direct Cap Costs
Capital Costs ($) (x1000)	10,096	10,096	10,096	10,096	10,096	12,620
Present Worth ($) Total O & M $ (x1000)	6,656	3,509	2,238	4,659	9,984	6,656
Total Present Worth $ (x1000)	16,752	13,605	12,334	14,755	20,080	19,276

Form I
Date: 6/6/93

APPENDIX H

SOCIOECONOMIC METHODOLOGY FOR CALCULATING IMPACTS ON EMPLOYMENT, HOUSEHOLDS, AND POPULATION FOR REMEDIATION ALTERNATIVES

Appendix H
Socioeconomic Methodology for Calculating Impacts for on Employment, Households, and Population for Remediation Alternatives

As explained in the text, the impacts methodology used to evaluate the site-wide alternatives was input-output analysis. The Regional Input-Output Modeling System (RIMS II) of the U.S. Bureau of Economic Analysis (BEA) developed for Erie and Niagara Counties was used. The purpose of this Appendix is to document the methodology and assumptions used to calculate the impacts on employment, households, and population discussed under each alternative.

The estimation of employment impacts due to public and private-sector projects can be conducted effectively through the use of input-output analysis. In order to systematically evaluate the regional responses to project changes, it is necessary to account for interindustry relationships within regions. The input-output framework is a useful tool for economic impact analysis because its multipliers depend upon the interindustry relationships within regions.

Input-output analysis focuses upon identifying the linkages (inputs purchased and outputs sold) among industries within an economy and, utilizing these linkages, tracing the impacts of specific changes on detailed sectors of the economy. For example, an industry (say industry "A") purchases inputs from 10 other industries ("B to K"). Assume that two of these industries (say industries "B" and "C") purchase inputs from industry "A" as part of their production process. A change in demand for industry "A" (the "direct" effect) would then impact industries "B" and "C" (the "indirect" effect). In an input-output framework, multipliers are available for each industry included in the model, a clear advantage over the other models which often rely upon "aggregate" multipliers for the entire economy. A national input-output model has been estimated by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). The latest national input-output matrix reflects technical relationships in place in 1987.

Converting the national model to a regional (county level) model requires a process referred to as "regionalizing" the coefficients. This simply means that the national input-output coefficients must be adjusted to more accurately reflect the economic structure of the region being analyzed. In the early 1970s, BEA adopted a specific method for regionalizing the national model based on a short-cut method of estimating regional multipliers without requiring detailed regional surveys. This model was called RIMS (Regional Input-Output Multiplier System model. In the early 1980s, the method for regionalizing the national coefficients was significantly revised, allowing for a more complete matrix of direct and indirect coefficients to be estimated. This new procedure utilized county-level employment and earnings data from BEA and allows regional input-output matrices to be updated as new employment and earnings data becomes available. Because it relies on county-level data, a RIMS II model can be developed for any county or multiple-county region in the U.S.

The regionalization process begins with the national table of direct coefficients. This table contains the input and output relationships between industries in the U.S. and reflects the technology used in each industry. Since not all of the industries exist in each county, the process of regionalization must account for the absence of some industries from the region. The process of identifying industries which do not exist in the study region utilizes BEA's county-level employment and earnings data. The strategy is to multiply regional location quotients and national coefficients to estimate regional technological relationships. A household section is estimated to capture the economic interrelationships in the regional economy resulting from increases in personal income. The end result of this process is a matrix of coefficients which recognizes the structure of the regional economy and its interindustry transactions. The transactions table is manipulated to estimate the matrix of total requirements (the sum of the indirect and induced effects of a change in final local demand of $1) for output, employment, and earnings.

Tests of the reliability of RIMS II estimates were conducted by BEA to determine the techniques' relative accuracy. The standard for testing compared the coefficients determined by survey-based input-output models for regions in Washington, Texas, and West Virginia. In these states, the RIMS II multipliers tended to overstate the survey-based estimates by less than 10%. RIMS II-based impact analysis has been conducted for a number of studies, including Department of Defense Environmental Impact Statements of military base realignments, evaluations of effects of increasing expenditures by tourists, and the results of a new factory locating in a state.

In order to apply input-output analysis, it is necessary to have a profile of local expenditures associated with each alternative. Total expenditures were estimated by SAIC based on May 1993 data for each of the alternatives to provide a cost profile. While there have been some minor changes in the expenditures, they are within the 10% threshold and, therefore, it was not considered cost effective or necessary to rerun the model. These numbers were developed under two categories: capital construction and operations and maintenance (O&M) expenditures. Capital costs include construction, provision of radiological crews, and administrative expenses. The number of years the construction would take place was also estimated, as were the direct employment impacts associated with each alternative. It was assumed that activity at the site would be possible for eight months of the year. The employment estimates shown in Table H-1 represent the annual full-time equivalent (FTE) of that labor requirement. Employment associated with O&M expenditures involved monitoring. Each construction employee is assumed to earn approximately $43,000 per year. All other personnel were assumed to earn approximately $35,000 per year.

Table H-1 shows the assumptions regarding the final demand vector for each year of the analysis for each alternative. It also reports the estimated number of FTE positions assumed to be filled for the remediation activities for each year. Since not every employee is assumed to work full-time over the year, the FTE can reflect temporary employees, hired to work only part of the year. Final demand is separated into three categories: Labor, Equipment and Materials, and Business Services. These categories correspond to columns in the input-output tables: Labor costs represent payments to Households; Equipment and Materials are assumed to be purchased

Table H-1. Annualized Expenditures by Alternative Assumptions for RIMS II Final Demand Input (Spending in Thousands of Dollars).

	Percent Spending Within Region:		90.0%	20.0%	0.5%	Direct FTE*
Alt. No.	Alternative	Year	Labor	Equip/Mat.	Bus. Serv.	Employment (Number)
1	No Action	1	7.0	5.0	107.2	0.2
1	No Action	2-30	7.0	0.0	104.7	0.2
2	Complete Excavation and Offsite Disposal	1-3	1,069.9	4,306.3	2,782.4	27.3
3	Complete Excavation and Onsite Disposal	1-3	1,213.5	10,484.3	5,988.4	31.7
3	Complete Excavation and Onsite Disposal	4-30	7.0	0.0	151.3	0.2
4	Partial Excavation and Offsite Disposal	1-3	1,291.8	2,458.2	1,971.0	32.2
4	Partial Excavation and Offsite Disposal	4-30	10.5	0.0	24.4	0.3
5	Partial Excavation and Onsite Disposal	1-3	2,048.4	7,409.1	4,895.4	50.8
5	Partial Excavation and Onsite Disposal	4-30	10.5	0.0	182.7	0.3
6	Containment	1	513.2	4,060.3	2,366.2	13.2
6	Containment	2-30	17.5	0.0	122.2	0.5

*FTE = full-time equivalent

from the Wholesale Trade industry; and Business Services represents the Business Services industry.

One of the most important issues to determine in conducting input-output analysis is the share of project expenditures actually going to firms located within the region defined by the RIMS II multipliers. For example, dollars may be spent on technical monitoring of a site, but the lab work could be conducted at the home office away from the project region. Therefore, it is necessary to make assumptions regarding the share of expenditures that will actually go to firms and individuals within the region. The input-output multipliers reflect interactions within a region, and do not show impacts that could be derived by expenditures outside the region feeding back into the local economy.

One of the ways to determine how much of the expenditures will be local versus non-local is to separate expenditures for direct labor from other expenditures. In this analysis it is assumed that 90% of the expenditures for wages and salaries will be spent in the local area. This share assumes a fairly high average propensity to consume; for individuals with relatively high average incomes, this value would be lower just to reflect deductions for taxes. However, this share represents a conservative assumption, reflecting an upper-bound on indirect employment effects resulting from direct employment. Each alternative also includes expenditures for materials and equipment. Since it is assumed that these purchases will be made at the wholesale level and that they reflect transactions within national markets rather than regional markets, it is assumed that 20% of the expenditures for equipment and materials will go to local firms. Other expenditures, which for the most part reflect technical business services, are assumed to be purchased from expert firms located outside the region; only 0.5% of these expenditures (with labor expenditures already accounted) are assumed to actually go to firms within the region.

The RIMS II earnings multipliers of the three industry categories (households, wholesale trade and business services) were used to convert the final demand vector of local expenditures into feedback effects affecting earnings in the local community. Average wage rates by two-digit Standard Industrial Classification industry were used to convert the earnings figures into indirect employment numbers. The estimated indirect employment effects by alternative are reported in Table H-2.

The next step in the estimation process is to use the employment requirements as the basis for the estimation of the maximum number of new households that could be generated from the employment increase. The maximum number of in-migrating households is estimated to be equal to the number of in-migrating job holders required (which is equal to the total employment impact) divided by 1.34, which is the average number of jobs held per household.

Population is calculated from the number of households by multiplying households times the average household size of Erie and Niagara Counties in 1990, which was 2.41 [Bureau of the Census, U.S. Department of Commerce, 1990 Census of Population and Housing, Summary Population and Housing Characteristics, New Jersey, 1990 CPH-1-32].

Table H-2. Summary of Impacts on Employment, Households, and Population From the Base Year for Tonawanda Alternatives.

Alt. No.	Alternative	Year	Direct Employment	Indirect Employment	Total Employment	House-holds	Population
1	No Action	1	0.2	0.1	0.3	0	0
1	No Action	2-30	0.2	0.1	0.3	0	0
2	Complete Excavation and Offsite Disposal	1-3	27.3	37.7	65	49	118
3	Complete Excavation and Onsite Disposal	1-3	31.7	71.9	103.6	77	186
3	Complete Excavation and Onsite Disposal	4-30	0.2	0.1	0.3	0	0
4	Partial Excavation and Offsite Disposal	1-3	32.2	31.2	63.4	47	113
4	Partial Excavation and Offsite Disposal	4-30	0.3	0.2	0.5	0	0
5	Partial Excavation and Onsite Disposal	1-3	50.8	67.8	118.6	89	215
5	Partial Excavation and Onsite Disposal	4-30	0.3	0.2	0.5	0	0
6	Containment	1	13.2	28.5	41.7	31	75
6	Containment	2-30	0.5	0.3	0.8	1	2

REFERENCES

Drake, Ronald L., 1976. "A Short-Cut to Estimates of Regional Input-Output Multipliers," *International Regional Science Review*, Vol. 1, Fall, pp. 1-17.

Miernyk, William H., 1965. *The Elements of Input-Output Analysis*, New York: Random House.

U.S. Bureau of Commerce, 1981. *Regional Input-Output Modeling System (RIMS II); Estimation, Evaluation, and Application of a Disaggregated Regional Impact Model*, Department of Commerce, Regional Economic Analysis Division, April.

U.S. Bureau of Commerce, 1992. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)*, Department of Commerce, Economics and Statistics Administration, Second Edition, May.

APPENDIX I

HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

Appendix I: Human Health Risk Assessment Methodology

Potential health impacts of remedial action at the Tonawanda site were assessed by estimating the radiological and chemical risks to workers and the general public that could result from exposure to site releases. Such releases could occur during the excavation, treatment, transportation, and disposal activities associated with implementing any one of the action alternatives for site cleanup. Potential impacts for the remedial action alternatives were evaluated in terms of the increased likelihood of cancer induction for both radioactive and chemical contaminants. Noncarcinogenic impacts were also evaluated for chemical contaminants and the potential for occupational injuries and fatalities and non-exposure related transportation fatalities was estimated.

The scope of this assessment is limited to impacts resulting from remedial action activities. Other components of the risk assessment process are presented in the baseline risk assessment (BRA) (SAIC 1993). Assessment of health impacts to workers and the general public during the remediation action period was conducted in accordance with EPA methodology provided in the Risk Assessment Guidance for Superfund, Part C - Risk Evaluation of Remedial Alternatives (EPA 1991). Risks associated with no action at the site were determined in accordance with EPA methodology for conducting baseline risk assessments. The methodologies used for the exposure assessment, toxicity assessment, and risk characterization are described in detail in the BRA.

From the analysis of preliminary alternatives in Section 4, six final remedial action alternatives were identified for detailed evaluation. Alternative 1, the no-action alternative, was evaluated for the purpose of comparison with the action alternatives. The potential impacts to human health and the environment associated with Alternative 1 are given in the BRA.

POTENTIAL RECEPTORS AND EXPOSURE SCENARIOS

General Public

The general public could potentially be exposed to radioactive and chemical contaminants from the site via airborne dust and gaseous emissions generated during the remediation effort. Potential receptors include nearby residents and individuals working at commercial facilities near the Tonawanda site.

Although other potential receptors could be identified for the general public (e.g., individuals driving by the site, or visitors to the site), risks to these receptors were not evaluated because their exposures would be substantially less than those estimated for the specific receptors identified in this analysis. In addition to assessing the potential health risks to individual receptors, the potential health risks associated with exposures to radioactive contaminants were assessed for the population within a defined radius of the site (1 km [0.62 mi]).

A parallel assessment was not performed for chemical contaminants because the potential health risks to members of the general public would be much lower than for the radioactive contaminants. Thus, the potential health risks to members of the population are represented by those estimated for exposure to radioactive contaminants.

Remediation Workers

Potential remedial action worker radiological exposures and chemical intakes were evaluated for workers directly involved in handling contaminated material. Remedial action workers could be exposed to site contaminants while the various activities required to implement the selected alternative were being conducted. These activities would be conducted in accordance with health and safety plans developed for the Tonawanda site in order to minimize potential occupational exposures to contaminants. Remediation workers at the site would be supplied with protective clothing and equipment as required. It was conservatively assumed for this assessment that the workers would routinely wear appropriate protective clothing but may not be wearing respiratory protective equipment.

EXPOSURE PATHWAYS

The principal source of contamination at Tonawanda is radiologically and chemically contaminated soil. Remedial action activities such as excavation and loading for disposal could provide a mechanism for contaminant release. Fugitive dust would be generated during waste excavation, loading, treatment, unloading, and waste placement activities. The principal contaminant release mechanisms and transport media associated with such activities are:

- Emission of gamma radiation from radioactively contaminated material to the atmosphere,
- Resuspension of radioactively and chemically contaminated particulate material to the atmosphere through erosion of soil or agitation of soil during remediation, and
- Emission of radon gas from radium contaminated soil to the atmosphere.

The potential routes of human exposure to site contaminants presented in this assessment are:

- Inhalation of radon and its short-lived decay products,
- External gamma irradiation,
- Inhalation of radioactively and chemically contaminated airborne dust, and
- Incidental ingestion of radioactively and chemically contaminated soil.

EXPOSURE POINT CONCENTRATIONS

The exposure point concentrations of radioactive and chemical contaminants were estimated for the individual receptor locations. Because remedial action activities at the Tonawanda site would involve the handling of material from four distinct source areas (Linde, Ashland 1 and 2, and Seaway) at the site that are contaminated with varying concentrations of different contaminants, contaminant concentrations were developed for material at each area identified for excavation treatment and disposal activities. The concentrations of radioactive and chemical contaminants for the four source areas comprising the Tonawanda site are taken from the BRA. These data are the upper confidence limit on the arithmetic average (i.e., UL95), used as the reasonable maximum exposure (RME) point concentration. The RME is reported in this assessment as a reasonable estimate of the maximum exposure likely to be received. Because remediation workers may be involved in cleanup activities across all sites at Tonawanda, the airborne contaminant concentrations used to estimate inhalation exposures were derived from UL95 contaminant concentrations in sitewide soil. Soil concentrations were used to estimate remedial worker exposure dose and to estimate exposure point concentrations in the air at nearby receptor locations.

Airborne contaminant concentrations of radionuclides other than radon were estimated for each offsite receptor location on the basis of atmospheric transport modeling and site-specific meteorological data. These concentrations were determined from the contaminant concentrations in the soil being remediated and the estimated air concentrations of particulates resulting from excavation, treatment, and loading. Particulate concentrations at the exposure points beyond the site perimeter were estimated by determining the concentration of each radionuclide released from the site per year. The airborne contaminant release rate from the Tonawanda site was estimated using contaminated volume and AP-42 (EPA 1985) emission factors. The following equation was used to estimate the contaminant release rate for the no-action alternative:

$$Ci/yr = Cs \times A \times R \times T \times CF$$

where:

Cs	=	Concentration of radionuclide in soil (pCi/g),
A	=	area of site (m^2),
R	=	release rate (0.05 g/1000 m^2 - day),
T	=	time (365 d/yr), and
CF	=	conversion factors (0.01 1000 m^2/m^2; 10^{-12} Ci/pCi).

The following equation was used to estimate the contaminant release during remedial activities:

$$Ci = Cs \times V \times R \times CF$$

where:

Cs	=	concentration of radionuclide in soil (pCi/g),
V	=	volume of material (m^3),
R	=	released fraction (1.358 g/m^3), and
CF	=	conversion factor (10^{-12} Ci/pCi).

Only estimates for fugitive dust originating from contaminated areas were used in this assessment; estimates of dust generated by the movement of construction equipment on uncontaminated areas were not included. These contaminant concentrations were used to estimate potential inhalation exposures for the offsite receptors.

ESTIMATED DOSES AND INTAKES OF CONTAMINANTS

Estimates of exposure are based on the contaminant concentrations at the exposure points and scenario specific assumptions and intake parameters.

For radioactive contaminants the exposure is expressed in terms of the effective dose equivalent for all exposure pathways. For chemical contaminants, exposure is expressed in terms of intake, which is the amount of contaminant taken into the body per unit body weight per unit time.

General Public

Radioactive Contaminants

The CAP-88 computer code (Parks 1991) was used for the radiological population and maximally exposed individual dose assessment. CAP-88 is intended for use in estimating effective radiation dose equivalents and risks from radionuclides emitted into the air. The code consists of computer models, databases, and associated utility programs developed by the EPA for assessing compliance of radionuclide releases with limits established under the Clean Air Act. CAP-88 considers exposures to emitted radionuclides from inhalation of and immersion in contaminated air; ingestion of meat, milk and vegetables; and direct exposure to contaminated land surfaces. Radiation dose equivalents to the maximally exposed individual and to regional populations within kilometers of the emission source were calculated. Doses for the maximally exposed individual are estimated for the location of highest risk. The effective dose equivalent is for a 50 year exposure. The collective population dose is found by summing, for all sector segments, the intake and exposure rates multiplied by the appropriate dose conversion factor. Collective population dose is reported in person-rem/year. Table I-1 shows the input assumptions for the Tonawanda site.

Atmospheric transport of radionuclides is modeled using a slightly revised version of the AIRDOS-EPA computer code. This code uses a modified Gaussian plume equation to calculate radionuclide-specific average ground-level air concentrations at selected locations. Radon

Table I-1. Input Assumptions for CAP-88-PC

Site Information

		Source
Annual average temperature	9°C	RI
Precipitation	96 cm/y	RI
Mixing Height	1000 m	default

Source Information

Source Height	1 m
Plume Rise	0

Area (m^2)

Ashland 1	26306
Ashland 2	21854
Seaway	60300
Linde	25496

Mean radionuclide soil concentrations:

Ra226	2.7 pCi/g
U238	29 pCi/g
Th232	0.08 pCi/g
Th230	19 pCi/g

exposures were not modeled because actual measurements at the Tonawanda site indicate that radon flux is minimal.

Radiological exposures were calculated for an individual receptor with pathway-specific equations and receptor-specific intake parameters. For each pathway, the exposure point concentration was multiplied by the quantity of the intake and the appropriate dose conversion factor, which gives the dose (in mrem) for a unit intake of a radionuclide. In addition to inhalation, airborne contaminants released during the cleanup period could settle on the ground, resulting in three additional pathways, direct external gamma irradiation, incidental ingestion of soil and ingestion of food. Although these three potential exposure pathways are not expected to be significant, the radiation doses from these pathways were included for completeness.

The results indicate that, for an offsite receptor, the radiological exposures from ingestion of food and incidental ingestion of soil would be very low, as would exposure to external gamma irradiation from radioactive contaminant deposited on the ground. Therefore, these pathways of exposure are not considered further.

The estimated dose to the hypothetical maximally exposed member of the general public at 5,000 m from the site is 4×10^{-4} mrem per year for all alternatives. The results of this analysis indicate that no individual would receive a dose from the combined exposure pathways that could be associated with site activities in excess of DOE exposure guidelines of 100 mrem/year.

Offsite population doses from radioactive contaminants were calculated for all persons residing within a 1 km (.62 mi) radius of the site. The maximum estimated dose to the population residing within this area during the remedial action period is 5×10^{-4} person-rem per year, for Alternative 2 (complete excavation). The major contributor to dose is inhalation of contaminated particulate material.

Potential offsite exposures associated with airborne emissions following the cleanup period when the wastes are disposed of onsite, is not evaluated in this assessment. The disposal cell would be routinely examined to ensure its integrity and corrective actions would be performed as necessary.

Chemical Contaminants

Offsite exposures to chemical contaminants in terms of intake were not estimated for this assessment.

Remediation Workers

During the remedial action period, onsite workers would include both remedial action workers directly involved with cleanup activities and a variety of workers involved in oversight management and monitoring. The maximum exposed individual would be the remedial worker engaged in excavation and loading of wastes. All other worker doses would be significantly lower. Therefore, only the dose and risk to the maximally exposed worker was assessed. The dose was estimated by assuming exposure for 7 h/d for 250 d/y. This is a conservative assumption, since a typical construction season in New York is likely to be shorter.

Cleanup activities are expected to occur only during a portion of the remedial action period. It was assumed that a worker would be involved in cleanup throughout the length of time required for site cleanup. This provides a conservative estimate of the health risk for any individual remedial action worker.

Workers involved in remedial action activities were assumed to not be using any respiratory protective equipment in order to provide the most conservative estimate of exposure dose. Realistically, respiratory protective equipment would probably be used for any activity with a potential of generating a significant amount of contaminated dust. In this case, respiratory protective equipment would at the very minimum provide an assigned protection factor of 10 (NIOSH 1990). If respiratory protective equipment were used, the only significant exposure pathway for workers would be external gamma irradiation.

Following completion of remedial action activities, exposures of workers would be negligible because only monitoring and maintenance activities would be conducted and few workers would be involved. Workers would be present onsite periodically to collect samples, inspect and maintain the containment system, and perform other routine monitoring and maintenance activities. During this time, workers would not be exposed directly to wastes, and exposures would be negligible. However, if major repairs to the containment system were needed in the future, exposure doses could be significant.

Radiological Contaminants

All radiological exposure dose estimates were made using the RESRAD computer code, version 4.6 (see Table I-2). The maximum potential estimated annual dose to an onsite remedial action worker from exposure to radioactive contaminants was estimated to be about 500 mrem/yr for all of the alternatives evaluated. This exposure dose would be adjusted by the actual number of years required to complete each action to give a comparative estimate of the total exposure dose. The estimated annual exposure dose is considerably below the occupational dose limit of 5 rem/yr (DOE Order 5480.11).

The estimated annual dose to an onsite employee monitoring onsite storage of all excavated materials is 0.15 mrem/y. The estimated annual exposure dose to an employee following completion of remedial activities in Alternatives 5 and 6 was 0.13 mrem/y.

Chemical Contaminants

Pathways contributing to dose and risk considered in this assessment were inhalation of airborne contaminants generated during remedial activities and incidental ingestion of soil.

Table I-2.

Input Parameters for Tonawanda RESRAD Runs

Area of contaminated zone (m^2)

Linde:	26000
Ashland 1:	26000
Ashland 2:	22000
Seaway:	60000

Time since placement of material (yr) 0

	Surface	Subsurface
Thickness of contaminated zone (m)		
All Properties	0.15	2.0

Cover Depth (m)	Surface	Subsurface
All Properties (remediation worker)	0	0.15
Capping	1.2	
Seaway Property	12.3	

Contaminated Zone:

Total porosity	0.45
Hydraulic conductivity (m/yr)	123
Evapotranspiration	0.46
Precipitation (m/yr)	1.23
Runoff coefficient	0.25

Saturated Zone:

Total porosity	.45
Hydraulic conductivity (m/yr)	100

Uncontaminated, Unsaturated Zone:

Hydraulic conductivity (m/yr)	10

Table I-2. (continued)

	Average	RME
Exposure Duration (yr)		
Site employee	7	25
remediation worker	1	1
Inhalation (m^3/yr)		
Site employee	5430	7300
Remediation worker	10000	10000
Mass loading rate (g/m^3)	0.00016	0.00032
Time fraction indoors[a]		
Site employee	0	0
Remediation worker	0	0
Time fraction outdoors[a]		
Site employee	0.009	0.03
Remediation worker	0.114	0.2
Soil ingestion (g/yr)		
Site employee	0.05	0.13
Remediation worker	50	120

[a]Assumes an average site employee is outside for 0.3 h/d, 250 h/y (RME = 1 h/d)
Assumes the average remediation worker works 4 h/d, 250 d/y (RME = 7 h/d)

Chemical exposures or intakes, were estimated using the following equations detailed in the Tonawanda BRA and RAGS procedures (EPA 1989):

$$Ingestion = \frac{SF\ C \times E^{-6}\ kg/mg \times EF \times ED \times IR_{soil}}{BW \times AF \times AD},\ and$$

$$Inhalation = \frac{SF\ C \times EF \times ED \times IR_{air} \times 1/PEF}{BW \times AF \times AD}$$

where:

C	=	Chemical concentration in soil (mg/kg),
EF	=	Exposure frequency (250 days/yr),
ED	=	Exposure duration (1 yr),
IR	=	Soil ingestion rate (480 mg/d),
BW	=	Adult body weight (70 kg),
AF	=	Averaging frequency (365 days/yr),
AD	=	Averaging duration, (70 years for carcinogens, 1 year for noncarcinogens),
PEF	=	Particulate emission factor (4.63 x 10^9 m^3/kg), and
SF	=	Slope factor.

Results were used to calculate hazard indices and chemical carcinogenic risks, using EPA slope factors and chronic reference dose for risk and hazard quotients, respectively. The carcinogenic risks associated with radiological contaminant exposure are higher than the calculated chemical risks. Thus, the health risks to workers involved in remedial action at the Tonawanda site are generally represented by the risks from exposure to radioactive contaminants.

CONTAMINANT EXPOSURE HEALTH RISK EVALUATION

Potential health risks to the general public and workers from site remediation activities were estimated for both radionuclides and chemicals.

Radiological Risks

Radiological risks were determined based on the estimated doses associated with the remedial activity. The health risk evaluated is the induction of cancer related to exposure to low levels of ionizing radiation. The likelihood of cancer induction was estimated on the basis of a risk factor of 6 x 10^{-7}/mrem (EPA 1989b). The estimated radiological risks are given in Table 5-9.

The lifetime individual risks to the general public from radiation exposure as a result of remedial action activities would be low, i.e., much less than 1 x 10^{-6} for all receptors. It is unlikely that any cancer induction in offsite individuals would result from site cleanup.

Exposure to the public during transport of radioactive material would have minimal risk. An employee driving a truck with radioactive materials of the same type as those at the Tonawanda site would receive a maximum dose of 70 mrem/yr (DOE 1986a). This translates to an annual risk of 4 x 10^{-5}. The risk to the public of exposure to radiation emanating from a truck passing by would be far lower than that to the driver. Additionally, it has been estimated that the worst case spill from a truck of radioactive wastes similar in specific activity to those at the Tonawanda site would take 2 workers 10 hours each to clean up for a maximum dose to each worker of 0.4 mrem or a total of 0.8 mrem. Exposure to the public from such a spill would be far lower because institutional controls would immediately be implemented around such a spill.

The risks to remediation workers are also expected to be low. The estimated annual risk to the maximally exposed worker is about 5 x 10^{-5}. The total risk associated with remedial activities will be dependent on the amount of time required to complete all activities for each alternative.

Chemical Risks

The potential risk to an individual resulting from exposure to chemical carcinogens is expressed as the increased probability of a cancer occurring over the course of a lifetime. To calculate excess cancer risk, the daily intake averaged over a lifetime is multiplied by a chemical specific slope factor. Slope factors have been derived by EPA for a number of carcinogens to represent the lifetime cancer risk per milligram of carcinogen per kilogram of body weight, assuming that the exposure occurs over a lifetime of 70 years. The estimated risks to a remedial action worker are given in Table 5-10. The chemical carcinogenic risk for the maximally exposed onsite worker is estimated to be 2 x 10^{-5}, based on 1 year of exposure. These exposures were estimated assuming no respiratory protection, so the risks given are a conservative estimate of the actual hazard potential. The total risk is dependent on the total amount of time required to complete remedial activities.

Potential adverse health effects resulting from exposures to noncarcinogens are assessed by comparing exposure estimates (intakes) to EPA-established reference doses in order to calculate a Hazard Index. The maximum Hazard Index estimated for a remediation worker was 2.6. This exposure assessment was based on the assumption that a remedial worker would not be wearing respiratory protective equipment. In practice, however, workers would be provided with respiratory protective equipment during the remediation activities, so the actual risk to a worker would be significantly lower than the levels estimated for this analysis.

NON-EXPOSURE RELATED HEALTH RISK EVALUATION

Occupational injuries and fatalities

Occupational accidents could occur during the various activities associated with implementing any of the alternatives. Accidental injuries and death usually arise from improper use of equipment, or failure to take proper precautions. The estimated numbers of potential occupational injuries and fatalities are summarized in Table 5-10. Estimated injuries and fatalities are based on the construction industry incidence rate for occupational injuries and fatalities and the number of man-hours required to implement the action. The maximum number of occupational fatalities associated with remedial activities was estimated for Alternative 2 (3×10^{-3}). In general, alternatives involving the most activities relative to construction and material handling and processing will have the greatest risk of worker injuries and deaths.

TRANSPORTATION RISK ANALYSIS

In its July 1988 Final Generic Environmental Impact Statement for promulgation of regulations for low-level radioactive waste transporters, the New York State Department of Environmental Conservation assesses potentials for highway and railway accidents during shipments of low-level radioactive wastes in New York State (NYSDEC, 1988). While the regulations addressed in the NYSDEC EIS are not directly applicable to FUSRAP, the accident probability factors used in NYSDEC's report were used to assess the accident potential for transport of wastes from the Tonawanda Site to offsite disposal locations and transport of borrow materials to the Tonawanda site.

The probability of accidents presented in the 1988 report are provided in terms of accidents per mile traveled and are as follows:

Probability of small accident, highway	4.0E-6
Probability of large accident, highway	4.0E-7
Probability of small accident, railway	7.2E-6
Probability of large accident, railway	7.2E-7

The 1988 report also presents probability of fatal accidents associated with highway and railway accidents as follows:

Highway	4.8E-8
Railway	5.4E-8

Roundtrip mileage via highway or railway required to transport wastes to offsite locations were used, with the number of roundtrips required (refer to Table I-3), to estimate accident risks (refer to Table I-4).

Assumptions used for calculating transportation accident risks were:

Distance from Tonawanda site (in miles):
- NY hypothetical site - 200 (highway)
- Hypothetical National FUSRAP disposal site, Eastern U.S. - 500 (rail)
- Hypothetical National FUSRAP disposal site, Western U.S. - 2,800 (rail)
- Commercial disposal site (Envirocare, UT) - 2,060 (rail)
- DOE disposal site (Hanford, WA) - 2,530 (rail)
- Borrow area - 50 (highway)
- Asphalt plant - 50 (highway)

Distance from Linde to Ashland - 3.5 miles

Rail cars per train - 100

Table I-3. Input Values for Estimation of Transportation Risks for the Tonawanda Remedial Alternatives

Alternative 1- No action

No probability of a fatal accident

Alternative 2- Complete excavation and offsite disposal

Probability of fatal accident for in-state disposal consists of:
Transport of waste to NY disposal site (28,514 truckloads, 400 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to NY disposal facility for construction (22,921 truckloads, 100 mile round trip)

Probability of fatal accident for hypothetical national FUSRAP-east disposal consists of:
Transport of waste to eastern U.S. disposal site (634 trains, 1000 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to eastern U.S. disposal site for construction (22,921 truckloads, 100 mile round trip)

Probability of fatal accident for hypothetical national FUSRAP-west disposal consists of:
Transport of waste to western U.S. disposal site (634 trains, 5600 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to western U.S. disposal site for construction (22,921 truckloads, 100 mile round trip)

Probability of fatal accident for commercial disposal consists of:
Transport of waste to commercial disposal facility (634 trains, 4120 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)

Probability of fatal accident for disposal at DOE facility consists of:
Transport of waste to DOE facility (634 trains, 5060 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)

Table I-3. (continued)

Alternative 3- Complete excavation and onsite disposal

Probability of fatal accident consists of:
Transport of waste from Linde to Ashland (5008 truckloads, 7 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to Tonawanda for construction (22,921 truckloads, 100 mile round trip)

Alternative 4- Partial excavation and offsite disposal

Probability of fatal accident for in-state disposal consists of:
Transport of waste to NY disposal site (25,971 truckloads, 400 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to NY disposal facility for construction (21,683 truckloads, 100 mile round trip)

Probability of fatal accident for hypothetical national FUSRAP-east disposal consists of:
Transport of waste to eastern U.S. disposal site (578 trains, 1000 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to eastern U.S. disposal site for construction (21,683 truckloads, 100 mile round trip)

Probability of fatal accident for hypothetical national FUSRAP-west disposal consists of:
Transport of waste to western U.S. disposal site (578 trains, 5600 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to western U.S. disposal site for construction (21,683 truckloads, 100 mile round trip)

Probability of fatal accident for commercial disposal consists of:
Transport of waste to commercial disposal facility (578 trains, 4120 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)

Probability of fatal accident for disposal at DOE facility consists of:
Transport of waste to DOE facility (578 trains, 5060 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)

Table I-3. (continued)

Alternative 5- Partial excavation and onsite disposal

Probability of fatal accident consists of:
Transport of waste from Linde to Ashland (4569 truckloads, 7 mile round trip)
Transport of fill material to Tonawanda (17,180 truckloads, 100 mile round trip)
Transport of asphalt to Tonawanda (233 truckloads, 100 mile round trip)
Transport of fill material to Tonawanda for construction (21,683 truckloads, 100 mile round trip)

Alternative 6- Containment and institutional control

Probability of fatal accident consists of:
Transport of waste from Linde to Ashland (539 truckloads, 7 mile round trip)
Transport of fill material to Tonawanda for capping (8,153 truckloads, 100 mile round trip)

Table I-4. Estimated Accident Risks for the Tonawanda Remedial Alternatives

Alternative 1- No action

No probability of a fatal accident

Alternative 2- Complete excavation and offsite disposal

Probability of fatal accident for in-state disposal consists of:
Transport of waste to NY disposal site- Probability = .55
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to NY disposal facility for construction- Probability = .11
TOTAL Probability = .74

Probability of fatal accident for hypothetical national FUSRAP-east disposal consists of:
Transport of waste to eastern U.S. disposal site- Probability = .03
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to eastern U.S. disposal site for construction- Probability = .11
TOTAL Probability = .22

Probability of fatal accident for hypothetical national FUSRAP-west disposal consists of:
Transport of waste to western U.S. disposal site- Probability = .19
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to western U.S. disposal site for construction- Probability = .11
TOTAL Probability = .38

Probability of fatal accident for commercial disposal consists of:
Transport of waste to commercial disposal facility- Probability = .14
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
TOTAL Probability = .22

Probability of fatal accident for disposal at DOE facility consists of:
Transport of waste to DOE facility- Probability = .17
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
TOTAL Probability = .25

Table I-4. (continued)

Alternative 3- Complete excavation and onsite disposal

<u>Probability of fatal accident consists of:</u>
Transportation of waste from Linde to Ashland- Probability = .002
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to Tonawanda for construction- Probability = .11
TOTAL Probability = .19

Alternative 4- Partial excavation and offsite disposal

<u>Probability of fatal accident for in-state disposal consists of:</u>
Transport of waste to NY disposal site- Probability = .50
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to NY disposal facility for construction- Probability = .10
TOTAL Probability = .68

<u>Probability of fatal accident for hypothetical national FUSRAP-east disposal consists of:</u>
Transport of waste to eastern U.S. disposal site- Probability = .03
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to eastern U.S. disposal site for construction- Probability = .10
TOTAL Probability = .21

<u>Probability of fatal accident for hypothetical national FUSRAP-west disposal consists of:</u>
Transport of waste to western U.S. disposal site- Probability = .17
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to western U.S. disposal site for construction- Probability = .10
TOTAL Probability = .35

<u>Probability of fatal accident for commercial disposal consists of:</u>
Transport of waste to commercial disposal facility- Probability = .13
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
TOTAL Probability = .21

Table I-4. (continued)

Probability of fatal accident for disposal at DOE facility consists of:
Transport of waste to DOE facility- Probability = .17
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
TOTAL Probability = .25

Alternative 5- Partial excavation and onsite disposal

Probability of fatal accident consists of:
Transport of waste from Linde to Ashland- Probability = .002
Transport of fill material to Tonawanda- Probability = .08
Transport of asphalt to Tonawanda- Probability = .001
Transport of fill material to Tonawanda for construction- Probability = .10 trip)
TOTAL Probability = .18

Alternative 6- Containment and institutional control

Probability of fatal accident consists of:
Transport of waste from Linde to Ashland- Probability = .0002
Transport of fill material to Tonawanda for capping- Probability = .04
TOTAL Probability = .04

REFERENCES

NIOSH 1990. *NIOSH Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Service Centers for Disease Control, National Institute for Occupational Safety and Health, June.

NYSDEC 1988. *Final Generic EIS for Promulgation of 6 NYCRR Part 381: Regulations for Low-Level Radioactive Waste Transporters Permit and Manifest System*, Vol. II, July.

APPENDIX J

WETLANDS ASSESSMENT FOR THE REMEDIAL ACTION AT THE TONAWANDA SITE

Appendix J: Wetlands Assessment for the Remedial Action at the Tonawanda Site

J.1 PROJECT PURPOSE AND DESCRIPTION

The excavation activities proposed for the remediation of the Tonawanda site could adversely impact wetland areas. DOE is committed to avoiding or minimizing adverse impacts to wetlands from its activities to the extent possible (10 CFR 1022), and all remedial activities at the Tonawanda site are being conducted in compliance with Executive Order 11990, Protection of Wetlands. The Wetlands Notice of Involvement for the Tonawanda site is scheduled to be published in the *Federal Register* in November 1993.

From 1942 to 1946, several buildings and other portions of Linde property in the Town of Tonawanda, New York, were used for separation of uranium ores. These processing activities, conducted under a Manhattan Engineer District (MED) contract, resulted in radioactive contamination of portions of the property and buildings. Subsequent disposal and relocation of processing wastes from the Linde property resulted in radioactive contamination of three nearby properties in the Town of Tonawanda: the Ashland 1 property, the Seaway property, and the Ashland 2 property. Together these four properties and adjacent areas of contamination are referred to as the Tonawanda site (see Figures 1-1 and 1-2). These properties also contain contamination from other sources not related to MED activities.

The U.S. Department of Energy (DOE) is conducting an evaluation of the Tonawanda site under its Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to identify and clean up, or otherwise control sites where residual contamination remains from activities conducted under contract to MED or the U.S. Atomic Energy Commission (AEC).

The proposed action for the site is remediation. It is based on historical data and the results of the remedial investigation (RI) that present information on the nature and extent of contamination, and the baseline risk assessment (BRA) that evaluates potential health and ecological risks if no remedial action is taken at the site. Action is warranted based on the potential for unacceptable exposure if existing access restrictions are not maintained in the future. The Feasibility Study (FS) evaluates potential remedial actions to address risk at the site. The RI, BRA, and FS comprise the primary evaluation documents for the integrated FS/PP-Environmental Impact Statement (EIS) (the RI and BRA have been summarized and incorporated by reference in the FS. The Proposed Plan (Plan) is published separately but is considered an integral part of the RI/FS/PP-EIS process. The Plan highlights information from the FS and identifies the preferred alternative. It is the fourth major document of the RI/FS/PP-EIS process. After the completion of the RI, BRA, FS, and the Proposed Plan, and after public and agency review, the process will conclude with the issuance of a Record of Decision (ROD) that will identify the remedies selected for the site.

The Federal Insurance Administration (FIA) coordinated a flood analysis of both the Town of Tonawanda and the City of Tonawanda, but an intensive study of Twomile Creek was not performed (FIA 1979). No portion of the Linde property is within the 100-yr flood zone of Twomile Creek since it is contained in twin box culvert conduits along the western boundary of the property. The 100-yr flood zone for the Niagara River lies between the river and River Road (BNI 1993), and no portion of Ashland 1, Seaway, or Ashland 2 is within the flood zone.

Review of National Wetland Inventory (NWI) maps (Tonawanda West and Buffalo Northwest quadrangles) identified an area onsite at Ashland 2 (Rattlesnake Creek) (see Figure 2-7) as a palustrine emergent wetland with persistent narrow-leaved vegetation (i.e., cattails) and a seasonally saturated water regime. No floodplains and wetlands appear onsite at Linde, according to NWI maps, but surface runoff from the site drains into two offsite floodplain and wetland areas to the north and west (see Figure 2-8). West of Linde, a marshy strip lying along twin conduits situated in a stream bed that runs parallel to the western boundary and empties into Twomile Creek is mapped as a palustrine emergent floodplain and wetland with persistent narrow-leaved vegetation and temporary water regime. On the northeast corner of Linde, a palustrine forested floodplain and wetland with broad-leaved deciduous vegetation and a temporary water regime was identified on NWI maps. Also, information in the *Soil Survey of Erie County, New York* (SCS 1986) indicates areas of Ashland 2 and Linde that meet the criteria for hydric soils. Types of hydric soils and soils with aquatic suborders that occur onsite are Wayland, Churchville, and Odessa-Lakemont (see Table 2-5). In the technical guide for New York hydric soils (SCS 1989), Wayland is listed as a hydric soil; the Churchville and Odessa soils are listed as soils with potential hydric inclusions.

In 1976, an inspection was performed on the Twomile Creek watershed by the NYSDEC Division of Fish and Wildlife for the purpose of mapping eligible portions of the creek as New York state-regulated wetland (NYSDEC 1992b). A wetland area was identified in and along Twomile Creek in the vicinity of Twomile Creek Park and in and along its first tributary (Rattlesnake Creek). An uncontested fill in Rattlesnake Creek severed the wetland into two parts, each less than the 5 ha (12 acres) required for New York wetlands jurisdiction (NYSDEC 1992b).

Three distinct plant communities were identified in the wetland area. These included wooded wetland, emergent vegetation, and wet meadow vegetation. Species of wildlife that were either sighted or of whom signs were observed in the wetland included muskrat, redwinged blackbird, ring-necked pheasant, mallard (female and brood), raccoon, mink, and killdeer. The area is probably used to some extent by waterbirds such as herons, and because of the presence of flooded dead trees and good brooding cover, the area should provide woodduck breeding habitat (NYSDEC 1992b).

In October and November of 1990 and December of 1991, a wetland delineation was conducted on the Ashland 2 property (BCI 1992a). The delineations were performed as part of a proposed industrial park development plan. The 1990 delineation was conducted using the 1989 COE *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. In 1991 the site was reevaluated due to the implementation of the *Corps of Engineers (COE 1989) Wetland Delineation Manual* (Environmental Laboratory 1987) while the 1989 manual was being revised.

For the 1990 delineation, the intermediate onsite method was used with the quadrant transect sampling procedure throughout most of the site. After a general reconnaissance of the site, four transects were selected in which to examine and document habitats and soil types on the property. The three intermittent streams (drainage shales) were delineated using the routine onsite determination method. After a review of the 1990 delineation data, the southern part of the site was reexamined. Additional sample points and two transects were added to redetermine the boundaries of Wetland H. For all sample points, the standard 1.52-m (5-ft) radius was used to define the herbaceous cover and a 9.14-m (30-foot) radius was used for the remaining layers. Soil samples were taken with a soil bucket auger. Based on the results of the sample points, the wetland/upland boundary was identified by changes in elevation and vegetation. Wetland boundaries are shown on Figure 2-9.

The vegetative cover types on the site are shown on Figure 2-10. The forested area near River Road is dominated by common buckthom *(Rhamnus canthartica)* and hawthom *(Crataegus* sp.). Most of the site is characterized by a uniform dogwood-hawthorn shrub community. This facultative plant-dominated community is located on higher elevations and adjacent to the swales. At these sample plots, hydric soils and wetland hydrology were not present. The assumed landfill areas on the site are dominated by grasses and forbs, such as goldenrods and asters. These areas are shown as grasslands on Figure 2-10. The excavated area has predominantly bare soils and no field indicators of jurisdictional wetlands. The former storage tank area was not investigated in detail, but it contains extensive stone fill with various pioneer herbaceous species and a stand of *Phragmites australis* in one corner. The three drainage swales met the three technical criteria for jurisdictional wetlands. They are dominated by nearly monocultural stands of the non-native common reed *(Phragmites australis)* and purple loosestrife *(Lythrum salicaria)* with occasional stands of cattail *(Typha latifolia)*. Hydrologic characteristics were apparent with saturated soils and standing water. Flowing water was not observed at the time of the site visits. Eight isolated wetlands met the three technical criteria for jurisdictional wetlands. Five are located in the southern portion of the site and three are in the northern portion. Wetlands G and H are located in the upland woods and have similar vegetation. The other six isolated wetlands are small depressions with nearly identical vegetation and distinct boundaries. The man-made ditches on the property are located along the access road or in other upland areas and have no upstream natural component. They are not considered to be subject to jurisdiction under Section 404 of the Clean Water Act and were not sampled for wetland criteria.

In summary, the total wetland area on the Ashland 2 site is 3.41 ha (8.42 acres). Of the total acreage, the drainage swales comprise 3.09 ha (7.63 acres) and the remaining small wetlands comprise 0.31 ha (0.77 acre).

J.2 DESCRIPTION OF SITEWIDE ALTERNATIVES

In this section, the six sitewide alternatives developed for the Tonawanda site are described. Detailed descriptions of those actions in Sections 5.2.1 are referenced.

J.2.1 Alternative 1 — No Action

The no-action alternative is considered in accordance with CERCLA requirements and NEPA values, and provides a baseline for comparison with other alternatives. Under this alternative, no action is taken to implement remedial activities. Periodic monitoring of contaminant levels in appropriate media is continued.

Fencing and signs currently in existence would be left in place but would not receive maintenance or repairs. Site security at the Tonawanda site would continue indefinitely under the no-action scenario.

J.2.2 Alternative 2 — Complete Excavation and Offsite Disposal

Complete excavation involves removing all soils contaminated above DOE guidelines for residual radioactivity. At Linde, contaminated buildings would be demolished. The railroad spur, concrete floors, and pavement would be removed to gain access to contaminated soils beneath these structures. A large hoe, a small backhoe, and/or front-end loaders would be used to excavate surface and subsurface soils. Before building demolition, spray sealants would be applied to mitigate impacts to ambient air from fugitive dust and particulate emissions. Conventional heavy equipment would be utilized to demolish the four buildings at Linde. Grappling hooks attached to cranes would remove debris and feed the debris directly into volume reduction equipment such as a portable hammer mill with its associated air pollution control equipment. Processed demolition debris could be fed directly into container trucks for offsite disposal. Drainage to storm drain lines would be prevented during excavation activities to minimize additional impact on the storm sewer system.

Contaminated sediments within Linde storm lines and sumps would be snaked, contaminants removed, and lines cleaned. It is estimated that approximately 670 m (2200 linear ft) of storm lines would require cleaning. Contaminated sediments within the wetlands at the northeast corner of Linde would be removed followed by wetland restoration.

At Ashland 2, surface water of Rattlesnake Creek and its associated drainage ditches within the Niagara-Mohawk easement would be temporarily diverted using dikes (if necessary) to reroute flow as appropriate. Erosion control devices would prevent sediments from migrating offsite. Contaminated sediments from the creek and drainage ditch would be removed using a "clamshell" crane. The disturbed areas of Rattlesnake Creek and the drainage ditches would be reconstructed with native materials. The wetlands associated with Rattlesnake Creek would be restored in all disturbed areas.

At Ashland 1 and 2 and the waste piles at Seaway (Area A) and Linde, contaminated soils could be excavated and removed with conventional earth-moving equipment. Soils at these properties are readily accessible and no obstructions would prohibit removal.

At the Seaway property, the "access-restricted" soils located within and under the refuse would be removed. Utilizing conventional excavation techniques would result in greater short-term impacts especially with regard to landfill gas emissions, odors, and temporary storage of excavated waste. Specifications and details for accessing the contaminated soils within the Seaway landfill can be finalized as part of the remedial design process.

General aspects of offsite disposal are discussed in Section 5.2.1.3. The contaminated soil would be placed into rail cars or trucks for bulk shipment to the disposal facility. Loading facilities would have to be constructed, or existing sidings on Ashland 1 and Linde used, to load material into rail cars. Offsite transportation issues are discussed in Section 5.2.1.2.

Radioactively contaminated solid waste would be placed into containers acceptable for transportation and shipment offsite and would meet the waste acceptance criteria for receipt by the permanent disposal facility. Optional disposal sites are described in Section 5.2.1.3. Solid waste would be transported by enclosed semitrailers or by rail. The trucks or rail cars used to transport contaminated materials would be safety inspected before use. All containers would be checked for surface contamination and decontaminated, if necessary, before being loaded onto the trucks or rail cars. The shipments would be manifested according to the applicable requirements for shipment of radioactive waste materials. As required, predesignated routes would be traveled and an emergency response program would be developed to respond to any accidents. Upon arriving at the disposal facility, the containers would be removed from the trucks or rail cars for disposal. The transportation of radioactively contaminated materials would strictly comply with all applicable state and federal regulations.

J.2.3 Alternative 3 — Complete Excavation and Onsite Disposal

This alternative is similar to Alternative 2, except for the disposal option. All activities would be identical to those described in Alternative 2. All radioactive materials would be collected in bulk and trucked to the onsite land encapsulation disposal facility located at Ashland 1, Seaway, or Ashland 2. The property containing the disposal cell would be purchased and maintained by DOE. Construction aspects of the onsite disposal facility are discussed in Section J.2.1. Onsite monitoring of air, surface water, and groundwater would be implemented for the life of the facility.

J.2.4 Alternative 4 — Partial Excavation and Offsite Disposal/Reuse

This alternative is similar to Alternative 2 except that contaminated soils under Building 30 at Linde and soils in Areas B and C of Seaway would not be excavated. When Building 30 is abandoned and subsequently demolished, the soils would become accessible for future DOE removal. Because contaminated soils would remain in place, institutional controls and containment, as appropriate, would be necessary to prevent exposure to remaining contaminants. Institutional controls would include access restrictions, deed restrictions, and/or perpetual prohibition of excavation/demolition activities on the site. Physical and chemical methods would be used to selectively decontaminate Building 30. Buildings 14, 31, and 38 would be completely demolished at Linde. Sediments located within the storm drains and sumps at Linde, as well as the waste pile stored at Linde would be removed.

Contaminated sediments within the wetlands at the northeast corner of Linde would be removed and the wetland restored. The accessible soils at Ashland 1 (including Seaway Area D) and Ashland 2 plus the waste pile at Seaway (Area A) would be removed under this excavation scenario. Surface water in Rattlesnake Creek and its associated drainage ditches within the Niagara-Mohawk easement would be diverted using dikes (if necessary) to reroute flow as appropriate. Erosion control devices would be placed to contain sediments to prevent offsite migration. Sediments from the creek and drainage ditch would be removed using a "clamshell" crane. Rattlesnake Creek and the drainage ditches would be reconstructed with similar soils in disturbed areas. The associated wetlands of Rattlesnake Creek would be restored in all disturbed areas. In order to assess contaminant migration, onsite monitoring of air, surface water, and groundwater would be implemented and would continue for as long as the contaminants remain in place.

J.2.5 Alternative 5 — Partial Excavation and Onsite Disposal

This alternative is a combination of Alternatives 3 and 4, consisting of partial excavation to remove all soils not described as "access-restricted" in Alternative 4 and onsite disposal activities as described in Alternative 3.

J.2.6 Alternative 6 — Containment and Institutional Controls

This action involves the use of an earthen cap to reduce the infiltration of water through the Tonawanda site to the groundwater, reduce surface runoff to offsite waterways, reduce the potential for direct human contact with contaminated surface soils, and minimize the potential for airborne migration of surface contamination to human and ecological receptors.

Containment involves covering the surface of the in-place radioactively contaminated soils at Ashland 1 and Ashland 2, and the waste piles at Seaway and Linde properties, with a low-permeability earthen cover constructed to prevent infiltration of water through the cap. Discrete areas where waste is known to be buried are considered for a low-permeability cap. A low-permeability cap should prove effective in reducing the risk of infiltration of rainwater through the waste and into the groundwater. The cap would consist of a 0.6-m (2-ft) thick layer of clay with a hydraulic conductivity of less than 1×10^{-7} cm/s, and a 0.3-m (1-ft) thick topsoil cover layer. The cover would be graded to promote surface runoff from the capped area, and indigenous vegetation would be planted to stabilize the topsoil cover.

Surface water in Rattlesnake Creek and drainage ditches at Ashland 1 and Ashland 2 would be diverted to access and remove contaminated sediments. Sediments located within the storm drains and sumps at Linde would be removed. The sediments would be incorporated into the capped areas at Ashland 1 and 2.

Radioactively contaminated soils within the commercial landfill at Seaway as well as the contaminated soils located beneath paved areas and buildings and structures at Linde would be left undisturbed.

Radionuclides on the surfaces of buildings and structures would be contained by applying sealants.

Institutional controls currently in place are necessary to limit permissible activities on and access to the Tonawanda site and maintain the integrity of the soil cover or cap. Unrestricted access to any capped area could lead to penetration of the capped areas. These actions include maintenance of the perimeter fence and continued security to prevent entry to the properties. Additional actions may include placing warning signs and establishing perpetual deed restrictions to prohibit intrusive activities on and access to the site. Continuing environmental monitoring to assess contaminant migration is also an institutional control action.

J.3 WETLANDS EFFECTS

J.3.1 Impacts

Under the No-action alternative, the contaminants would not be excavated from the wetlands identified at Ashland 2. Because contaminants remain in place, wetlands biota would be subject to continued exposure, potentially resulting in adverse effects to these biota and any fauna that feed upon them.

All of the other alternatives include removal of the contaminants from the wetlands at Ashland 2 and the contaminated soils and sediments in the northeast corner of the Linde property (see Figure 2-7).

Remedial actions to remove contaminated soils and sediments in the northeast corner of Linde (see Figure 2-7) would impact approximately 0.32 ha (0.80 acres) of the associated wetland area (see Figure 2-19). Removal of contaminated material found in Rattlesnake Creek would be performed during the dry season to avoid need for dikes and berms. Contaminated soils and sediments removed from an estimated 200 m (610 ft) of the streambed. An additional 50 m (165 ft) of streambed of the unnamed tributary to the west of Rattlesnake Creek would also be excavated. The estimated volume of this material is 8,352 cubic yards. Approximately 0.52 ha (1.3 acres) would be impacted in the Rattlesnake Creek low lying areas and the associated wetland area. The excavation of contaminated sediments in these areas would result in the loss of the affected wetlands' hydrogeologic, hydrologic, soil, and biological characteristics and functions. Remedial actions that require soil removal within the Rattlesnake Creek low lying area could temporarily affect the storage volume, but they would be scheduled during dry periods (July - November) when the potential for flooding is low. Over the long term, the flood storage volumes would not be affected because the area that would be disturbed is small and the area would be restored to its original contours upon completion of remedial activities. No significant impoundment, diversion, or other modification of floodwaters would result.

Impacts to floodplains and wetlands at the hypothetical disposal sites involved with Alternatives 2 and 4 will be evaluated prior to site selection. Locations in the western United States could be expected to require little or no design features to mitigate possible impacts from or to floodplains or wetlands.

Alternatives 3 and 5 involve the construction of an onsite disposal cell at Ashland 1, Seaway, or Ashland 2. Construction of an onsite disposal facility at Ashland 2 would potentially eliminate the 0.09 ha (0.24 acre) Wetland H identified on Figure 2-9. New wetlands would be created to replace those eliminated. No wetlands would be involved at the potential Ashland 1 and Seaway locations. There are no anticipated impacts from flooding on the site because the site is located above the 500 year flood elevation.

J.3.2 Mitigation

Proper engineering controls would be instituted to mitigate potential disturbances to the wetland areas surrounding Rattlesnake Creek and the northeast corner of the Linde property. Mitigation for the wetland areas would be incorporated in the mitigative action plan that will be prepared by DOE in consultation with other agencies as part of the remedial action process. Appropriate erosion and siltation controls would be used and maintained during the remedial actions. Also, heavy equipment utilized in wetlands would be of the low ground-pressure type (e.g., high floatation tires or specialized tracks), or placed on mats to minimize soil disturbance.

Probably the most critical aspect of any wetland creation or restoration plan is that of hydrology. Because restoration under this alternative is an extension of an existing wetland and proposed conditions are similar to those in the existing wetland, establishing similar grades on suitable soils would be sufficient to create a proper hydrologic setting. Replacement soils would be of similar soil classification and sufficient to support the intended vegetation or provide other functions such as groundwater discharge control or pollution attenuation.

The preferred time of year for reconstruction is site-specific depending on hydrologic factors, breeding of wildlife and fish, logistical constraints (e.g., work in frozen organic soils), optimum times for planting, and downstream concerns. The preferred time for the removal and wetland restoration activities at the Tonawanda site would be from July to October.

Active reintroduction of wetland vegetation is probably not necessary, as natural colonization would usually occur within two or three growing seasons as conditions become suitable. To protect unstabilized soils from eroding until wetland vegetation becomes established, a fast-growing annual grass (e.g., millet) or a perennial grass that is acceptable to include in the plant community would be planted. Also, exposed soil surfaces would be straw-mulched or comparably covered (netted if inundated and potentially subject to flowing water) to minimize erosion during the nongrowing season. Mitigation for the wetlands areas would be incorporated in consultation with other agencies as part of the remedial action process.

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FS/PP-EIS DOCUMENT: DOE/EIS-0191D
PROPOSED PLAN: DOE/OR/21950-233

PROPOSED PLAN FOR THE TONAWANDA SITE

TONAWANDA, NEW YORK

NOVEMBER 1993

U.S. Department of Energy
Oak Ridge Operations Office
Formerly Utilized Sites Remedial Action Program

Documents Comprising the Draft
Feasibility Study/Proposed Plan-Environmental Impact Statement (FS/PP-EIS)
for the Tonawanda Site,
Formerly Utilized Sites Remedial Action Program

- Feasibility Study for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-234, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, November 1993.

- Proposed Plan for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-233, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, November 1993.

The following documents have been incorporated by reference in the Draft FS/PP-EIS:

- Remedial Investigation Report for the Tonawanda Site, DOE/OR/21949-300, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, August 1993.

- Baseline Risk Assessment for the Tonawanda Site, Tonawanda, New York, DOE/OR/21950-003, U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee, August 1993.