DEPARTMENT OF THE ARM
KANSAS CITY AND BALTIMORE DISTRICT
CORPS OF ENGINEERS

RI/FS at the Former Lake Ontario Ordnance Works
Lewiston/Porter, Niagara County, New York

Contract No. DACA41-88-C-0005
Modification No. 00021

FINAL ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) FOR REMOVAL ACTIONS IN OPERABLE UNITS 1 AND 2

March 1995
P09818.28

ACRES INTERNATIONAL CORPORATION
140 John James Audubon Parkway
Amherst, New York 14228-1180

ACRES

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Executive Summary

1 General

This Engineering Evaluation/Cost Analysis (EE/CA) for removal actions at the Former Lake Ontario Ordnance Works (LOOW) Site located in Lewiston/Porter, New York has been authorized under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS).

The purpose of the EE/CA is to address interim removal action measures for the following areas at the LOOW site:

- Operable Unit No. 1
  - Area A - Buried drum trench
  - Area B - Former burn pit area
  - Buried TNT waste pipelines
- Operable Unit No. 2
  Air Force Plant 68 areas consisting of:
  - Chemical waste sewer system sewage and sludges
  - Loose asbestos-containing materials on the Somerset Group property
  - Miscellaneous containers of hazardous liquids and oils on the Somerset Group property

The objective of this EE/CA was to evaluate non-time critical removal action alternatives for the identified source areas in terms of effectiveness, implementability, and cost criteria. Based on this evaluation, recommended remediation alternatives have been identified for lowering the assessed risk to human health and the environment.

2 Site Characterization

Site Background

The original LOOW site encompassed approximately 7,500 acres with actual DOD site activities having occurred on 2,500 acres. During the early 1940s, the LOOW was used as a manufacturing plant producing the explosive trinitrotoluene (TNT) for World War II. Portions of the LOOW site have since been used by several branches of the Departments of Defense and Energy for various manufacturing and storage activities, including the pilot production of high-energy fuels.

In 1969, Chem-Trol Pollution Services, Inc. acquired portions of the LOOW for the development of a hazardous waste treatment, storage, and disposal (TSD) facility. Chem-Trol was acquired by SCA Chemical Services Inc. (SCA) in 1973, and subsequently acquired by Chemical Waste Management (CWM) in the early 1980s. In 1972, the Somerset Group obtained an approximate 100-acre section of the former LOOW property which contained Air Force Plant (AFP) 68. Around 1979, the southern half of the former AFP-68 (about 50 acres) was sold to SCA Chemical Services. This section is presently owned by CWM.

The identified contaminant source areas to be addressed by the EE/CA are located within the present property boundaries of CWM and on adjacent property owned by the Somerset Group.

Identified Contamination

Previous investigations conducted at the site have identified the following contamination source areas which are to be addressed by the interim removal action:

Area A

A buried drum trench area approximately 220 ft long by 40 ft wide by 10 ft deep. Samples of the test pit soils, water and the contents of drums uncovered during test pit investigations in Area A indicated the presence of volatile and semi-volatile organics with predominant contaminants being acetone, 2-butanone, total xylenes, and toluene. The buried drums and test pit water displayed the greatest concentrations of contaminants.

Area B

A former burn pit area used by AFP-68 for the open incineration of wastes. The contaminated area includes a bermed pond and a buried surface depression identified in historical aerial photographs. Samples of the pond sediments have indicated contaminant concentrations consisting predominantly of benzene derivative compounds. Investigations have also identified deteriorated drums and lab pack materials in the pond sediments. Subsurface soil samples in the area of the former surface depression displayed elevated levels of carbon tetrachloride, hexachloroethane, and tetrachloroethane.

TNT Waste Pipelines

Analytical results for pipeline sediment samples taken during previous investigations by the Corps of Engineers (COE) and CWM have confirmed the presence of explosive compounds (nitroaromatics). Based on other U.S. Army ordnance works projects, verification of the presence of explosive contaminated residues in pipelines indicates that pockets of higher concentrations (potentially detonable pockets) may exist in other sections of the system. Recent sampling and analyses of pipeline sediments by CWM have also identified the presence of elevated levels of several other volatile and semi-volatile organic contaminants.

Chemical Waste Sewer System

Numerous contaminants were identified in the bottom sludge and sewage within the chemical waste sewer system lift stations. The sludge sampling indicated substantial concentrations of total volatile organics (as high as 165,000,000 μg/kg), total semi-volatile organics (as high as 43,000,000 μg/kg), and high concentrations of pesticides, PCBs, mercury, barium, chromium, and lead.

Miscellaneous Liquids and Oils

Several locations on the former AFP-68 site contain containers of hazardous liquids and oils. These include:

- One 55-gallon open-top drum of oil composed of predominantly semi-volatile organic compounds;
- Two 5-gallon metal containers and sixteen 1-gallon glass containers of a red liquid with high chromium concentrations (probably chromic acid);
- Approximately sixteen 1-gallon glass containers of miscellaneous laboratory chemicals (e.g., sodium hydroxide, hydrochloric acid, and pentane).

Loose Asbestos-Containing Materials

These identified on-site materials include bags of dry asbestos mortar mix; detached loose pieces of corrugated siding and roof panels, many of which have been fragmented; an asbestos-insulated hopper; and asbestos-containing pipe insulation.

3 Goals and Objectives

The intent of the non-time critical removal action at the LOOW site is to lower the threat of exposure and/or contaminant migration from several identified source areas until a final remedial action(s) is implemented. Specific objectives for accomplishing this goal were defined as:

1. Removal of previously identified contaminated sediment, soil and drums from the Area A drum trench and the Area B burn pit.

2. Removal of the former TNT waste pipeline system.

3. Removal of accumulated sludges and liquids in the chemical waste sewer system and associated lift stations.

4. Dewatering of all areas, as needed, to remediate the above referenced areas.

5. Removal of loose asbestos-containing materials and miscellaneous containerized liquids and oils identified during previous site investigations on the Somerset Group Property.

6. Properly treat and/or dispose of all waste streams from the removal actions.

7. Restoration of all disturbed areas.

8. Implementation of any required post-removal action monitoring.

4 Identification and Analysis of Removal Action Alternatives

A maximum of three removal action alternatives were identified for each main source area. In the case of Area A, Area B, and the TNT waste pipeline system, the previously completed Feasibility Study for Operable Unit No. 1 (Acres, 1990) was used as a guide in identifying the most feasible alternatives. The identified alternatives were as follows:

Areas A and B (Solid Matrix)

1. Excavation/Fixation
2. Excavation/Treatment (by solvent extraction)
3. Excavation/Landfilling at an existing permitted facility

TNT Waste Pipelines

A. Crystalline Solids (these materials are assumed to be unstable and not suitable for transport on public roads):

1. Removal/Open Flaming or Detonation
2. Removal/Incinerate Nearby (Mobile Unit)

B. Sediments/Soils (≥10% nitroaromatic concentrations):

1. Removal/Open Flame
2. Removal/Incinerate (off-site)
3. Removal/Biotreatment (off-site), nearby

C. Hazardous Solids (<10% nitroaromatic concentrations);

1. Removal/Fixation
2. Removal/Treatment (by soil washing)
3. Removal/Landfilling at an existing permitted facility

D. Nonhazardous Solids (only one feasible alternative):

1. Landfill at 6NYCRR Part 360 permitted facility

Chemical Waste Sewer System/Lift Stations (solid matrix);

1. Removal/Fixation/Landfill
2. Removal/Treatment (solvent extraction)/Disposal of Residual
3. Removal/Incinerate (off-site)

Aqueous Matrix (applicable to all of the above areas):

1. Treatment at an existing on-site aqueous treatment facility
2. Treatment at an off-site facility
3. Treatment on-site at a temporary facility with discharge to surface drainage

Miscellaneous Oils and Liquids (one feasible option):

1. Removal and disposal by a recycling/disposal service firm.

Asbestos-Containing Materials (one feasible option):

1. Removal and disposal at 6NYCRR Part 360 permitted facility.

Each alternative was evaluated in terms of the criteria defined in the EE/CA scope of work developed by the COE dated July 18, 1994 and in accordance with the USEPA guidelines. A matrix-type comparison analysis was completed with respect to the three main criteria categories (effectiveness, implementability, and cost) and associated subcriteria. The comparison assigned an appropriate equal weighting to each main criterion (effectiveness - 33 percent; implementability - 33 percent; cost - 34 percent) with the best score achievable of 100 and the poorest of 300.

The results of the evaluation and final ranking of removal action alternatives are summarized in Table ES-1.

5 Recommended Removal Action

Based on this EE/CA, the following preferred removal plan is recommended:

Areas A and B

The highest ranked removal action for Areas A and B is the excavation/landfilling disposal alternative. Under this alternative, the contaminated sediment, soils, drums and miscellaneous materials would be excavated and transferred by truck to the operating RCRA landfill located on the property for disposal. The material would be pretreated as required for disposal.

TNT Waste Pipelines

The preferred plan would consist of:

- Removal and open flaming/detonation of any encountered crystalline TNT solids at a nearby secure site.

- Removal and biotreatment of explosives contaminated sediments and solids with ≥ 10 percent nitroaromatics.

- Removal and disposal of all remaining excavated materials characterized as a hazardous waste at a permitted RCRA landfill.

- Removal and disposal of all nonhazardous materials at a 6NYCRR Part 360 permitted landfill.

Chemical Waste Sewer System/Lift Stations

The highest ranked removal action would consist of:

- Removal of the bottom sludges by vacuum extraction.

- Treatment of the removed sludges by thermal destruction at an existing off-site permitted incinerator.

- High-pressure water jet cleaning of the lift stations and trunkline. The sludge/wastewater mixture from the cleaning operation would be vacuumed into a tank truck and transferred to the existing on-site aqueous treatment facility.

- Final sealing of the lift stations.

Aqueous Matrix (for above areas):

The liquid fraction present in the excavations, pipeline systems, and lift stations would be collected as part of the removal action and pumped into a tank truck for transfer for treatment at the existing on-site aqueous treatment facility. Treatment requirements would be determined based on sampling results for the contaminated water.

Miscellaneous Containerized Liquids and Oils would be properly containerized, as needed, and transferred to a permitted off-site facility for cost-effective recycling, treatment, or alternate disposal method.

Asbestos-Containing Materials would be removed by a licensed asbestos contractor and transferred to one of several nearby permitted 6NYCRR Part 360 landfills.

The estimated total costs for the recommended removal action program are as follows:

Area		Solid Matrix	Aqueous Matrix
Area A		$1,905,000	$183,000
Area B		4,449,000	110,000
TNT Waste Pipelines			
Crystalline Solids	95,000		
Sediments/Soils	406,000		
Hazardous Solids	192,000		
Nonhazardous Solids	264,000		
Excavation/Backfill	1,223,000		
	2,180,000	2,180,000	259,000
Chemical Waste Sewer System		271,000	29,000
Miscellaneous Liquids/Oils		11,000	–
Asbestos-Containing Materials		135,000	–
	Matrix Total:	$8,951,000	$581,000
		Total Estimated Removal Action Costs:	$9,532,000

TABLE ES-1
ENGINEERING EVALUATION/COST ANALYSIS SUMMARY
COMPARISON OF REMOVAL ACTION ALTERNATIVES

Source	Rank - Removal Action Alternative	Total Weighted Score	Estimated Cost in $1,000s			
			Direct	Indirect	PRSC	Total
Area A						
(Solid Matrix)	1 - Disposal (by Landfilling)	156	$ 1,738	$ 167	0	$ 1,905*
	2 - Fixation	210	1,156	189	41	1,386
	3 - Treatment (by Solvent Extraction)	223	1,933	305	41	2,279
Area B						
(Solid Matrix)	1 - Disposal (by Landfilling)	156	4,164	285	0	4,449*
	2 - Fixation	210	2,672	392	86	3,150
	3 - Treatment (by Solvent Extraction)	223	5,031	734	86	6,121
TNT Waste Pipeline System						
A. Crystalline Solids	1 - Open Flame/Detonate Nearby (Off-Site)	100	80	15	0	95*
	2 - Incinerate Nearby/(Mobile Unit)	212	1,217	222	0	1,439
B. Sediments/Soils (≥10% Nitroaromatics)	1 - Biotreatment Nearby (Off-Site)	166	338	68	0	406*
	2 - Incinerate (Off-Site)	168	1,681	221	0	1,902
	3 - Open Flame Nearby (Off-Site)	200	635	98	0	733
C. Hazardous Solids (≤10% Nitroaromatics)	1 - Landfill (Off-Site)	156	174	18	0	192*
	2 - Treatment (by Soil Washing)	223	175	25	0	200
	3 - Fixation	221	150	22	0	172
D. Nonhazardous Solids	1 - Landfill at 6NYCRR Part 360 Permitted Facility	**	225	39	0	264*
	Excavation/Backfill Costs (all Materials)		1,094	129	0	1,223*
Chemical Waste Sewer System						
(Sludge/Solids)	1 - Fixation/Landfill	166	223	39	0	262
	2 - Incinerate (Off-Site)	134	231	40	0	271*
	3 - Treatment (by Solvent Extraction)	223	253	43	0	296
Aqueous Matrix (All Areas)	1 - Treatment at CWM Facility	134	581	0	0	581*
	2 - On-Site Treatment	166	334	0	0	334
	3 - Treatment Off-Site	179	620	0	0	620
Miscellaneous Liquids and Oils	1 - Remove for Off-Site Treatment and Recycling	**	7	4	0	11*
Asbestos-Containing Materials	1 - Remove and Landfill at 6NYCRR Part 360 Permitted Facility	**	110	25	0	135*
TOTAL ESTIMATED COST FOR PREFERRED ACTION PLAN						$9,532

* Preferred alternative
** Only alternative evaluated

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1 Introduction

The following report presents the results of an Engineering Evaluation/Cost Analysis (EE/CA) for portions of the former Lake Ontario Ordnance Works (LOOW) located in Niagara County, New York (Figure 1-1). This EE/CA has been prepared for the Department of the Army, Kansas City and Baltimore Districts, Corps of Engineers (COE) under Modification No. P00021 to Acres engineering services contract (Contract No. DACA41-88-C-0005) as part of the Defense Environmental Restoration Program (DERP). All work has been performed in accordance with the COE Scope of Work dated July 18, 1994.

1.1 Areas of Concern

Under the authority of DERP, the COE has undertaken a Remedial Investigation/Feasibility Study (RI/FS) at the LOOW. In 1987, the COE contracted Acres to perform the RI/FS including the management of all contractors and subcontractors required to complete the project. As part of the RI/FS, Acres has investigated areas grouped into two separate operable units, Operable Unit No. 1 and Operable Unit No. 2 (Figure 1-2).

1.1.1 Operable Unit No. 1

Operable Unit No. 1 consists of the following seven areas on property currently owned by CWM Chemical Services, Inc. (CWM):

- An area originally suspected to contain approximately 30 buried drums, identified as Area A;
- An area used for the open incineration of wastes from Air Force Plant 68 (AFP-68), identified as Area B;
- Three areas, originally suspected to contain a buried drum trench containing 200 to 300 drums also related to AFP-68, identified as Areas C, D, and Area North of C;
- An area originally suspected to contain buried drums located west of Area B, identified as the Wooded Area; and
- The underground trinitrotoluene (TNT) and acid waste sewer systems from the original LOOW TNT manufacturing plant.

Remedial investigations for Operable Unit No. 1 were conducted in 1988 and 1989. The investigations verified the presence of buried drums and localized soil and groundwater contamination in Area A, and contaminated sediments and localized groundwater contamination in Area B. None of the suspected buried drums in Areas C, D and the Area North of C were found, nor were any drums or contamination found in the Wooded Area. Investigations of the buried TNT sewer system identified the presence of TNT residues in the sewer system.

Based upon the findings of the RI, which included a qualitative risk assessment, an FS for Operable Unit No. 1 was initiated in 1989 with an Advance Final FS report completed in 1990. On January 6, 1992, the New York Department of Environmental Conservation (DEC) formally approved of the preferred remedial alternative which consisted of the excavation of contaminated drums and soils from Areas A and B and disposal of these materials at an approved RCRA permitted landfill. A decision regarding the remediation of the TNT lines was never made by the DEC.

1.1.2 Operable Unit No. 2

Operable Unit No. 2 consists of the former AFP-68, located on properties owned by CWM and the Somerset Group; a portion of the former Nike Missile Base, located on CWM property; and the former LOOW Wastewater Treatment Plant, located on property owned by the Town of Lewiston.

The first investigations of Operable Unit No. 2 began during RI activities for Operable Unit No. 1 during which time (i.e., 1988) Acres performed a Reconnaissance Survey of those properties comprising Operable Unit No. 2 plus the existing TNT buildings located on CWM property. The Reconnaissance Survey consisted of a detailed site walkover that included confirming site conditions with numerous available site maps and as-built drawings. Acres prepared and submitted a summary report of this survey to the COE in late 1988. In 1992, Acres was issued a Scope of Work by the COE to perform a confirmation study of the Operable Unit No. 2 areas of concern, excluding the TNT buildings.

Because no previous sampling had been performed at any of the Operable Unit No. 2 study areas, and under the supposition that contamination existed in some of those areas, the confirmation study investigations included some investigative aspects more applicable to an RI. These additional investigations included monitoring well installation and groundwater sampling, perimeter and personnel exposure air monitoring, Hazard Ranking System II scoring, and a preliminary contamination assessment which incorporated most aspects of a baseline risk assessment.

The results of the Operable Unit No. 2 investigation were summarized in Preliminary Contamination Assessment Report that was issued final in December 1992. The results indicated the presence of several contaminant source areas, specifically portions of the AFP-68 chemical waste sewer system, loose asbestos-containing materials, and miscellaneous containers of hazardous liquids and oils.

1.2 Purpose

The purpose of this EE/CA is to address interim removal action measures to be undertaken in the following areas:

- Operable Unit No. 1
  - Area A - buried drum trench
  - Area B - burn pit area; and
  - TNT waste pipelines.
- Operable Unit No. 2
  - AFP-68 consisting of:
    - Chemical waste sewer system sewage and sludges;
    - Loose asbestos-containing materials on the Somerset Group property; and
    - Miscellaneous containers of hazardous liquids and oils on the Somerset Group property.

1.3 Organization of the Report

Section 2 of this report presents a site characterization of the LOOW site including:

- A description of the LOOW site and surrounding area;
- A description of the sources, nature and extent of contamination;
- Previous removal actions;
- Presentation of existing analytical data; and
- A description of site conditions that justify a removal action under DERP.

Section 3 identifies the removal action objectives while Section 4 identifies the removal action alternatives. Section 5 presents a description of each removal action alternative with brief discussions and analysis of each action's ability to attain various criteria. Section 6 presents a comparative analysis summary of the removal action alternatives. Finally, Section 7 presents the recommended removal action alternative for each area of concern.

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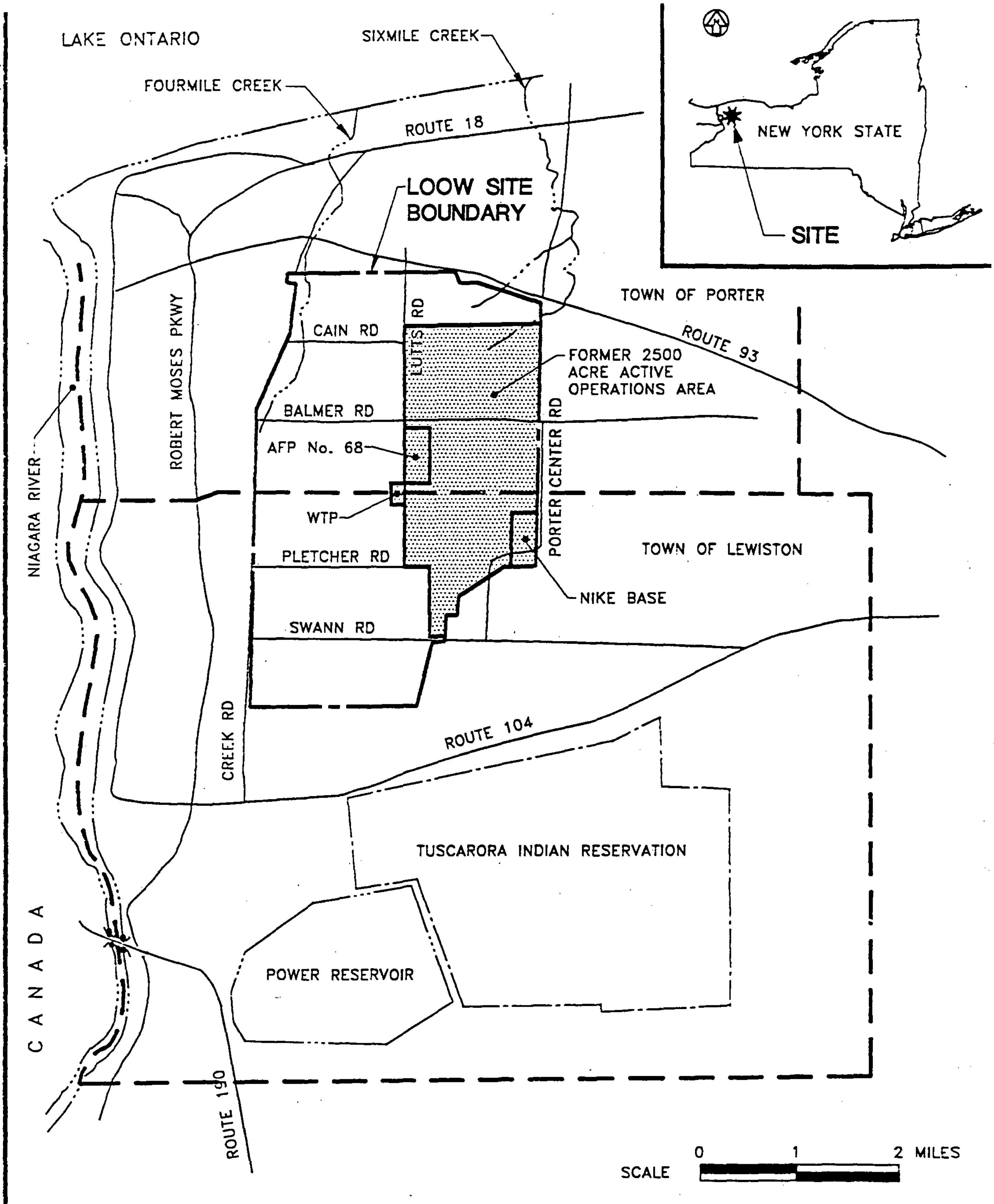

LOOW LOCATION MAP

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FIGURE 1

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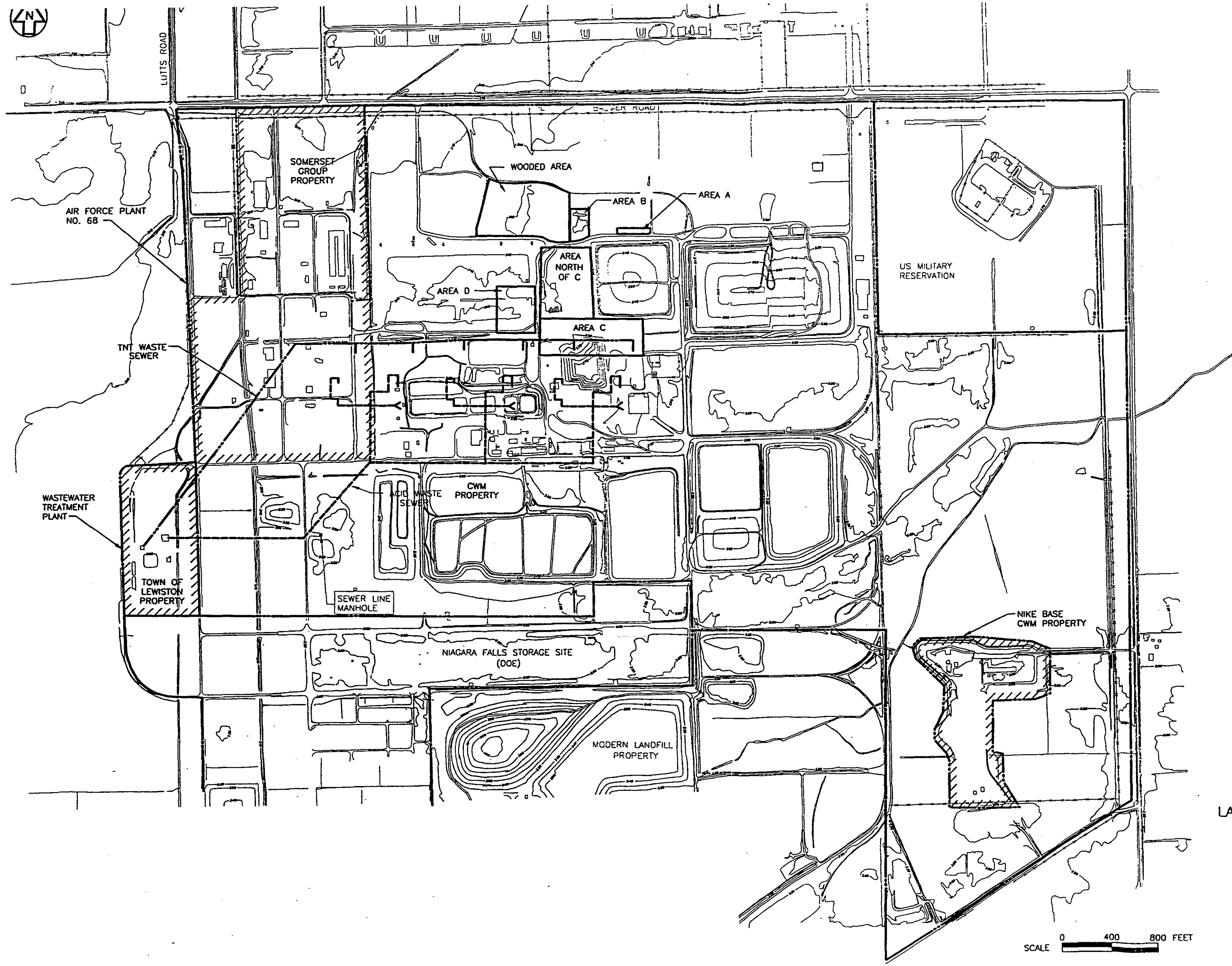

LEGEND:

- LOOW RI/FS OPERABLE UNIT NO. 1
- LOOW RI/FS OPERABLE UNIT NO.2
- TNT WASTE SEWER LINE
- ACID WASTE SEWER LINE

NOTE:

1. ALL LOCATIONS ARE APPROXIMATE

LAKE ONTARIO ORDANCE WORKS

STUDY AREA LOCATION MAP

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FIGURE 1-2

2 Site Characterization

2.1 Site Setting

2.1.1 Location

The former LOOW site is located within the townships of Lewiston and Porter in Niagara County, New York (Figure 1-1). The site is approximately ten miles north of the city of Niagara Falls, New York.

The original LOOW site, approximately 7,500 acres in size, extended from between Route 104 and Swann Road in Lewiston on the south to roughly Route 93 in Porter on the north. The east and west boundaries were formed, for the most part, by Porter Center Road and Creek Road (Route 18), respectively. The former LOOW site covered approximately four miles from north to south and three miles from east to west.

The majority of operations occurred on 2,500 acres on the eastern half of the LOOW site. Originally, TNT manufacturing operations occurred in a 1,500 acre area of the site. This operations area extended from Balmer Road on the north, southward past Pletcher Road to Swann Road. For the most part, Porter Center Road formed the eastern boundary and the site extended westward to Lutts Road. The approximate 1,000 acre parcel north of Balmer Road contained ammunition bunkers for the storage of the TNT.

2.1.2 Land Use and Population

(a) Land Use

Land use within the townships of Lewiston and Porter is primarily rural and includes agriculture, orchards, second-growth forests and recreational areas. Existing and projected land uses for the towns of Lewiston and Porter are presented in Table 2-1.

Relative to the project study area, a residential trailer park is located 1.3 miles to the northwest on Balmer Road. The nearest permanent residence is 0.8 miles to the northwest on Balmer Road. The Lewiston-Porter Central schools are located two miles to the west on Creek Road (Route 18). The

1,000 acre area north of Balmer Road is owned by the U.S. Government and is used by the National Guard for maneuvers and detonation of out-of-date explosives.

The areas of concern are located within the property boundaries of CWM and adjacent property owned by the Somerset Group. The majority of the CWM facility is permitted under the Resource Conservation and Recovery Act (RCRA) for the treatment, storage, and disposal of hazardous wastes.

Southeast of the CWM property is the Niagara Falls Storage Site (NFSS). The NFSS has been used since 1944 for the storage of radioactive waste and residues and is currently administered by the U.S. Department of Energy (DOE). South of the CWM property and east of the NFSS is a non-hazardous industrial waste landfill operated by Modern Landfill, Inc. Immediately south of Modern Landfill is federal government property controlled by the Department of Labor (DOL). This property is used for training construction equipment operators.

The Town of Lewiston maintains a closed sanitary landfill south of the DOL property and also owns a tract of land which was formerly the LOOW wastewater treatment facility located to the southwest of the project study area (Figure 2-1).

The Somerset Group property occupies approximately the northern half of the former AFP-68. AFP-68 operated as a pilot plant for the production of high energy fuels. The southern half of AFP-68 is situated on CWM property.

The northern, western and southern portions of the former LOOW site are zoned agricultural and residential; the eastern and central portions are zoned industrial. The areas surrounding the former LOOW site are primarily zoned agricultural and residential.

(b) Population

According to 1990 U.S. Bureau of the Census data, the population of Niagara County was 220,756 with three-quarters of the population living in urban areas. The majority of the population in the vicinity of the CWM property is centered in the Towns of Lewiston (15,453), Porter (7,110) and Niagara (9,880) and the City of Niagara Falls (61,840), all in Niagara

County. Population changes from 1980 to 1990 for Niagara County an municipalities in Niagara County were as follows:

- Niagara County, decrease of 3 percent;
- Lewiston, decrease of 5 percent;
- Porter, decrease of 2 percent;
- Niagara, increase of 2 percent; and
- City of Niagara Falls, decrease of 13 percent.

2.1.3 Climate and Weather

The LOOW site vicinity has a humid, continental climate which is characterized by warm summers and long, cold winters. Basic climatologic data are presented in Table 2-2. The mean annual temperature is approximately 48°F with a normal seasonal temperature range of between 25° and 76°F. The mean annual precipitation in the site area is approximately 29.44 inches. Precipitation is fairly evenly distributed throughout the year. Snowfall for the area averages about 50.8 inches per year and occurs primarily between November and March. Annual wind data for the region indicate that the wind is predominantly from the southwest with average monthly wind speed ranging from 9.9 to 14.3 miles per hour. An annual wind rose developed for the study area vicinity during 1985 is presented in Figure 2-2.

2.1.4 Physiography

(a) Regional Physiography

The former LOOW site is located on the Lake Ontario Plain, an area characterized by relatively flat to gently rolling terrain. The Lake Ontario Plain originates at the Niagara Escarpment and slopes gently northward towards Lake Ontario at a rate of approximately 20 feet per mile. Land elevations at the top and bottom of the Niagara Escarpment are approximately 630 ft and 360 ft, respectively. The elevation at Lake Ontario is approximately 250 ft above mean sea level (MSL).

The terrain of the Lake Ontario Plain consists of slightly undulating hills near the Niagara Escarpment and a relatively flat glacial plain in the central and northern areas. A number of southwest to northwest trending valleys formed by the actions of the major drainages occur in the plain. The

Niagara Gorge, formed by the Niagara River, is a major geomorphic feature along the western boundary of the Lake Ontario Plain in New York State.

(b) Topography and Soils

Topography in the area including the former LOOW site is generally level. Topographically, the land slopes gently to the northwest at natural elevations ranging from 318 to 321 ft MSL. Manmade ditches and waste landfills have altered the natural relief of the area.

Natural soils on the LOOW site consist predominantly of silt loams belonging to the Rhineback-Ovid-Madalin association. These soils are nearly level to gently sloping, deep, and somewhat to very poorly drained. Subsoils are moderately fine to fine-textured.

In the areas of concern, Made Land (Me) is almost the exclusive type of soil encountered. Made lands are areas that have been extensively disturbed and filled.

2.1.5 Ecology

(a) Vegetation

The original forest once found throughout the region including the former LOOW site was cleared in the 1800s as a result of logging activities and agricultural development. The deep, poorly-drained soils predominant in the area suggest the original forest consisted of species adapted to wet conditions. The community was, therefore, dominated by species like red maple and white oak. Second-growth forest found in wooded areas of the site is characterized by the predominance of maple, ash, and oak species.

In addition to second-growth forest, other plant communities present in the study area include northern shrub, pasture-grass and cattail-marsh grass. The cattail-marsh grass community is found at the site in drainage ways and low-lying areas with very poor drainage.

Construction and other activities at the site have resulted in the removal of considerable amounts of soil and vegetation. Closed landfills and other recovered areas in the vicinity of the project study area have been seeded with various grass and perennial species.

(b) Wildlife and Fish

Although no quantitative wildlife surveys have been conducted in the project study area, animals and birds observed there are common to Niagara County and characteristic of the available habitat. Bird population surveys conducted in the vicinity of the project study area indicate that at least 60 species may breed in the area. No plant or animal species designated as threatened or endangered under state or federal law are known to inhabit the area.

Fourmile Creek is known to support spawning populations of northern pike and various panfish. The creek reportedly supports a limited spring migration of salmonoids such as coho salmon and rainbow trout.

2.1.6 Geology

(a) Regional Geology

The Western New York region is overlain by a thin cover of unconsolidated glacial deposits. Three primary types of glacial deposits have been identified in the Western New York region. These types are:

- Glacial till composed of an unsorted mixture of boulders, clay, and sand;
- Clay, silt, and fine sand which was deposited in lakes that formed during the melting of the ice sheet; and
- Sand and gravel which was either deposited by streams carrying melt-water from the ice sheet or was produced by reworking till and other deposits along the shore of glacial lakes.

The glacial till directly and conformably overlies bedrock in most areas. The glaciolacustrine clay, silt, and sand overlay the till and are the materials found at the surface throughout most of the area. Sand and gravel occur as isolated deposits throughout the area. In some areas the glaciers have scoured away the overburden to the bedrock surface.

The bedrock throughout the Western New York region consists of nearly flat-lying sedimentary sequences of shale, siltstone, sandstone, dolostone, and limestone. The bedrock sequence dips gently to the south at about 30 ft per mile; thus the oldest rock units are exposed to the north and the youngest to the south.

The Queenston Formation underlies most of the Ontario Plain in the Western New York region. This sequence is composed primarily of red or purplish-red finely-bedded to massive shale interbedded with siltstone and silty dolostone. The upper contact of the Queenston Formation is located at the Niagara Escarpment and the Falls. The lower contact of the Queenston Formation is not exposed in the Western New York area.

(b) Site Geology

The site-specific subsurface information discussed in the following subsection represents a compilation of information on the regional geology and data. This information was compiled from over 400 borings, test pits, monitoring wells, piezometers, and foundation borings performed in previous investigations throughout the CWM, NFSS, and Modern Landfill properties.

The former LOOW site is underlain by 30 to 60 ft of unconsolidated glacial deposits. These deposits unconformably overlay the shale bedrock of the Queenston Formation. The unconsolidated material consists of, in ascending stratigraphic order:

- Lodgement till;
- Glaciolacustrine silt and sand;
- Glaciolacustrine clay;
- Middle Silt till;
- Upper glacial till sequence;
- Recent alluvium; and
- Fill.

A typical geologic cross-section of the CWM facility is shown in Figure 2-3 (the location of the cross-section is presented on Figure 2-4). These glacial deposits are briefly described below in ascending stratigraphic order (oldest to youngest).

1. Lodgement Till

The lowermost glacial unit occurring throughout the site is a red lodgement till. A lodgement till is a till deposited beneath a moving glacier. The deposit is characterized by compact fissile structures and stones oriented with the long axes parallel to the direction of glacial flow. The lodgement till is reddish in color with high density and dry, indurated texture. Red and green shale clasts originating from the underlying Queenston Formation are common features in the lodgement till. The deposit, also referred to as the basal red till unit, is commonly composed of silt and fine to coarse sand and little fine gravel.

The basal red till has an average moisture content of 11 percent and is generally non-plastic or only slightly plastic. The moisture content and plasticity of the unit varies across the site as a function of the gravel and clay content.

The surface elevation of the basal red till ranges from approximately 260 ft MSL in the northern portion of the site to about 280 ft MSL in the southern portion of the site. The basal red till ranges in thickness from 0 to about 22 ft with an average thickness of about 5 ft. The unit is absent over a large area of the northern portion of the site and in a few isolated areas throughout the remainder of the site.

2. Glaciolacustrine Silt and Sand

Overlying the basal red till is a sequence of glaciolacustrine silt and sand. This unit has been found to vary in composition across the former LOOW site. Four major subcategories of this unit have been identified:

- Stratified coarse sand composed of very dense, brown to multicolored coarse to fine sand with little silt and fine gravel;

- Non-stratified silt and sand composed of poorly sorted compact to very dense brown silt and coarse to fine sand with little fine gravel;

- Stratified silt and fine sand composed of well sorted, brown-gray to brown silt with some fine sand and silt; and

- Interlayered silt, sand, and clay composed of laminated soft gray silty clay with 1/2-inch to 6-inch silt or fine sand layers. This subunit is transitional in some areas with the overlying glaciolacustrine clay unit.

The silt and sand unit, referred to as the glaciolacustrine silt/sand, has filled into the surface of the bedrock and basal red till unit. The glaciolacustrine silt/sand varies in elevation from about 265 ft MSL in the northern portion of the site to about 290 ft MSL in the southern portion of the site. The glaciolacustrine silt/sand is absent in areas where the basal red till unit has occurred as high points on the bedrock surface.

3. Glaciolacustrine Clay

A glaciolacustrine clay unit typically overlies the glaciolacustrine silt/sand unit. This clay unit is composed of laminated, very soft to firm, gray to gray brown silty clay with traces of fine sand. Laminations may occur as thin red-brown to gray silt and fine sand layers. Laminations are more common near the base of this unit.

The clay is of low to medium plasticity with an average plasticity index of 16. The majority of the unit has a high natural moisture content, averaging 28 percent.

The glaciolacustrine clay unit attains a thickness of up to 25 ft in the southwestern portion of the site. The unit is separated into two units in the northwestern portion of the site by a till deposit. In this area, the two strata of clay are identified as the upper and lower glaciolacustrine clay units. The upper glaciolacustrine clay unit ranges in thickness up to 10 ft. The lower glaciolacustrine clay unit ranges up to 6 ft in thickness. The two clay strata are discontinuous and may be absent in some areas.

4. Middle Silt Till Unit

The glaciolacustrine clay unit is separated into two members by a till unit referred to as the middle silt till. This till is composed of well graded, compact to very dense, gray to gray-brown silt and coarse to fine sand with a trace of fine gravel. The middle silt till only occurs in the northwestern and western portion of the site.

5. Upper Glacial Till Sequence

A sequence of glacial tills overlays the glaciolacustrine clay unit. This sequence can be frequently divided into two strata: an upper silt till and an upper clay till.

The upper silt till is discontinuous across the site, commonly being absent in the southern portion of the site. This unit is typically composed of compact to very dense, brown to purple-brown silt, and coarse to fine sand with little fine gravel. Wet discontinuous layers of silt and sand are occasionally found within the unit. The unit is generally nonplastic.

The upper clay till is commonly composed of non-stratified to faintly laminated, stiff to hard brown to purple-brown clayey silt with some fine to coarse sand and little fine gravel. This deposit occasionally contains cobbles and discontinuous, wet sand, gravel, and silt layers. This unit exhibits low to medium plasticity with an average plasticity index of 13 and an average moisture content of 15 percent.

The combined thickness of the upper silt and clay till units is fairly uniform across the site varying from 15 to 20 ft. The units become thinner toward the southern portion of the site, averaging 10 to 15 ft.

6. Recent Alluvium

Alluvium is found discontinuously across the site. This unit is typically laminated and varies from a fine sand with some silt to a silt or silty clay. This layer may occur in thicknesses of up to 5 ft.

7. Fill

Because the former LOOW site has been used for various purposes including the original agricultural activities prior to the construction of the LOOW and subsequent landfilling and building construction activities, the natural topography and composition of the surface and near surface soils has been significantly altered. In addition to the obvious landfills and buildings constructed on the site, some areas have received "borrow material" which was either brought into the site or moved from one area of the site to another. Because much of this "borrow material" is locally derived, it is commonly of similar composition to the native deposits and may only be distinguishable by signs of disturbance or inclusion of foreign material such as wood, metal, etc.

2.1.7 Hydrology

(a) Surface Waters and Drainage

The major surface drainage patterns in the area of the former LOOW site are presented in Figure 2-5. Fourmile, Sixmile and Twelvemile Creeks receive natural surface runoff, agricultural drainage and treated and institutional waste discharges before emptying into Lake Ontario. Major sections of these streams are intermittent. These creeks are used primarily for boating and fishing. Where Fourmile and Twelvemile Creeks flow into Lake Ontario, the creeks are designated as recreational areas with public swimming sites.

As part of the former LOOW site operations in the 1940s, a system of ditches was constructed to drain surface waters from the site to the Central Drainage Ditch (Figure 2-5). The section of Sixmile Creek which originally flowed through the site was diverted to the Southwestern Drainage Ditch and Fourmile Creek. Drainage from the southwestern portion of the site that had once flowed eastward into Twelvemile Creek was diverted to the S-31 ditch. Several additional ditches at the site drain into the Central Drainage Ditch which ultimately discharges into Fourmile Creek. The Central Drainage Ditch is a channelized ditch measuring approximately 10-15 ft deep, 10-20 ft wide at the bottom, 40-50 ft wide at the surface. The ditch is approximately three miles in length.

A flood zone map for the former LOOW site is presented as Figure 2-6. The 100-year flood level in the area including the site is estimated to be approximately 319 ft MSL. On the LOOW site, 100-year floodplains exist along Fourmile Creek, Twelvemile Creek, and the Southwestern Drainage Ditch. Flooding is generally contained within the Central Drainage Ditch. The project areas of concern do not lie within either a 100-year or 500-year floodplain.

During most of the year, there is very little surface flow. Major runoff occurs in the spring and ponded water is common during and following spring snowmelt and periods of heavy precipitation.

There are eleven wetlands designated by the DEC on the LOOW site. The locations of these wetlands are shown in Figure 2-6. The classifications are listed on Table 2-3.

Seven of these wetlands have been designated as Class II wetlands by the DEC. The other four are Class III wetlands. Under the DEC classification system, Class I wetlands have the highest rank or value and Class IV the lowest.

None of the 11 wetlands designated by the state on the LOOW site fall within the project study area.

(b) Groundwater

The subsurface stratigraphy of the former LOOW site has been divided into three hydrostratigraphic units. These units are identified as:

- Zone 1: consists of the unconfined water-bearing zone within the upper glacial till and alluvium units;
- Zone 2: consists of the relatively impermeable glaciolacustrine clay unit; and
- Zone 3: consists of a confined water-bearing zone occurring predominantly within the glaciolacustrine silt/sand unit and to a lesser degree, within the basal red till and upper portion of bedrock.

The hydraulic conductivities (permeabilities) of the geologic formations are summarized in Table 2-4. The glaciolacustrine silt/sand unit is the most permeable formation and, as such, the primary aquifer being monitored by CWM.

Potentiometric groundwater surface contours in the glaciolacustrine silt/sand unit (Zone 3) indicate that groundwater flow is generally to the northwest across the project study area (Figure 2-4). Potentiometric contours indicate a strong westerly component of groundwater flow in the northwestern area of the CWM facility. Apparent horizontal hydraulic gradients across the project study area vary from 0.01 to 0.002.

The potentiometric surface map for the Zone 1 water-bearing zone, using water level data recorded in December 1986, is presented in Figure 2-7. The data indicate the presence of localized mounding of groundwater as a result of landfill mounds and facultative ponds and lagoons. Generally, groundwater levels of the Zone 1 potentiometric surface are approximately 4 ft above the potentiometric surface representation for Zone 3; indicating a downward migration potential between the two zones.

CWM obtains groundwater elevation data on a site wide basis each year. From 1985 to 1990, the groundwater flow in the glaciolacustrine silt/sand unit has been interpreted to be flowing generally in the north-northwest direction across the CWM facility. However, since 1990, the potentiometric data obtained from the glaciolacustrine silt/sand unit indicate a change in gradient and the presence of a groundwater divide on the southern portion of the CWM facility. Groundwater flow conditions at the CWM facility in the glaciolacustrine silt/sand unit are being affected due to dewatering activities at the Modern Landfill facility, located to the south of the CWM facility. Modern is actively dewatering the glaciolacustrine silt/sand unit through a porewater drain system that underlies two landfill cells at the Modern Facility system since 1990. The DEC has requested that Modern modify the dewatering activity in an attempt to reduce the hydraulic affect that dewatering is having on the glaciolacustrine silt/sand unit at the CWM facility.

2.1.8 Site History

(a) TNT Manufacturing Plant

The LOOW site originated in early 1942 with the acquisition by the Army of approximately 7500 acres of land in northwestern New York State. The LOOW was initially developed for the construction of a TNT manufacturing plant which occupied about 2500 acres. Once completed, the complex contained a power plant, hospital, fire department, a water supply system adequate for a city of 100,000, water supply and wastewater treatment systems, toluene and acid storage tanks, and an extensive system of underground water, sewage, acid, and TNT waste pipelines.

The manufacturing portion of the plant was situated in the central southwestern section of the LOOW site, south of Balmer Road (Figure 2-8). Wastewater from the TNT manufacturing operation, as well as stormwater and sanitary sewage, was transferred through an underground sewer network to a wastewater treatment plant located in the western portion of the TNT plant. The TNT waste sewer lines ran in one pair of east-west trending lines across the TNT production area before being routed south to the wastewater treatment plant at the west end of the production line.

The manufactured explosives were stored in concrete reinforced bunkers located in the area north of Balmer Road. The remaining portion of LOOW, approximately 5000 acres, was unused and acted as a buffer zone.

When in production, the TNT plant had six production lines with a daily capacity of 390,000 pounds of TNT. An overestimation by the Army of the need for TNT during World War II resulted in the closure of the TNT plant in July 1943 after only nine months of operation.

(b) Air Force Plant 68

In 1955, the Navy and Air Force acquired 360 and 200 acres, respectively, of the former TNT plant. The acquisition of the properties by the Navy and the Air Force was for the joint development of a boron and lithium based high-energy fuels production plant. The Air Force subsequently assumed responsibility for the project which was identified as Air Force Plant 68 (AFP-68). The plant was constructed on the western portion of the original

TNT plant and incorporated portions of the original TNT wastewater treatment plant.

When completed, AFP-68 was operated by Olin-Matheison under contract to the Air Force and included 79 structures and an extensive system of overhead pipelines. The plant consisted of numerous process areas integrated to allow recycling of intermediates. Each area was essentially a complete plant with provision for raw material storage, a processing area, control room and production storage. The process structures typically had walls made of corrugated asbestos panels while the control rooms were of concrete block construction. Chemical wastewater, sanitary sewage, and stormwater were collected and conveyed in an underground sewer system that utilized the original TNT plant wastewater treatment plant (Figure 2-9).

The plant was decommissioned in 1959 while still in pilot plant status.

(c) Ownership History of LOOW

A number of federal entities have been involved with the LOOW site. Groups identified with the site include:

- Department of the Army;
- Department of the Air Force;
- Department of the Navy;
- Department of Labor;
- Department of Energy;
- Chemical Warfare Service;
- General Services Administration;
- Atomic Energy Commission;
- Manhattan Engineering District of the Corps of Engineers;
- Army National Guard; and
- War Assets Administration.

Operations conducted by the federal government included:

- Manufacture of explosives (TNT);
- Storage and detonation of explosives;
- Storage of chemical warfare agents;
- Storage and disposal of radioactive materials and wastes;
- Separation of boron isotopes for fission reactors;

- Nike Missile base;
- Defense communications base;
- Rocket and laser testing (AFP-38);
- Production of high energy fuels (AFP-68); and
- Various classified activities.

Although the LOOW site has been used by the federal government for numerous purposes, it's the operation of the TNT manufacturing plant, specifically the waste TNT sewer system, and the operation of AFP-68, that are directly associated with the areas of contamination which are the subjects of this EE/CA.

The past and current owners of the properties on which the identified contamination occurs have a significant impact on the implementation of removal actions in subject areas.

In 1969, Chem-Trol Pollution Services, Inc. obtained approximately 280 acres of the former TNT production plant for the development of a hazardous and industrial waste treatment, storage, and disposal facility. Chem-Trol was subsequently acquired by SCA Chemical Service, Inc. who, in turn, was acquired by CWM Chemical Services, Inc. Under the current ownership of CWM, a majority of the property functions as a licensed RCRA treatment, storage and disposal facility.

In 1972, the Somerset Group obtained an approximate 100 acre portion of the former LOOW which contained AFP-68. Around 1979, the southern half of former AFP-68, about 50 acres, was sold to SCA Chemical Services. The current land ownership of the former LOOW is presented in Figure 2-1. A timeline presenting the ownership history of LOOW is presented in Figure 2-10.

2.2 Previous Removal Actions

Documented removal actions are only known to have occurred for sections of the TNT waste sewer lines and contaminated materials in Area B. The following text provides a brief description of those actions.

2.2.1 TNT Plant

Following the decommissioning of the TNT manufacturing plant in 1943, the Army conducted a limited decontamination of the LOOW site. In an attempt to decontaminate the buried acid and TNT waste lines, the Army flushed the waste lines with a caustic solution. It was noted by an outside consultant, contracted by the Army in 1948 to evaluate the decommissioning effort, that the flushing may have stabilized, rather than neutralized the TNT.

In 1978, SCA had reportedly been utilizing portions of the former LOOW sewer system for the storage and disposal of wastewaters. Following a related spill incident as a result of overflow from the sewer system, the DEC requested SCA to excavate and plug sections of the sewer system so the sewers could no longer transmit wastewater. In 1978, SCA excavated and plugged several locations along the TNT sewer system: one location was in the vicinity of the North Salts area, the other located about 800 feet further west (downgradient, see Figure 2-11).

In 1990, during the construction of the leachate collection system for SLF-12, CWM encountered and excavated portions of the TNT sewer system located off the southeast corner of the landfill. The excavated sections of sewer line and nearby contaminated soils were loaded into four roll-off boxes. The materials were determined to be non-hazardous waste and disposed of accordingly.

2.2.2 AFP-68

Area B

During the operating life and decommissioning of AFP-68, quantities of hazardous compounds including lithium chloride, kerosene, methanol, and potassium chloride were drummed and buried on the LOOW property by Olin or subcontractors to Olin.

On May 1, 1981, the DEC conducted an inspection of the former AFP-68 in an attempt to identify areas of disposal. AFP-68 utilized a burning pit (Area B) for the open incineration of lithium and sodium hydride, kerosene, and some unstable gases produced in the production process. The gases were contained in cylinders. The cylinders were brought to the burn pit area, placed in the pit, and perforated with bullets and burned. At the time of the inspection, the burn pit was filled with gas cylinders and carbon dust and rods.

As a result of the DEC inspection, the burn pit was placed on the New York State Registry of Uncontrolled Hazardous Waste Sites (No. 932061A). The DEC also requested Olin and SCA to take actions to remediate the burn pit. Under a joint agreement with Olin, SCA initiated cleanup of the burn pit area in October, 1981. In December, 1981, approximately 2070 tons of contaminated material was removed from the burn pit area. In 1986, SCA constructed berms around the burn pit to prevent the migration of surface water from the area.

2.3 Previous Investigations

2.3.1 TNT Sewer Lines

(a) COE's Initial Remedial Investigation

The TNT sewer lines were first officially investigated in 1988 during COE's initial RI. The investigation included magnetometer and terrain conductivity geophysical surveys and test pit explorations. As part of the investigation, test pits were excavated in Area C and in the area directly north of the existing TNT buildings (i.e., south of SLF-12, see Figure 2-11). It was interpreted that the concrete encountered in test pits in Area C and south of SLF-12 were building foundations. At that time it wasn't known that the sewer lines were encased in concrete.

(b) COE's Supplemental Remedial Investigation

The TNT sewer lines were again investigated during the COE's Supplemental RI in 1989. The investigation included ground penetrating radar geophysical surveys and test pit excavations in the immediate vicinity of the TNT buildings and in the area south of SLF-12 where one section of the line was previously encountered. The sewer line at this particular location was opened and samples of the black sediment and water within the line were collected and analyzed for nitroaromatic compounds. Both a field TNT screening method and the analytical results for these samples indicated the presence of TNT. The analytical results are presented in Table 2-5. Although the concentrations of TNT in the samples was believed not to be shock sensitive, an explosives expert from the Aberdeen Proving Ground stated that due to the nature of the settling out of TNT in the wastewater, detonable concentrations could still be present within the sewer lines.

(c) SCA Investigation

SCA had also sampled the TNT lines in October, 1982 but the exact location and analytical results are not available. It is known, however, that the samples contained up to 35% by weight TNT and were determined by an outside consultant to be potentially detonable. The DEC had also obtained samples at that time. The DEC report of the sampling event indicated that the samples were collected from several locations. The DEC obtained a portion of one sample from a 24 inch line a few feet south of a manhole into which individual sewers from the production areas flowed (this exact location could not be determined). The material sampled was described as a three to four inch layer of brownish yellow crystals above a one 1-1/2 inch tarry layer. The sample was determined to be the only one of six samples collected to be shock sensitive.

(d) CWM Construction of SLF-12

The sewer lines were most recently sampled by CWM in 1990 when the lines were encountered during the construction of SLF-12. Samples of residues from the north and south lines as well as aqueous samples were collected and analyzed for volatile organics, semi-volatile organics, pesticides and PCBs, inorganics, and nitroaromatics. The analytical results for the aqueous and residue samples from the south line indicated the presence of substantial volatile and semi-volatile organic contamination in addition to the presence of nitroaromatics (Table 2-6). The samples from the north line contained only nitroaromatic contamination.

2.3.2 Area A

(a) Olin/SCA Investigation

Area A was first investigated by SCA when the buried drum trench was found in 1981. At that time SCA sampled two of the drums. The samples were analyzed for pH, conductivity, TOC and several metals including boron and lithium (two metals associated with AFP-68). The analytical results, presented in Table 2-7, were interpreted to indicate that the drums originated from AFP-68. As a result, SCA contacted the Huntsville District, COE, which initiated an investigation of the contamination associated with AFP-68.

Table 2-5
Summary of Analyses of TNT Waste Pipeline Samples
Acres Supplemental Remedial Investigation

Parameter (mg/kg)	TNT-1-89-W	TNT-1-89-S	TNT-2-89-W	TNT-2-89-S
HMX	80	–	–	–
RDX	6	–	–	–
TNB	17	–	–	–
TNT	18,019	4.96	–	–
2,4-DNT	6,957	1.56	–	–
Total	25,079	6.52	–	–

Notes:

(1) Explosives analyses of samples performed by MRD Laboratory according to USATHAMA Method SM-02.

(2) No data entry indicates compound not detected.

(3) Explosives compounds are as follows:
HMX - Cyclotetramethylenetetranitramine
RDX - Cyclotrimethylenetrinitramine
TNB - Trinitrobenzene
TNT - Trinitrotoluene
2,4-DNT - 2,4-Dinitrotoluene

(4) W indicates waste residue sample.
S indicates adjacent soil sample.

(5) In 1982, SCA also detected up to 35% by weight TNT - analytical data not available.

Table 2-6
Analytical Results - TNT Sewer Line by CWM, 1990

Parameter	South Line		North Line		Roll-off
	Solid	Aqueous	Solid	Aqueous	Solid
Volatiles	(µg/Kg)	(µg/L)	(µg/Kg)	(µg/L)	(µg/Kg)
Acetone	5800E	32000D*			
Benzene	260	790			
2-Butanone	630*	5800DJ			
Chlorobenzene	150	640			
1,1-Dichloroethane		12000D			
1,2-Dichloroethane	37	540			
1,1-Dichloroethene	950*	64*			
trans-1,2-Dichloroethene	6.4J	130			
1,2-Dichloropropane		31*			
Ethyl Benzene	130	400			
2-Hexanone	35J	210J			
4-Methyl 2-Pentanone	1000E*	8600D*			
Methylene Chloride	270	8500D*			
Tetrachloroethane		360			
Toluene	940	5800D			6.2*
1,1,1-Trichloroethane			5.1		
Trichloroethene	130	7700D			
Vinyl Chloride	160*	720			
Xylenes	270	1300			
TOTAL	10,768.4	85,585	5.1	–	6.2
Semi-volatiles	(µg/Kg)	(µg/L)	(µg/Kg)	(µg/L)	(µg/Kg)
Acenaphthalene	690*				
Benzoic Acid	9400	99000D			
2,4-Dimethylphenol	1800*	9700D*			830*
4-Methylphenol	3900	20000D*			
Phenol	4700	77000D*			1900*
TOTAL	20,490	205,700	–	–	2,730

Table 2-6
Analytical Results - TNT Sewer Line
by CWM, 1990

Parameter	South Line		North Line		Roll-off
	Solid	Aqueous	Solid	Aqueous	Solid
Pesticides/PCBs	(µg/Kg)	(µg/L)	(µg/Kg)	(µg/L)	(µg/Kg)
Aldrin	5.4				
Endosulfan I			37		
Inorganics	(mg/Kg)	(mg/L)	(mg/Kg)	(mg/L)	(mg/Kg)
Antimony	ND	ND	ND	ND	ND
Arsenic	10.7	0.542	10.1	0.052	12.6
Beryllium	ND	0.0030	ND	0.003	ND
Boron	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND
Chromium	6.7	0.25	8.8	0.028	14
Copper	12	0.36	17	0.12	25
Lead	27.2	0.656	9.36	0.145	5.92
Lithium	ND	4.1	ND	3.9	ND
Mercury	ND	ND	ND	ND	ND
Nickel	10	0.82	12	0.92	17
Selenium	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND
Zinc	24	0.79	32	0.44	39
Cyanide	0.044		0.046		0.43
Cyanide, amenable	0.037		0.019		
Nitrate	15.5(mg/L)	10.9	8.63 (mg/L)	3.95	
Sulfate	500 (mg/L)	378	912 (mg/L)	832	194
Sulfide	5.1		2.1		70
% Moisture	33.0		24.3		14.8

Table 2-6
Analytical Results - TNT Sewer Line
by CWM, 1990

	South Line		North Line		Roll-off
Parameter	Solid	Aqueous	Solid	Aqueous	Solid
Nitroaromatics	(mg/Kg)	(μg/L)	(mg/Kg)	(μg/L)	(mg/Kg)
Tetryl	–	6820Y	294Y	42.0	650Y
2,4,6-Trinitrotoluene	–	3000Y	213Y	161Y	467Y
TOTAL	–	9,820	507	203	1,117

Notes:

No data entry indicates parameter not detected.
• - Indicates estimated result less than fives times the detection limit.
E - Indicates estimated result.
D - Indicates sample diluted for the analyte.
J - Indicates concentration detected less than detection limit.
Y - Indicated result exceeds validation range for this compound.

Table 2-7
Analytical Results - Drum Samples
SCA, 1981

Parameter	Sample Number 1	Sample Number 2
pH	7.58	7.93
Cond (umohs/cm)	749	2,450
TOC (mg/ℓ)	88.5	410
Li (mg/ℓ)	10.5	134
B (mg/ℓ)	79.0	84.0
Ni (mg/ℓ)	<0.1	0.34
Co (mg/ℓ)	0.15	<0.1
Fe (mg/ℓ)	3.08	11.72
Mn (mg/ℓ)	0.41	4.59
Cu (mg/ℓ)	<0.06	<0.06
Cr (mg/ℓ)	<0.2	<0.2
Cd (mg/ℓ)	<0.03	<0.03
Zn (mg/ℓ)	<0.05	0.14

Table 2-8
Analytical Results - Drum Samples
Acres, 1988

Chemical Parameters	Drum Samples					
	DS-1	DS-2	DS-3	DS-4	DS-5	DS-Dup-1
Volatile Organic Compounds - μg/kg						
Methylene Chloride	–	97B	–	90B	76B	80B
Acetone	980E	7300E	1500E	4600E	3200E	2800E
1,1 Dichloroethane	–	–	–	5J	5J	–
1,2-Dichloroethene (Total)	–	9	10	12	9	4J
2-Butanone	–	79		52	37	32
Trichloroethene	–	1J	1J	1J	0.5J	–
Benzene	2J	6J	7	8	10	3J
Tetrachloroethene	–	2J	0.5J	3J	3J	–
Toluene	24	86	94	100	170	38
Ethylbenzene	0.7J	4J	18	6J	6	4J
Styrene	1J	4J	5J	5J	7	1J
Total Xylenes	4J	15	10	24	33	14
Total Volatile Organics	1011.7	7603	1645.5	4906	3556.5	2976
Semi-Volatile Organics - μg/kg						
Naphthalene	–	–	–	86J	76J	–
2-Methylnaphthalene	–	90J	280J	370J	330J	350J
Acenaphthylene	–	–	–	–	9J	–
Acenaphthene	–	–	–	–	–	41J
Diethylphthalate	33J	–	100J	75J	52J	51J
N-Nitrosodiphenylamine (1)	–	–	150J	330J	83J	–
Phenanthrene	46J	–	230J	1500	130J	220J
Anthracene	–	–	–	45J	–	–
Fluoranthene	–	–	–	54J	–	–
Pyrene	25J	–	25J	300J	–	37J
Chrysene	–	–	–	54J	–	–
Total Semi-Volatile Organics	104	90	785	2814	680	699

Table 2-8
Analytical Results - Drum Samples
Acres, 1988

Sheet 2 of 2

Chemical Parameters	Drum Samples					
	DS-1	DS-2	DS-3	DS-4	DS-5	DS-Dup-1
Pesticides/PCBs - μg/kg						
Heptachlor epoxide	2.0J	–	–	–	–	–
Endosulfan I	29	–	8.5J	–	2J	–
4,4'-DDE	19J	–	–	–	–	–
Total Pesticides/PCBs	50	–	8.5	–	2	–
Metals - μg/g						
Total Arsenic	7.6	11	7.7	7.6	6.2	19
Total Barium	81	77	85	110	110	100
Total Beryllium	0.62	0.63	–	–	–	–
Total Chromium	19	20	15	16	14	22
Total Copper	44	35	32	26	28	40
Total Iron	46,690	34,970	41,160	27,120	28,540	39,690
Total Lead	11	13	13	12	15	21
Total Lithium	62	67	60	66	63	59
Total Nickel	21	19	20	21	15	17
Total Potassium	3,570	2,940	3,290	2,830	2,710	2,870
Total Silver	–	–	–	0.65	1.1	–
Total Zinc	63	58	64	74	75	71

Notes:
(1) Quantities listed indicate detected concentrations; no data entry indicates no detectable concentration or data were negated.
(2) J indicates that the detected concentration is below the Contract Required Quantification Limit (CRQL).
(3) B indicates the presence of the compound in the method blank.
(4) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.

Table 2-9
Analytical Results - Test Pit Soil and Water Samples
Acres, 1988

Chemical Parameters	Test Pit Water (µg/ℓ)		Test Pit Soil (µg/kg)	
	TP-A1-WAT	TP-A1-WAT-DL	TP-A1-5	TP-A1-BOT
Volatile Organic Compounds				
Vinyl Chloride	12	12DJ		
Acetone	1600E	1700DE	–	990D
1,1-Dichloroethane	31	30D	–	–
1,2-Dichloroethene (total)	110	110D	–	12DJ
Methylene Chloride	–	–	–	30BD
2-Butanone	120	130D	–	–
Trichloroethene	11	10D	–	–
Benzene	32	32D	–	11DJ
cis-1,3-Dichloropropene	–	7DJ	–	–
4-Methyl-2-Pentanone	6J	6DJ	–	–
Tetrachloroethene	–	0.8DJ	–	–
Toluene	260E	260D	–	150D
Ethylbenzene	4J	4DJ	–	10DJ
Styrene	6	7DJ	–	9DJ
Total Xylenes	16	16D	–	46D
Total Volatile Organic Compounds	2,208	2,324.8	–	1,258
Semi-Volatile Organics				
Phenol	97	NR	–	–
2-Methylphenol	26	NR	–	–
4-Methylphenol	64	NR	–	–
2,4-Dichlorophenol	7J	NR	–	–
Naphthalene	25	NR	–	–
2-Methylnaphthalene	29	NR	–	360J
Phenanthrene	5J	NR	–	–
Di-n-Butylphthalate	1J	NR	–	–
Pyrene	0.4J	NR	–	–
Diethylphthalate	–	NR	52J	–
Total Semi-Volatile Organics	157.4	NR	52	360

able 2-9
Analytical Results - Test Pit Soil and Water Samples
Acres, 1988

Sheet 2 of 2

Chemical Parameters	Test Pit Water (μg/ℓ)		Test Pit Soil (μg/kg)	
	TP-A1-WAT	TP-A1-WAT-DL	TP-A1-5	TP-A1-BOT
Pesticides/PCBs				
delta-BHC	–	NR	–	50
Endosulfan I	–	NR	6.1J	–
4,4'-DDT	–	NR	1.3J	–
Total Pesticides/PCBs	–	NR	7.4	50
Metals - mg/ℓ water, μg/g soil				
Total Arsenic	0.012	NR	9.6	10
Total Barium	0.14	NR	100	130
Total Boron	120	NR	–	–
Total Beryllium	–	NR	0.67	–
Total Chromium	–	NR	18	19
Total Copper	0.015	NR	30	32
Total Iron	7.7	NR	22,460	35,790
Total Lead	0.010	NR	13	16
Total Lithium	38	NR	28	62
Total Nickel	0.16	NR	22	17
Total Potassium	5.0	NR	3,870	3,190
Total Sodium	65	NR	NA	NA
Total Zinc	0.34	NR	62	71

Notes:
1. Quantities listed indicate detectable concentrations; no data entry indicates no detectable concentration or data were negated.
2. J indicates that the detected concentrations is below the Contract Required Quantification Limit (CRQL).
3. B indicates the presence of the compound in the method blank.
4. E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
5. NR indicates analysis not required.
6. NA indicates not analyzed.

Table 2-10
EP Toxicity and RCRA Waste Characterization
Drum Samples
Acres, 1988

Chemical Parameters	Drum Samples					
	DS-1	DS-2	DS-3	DS-4	DS-5	DS-DUP-1
EP Toxicity - Metals						
Total Barium	2.1	0.78	1.8	1.9	2.4	
Total Cadmium	–	–	–	0.007	0.006	
Total Chromium	–	0.01	0.013	–	–	
Total Selenium	0.021	0.006	0.011	0.009	–	
RCRA Waste Characteristics						
Corrosivity - Leaching pH	8.43	7.63	7.69	7.97	7.74	7.56
Flash Point (3F)	>200	>200	>200	>200	>200	>200
Oxidizer Spot Test	Neg	Neg	Neg	Neg	Neg	Neg
Total Available Cyanide (mg/kg)	<10	<10	<10	<10	<10	<10
Total Available Sulfide (mg/kg)	<10	<10	<10	<10	<10	<10
Paint Filter Free Test	Pass	Pass	Pass	Pass	Pass	Pass

Notes:
1. Quantities listed indicate detected concentrations. No data entry indicates no detectable concentration or data were negated.

Table 2-11
Analytical Results - Subsurface Soils
Area A
Acres, 1989

Chemical Parameters	ACB-1 2-4'	ACB-1 14-16'	AB-2 6-8'	AB-4 12-14'	AB-9 6-8'	AB-13 12-14'	AB-14 6-8'	AB-14 6-8 (dup)	AB-14 8-10'	B-1 8-10'
Volatile Organics (µg/kg)										
Methylene Chloride	–	–	6DJ	–	14BDJ	–	–	–	–	17B
Acetone	28	–	330D	49	610D	350D	40	130	–	130
Toluene	1J	–	–	–	11DJ	–	–	–	–	2J
Total Volatile Organics	29	–	336	49	635	350	40	130	–	32
Semi-Volatile Organics (µg/kg)										
Phenol	–	–	–	–	–	–	–	–	86J	–
4-Chloroaniline	150J	–	–	–	–	–	–	–	–	–
2-Methylnaphthalene	38J	–	–	–	–	–	–	–	–	–
Di-n-butylphthalate	4,400B	–	–	–	750BJ	–	2,500B	–	–	–
Total Semi-Volatile Organics	4,588	–	–	–	750	–	2,500	–	86	–
TOTAL ORGANICS	4,617	–	336	49	1,385	350	2,540	130	86	32
Inorganics (mg/kg)										
Boron	<5.8	70.0	<5.5	63.7	86.8	<5.5	8.4	14.0	6.4	19.3
Lithium	35.7	32.7	27.4	49.1	107	27.2	37.5	42.0	36.4	30.1

Notes:
1. Quantities listed indicated detected concentrations. No data entry indicates no detectable concentration.
2. J indicates that the detected concentration is below the Contract Required Quantification Limit (CRQL).
3. B indicates the presence of the compound in the method blank.
4. E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
5. < indicates that the compound was not detected at the Contract Required Detection Limit (CRDL).
6. D indicates compound analyzed at secondary dilution factor.

Table 2-12
Analytical Results - Area B
Olin/SCA, 1981

Sample Location	Sample No.	Lithium	Boron
Soil (mg/kg)			
Undisturbed soil West 6-8" below surface	1	1,150.0	558.0
Undisturbed soil North 8-10" below surface	2	304.0	25.5
Disturbed soil East	3	8.2	20.6
Groundwater (mg/ℓ)			
B-21		0.06	0.81
B-32		0.06	0.48
B-36		0.02	0.34

*Sample and analyses conducted by SCA.
See Figure 2-13 for approximate sample locations.

Table 2-13
Analytical Results - Area B
Surface Water and Soil Samples
E&E, 1985

Chemical Parameters	Surface Water (μg/ℓ)		Soil (μg/g)	
	W-1	W-2	B-1	B-2
Benzene	NA	NA	≤ 0.05	≤ 0.05
Toluene	≤ 5	< 5	< 0.05	< 0.05
Trichloroethene	6.7	< 5	NA	NA
Boron	22,200	25,500	281	178
Lithium	25,700	27,800	230	644
Potassium	1,900	2,050	1,090	841

Notes:

NA = Not analyzed
< = Not detected at working detection limit
≤ = Compound present but at concentrations below working detection limit.

Table 2-14
Example Summary of Compounds Detected in CWM Wells Near Area B

Well I.D.	Date	Compound	Concentration ($\mu g/\ell$)
MW-7-3S	8/86	Carbon Tetrachloride	275
	8/86	Chloroform	463
	8/86	Methlene Chloride	844
	11/86	Carbon Tetrachloride	234
	11/86	Chloroform	382
	11/86	Methylene Chloride	22.9
	11/86	Toluene	58.8
	3/87	Carbon Tetrachloride	208
	3/87	Chloroform	249
	3/87	Methylene Chloride	16.0

Table 2-15
Analytical Results - Area B
Surface Water and Sediment Sample
Acres, 1988

Chemical Parameters	Sediment Samples (µg/kg) SS-B1	Sediment Samples (µg/kg) SS-DUP-1	Surface Water (µg/ℓ) SW-B-1
Volatile Organic Compounds			
Methylene Chloride	5600B	6500B	–
Benzene	270J	–	–
Toluene	800J	780J	0.8J
Chlorobenzene	1500	1800	–
Ethylbenzene	7100	7300	–
Styrene	4400	4800	–
Total Xylenes	–	310J	–
Total Volatile Organic Compounds	19,670	21,490	0.8
Semi-Volatile Organics			
1,4-Dichlorobenzene	5500J	5900J	–
1,2,4-Trichlorobenzene	33000	35000	–
2-Methylnaphthalene	560J	600J	–
Diethylphthalate	1100BJ	860BJ	–
N-Nitrosodiphenylamine	1700BJ	2000BJ	–
Di-n-Octyl phthalate	84BJ	–	–
Bis(2-ethylhexyl)phthalate	–	–	4J
Total Semi-Volatile Organics	41,944	44,360	4
Pesticides/PCBs			
alpha-BHC	740	1200	–
Aldrin	40	41	–
Heptachlor epoxide	20	39	–
Endosulfan I	2J	2J	–
Dieldrin	–	930	–
4,4'-DDE	14J	–	–
Total Pesticides/PCBs	816	2,212	–

Table 2-15
Analytical Results - Area B
Surface Water and Sediment Sample
Acres, 1988

Chemical Parameters	Sediment Samples (μg/kg)		Surface Water (μg/ℓ)
	SS-B1	SS-DUP-1	SW-B-1
Metals (μg/g)			
Total Arsenic	1.2	1.3	–
Total Barium	120	110	0.050
Total Boron	130	950	24
Total Chromium	24	24	0.015
Total Copper	35	34	–
Total Iron	18060	15010	0.48
Total Lead	28	29	0.014
Total Lithium	160	160	19
Total Manganese	700	790	0.34
Total Mercury	–	0.21	–
Total Nickel	12	16	–
Total Potassium	1480	1490	2.3
Total Sodium	–	–	12
Total Zinc	220	91	0.033

Notes:
1. Quantities listed indicate detectable concentrations; no data entry indicates the following: no detectable concentration or data were negated.
2. J indicates that the detected concentration is below the Contract Required Quantification Limit (CRQL).
3. B indicates the presence of the compound in the method blank.
4. D identifies all compounds identified in an analysis at secondary dilution factor.

Table 2-16
Analytical Results - Area B
Soil Boring SB-3
Acres, 1988

Chemical Parameters	Soil Boring Samples		
	SB-3-2-3.5	SB-3-8-9.5	SB-DUP-2
Metals - µg/g			
Total Arsenic	7.5	3.3	3.6
Total Barium	110	61	56
Total Beryllium	1.2	0.77	–
Total Boron	–	–	670
Total Chromium	29	22	21
Total Copper	37	25	26
Total Iron	33,550	19,520	20,930
Total Lead	8.2	–	–
Total Lithium	30	26	26
Total Nickel	33	22	17
Total Potassium	6,230	5,700	5,970
Total Silver	0.82	–	–
Total Zinc	88	49	57

Notes:
1. Quantities listed indicate detectable concentrations.
2. No data entry indicates the following: no detectable concentration or data were negated.

Table 2-17
Analytical Results - Area B
Groundwater Samples
Acres, 1988

	MW-B-1S	MW-B-1D	MW-B-3
ORGANICS (μg/kg)			
Chloroform	2J	–	1J
Bis(2-ethylhexyl)phthalate	–	2J	–
delta-BHC	–	0.005J	–
METALS (mg/ℓ)			
Total Arsenic	0.080	0.0095	–
Total Barium	0.62	0.065	0.23
Total Boron	–	–	11
Total Chromium	0.12	–	–
Total Copper	0.21	0.012	0.006
Total Iron	140	3.2	0.36
Total Lead	0.042	0.046	–
Total Lithium	0.22	0.12	26
Total Manganese	–	–	–
Total Mercury	–	–	0.0007
Total Nickel	0.16	–	–
Total Potassium	19	14	13
Total Sodium	36	150	43
Total Zinc	0.42	0.13	0.037

Notes:

No data entry indicates compound not detected.
J indicates compound present but below quantitation limit.

Table 2-18
Analytical Results - Area B
Surface Water Samples
Acres, 1989

	SS-89-3W (upgradient)	SS-89-4W (downgradient)	Sw-89-1 (Pond)
ORGANICS (μg/kg)			
Bis (2-ethylhexyl)phthalate	11BJ	12BJ	8BJ
alpha-BHC	0.49	0.30	≤0.07
METALS (mg/ℓ)			
Total Arsenic	0.071	<0.005	0.00578
Total Barium	1.3	0.36	0.32
Total Beryllium	<0.005	<0.005	<0.005
Total Boron	0.89	2.00	27.0
Total Cadmium	0.023	0.008	0.008
Total Chromium	0.17	0.012	<0.010
Total Copper	0.22	0.009B	0.017B
Total Iron	68.8	1.3	4.4
Total Lead	0.096	<0.005	0.012
Total Lithium	0.43	0.89	42.9
Total Mercury	0.006	<0.0004	<0.0004
Total Nickel	0.14	<0.04	<0.04
Total Potassium	15.8	4.9B	8.1
Total Selenium	0.0085	0.0077	0.0039B
Total Silver	0.006B	<0.005	<0.005
Total Zinc	0.96	0.080	0.079

Notes:

No data entry indicates compound not detected.
B indicates compound detected in blank.
J indicates an estimated concentration below the CRQL.
< indicates compound not detected at the given detection limit.

Table 2-19
Analytical Results
Area A & B Drainage Ditch System Sediment Samples
(Acres, 1989)

Chemical Parameters	Area A			Area B		Downgradient
	SS-89-1S	SS-89-2S	SS-89-2S (Dup)	SS-89-3S	SS-89-4S	SS-89-5S
Volatile Organics (ug/kg)						
Acetone	130	150	81	190	80	150
Semi-Volatile Organics (ug/kg)						
Di-N-Butylphthalate	N	N	N	N	23000B	N
Pesticides/PCBs (ug/kg)						
Aroclor - 1248	-	240	-	-	-	-
Aroclor - 1260	≤1400	700	≤1400	3400	1500	≤1500
Inorganics (mg/kg)						
Arsenic	13.3	9.3	10.0	9.7	13.0	11.4
Barium	186	102	131	291	252	133
Beryllium	0.88	1.5	1.5	1.1	1.5	1.8
Boron	<88	73.1	<82.7	121	254	430
Cadmium	3.7	2.5	3.5	6.1	5.8	2.5
Chromium	50.8	23.2	24.8	59.6	76.2	66.1
Copper	65.4	40.8	45.6	97.4	77.7	58.7
Iron	35700	29100	30900	26600	26900	28300
Lead	56.2	30.7	29.8	139	70.0	42.7
Lithium	40.8	33.8	38.5	150	104	86.4
Mercury	0.44	1.2	1.5	1.8	2.2	0.67
Nickel	36.9	32.2	34.7	53.2	46.3	30.2
Potassium	2760	2030	2080	1990	2120	1700
Selenium	0.88	<0.73	0.86	<0.68	<1.2	1.0
Silver	1.8	1.0	1.7	2.2	1.1	<0.89
Thallium	0.88B	<0.73	<0.83	<0.68	<1.1	<0.89
Zinc	624	269	217	351	2.3	244

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) B indicates the presence of the compound in the method blank.
4) N indicates compound negated through data validation.
5) < indicates that the compound was not detected at the Contract Required Detection Limit (CRDL).
6) ≤ indicates compound may be present at trace levels relative to the detection limit but not subject to accurate quantification.

Table 2-20
Analytical Results - Area B
Subsurface Soil Samples
Acres, 1989

Chemical Parameters	BB-1 10-12'	BB-1 12-14'	BB-2 6-8'	BB-2 10-12'	BB-3 6-8'	BB-3 8-10'	BB-4 6-8'	BB-5 4-6'	BB-7 10-12'	BB-7 10-12' (Dup)	BB-9 12-14'	SB-3-89 0-2	SB-3-89 4-6'	SB-3-89 6-8'	B-3 0-2'	B-3 8-10'	1
Volatile Organics (µg/kg)																	
Methylene Chloride	–	–	–	–	–	8B	–	–	–	–	–	N/A	–	N/A	N/A	N/A	
Acetone	69	–	–	–	–	–	–	–	–	–	–	N/A	800	N/A	N/A	N/A	1
Carbon Disulfide	26	–	–	–	–	–	–	–	–	–	–	N/A	–	N/A	N/A	N/A	
Chloroform	35	–	–	–	–	–	–	1J	2J	3J	110J	N/A	–	N/A	N/A	N/A	1
Carbon Tetrachloride	–	–	–	–	–	–	–	–	–	–	4500	N/A	–	N/A	N/A	N/A	2
Benzene	3J	–	–	–	–	–	–	–	–	–	–	N/A	–	N/A	N/A	N/A	
Tetrachloroethene	–	–	–	–	–	–	–	–	–	–	11000	N/A	–	N/A	N/A	N/A	4
Toluene	–	–	–	–	–	–	–	–	–	–	–	N/A	–	N/A	N/A	N/A	4
TOTAL	133	–	–	–	–	8	–	1	2	3	15610	–	800	–	–	–	1
Semi-Volatile Organics (µg/kg)																	
Hexachloroethane	–	–	–	–	–	–	–	–	–	–	9000E	N/A	–	N/A	N/A	N/A	
Benzoic Acid	90J	–	39J	–	–	–	–	–	–	–	–	N/A	–	N/A	N/A	N/A	
Naphthalene	–	–	–	–	–	–	–	190J	–	–	36J	N/A	–	N/A	N/A	N/A	
2-Methylnaphthalene	–	–	–	–	–	–	–	580	–	–	57J	N/A	–	N/A	N/A	N/A	
Phenanthrene	–	–	–	–	–	–	–	–	–	–	53J	N/A	–	N/A	N/A	N/A	
Di-n-Butylphthalate	–	–	2500B	–	–	–	–	–	1400B	–	–	N/A	–	N/A	N/A	N/A	15
bis-(2-ethylhexyl) Phthalate	–	–	290BJ	450BJ	420BJ	450BJ	–	420BJ	90J	230J	–	N/A	–	N/A	N/A	N/A	
TOTAL	90	–	2829	450	420	450	–	1190	1490	230	9146	–	–	–	–	–	1
TOTAL ORGANICS	223	–	2829	450	420	458	–	1191	1492	233	24756	N/A	800	N/A	N/A	N/A	2
Inorganics (mg/kg)																	
Boron	84.9	32.0	18.5	15.9	26.1	53.8	23.4	58.0	31.5	33.2	12.5	18.8	29.8	10.1	55.0	57.8	
Lithium	33.1	32.9	30.5	28.3	56.3	53.6	39.3	39.1	53.8	60.4	34.0	25.6	28.5	14.5	20.7	32.9	

NOTES:
1. Quantities listed indicate detected concentrations; no data entry indicates no detectable concentration.
2. J indicates that the detected concentration is below the Contract Required Quantitation Limit (CRQL).
3. B indicate the presence of the compound in the method blank.
4. E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
5. N/A indicates compound not analyzed for.
6. D indicates analyses performed at a secondary dilution.

Soil Samples
Below
Water Table

Table 2-21
Analytical Results - Chemical Waste Lift Stations
CWM, 1989

IN Subsurface Piping. Leaks Verified.

Compound	Chemical Waste Lift Stations					
	Area 7		Area 8		Oil / Water Separator	
	Sludge (CWLS7-1)	Sewage (CWLS7-2)	Sludge (CWLS8-1)	Sewage (CWLS8-2)	Sludge (CWLS7A-1)	Sewage (CWLS7A-2)
Volatiles	(μg/kg)	(μg/ℓ)	(μg/kg)	(μg/ℓ)	(μg/kg)	(μg/ℓ)
Benzene			-	-	54	-
Carbon tetrachloride			160,000,000	>190	-	-
Chlorobenzene			-	-	60	-
Chloroform			2,900,000	>110	-	-
1,1-Dichloroethene			-	>24	-	-
Ethylbenzene			-	-	1,700	-
Methylene chloride			<7,000	<14	<28	-
Tetrachloroethene			1,100,000	>21	90	-
Toluene			490,000	<30	<60	-
1,1,1-Trichloroethane	-	-	-	>250	-	-
Trichloroethene	-	-	50,000	>9.5	<19	>1.9
Vinyl chloride	-	-	-	-	560	>5.0
Xylenes	11	-	1,100,000	-	2,800	-
TOTAL	13.1	–	165,647,000	648.5	5,371	6.9
Semi-Volatiles						
Anthracene	-	-	-	-	8,700	-
Chrysene	-	-	-	-	13,000	-
Fluoranthene	-	-	-	-	12,000	-
Hexachlorobenzene	-	-	69,000	-	-	-
Hexachlorobutadiene	5,900	-	-	-	-	-
Hexachloroethane	-	-	28,000	-	-	-
Phenanthrene	-	-	24,000	-	70,000	-
Pyrene	-	-	-	-	60,000	-
Bis(2-ethylhexyl)phthalate	>600	-	-	-	-	-
TOTAL	6,500	–	121,000	–	163,700	–
Pesticide/PCBs						
PCB 1248	-	-	710,000	-	-	-
PCB 1260	>0.066	-	150,000	-	-	-
TOTAL	0.066	–	860,000	–	–	–
Metals	(mg/kg)	(mg/ℓ)	(mg/kg)	(mg/ℓ)	(mg/kg)	(mg/ℓ)
Antimony	-	-	-	-	3.0	-
Arsenic	8.3	-	0.22	-	12	-
Beryllium	0.25	-	-	-	0.43	-
Boron	-	-	780	-	-	-
Cadmium	-	-	-	-	25	-
Chromium	3.4	-	8.4	-	71	-
Copper	1,500	<0.02	<1.5	-	360	-
Lead	12	<0.002	9.3	-	220	<0.002
Lithium	2.6	-	-	-	8.3	-
Mercury	0.05	-	-	-	-	-
Nickel	10	-	15	0.02	39	-
Selenium	50	-	-	-	64	-
Silver	2.9	-	-	-	3.7	-
Zinc	29	-	12	0.33	850	-

(From Golder, 1991)

Table 2-22

Analytical Results - Area 31
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-31-2	SLDG-31-1
Volatiles	(µg/ℓ)	(µg/kg)
Tetracholoroethene	-	28J
Trichloroethene	2.6J	320J
Trans 1,2-Dichloroethene	5.1	-
Vinyl chloride	3.7J	-
Total Volatiles	11.4	348
Volatile TICs	214	1,418,720
Semi-Volatile		
Benzoic Acid	-	90JB/-
Bis(2-ethylhexyl)phthalate	-	3900/-
Hexachorobutadiene	4400	100,000BEJ/ 242,000BJ
Acenaphthene	-	6.0J/-
Anthracene	-	42J/-
Benzo(a)anthracene	-	71J/-
Benzo(b)fluoranthene	-	58J/-
Benzo(k)fluoranthene	-	24J/-
Benzo(a)pyrene	-	36J/-
Phenol	-	16J/-
Pyrene	-	200J/-
p-Chloro-m-cresol	-	22J/-
Chrysene	-	87J/-
Fluoranthene	-	290J/-
Hexachlorobenzene	-	130J/-
Total Semi-Volatiles	4,400	246,972
Semi-Volatile TICs	119	4,390
Pesticides/PCBs		
delta-BHC	-	35J
Heptachlor	-	55J
Aroclor 1254	-	1300J

Table 2-22

Analytical Results - Area 31
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-31-2	SLDG-31-1
Metals	(mgℓ)	(mg/kg)
Arsenic	0.005U	3.5J
Barium	0.036	19
Boron	0.5U	50U
Cadmium	0.005U	0.59
Chromium	0.01U	18
Copper	0.01U	17
Iron	0.16	NR
Lead	0.003U	66
Manganese	0.38	NR
Mercury	0.0004U	0.22
Nickel	0.02U	14
Selenium	0.005UR	0.5UJ
Silver	0.01UJ	0.6UJ
Sodium	7.5	NR
Zinc	0.013J	53BR
Lithium	0.076	8.2

Notes:

B Indicates compound detected in blank.
E Indicates compound concentration exceeds calibration range of analytical instrument.
J Indicates an estimated concentration of the detected compound or an estimated concentration of the compound below the CRQL or CRDL.
NR Indicates analyses not run or required.
U Indicates compound not detected at given detection limit.

Table 2-23
Analytical Results - Area 4
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-4-2	/SEW-DUP-1	SLDG-4-1
Volatiles	(μg/ℓ)	(μg/ℓ)	(μg/kg)
Acetone	-	-	230
Ethylbenzene	-	-	150
Toluene	-	-	82
Xylene (total)	-	-	1600
Total Volatiles	-	-	2,062
Volatile TICs	-	-	11,440
Semi-Volatiles			
Acenaphthene	-	-	1200J
Anthracene	-	-	1800
Benzo(a)anthracene	-	-	1300
Bis(2-ethylhexyl) phthalate	-	-	18000
Chrysene	-	-	1600
Dibenzofuran	-	-	1700
Fluoranthene	-	-	6400
Fluorene	-	-	2300
2-Methylnaphthalene	-	-	12000
Naphthalene	-	-	5100
Acenaphthylene	-	-	170J
N-nitrosodiphenylamine	-	-	810J
Phenanthrene	-	-	19000
Pyrene	-	-	6100
Total Semi-Volatiles	-	-	77,480
Semi-Volatile TICs	6	99	131,600
Metals	(mg/ℓ)	(mg/ℓ)	(mg/kg)
Arsenic	0.005U	0.005U	6.8J
Barium	0.045	0.046	124
Boron	0.13J	0.089J	61
Cadmium	0.005U	0.005U	50
Chromium	0.01U	0.018	255
Copper	0.026J	0.048J	92
Iron	0.23	0.65	NR
Lead	0.003U	0.008	10
Manganese	0.12	0.12	NR
Mercury	0.0006U	0.0006U	1020
Nickel	0.02U	0.02U	1.2J
Selenium	0.005UR	0.005UR	42J
Silver	0.01U	0.01U	0.96UR
Sodium	9.9	10	NR
Zinc	0.02J	0.056J	2.0UR
Lithium	0.13J	0.13J	1070

Table 2-23
Analytical Results - Area 4
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-4-2	/SEW-DUP-1	SLDG-4-1
<u>Pesticides/PCBs</u>			
Aroclor 1242	-	-	37000J

Notes:

B Indicates compound detected in blank.
E Indicates compound concentration exceeds calibration range of analytical instrument.
J Indicates an estimated concentration of the detected compound or an estimated concentration of the compound below the CRQL or CRDL.
NR Indicates analyses not run or required.
U Indicates compound not detected at given detection limit.

Table 2-24
Analytical Results - Area 22
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-22-1	/ SEW-DUP-5	SLDG-22-1
Volatiles	(µg/ℓ)	(µg/ℓ)	(ug/kg)
Chloroform	4.0J	NR	-
1,1-Dichloroethane	1.0J	NR	-
Trans-1,2-Dichloroethene	3.0J	NR	-
Ethylbenzene	-	NR	7,440,000
Tetrachloroethene	0.9J	NR	1,400,000
1,1,2-Trichloroethane	3.0J	NR	180,000
1,1,2,2-Tetrachloroethane	0.8J	NR	890,000
Toluene	-	NR	15,000,000
Trichloroethene	4.0J	NR	300,000
1,1,1-Trichloroethane	-	NR	1,100,000
Xylene (total)	-	NR	40,000,000
Total Volatiles	16.7	-	66,310,000
Volatile TICs	ND	-	10,600,000
Semi-Volatiles			
Naphthalene	-	-	72,000J
Butylbenzyl phthalate	-	-	120,000J
Hexachlorobenzene	-	-	480,000J
Hexachlorocyclopentadiene	-	-	1,400,000J
Hexachloroethane	-	-	2,300,000J
Total Semi-Volatiles	-	-	43,720,000
Semi-Volatile TICs	91	-	76,140
Pesticides/PCBs			
Methoxychlor	-	NR	3400J
Dieldrin	-	NR	2,700J
Endrin	-	NR	15,000J
Endrin Ketone	-	NR	3,400J
Total Pesticides/PCBs			24,500

Table 2-24
Analytical Results - Area 22
Chemical Waste Lift Station
Acres, 1992

Parameter	SEW-22-1	/ SEW-DUP-5	SLDG-22-1
Metals	(mg/ℓ)	(mg/ℓ)	(mg/kg)
Arsenic	0.005U	NR	0.62J
Barium	0.03U	NR	1625
Boron	0.27J	NR	8.9
Cadmium	0.005U	NR	5.7
Chromium	0.01U	NR	629
Copper	0.01UJ	NR	181
Iron	0.18	NR	NR
Lead	0.003U	NR	785
Manganese	0.046	NR	NR
Mercury	0.0006U	NR	0.14
Nickel	0.02U	NR	37J
Selenium	0.005UR	NR	0.52UR
Silver	0.01U	NR	0.99UR
Sodium	722	NR	NR
Zinc	0.01UJ	NR	32J
Lithium	0.012J	NR	2.4
Cyanide	0.01U	NR	NR

Notes:

B Indicates compound detected in blank.
E Indicates compound concentration exceeds calibration range of analytical instrument.
J Indicates an estimated concentration of the detected compound or an estimated concentration of the compound below the CRQL or CRDL.
R Indicates a rejected compound concentration.
NR Indicates analyses not run or required.
U Indicates compound not detected at given detection limit.

Table 2-25
Analytical Results
Miscellaneous Liquids and Oils
Acres, 1992

Parameters	UO-1	UO-2	Area 6 UO-3	UO-DUP
Volatiles	(μg/ℓ)	(μg/ℓ)	(μ/kg)	(μg/kg)
Acetone	30	56	-	-
Toluene	-	-	-	240J
Total Volatiles	30	56	-	240
Volatile TICs	-	-	1,000	16,080
Semi-Volatiles	-	-	-	-
Acenaphthene	-	-	20,000J	18,000J/17,000J
Anthracene	-	-	97,000J	93,000J/59,000J
Dibenzofuran	-	-	37,000J	32,000J/34,000J
Fluorene	-	-	73,000J	65,000J/64,000J
2-Methylnaphthalene	-	-	350,000	310,000J/320,000J
Phenanthrene	-	-	1,300,000J	1,300,000J/1,200,000J
Total Semi-Volatiles	-	-	1,914,000	1,694,000
Semi-Volatiles TICs	30	-	20,440,000	12,160,000
Metals	(mg/ℓ)	(mg/ℓ)	(mg/kg)	(mg/kg)
Arsenic	0.025UJ	0.025UJ	0.25UJ	0.25UJ
Barium	0.03UJ	0.03UJ	10UR	10UR
Boron	0.5UJ	0.5UJ	9.8J	18J
Cadmium	0.005UJ	0.005UJ	0.67	0.74
Chromium	224,000	227,000	2.1	1.8
Copper	0.01UJ	0.01UJ	4.3J	5.0J
Iron	1100J	800	7.4J	5.4J
Lead	0.062	0.062	3.0UR	3.5RB
Manganese	0.1	1.3	0.5U	0.5U
Mercury	0.0037	0.0037U	0.093U	0.092U

Table 2-25
Analytical Results
Miscellaneous Liquids and Oils
Acres, 1992

Parameters	UO-1	UO-2	Area 6 UO-3 /	UO-DUP
Nickel	0.02UJ	0.02UJ	11	8.4
Selenium	0.005UR	0.005UR	0.25UR	0.25UR
Silver	1.8J	1.8J	5.4J	5.7J
Sodium	331	376	200U	198U
Zinc	0.68J	4.9J	8.2	7.8
Lithium	0.35	0.28	0.25U	0.35

Notes:

B Indicates compound detected in blank.
E Indicates compound concentration exceeds calibration range of analytical instrument.
J Indicates an estimated concentration of the detected compound or an estimated concentration of the compound below the CRQL or CRDL.
R Indicates a rejected compound con^entration.
NR Indicates analyses not run or required.
U Indicates compound not detected at given detection limit.

Table 2-26
Analytical Results - Asbestos
Somerset Group Property
Acres, 1992

Sample #	Location	Sample Type	Asbestos Percentage				
			Amosite	Chrysotile	Crocidolite	Others	Total Percentage
ASB-06-01	Area 6 - Building #6-01	Pipe insulation	10%	5%	ND	ND	15%
ASB-06-02	Area 6 - Building #6-01	Bagged material	ND	ND	ND	ND	0
ASB-06-03	Area 6 - Building #6-01	Bagged material	ND	8%	ND	ND	8%
ASB-06-04	Area 6 - Building #6-01	Bagged material	ND	ND	ND	ND	0
ASB-06-05	Area 6 - Building #6-01	Bagged material	ND	ND	ND	ND	0
ASB-06-06	Area 6 - Building #6-01	Hopper insulation	12%	3%	ND	ND	15%
ASB-062-01	Area 6 - Building #6-02 Building #14-01	Pipe insulation	12%	8%	ND	ND	20%
ASB-30A-01	Area 30A - Combustiles Warehouse	Pipe insulation	ND	ND	ND	ND	0

Table 2-26
Analytical Results - Asbestos
Somerset Group Property
Acres, 1992

			Asbestos Percentage				
Sample #	**Location**	**Sample Type**	**Amosite**	**Chrysotile**	**Crocidolite**	**Others**	**Total Percentage**
ASB-30A-02	Area 30A - Combustibles Warehouse	Bagged material	ND	40%	ND	ND	40%
ASB-41-01	Area 41 - Maintenance Shop	Pipe insulation	ND	ND	ND	ND	0
ASB-31-01	Area 31 - Laboratory	Pipe insulation	ND	30%	ND	ND	30%
ASB-27-01	Area 27 - Guard House	Corrugated panel	ND	10%	ND	ND	10%
ASB-DUP-01	Area 27 - Guard House	Corrugated panel	ND	10%	ND	ND	10%

Note:

ND Indicates Not Detected

Table 2-27
Materials Identified
for Removal Actions in
Operable Units No. 1 and 2

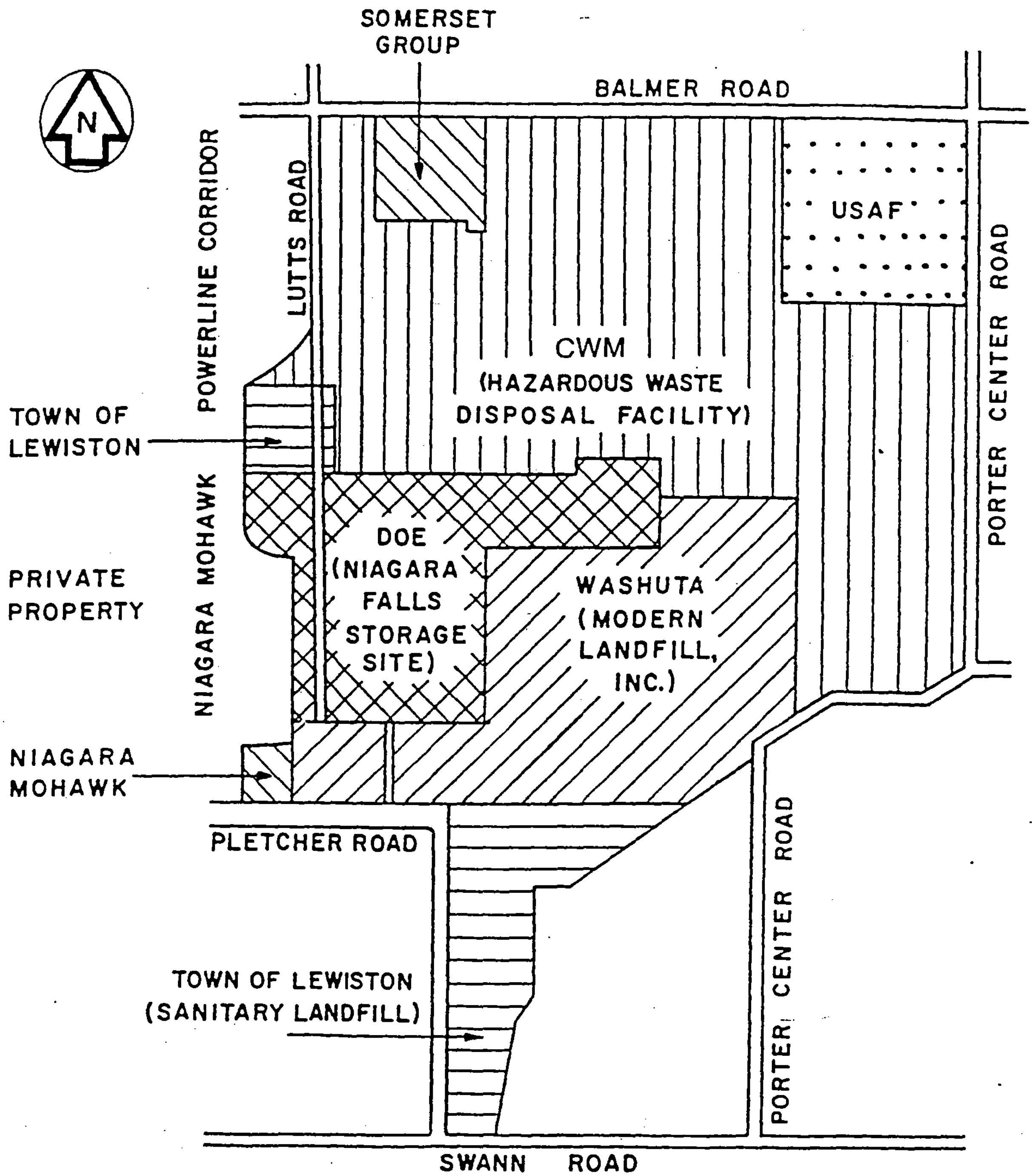
Area	Media	Weight	Volume	Contaminant	Approximate Concentration	Comments
TNT Sewers						
	Residue	255 tons	150 cu. yds.	Vol.	11 ppm	For alternatives evaluation and cost estimating, assume 10% crystalline solids and 90% sediments. Assume entire mass is potentially explosive (TNT >10%).
				S-Vol.	1 ppm	
				TNT	25,000 ppm	
	Soil	85 tons	50 cu. yds.	Assume same as for residues		For alternatives evaluation and cost estimating, assume 10% tests as hazardous and 90% non-hazardous. Assume all non-explosive.
	Concrete/Pipe	4,500 tons	2222 cu. yds.	Assume same as for residues		
	Water		45,000 gal.	Vol.	86 ppm	For cost estimating, assume water from within sewer system only.
				S-Vol.	206 ppm	
				TNT	10 ppm	
Area A						
	Soil/Drums	6,800 tons	4,000 cu. yds.	Vol.	8 ppm	For alternatives evaluation and cost estimating, assume 50% of mass tests as hazardous and 50% non-hazardous.
				S-Vol.	3 ppm	
				Pesticides	0.05 ppm	
	Water		200,000 gal.	Vol.	3 ppm	For cost estimating, assume free ground water from immediate excavation only.
				S-Vol.	0.5 ppm	

Area	Media	Weight	Volume	Contaminant	Approximate Concentration	Comments
Area B						
	Sediment/ Soils	20,400 tons	12,000 cu. yds.	Vol.	22 ppm	For alternatives evaluation and cost estimating, assume 50% of mass tests as hazardous and 50% non-hazardous.
				S-Vol.	45 ppm	
				Pesticides	3 ppm	
	Water		120,000 gal.	Assume same as for sediment and soils		For cost estimating, assume free ground water from excavation of former surface depression only.
AFP-68						
	Sludge	42.5 tons	25 cu. yds.	Vol.	165,640 ppm	For alternatives evaluation and cost estimating, assume all sludge tests as hazardous.
				S-Vol.	43,720 ppm	
				Pest/PCBs	860 ppm	
				Ba	1,625 ppm	
				Cu	1,500 ppm	
				Cd	50 ppm	
				Cr	255 ppm	
				Hg	1,020 ppm	
				Pb	785 ppm	
	Sewage		30,000 gal.	Vol.	1 ppm	
				S-Vol.	4.4 ppm	
	Drum of Oil		55 gal.	Vol.	16 ppm	
				S-Vol.	20,440 ppm	

Area	Media	Weight	Volume	Contaminant	Approximate Concentration	Comments
	Chromic Acid		26 gal.	Cr	227,000 ppm	
				pH	0.3 - 1.0	
	Misc. Liquids/ Oils		16 gal.	pH varies	1 - 12	
Asbestos						
	Panels	1,120 tons		Asbestos		
	Pipe Insulation	20 tons		Asbestos		
	Bagged Mortar	2 tons		Asbestos		
	Hopper	1		Asbestos		

Note: Quantity estimates based on 1.7 tons per cubic yard for soil, sediments and residues; 2 tons per cubic yard for concrete pipelines and asbestos panels; and 1 ton per cubic yard for asbestos pipe insulation.

Total: Soils/sludge/drums - 27,582.5 tons;
Concrete - 4,500 tons; and
Water/sewage - 395,000 gallons.

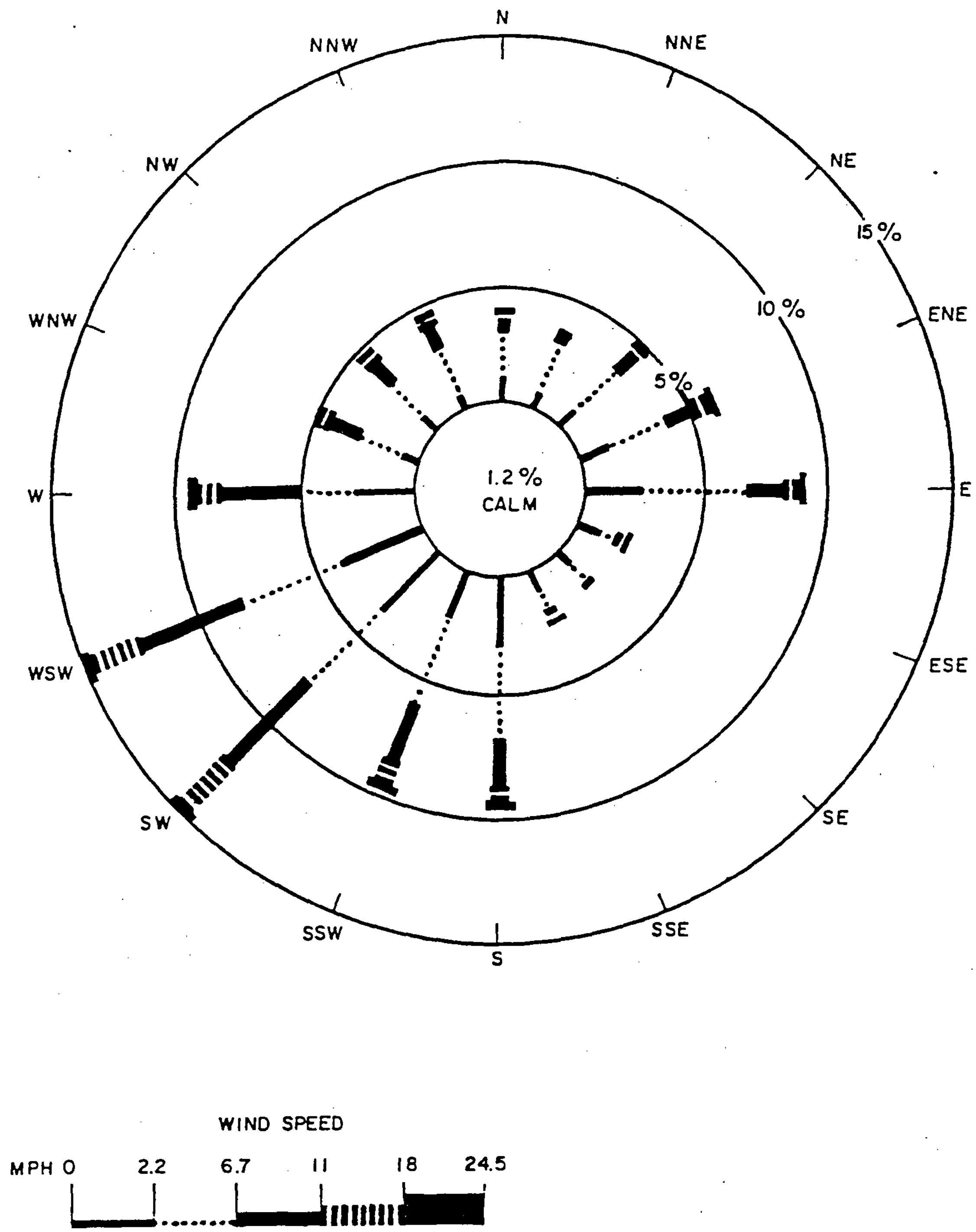


LAKE ONTARIO ORDNANCE WORKS

CURRENT OWNERSHIP

FIGURE 2-1

SOURCE: DOE, 1986.

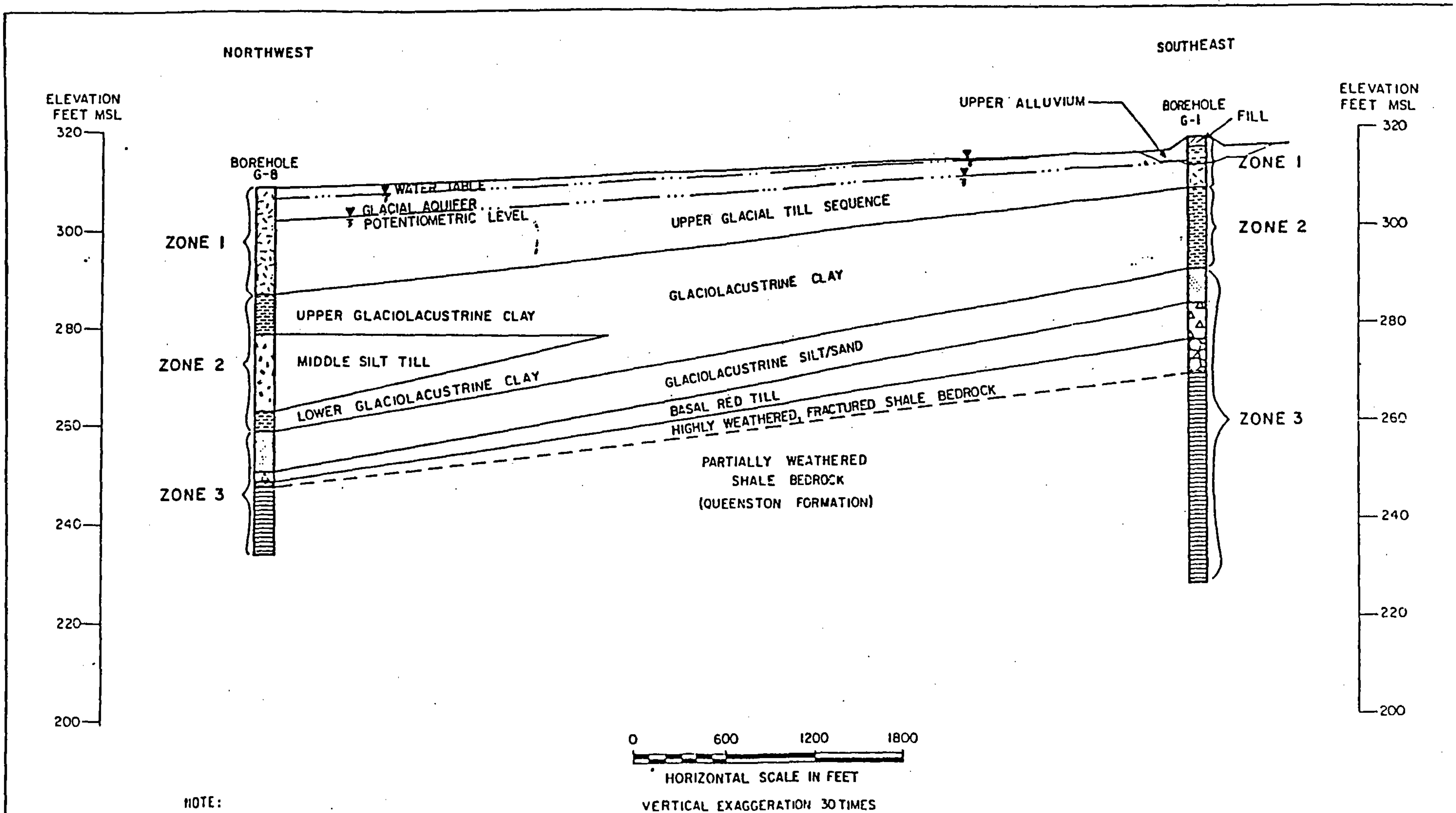


DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS

ANNUAL WIND ROSE FOR THE NFSS

FIGURE 2-2

(BECHTEL, 1987)



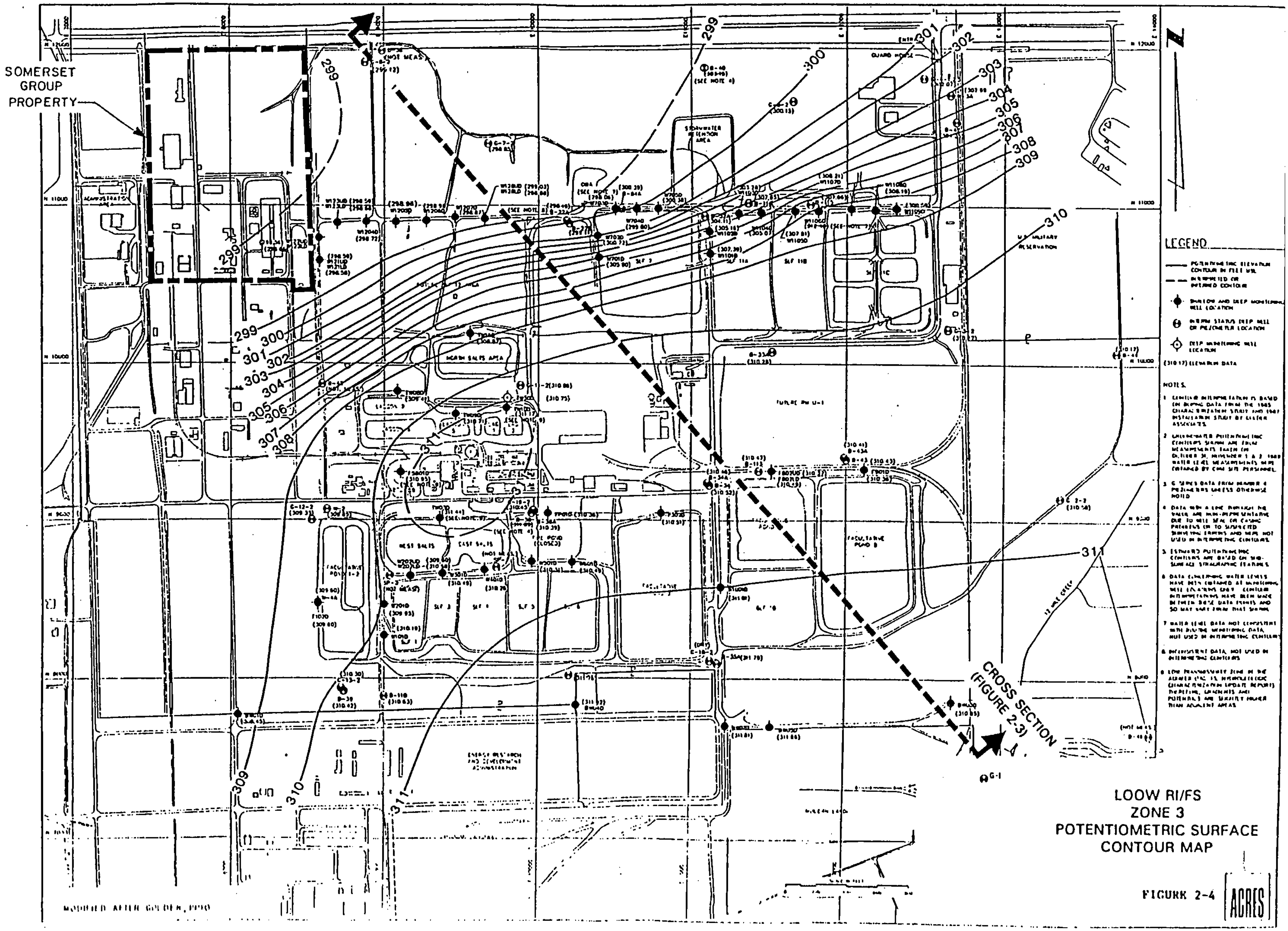
NOTE:

This figure is a schematic representation of the geologic stratigraphy made by straight line interpolation between boreholes G-1 and G-8. Some of the strata shown are discontinuous.

STRATIGRAPHIC CROSS SECTION OF CWM RCRA FACILITY

FIGURE 2-3

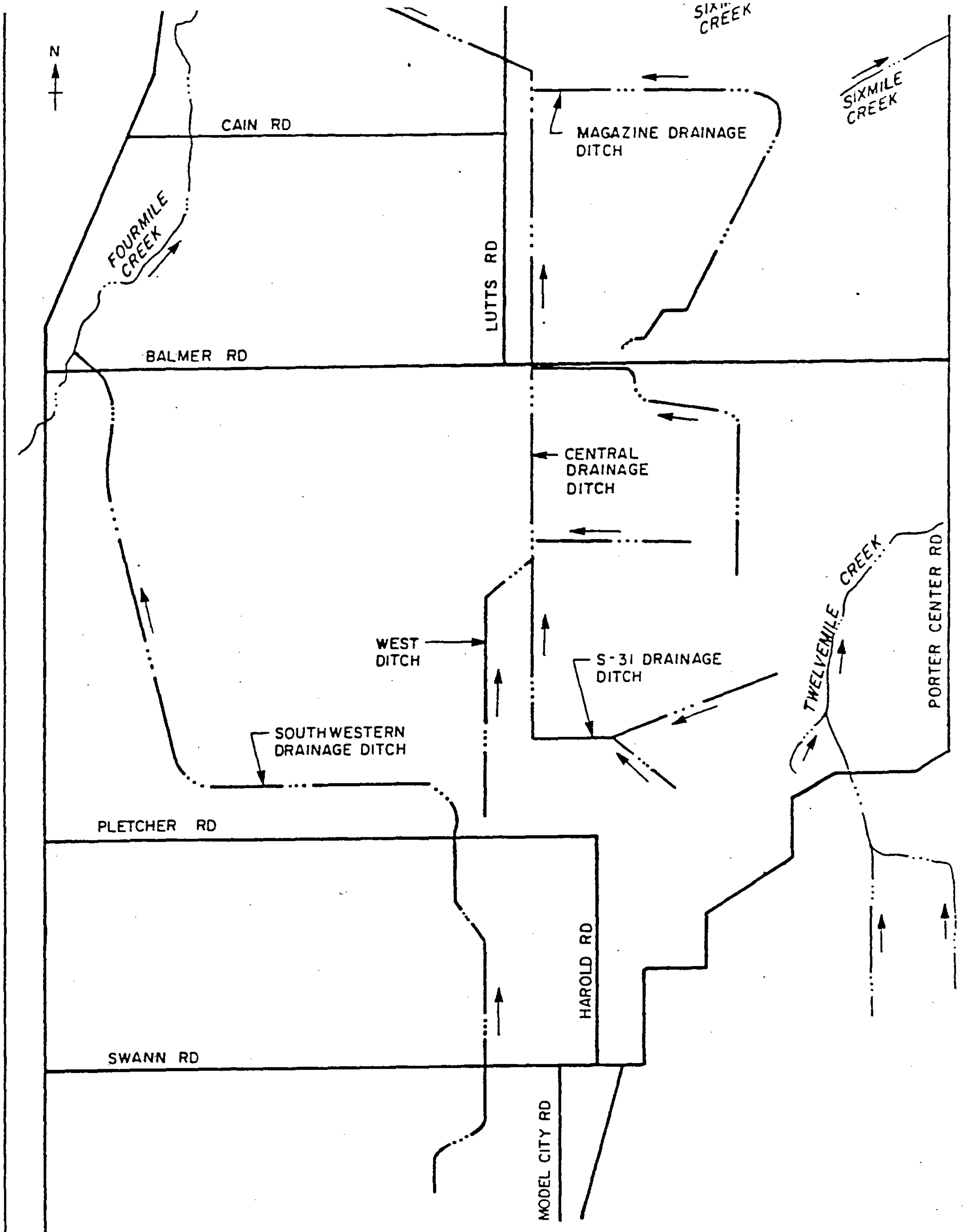
ACRES



LOOW RI/FS
ZONE 3
POTENTIOMETRIC SURFACE
CONTOUR MAP

FIGURE 2-4

ACRES



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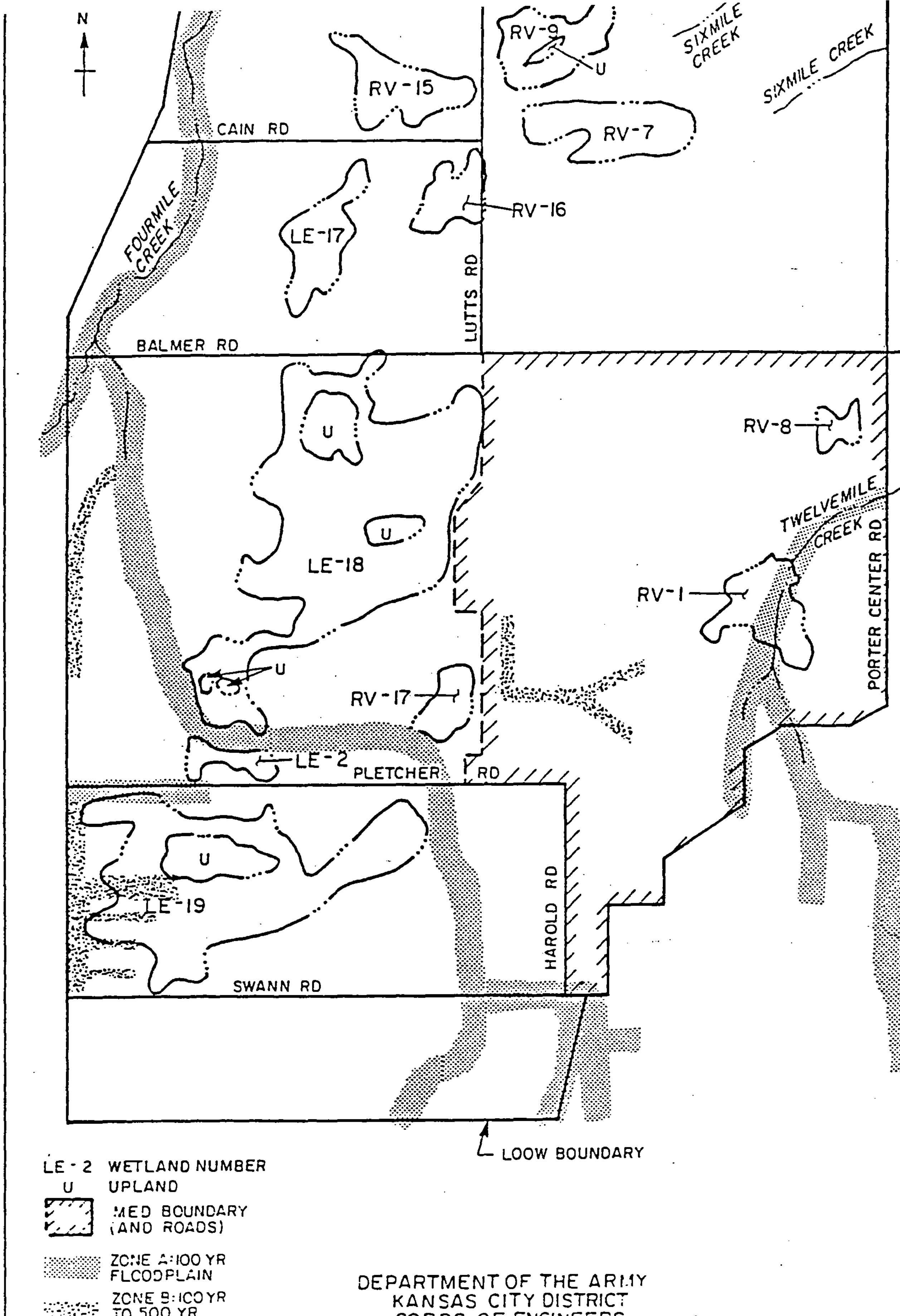
DRAINAGE PATTERNS AT THE FORMER LOOW SITE

FIGURE 2-5



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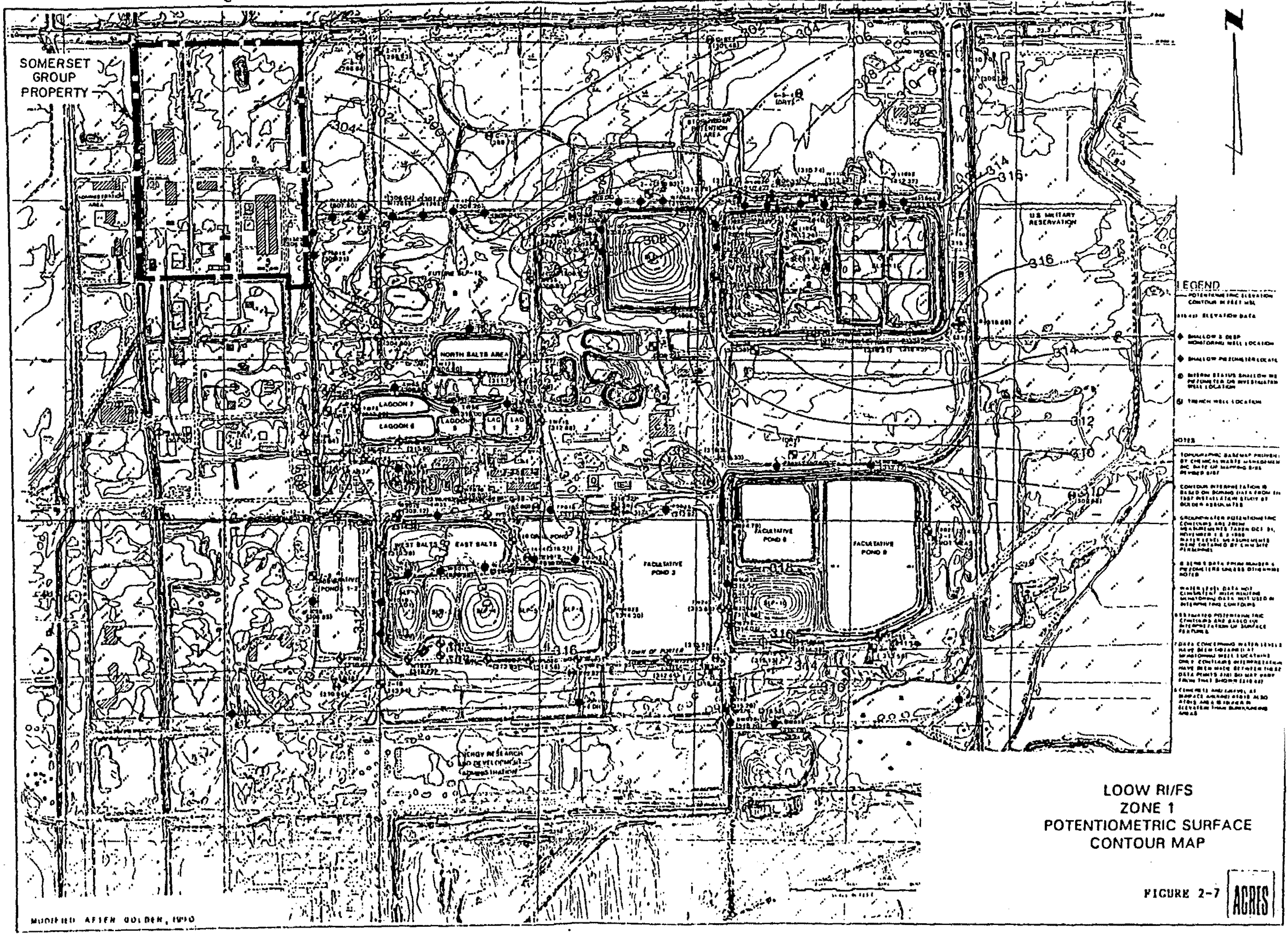
FLOODPLAINS & WETLANDS AT THE FORMER LOOW SITE

FIGURE 2-6

ACRES

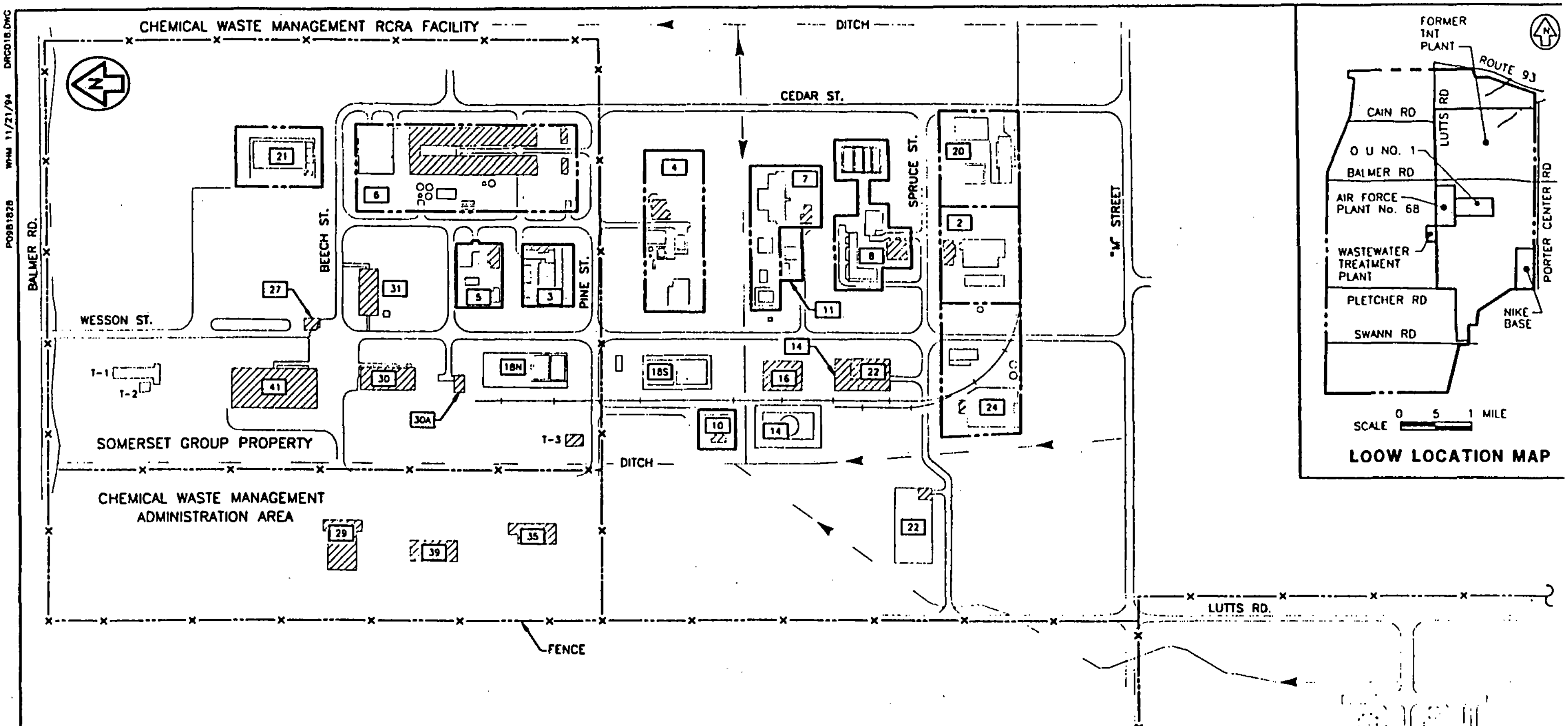


LOOW RI/FS
ZONE 1
POTENTIOMETRIC SURFACE
CONTOUR MAP

FIGURE 2-7

ACRES

MODIFIED AFTER GOLDEN, 1990



AREA DESIGNATION

T-1	TEMPORARY BUILDING #1	18N	TANK FARM
T-2	TEMPORARY BUILDING #2	18S	TANK FARM
T-3	TEMPORARY BUILDING #3	20	PRODUCT HANDLING
2	CHLORINATION UNIT	21	ELECTRICAL SUBSTATION
3	HYDROGENATION UNIT	22	WATER SUPPLY AND TREATMENT
4	GAS SYNTHESIS	24	SANITARY SEWAGE AND WASTE DISPOSAL
5	SALT PURIFICATION	27	GUARD HOUSE
6	SALT ELECTROLYSIS	29	OFFICE BUILDING
7	PYROLYSIS UNIT	30	NON-COMBUSTIBLES WAREHOUSE
8	ALKYLATION UNIT	30A	COMBUSTIBLES WAREHOUSE
10	HYDROGEN PRODUCTION	31	LABORATORY
11	NITROGEN PRODUCTION	35	DISPENSARY
14	STEAM PLANT	39	CAFETERIA
16	REFRIGERATION AND STEAM PLANT	41	MAINTENANCE SHOP

NOTES

BASE MAP TAKEN FROM DRAWINGS PREPARED BY CATALYTIC CONSTRUCTION CO., SINGMASTER-BREYER, BLAW-KNOX, WALTER KIDDIE CONSTRUCTION CO. AND J.G. WHITE.

REFERENCE DRAWINGS UTILIZED WERE MADE AVAILABLE BY THE SOMERSET GROUP, INC.

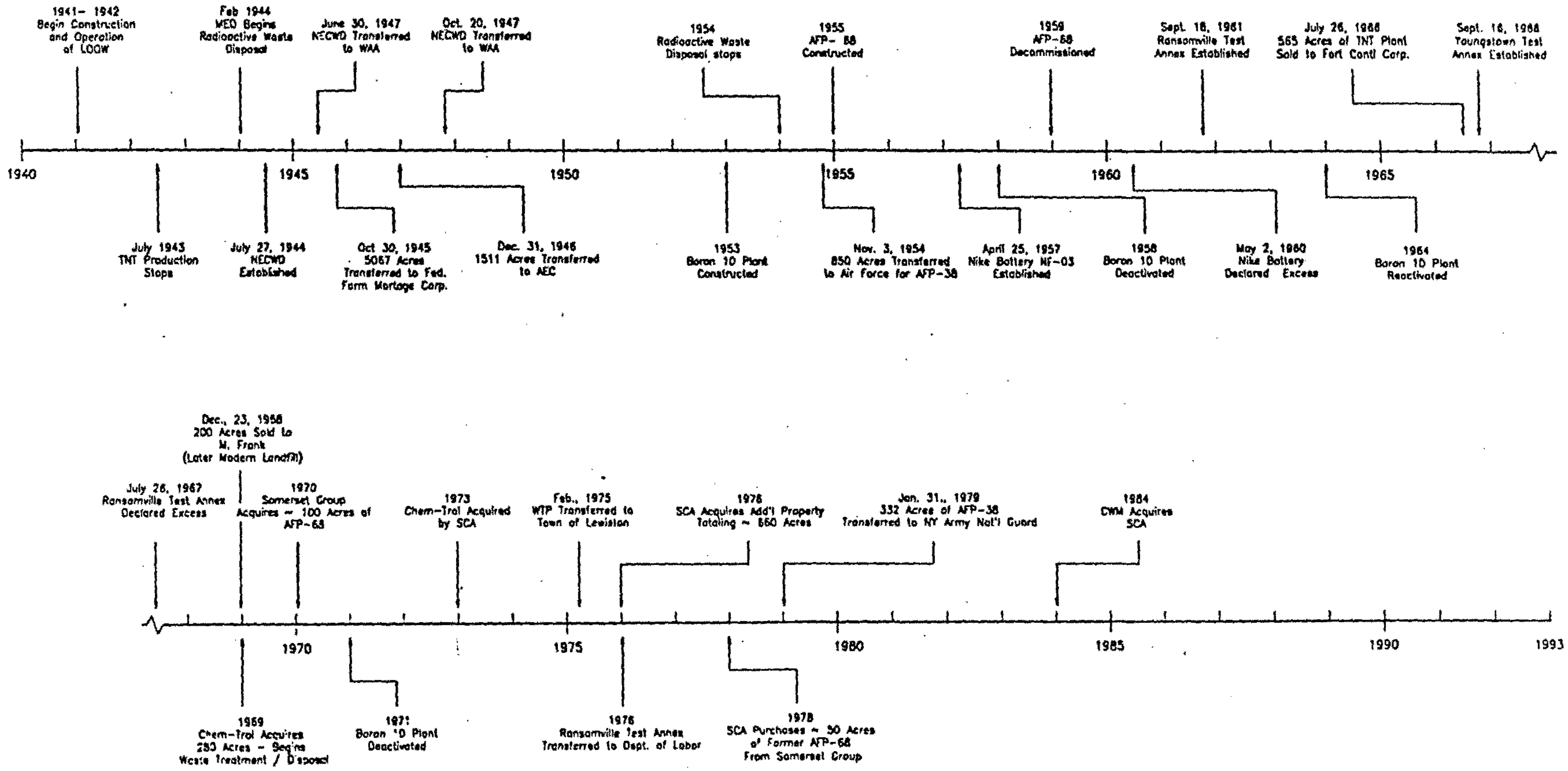
SCALE 0 300 600 FEET

AIR FORCE PLANT NO. 68

SITE LAYOUT

ACRES

FIGURE 2-9



Department of the Army
Kansas City District
Corps of Engineers

LOOW PROPERTY OWNERSHIP
TIMELINE

Figure 2–10

(b) **COE/E&E Investigation**

In 1985, the Huntsville COE issued a contract to Ecology and Environment, Inc. (E&E) to investigate contamination associated with the operation or decommissioning of AFP-68. As part of the investigation, E&E conducted magnetometer and terrain conductivity geophysical surveys and soil and surface water sampling.

The geophysical survey results indicated a strong magnetic anomaly approximately 140 feet long by 20 feet wide trending in an east-west direction on the north side of H Street (see Figure 2-12). The analytical results for two surface soil composite samples did not indicate any significant contamination. The surface water sample from a drainage ditch north of Area A indicated the presence of boron but not at substantial concentrations.

(c) **COE's Initial Remedial Investigation**

In 1988, additional terrain conductivity and magnetometer geophysical surveys were performed in Area A as part of the COE's initial RI. The results of the survey were used to verify the surveys performed by E&E and to aid in the selection of locations for test pit excavations. In addition to the geophysical surveys and test pit excavations, the initial RI also included monitoring well installation and drum sampling.

The results of the geophysical survey confirmed the presence of an elongated east-west trending anomaly. Four test pits were excavated to determine the extent and contents of the buried drum trench. Samples from five drums, the water within the test pit and soil from the test pit walls and floor were collected and analyzed. The analytical results for the drum samples indicated the presence of several volatile organic compounds with the most contaminated drum sample having a maximum total volatile organic concentration of 7603 μg/kg (Table 2-8). Acetone was the highest detected compound in each drum sample. A few semi-volatile organic compounds were detected with a maximum total semi-volatile organic concentration of 2814 μg/kg, which was primarily phenanthrene (1500 μg/kg). The test pit water sample had similar contaminants as the drum samples (Table 2-9). At that time, the samples were determined not to be hazardous waste based on the EP Toxicity Characteristics and RCRA waste characteristics (Table 2-10).

The soil sample from the test pit floor contained similar volatile organic contaminants as the drum samples but at a lesser concentration (i.e., total volatile concentration of 1258 μg/kg). The soil sample from the test pit wall had no detectable concentrations of volatile organics (Table 2-9). Only two semi-volatile organic compounds were detected, diethylphthalate, at 52 J μg/kg, in the wall sample and 2-methylnaphthalene, at 360 J μg/kg, in the floor sample. Trace concentrations of pesticides were also detected.

Monitoring wells installed about 200 feet downgradient of the buried drum trench did not detect any contamination.

(d) COE's Supplemental Remedial Investigation

Area A was again investigated by the COE during the Supplemental RI in 1989. The investigation included a ground penetrating geophysical survey, soil gas survey, subsurface soil sampling and analyses, and the installation of a monitoring well closer to the buried drum trench (Figure 2-13).

The results of the geophysical survey reconfirmed the presence and dimension of the buried drum trench. The soil gas (head space) survey was performed in order to define the extent of contamination migrating from the trench. Soil samples collected from areas with the highest organic vapor content were selected for laboratory analyses. The analytical results indicated the presence of acetone, methylene chloride, and toluene with acetone being the most predominant contaminant, detected at a maximum concentration of 610 μg/kg (Table 2-11). Four semi-volatile organic compounds were also detected with a maximum total semi-volatile organic concentration of 4588 μg/kg which was primarily di-n-butylphthalate (4400 μg/kg). The soil gas head space and laboratory analytical results indicated that the contamination extended outside the actual buried drum trench boundaries.

2.3.3 Area B

(a) Olin/SCA Investigation

Area B was first investigated in 1981 as part of the partial remediation by Olin/SCA. Initial activities involved the collection of three surface soil samples taken from the burn pit area and three groundwater samples taken from SCA wells in the vicinity (Figure 2-14). All samples were analyzed for boron and lithium.

Analytical results for the groundwater samples indicated no contaminated conditions. Two of the soil samples were contaminated with lithium; one of these samples also had elevated concentrations of boron. The third sample did not have elevated concentration levels of either boron or lithium (Table 2-12).

(b) COE/E&E Investigation

The COE investigation performed by E&E in 1985 included the collection of two surface water samples from the ponded water in Area B and two surface soil composite samples from the pit. The water samples were analyzed for toluene, trichloroethene, boron, lithium and potassium. The soil samples were analyzed for benzene, toluene, boron, lithium and potassium. A magnetometer geophysical survey was also performed to identify the presence of buried drums in Area B.

The results of the magnetometer survey indicated no evidence of buried drums in Area B. The analytical results for the surface water samples collected from Area B indicated the presence of trichloroethene at 6.7 μg/l in one of the samples. Both samples displayed high concentrations of both boron and lithium (Table 2-13). The soil samples had no detectable concentrations of organics but did have elevated concentrations of boron and lithium.

(c) CWM's Continuous Groundwater Monitoring

CWM, and their predecessors, SCA, have performed continuous monitoring of wells surrounding SLF-7 located to the south of Area B. CWM has noted repeated detections of several organic compounds in some of their wells, the occurrence of which CWM alleges to be related to contamination in Area B. An example of the compounds detected and the concentrations are provided in Table 2-14. As indicated in this table, the compounds most frequently detected were carbon tetrachloride, chloroform, and methylene chloride.

(d) COE's Initial Remedial Investigation

The initial RI performed by the COE in 1988 included the collection of one surface water and sediment sample (and duplicate) from the pond in Area B, one soil boring (SB-3) southwest of the bermed area, and the installation and sampling of groundwater monitoring wells downgradient and immediately adjacent to Area B.

The surface water sample indicated no evidence of contamination. The sediment sample, however, contained elevated concentrations of volatile, semi-volatile organic compounds, some pesticides, and boron and lithium (Table 2-15).

The soil sample from the soil boring southwest of Area B was analyzed for metals only. The analytical results for the sample indicated the presence of boron at an elevated concentration [i.e., 670 μg/g in the duplicate sample from the 8 - 9.5 ft depth (Table 2-16)].

The groundwater samples indicated no evidence of organic contamination. Well MW-B-3 did, however, display elevated concentrations of boron and lithium (Table 2-17).

(e) COE's Supplemental Remedial Investigation

The COE's Supplemental RI included the installation and sampling of a ground-water monitoring well closer to Area B, the collection of surface water and sediment samples from the adjacent drainage ditches, one surface water sample from the ponded water in Area B, a soil gas (head space) survey and subsurface soil sampling and analyses (Figure 2-15).

The analytical results for the surface water samples indicated no evidence of organic contamination. The surface water sample from the pond in Area B did, however, have elevated levels of boron and lithium (Table 2-18). The sediment sample from the drainage ditches had detected concentrations of acetone and two PCBs (Table 2-19).

The groundwater monitoring well had produced no water at the time of sample collection and therefore was not sampled.

The soil gas survey indicated the presence of some organic contamination at depth in the area but not at substantially elevated levels with the exception of two samples, one from the east side of the burn pit (B-3) and the other from the south side of the burn pit (BB-9). The sample analyzed from boring B-3 was collected from the 12-14 ft interval and had concentrations of acetone, chloroform, carbon tetrachloride, tetrachloroethane, and toluene with a total volatile organic concentration of 1181 ug/kg (Table 2-20). The sample collected from boring BB-9 had detected concentrations of chloroform, carbon tetrachloride, and tetrachloroethane totalling 15610 ug/kg and the semi-volatiles hexachloroethane, naphthalene, 2-methylnaphthalene, and phenanthrene totalling 9146 ug/kg.

2.3.4 AFP-68

(a) CWM Investigation

CWM's predecessor SCA, had previously used portions of the AFP-68 water supply and wastewater treatment systems for the temporary storage of wastewaters. As part of their RCRA permit, CWM was required to investigate the possible presence of contamination in areas previously used for waste management, either by CWM or their predecessors. As part of their RCRA Facility Investigation, CWM collected sewer water and sludge samples from three of the former AFP-68 chemical waste sewer system lift stations. The specific locations of the collected samples were the lift station adjacent to the oil/water separator, Area 7 lift station and Area 8 lift station (Figure 2-16).

The analytical results for the lift station samples indicated the presence of low level of volatile organic (hexachlorobutadiene) and copper contamination and significant levels of contamination in the other two lift stations. The sludge sample from the chemical waste lift station in Area 8 exhibited the greatest concentrations of organic contaminants which were predominantly composed of carbon tetrachloride at 160,000,000 ug/kg, chloroform at 2,900,000 ug/kg, and tetrachloroethane and total xylenes, each at 1,100,000 ug/kg (Table 2-21).

(b) **COE's Preliminary Contamination Assessment Investigation**

1. Chemical Waste Lift Stations

As part of the COE's Preliminary Contamination Assessment (PCA) investigation, Acres collected samples of sewage and sludge from the remaining chemical waste lift stations not sampled by CWM (i.e., Area 4, Area 22, and Area 31), samples of suspected asbestos-containing materials, and representative samples of miscellaneous liquids and oils found on the Somerset Group property.

The analytical results for the most upgradient chemical waste lift station (i.e., Area 31) contained organic contamination, including tentatively identified compounds (TICs), totalling over 1,700,000 μg/kg in the sludge sample (Table 2-22). The detected target compound concentration was comprised mostly of di-n-butylphthalate, at 100,000 μg/kg and hexachlorobutadiene, at 242,000 μg/kg. The associated sewage sample (and duplicate) had significantly less contamination.

The next downgradient chemical lift station sample, from Area 4, had less contamination with total volatile organic compounds including TICs at about 13,500 μg/kg and total semi-volatile organic compounds including TICs at just over 200,000 μg/kg (Table 2-23). Mercury, at 1020 mg/kg and chromium, at 255 mg/kg, were the highest detected metals in the sludge sample.

The sample from the chemical lift station in Area 22 displayed the greatest concentration of contamination with about 77,000,000 μg/kg of total volatile organics plus TICs, over 43,000,000 μg/kg total semi-volatile organics plus TICs and over 24,000 μg/kg of pesticides (Table 2-24). This sludge sample also had high concentrations of barium, at 1,625 mg/kg, chromium, at 629 mg/kg, and lead, at 785 mg/kg.

2. Miscellaneous Liquids and Oils

Miscellaneous liquids and oils sampled at AFP-68 included the following:

- One 55-gallon open-top drum of oil in Area 6;

- Two 5-gallon metal containers and sixteen 1-gallon glass containers of a red liquid at Temporary Building No. 2; and

- Approximately sixteen 1-gallon glass containers of miscellaneous laboratory chemicals in the non-combustibles warehouse in Area 30A.

The sample of oil collected from the drum in Area 6, identified as Sample No. OU-3, had a pH of 6 (Table 2-25). The analytical results indicated that the oil was comprised predominantly of six semi-volatile organics: acenaphthene, anthracene, dibenzofuran, fluorene, 2-methylnaphthalene, and phenanthrene with estimated concentrations ranging from 17,000 to 1,300,000 ug/kg.

The two samples from the containers in the Temporary Building No. 2 area identified as Samples OU-1 and OU-2, had pH values of 0.3 and 1.0 and specific conductivities of >10,000 uS/cm. The analytical results for the samples revealed high chromium concentrations at 224,000 and 227,000 mg/l indicating that the liquids are probably chromic acid.

Eleven of the sixteen containers of laboratory chemicals were inspected during the preliminary contamination assessment in 1992. The remaining containers were not discovered until a recent site visit (on April 20, 1994). The following observations of the laboratory chemicals were made:

Container / Content

1 - Clear glass, clear liquid, no label, pH = 11
2 - Clear glass, clear liquid, no label, pH = 11
3 - Clear glass, clear liquid, no label, pH = 12
4 - Clear glass, clear liquid, label indicates H_3PO_4, pH = 6
5 - Clear glass, clear liquid, label indicates NH_4OH, pH = 12
6 - Clear glass, clear liquid, illegible green label, pH = 7, smells like glue
7 - Amber glass, no label, pH = 6, smells like toluene
8 - Amber glass, label indicates pentane, pH = 7

9 - Clear glass, clear liquid, label indicates HCl, pH = 1
10 - Amber glass, no label, pH = 7
11 - Clear glass, clear liquid, pH = 6, pentane odor

3. Suspected Asbestos Containing Materials

Suspected asbestos containing materials were found throughout the former AFP-68 area. The material occurred as corrugated panels that had functioned as exterior walls enclosing the process areas; pipe insulation; hopper insulation; and unused bags of mortar. Representative samples of these materials were collected and analyzed for asbestos content.

The analytical results for the corrugated panels indicated that they contain 10% chrysotile asbestos (Table 2-26). The pipe insulation composition varies from 30% chrysotile to 12% amosite and 8% chrysotile to some with no asbestos content.

The bagged mortar material found in Area 6 was determined to contain 8% chrysotile asbestos and the bagged material in the non-combustibles warehouse in Area 30A contains 40% chrysotile asbestos. The hopper in Area 6 had 12% amosite and 3% chrysotile asbestos.

2.4 Source, Nature and Extent of Contamination

2.4.1 TNT Sewer Lines

Test pit excavation activities to date have indicated that the pipelines comprising the TNT waste sewer system are concrete encased with approximate dimensions of 2 feet wide by 3 ft high. The pipelines found during the test pit excavation activities were at the approximate locations as shown on available drawings of the original TNT facility layout. According to the drawings and site observations, the pipelines encased within the concrete are vitreous clay pipe and range in diameter from 10 to 18 inches. It is estimated that almost 10,000 linear feet of pipeline exist (Refer to Figures 2-18 and 2-19 for the location of the TNT pipelines). Based upon the field investigations, the excavated pipelines were found to be about 1/3 full of sediments and partially full of water. Using information obtained from original drawings and aerial photographs of the TNT facility, an estimated 150 cubic yards of contaminated sediment and 45,000 gallons of contaminated water have been estimated to be present within the pipelines (Table 2-26). As a result of the recent sampling and analyses by CWM, it is also assumed that the sediment and any water within the pipelines are contaminated by several volatile and semi-volatile organic compounds as well as TNT.

Based on the U.S. Army's experience at other former ordnance works remediation projects, the verification of the presence of explosives-contaminated residues in some of the pipeline sections indicates that pockets of high concentrations of explosives may exist in sections of the system.

Based upon information available to date, the following materials are identified for remediation (see Appendix A for volume calculations):

- An estimated 150 cubic yards of contaminated sediments within the pipeline (based on the 1/3 of the pipeline volume containing sediment);

- An estimated 45,000 gallons of contaminated water within the pipeline (based on the 1/2 of the pipeline volume containing water);

- Possible soil contamination at locations of possible breaks in the pipes and concrete casing (assuming 50 cubic yards for estimating purposes); and

- Approximately 10,000 linear feet of pipeline and associated construction materials.

For the purposes of this EE/CA, only contaminated water from within the pipeline is assumed. Any contaminated groundwater beyond the pipeline excavation is not considered part of this EE/CA removal action.

2.4.2 Area A

Test pit excavation activities conducted during the initial RI verified the presence of buried drums in Area A. The combined results of the geophysical surveys, test pit excavations, and soil boring activities indicate that the buried drum trench is approximately 220 ft long by 40 ft wide by 10 ft deep (Figure 2-18). The drum trench is located along the southern part of Area A and extends just under the northern side of H Street.

The predominant contaminants include acetone, 2-butanone, total xylenes and toluene. The buried drums and test pit water displayed the greatest concentrations of contaminants.

Based on the information gathered to date, the following materials have been identified for remediation (Table 2-27):

- Drums and contaminated trench soils with an estimated volume of approximately 4000 cubic yards (based on the trench dimensions of 220 ft by 40 ft by 10 ft for a total of 3259 cubic yards of contaminated material, plus 20% for overexcavation); and

- Localized contaminated groundwater from within the trench, estimated at 200,000 gallons (based on groundwater at 3 ft below ground surface which equates to 70% of the trench being within the saturated zone and an estimated porosity of 40% for the trench materials). The existence of any contaminated groundwater beyond the immediate trench is not considered part of this EE/CA removal action.

2.4.3 Area B

Aerial photographs dating back to 1963 indicate that the burn pit activities were apparently concentrated in the southern portion of Area B, just north of H Street. Two rectangular depressions also existed within the pit (Figures 2-17 and 2-18). One of these depressions measured about 200 ft long by 15 ft long and was located in the northern portion of the burn pit. The second surface depression measured about 100 ft long by 25 ft wide and was located in the southeast corner of Area B. During the construction of SLF-7, H Street was relocated about 25 ft north of its former location. This northern relocation of H Street appears to have resulted in the elimination of this second surface depression.

The pond sediment samples displayed the highest concentrations of contaminants detected in Area B. The contaminants were predominantly benzene derivatives (e.g., chlorobenzene, ethylbenzene, styrene, and 1,2,4-trichlorobenzene) and are distinctly different from the contaminants detected elsewhere in Area B. For example, subsurface soil samples collected from the area south of the bermed pond displayed elevated levels of carbon tetrachloride, hexachloroethane, and tetrachloroethane.

Based on the investigation results obtained to date, it appears that separate source areas exist in Area B. The sediment within the pond in Area B is contaminated with heterocyclic and aromatic compounds. Visual observations of the sediments identified the presence of deteriorated drums and lab pack materials. This contamination appears to be limited to the upper few feet of sediment as subsurface soil samples did not contain significant contamination at depth. Because the berms were constructed of locally derived materials, it is assumed that the berms are also contaminated. The contaminants detected in the subsurface soils and groundwater to the south of Area B were primarily chlorinated organics such as tetrachloroethene. Because of the differences in the types of contamination detected to the area south of Area B and those contaminants detected within the bermed pond in Area B, the occurrences of these different contaminants may represent separate source areas within Area B. It appears the contamination south of Area B may be related to the possible use of the former surface depression for wastewater storage.

Based on information gathered to date, the following materials have been identified for remediation (Table 2-27):

- Contaminated pond sediments estimated at approximately 3000 cubic yards (based on a 24,500 square foot area 3 ft in depth);

- Contaminated berm materials at approximately 6,000 cubic yards (based on 33,000 square feet of berm at an average height of 5 ft);

- Contaminated mounded sediments and soils within the ponded area estimated at 1,300 cubic yards (based on a 7150 square foot area with an average thickness of 5 ft);

- Contaminated soils within the former surface depression south of the present burn pit boundaries, estimated at 1,700 cubic yards (based on the depression dimensions of 100 ft long by 25 ft wide by 18 ft deep); and

- Locally contaminated groundwater from within the former surface depression, estimated at 120,000 gallons (based on the groundwater at 3 ft below ground surface resulting in 83% of the volume of the trench within the saturated zone and an estimated porosity of 40% for the trench materials). The existence of contaminated groundwater beyond the excavation trench is not considered part of this EE/CA removal action.

It is assumed, based on previous laboratory results, that the majority of ponded surface water within Area B could be discharged without treatment. It is anticipated that the water would be carefully removed to a predetermined depth so as to avoid disturbing any of the contaminated sediments. Monitoring of water quality would be performed as part of the discharge operation to ensure compliance with regulatory limitations.

2.4.4 AFP-68

Chemical Waste Sewer System

The chemical waste sewer system located on the Somerset and CWM properties was determined to contain numerous contaminants at substantial concentrations. Based on past observations of liquid levels within the lift stations, it appears that the liquid levels are constant and do not represent groundwater levels. This would imply that the contaminants may be confined within the sewer system. The portions of the sewer system to be addressed include the chemical waste lift stations (typically 10 ft by 10 ft by 10.5 ft) in Areas 4, 7, 8, 22, 31, and adjacent to the oil/water separator in Area 24 North; and associated interconnecting sewer lines. Based on available site drawings, the sewer lines range in size from 4 to 6 inches in diameter (Figure 2-20). Any contamination beyond the confines of the sewer system would be addressed in future investigations.

Based on field observations and information obtained from the drawings, the following materials are identified for remediation (see Table 2-27, volume calculations are presented in Appendix A):

- Contaminated sewage and sludge within the chemical waste lift stations estimated at 29,000 gallons of sewage and 2 cubic yards of sludge.

- Contaminated sewage and sludge within the interconnecting sewer lines estimated at 1,000 gallons of sewage and 2 cubic yards of sludge.

It is assumed that only sewage and sludge materials within the chemical waste sewer system lift stations and main trunkline will be remediated at this time. It is also assumed that the remediation will not include any materials within the system downgradient of the oil/water separator in Area 24. Investigations by CWM have indicated minimal contamination in these more downgradient portions of the waste water treatment system.

Asbestos

Asbestos-containing materials found throughout the former AFP-68 include pipe and hopper insulation, corrugated asbestos panels, and bags of asbestos mortar. Quantity estimates of the asbestos-containing materials were made during Acres Reconnaissance Survey in 1988. At the time of the survey the materials were identified as suspected asbestos-containing materials. Analyses of representative samples of these materials were performed during the Preliminary Contamination Assessment completed by Acres in 1992. The analyses indicated that most, but not all, of the materials did contain asbestos.

The asbestos-containing materials found throughout former AFP-68 occur in four main varieties: corrugated panels, pipe insulation, hopper insulation, and bags of asbestos-containing mortar. The corrugated panels had functioned as exterior walls and roofs of some of the process area structures. Most of these panels were removed form the structures during the decommissioning of AFP-68 and can presently be found throughout the former plant area. On the Somerset Group property, the current owner had most of the loose panels collected and placed in stacks throughout the property. The corrugated panels are generally non-friable but due to past site activities, there is an abundance of broken and crushed panels throughout the area.

Many of the buildings and process area structures had asbestos insulated pipes. As many of these buildings and structures are in various states of deterioration, much of the pipe insulation has been exposed to the elements and has significantly deteriorated. As a result, pipe insulation can be found on the ground surface, primarily beneath the overhead piping, but also spread throughout the surrounding areas.

One asbestos insulated hopper exists in the salt electrolysis building in Area 6. The insulation is generally non-friable and is somewhat contained on the hopper.

The bags of asbestos mortar are located on the lower level of the salt electrolysis building in Area 6 and in the combustibles warehouse in Area 30A. There are about twenty 94-lb bags of mortar in Area 6, some of which are partially opened. Because the exterior walls of the building are gone, the bags of mortar are exposed to the elements resulting in asbestos-containing dust being spread throughout the area.

There are about ten 94 lb bags of asbestos mortar in the combustibles warehouse in Area 30A. This building is in fair structural condition and the bags of mortar are fairly well protected from the weather.

Miscellaneous Liquids and Oils

One 55-gallon open-top drum of oil is located in building 6-02 in Area 6 (see Figure 2-19 and Table 2-27). Approximately 16 gallons of miscellaneous laboratory chemicals are located in the combustibles warehouse in Area 30A. Some labels still present on some of the bottles of chemicals identified hydrochloric acid, pentane and sodium hydroxide. Finally, there are two 5-gallon metal containers and sixteen 1-gallon glass containers of chromic acid on the foundation of former Temporary Building No. 1. These latter containers are open to the weather and the metal containers are showing signs of corrosion.

2.5 Site Conditions That Justify Removal

A qualitative risk assessment was performed for the Operable Unit No. 1 areas of concern as part of the RI. A quantitative preliminary risk characterization was performed in 1992 as part of the Preliminary Contamination Assessment for the areas of concern in Operable Unit No. 2. The results of these characterizations have indicated that several contaminants at the site exceed chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs), which identify potential threats to human health and the environment. As such, these characterizations have identified the need to remove or reduce several contaminant sources to levels below chemical-specific ARARs.

In accordance with the Scope of Work for this EE/CA, it was determined that these previous risk characterizations are sufficient to meet the requirements of a streamlined risk evaluation. Based on these previous risk characterizations, the following subsections summarize site conditions that justify removal actions.

2.5.1 TNT Waste Sewer System

The location and contents of the TNT sewer system have been defined in previous investigations. It has been determined that pockets of potentially explosive materials may exist within the pipeline system. The presence of these potentially explosive materials poses a direct hazard to CWM workers who are frequently performing excavation activities throughout the area.

2.5.2 Area A

The size and location of the buried drum trench in Area A has been well defined by past investigations. The Advance Final FS performed by the COE in 1990 recommended excavation and landfill disposal of the drum trench contents as the preferred remedial alternative. This alternative was accepted by the DEC in 1992. Delaying the removal of the drum trench materials may result in the migration of the contaminants beyond the boundaries of the trench. In addition, the presence of the drum trench is limiting CWM operations in the area.

2.5.3 Area B

As with Area A, the size, location, and contaminant conditions associated with Area B have been fairly well defined. The remedial alternative of excavation and disposal as recommended by the COE in the Advance Final FS was also approved by the DEC in 1992. The contaminants within the burn pit soils and sediments pose a hazard to the environment through the possible ingestion of contaminants by wildlife and possible dust inhalation by site workers. The presence of the burn pit also restricts CWM operations in this area.

2.5.4 AFP-68

Asbestos

Because of the loose and friable nature of the asbestos-containing materials located on the Somerset Group property, these materials pose a direct inhalation hazard to workers in the area.

Miscellaneous Liquids and Oils

The unsecured presence of the hazardous liquids and oils on the Somerset Group property pose a significant hazard to site workers. The chromic acid on the Temporary Building No. 1 foundation has the potential to contaminate the surrounding environment if left exposed to the weather.

Table 2-1
Existing (1975) and Projected (2000) Land Uses for the Townships of Lewiston and Porter for Niagara County[1]

Location	Status of Land Use	Percent of Land Area						
		Residential	Commercial/ Public/ Semipublic	Industrial	Forest/ Brush/ Outdoor Recreation/ Vacant	Agriculture	Water/ Wetland	Transporta-tion
Town of Lewiston (10,000 ha)	Existing	7.7	6.2	1.0	32	44	7.7	1.4
	Projected	8.0	6.5	1.0	32	43	7.7	1.4
Town of Porter (8,500 ha)	Existing	4.1	4.6	1.5	26	62	0.3	1.6
	Projected	4.2	4.8	1.5	26	62	0.4	1.6
Niagara County (140,000 ha)	Existing	6.4	2.1	1.7	20	65	3.5	0.9
	Projected	6.6	2.2	1.8	20	65	3.6	0.9

[1] All values rounded to two significant figures.

Data from Interstate Commerce Commission (1981).

Table taken from US DOE Final EIS for Long-Term Management of the Existing Radioactive Wastes and Residues at the Niagara Falls Storage Site, April 1986.

Table 2-2
Mean Monthly and Annual Precipitation, Snowfall, and Temperature
Lewiston, NY (Dec. 1966)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Avg	Years of Record
Mean Precipitation (inches)	1.98	2.35	2.49	2.66	3.08	2.22	2.38	2.51	2.94	2.51	2.32	2.00	29.44	25
Mean Snowfall (inches of snow)	12.6	13.5	9.5	1.4	0	0	0	0	0	0	4.2	9.6	50.8	24
Mean Minimum Temperature (°F)	19.4	20.0	25.8	35.9	45.9	55.9	61.0	60.1	52.8	43.1	34.2	24.1	39.8	25
Mean Maximum Temperature (°F)	33.7	35.4	42.7	56.4	68.7	79.1	84.0	82.5	74.5	63.2	49.1	37.4	58.9	25
Mean Temperature (°F)	26.6	27.6	34.3	46.2	57.4	67.5	72.5	71.4	63.7	53.2	41.7	30.8	49.4	25

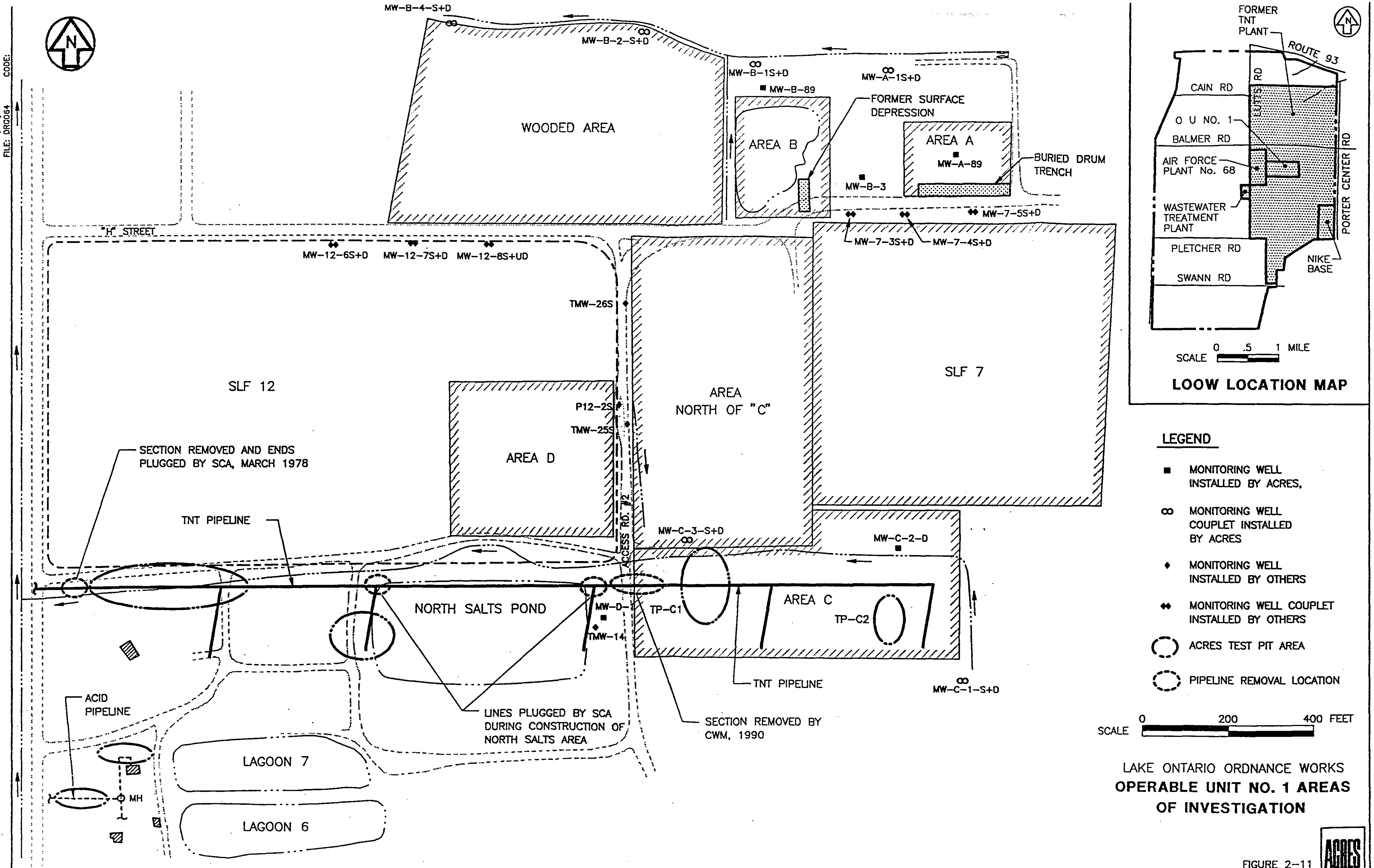
Table 2-3
Freshwater Wetland Classification
Niagara County (Dec. 1984)

Wetland Number	Classification
LE-2	Class II
LE-17	Class III
LE-18	Class II
LE-19	Class II
RV-1	Class II
RV-7	Class III
RV-8	Class III
RV-9	Class II
RV-15	Class II
RV-16	Class III
RV-17	Class II

Table 2-4
Hydraulic Conductivities of Stratigraphic Units at LOOW[1]
(cm/sec)

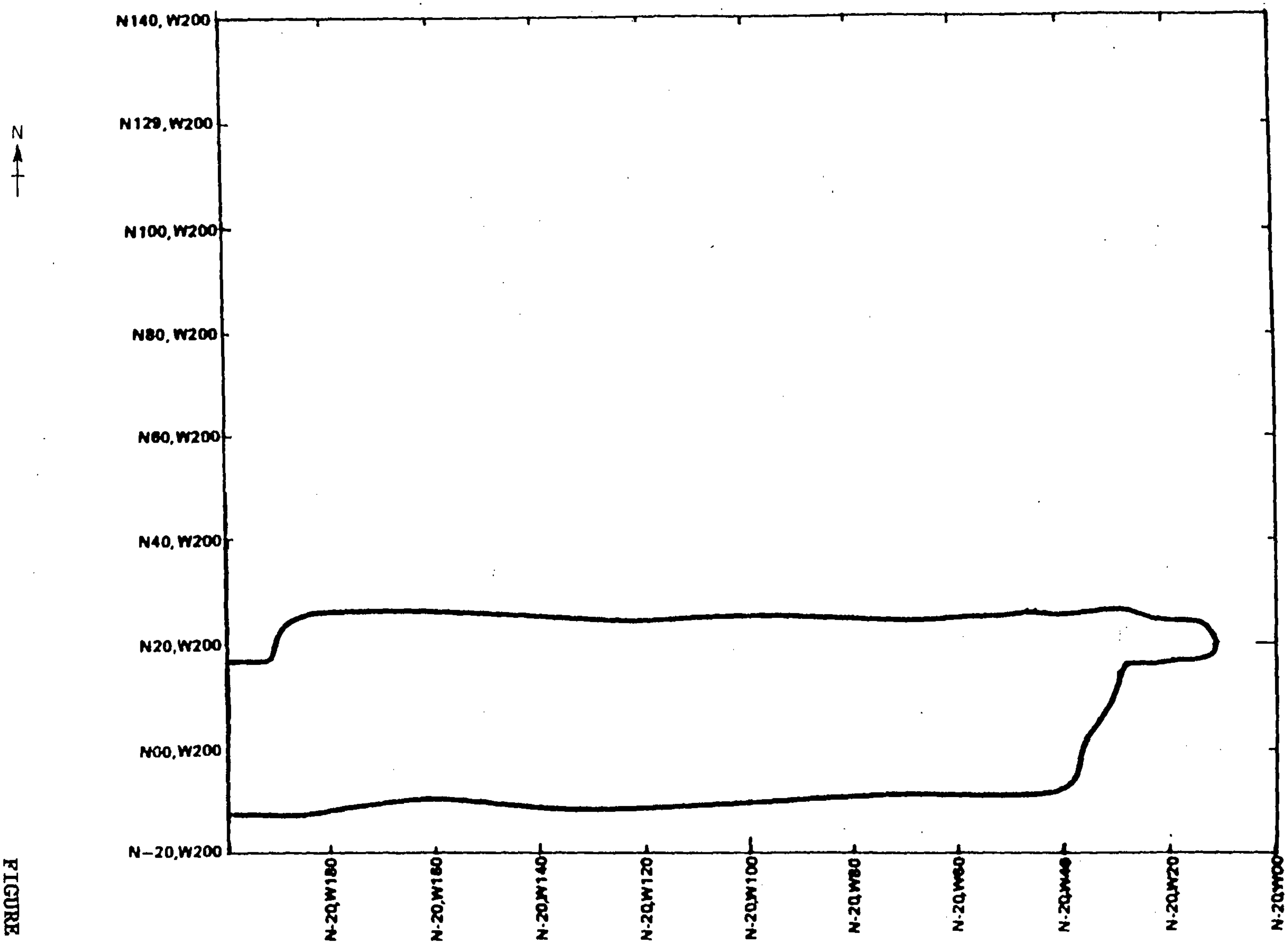
Zone	Stratigraphic Unit	Hydraulic Conductivity (cm/sec)	
		Vertical	Horizontal
1	Upper Clay Till Upper Silt Till	6×10^{-7}	2×10^{-6}
	Middle Silt Till	1×10^{-7}	3×10^{-6}
2	Glaciolacustrine Clay	2×10^{-8}	5×10^{-8}
3	Glaciolacustrine Silt/Sand		
	- Stratified Coarse Sand		2×10^{-4}
	- Non-Stratified Silt and Fine Sand		3×10^{-5}
	- Stratified Silt and Fine Sand		1×10^{-5}
	- Interlayered Silt Sand and Clay		3×10^{-6}
	Red Silt Till	3×10^{-8}	4×10^{-8}

[1] Hydraulic conductivities for CWM facility, calculated by Golder, 1987.



LAKE ONTARIO ORDNANCE WORKS
OPERABLE UNIT NO. 1 AREAS OF INVESTIGATION

FIGURE 2-11



DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS

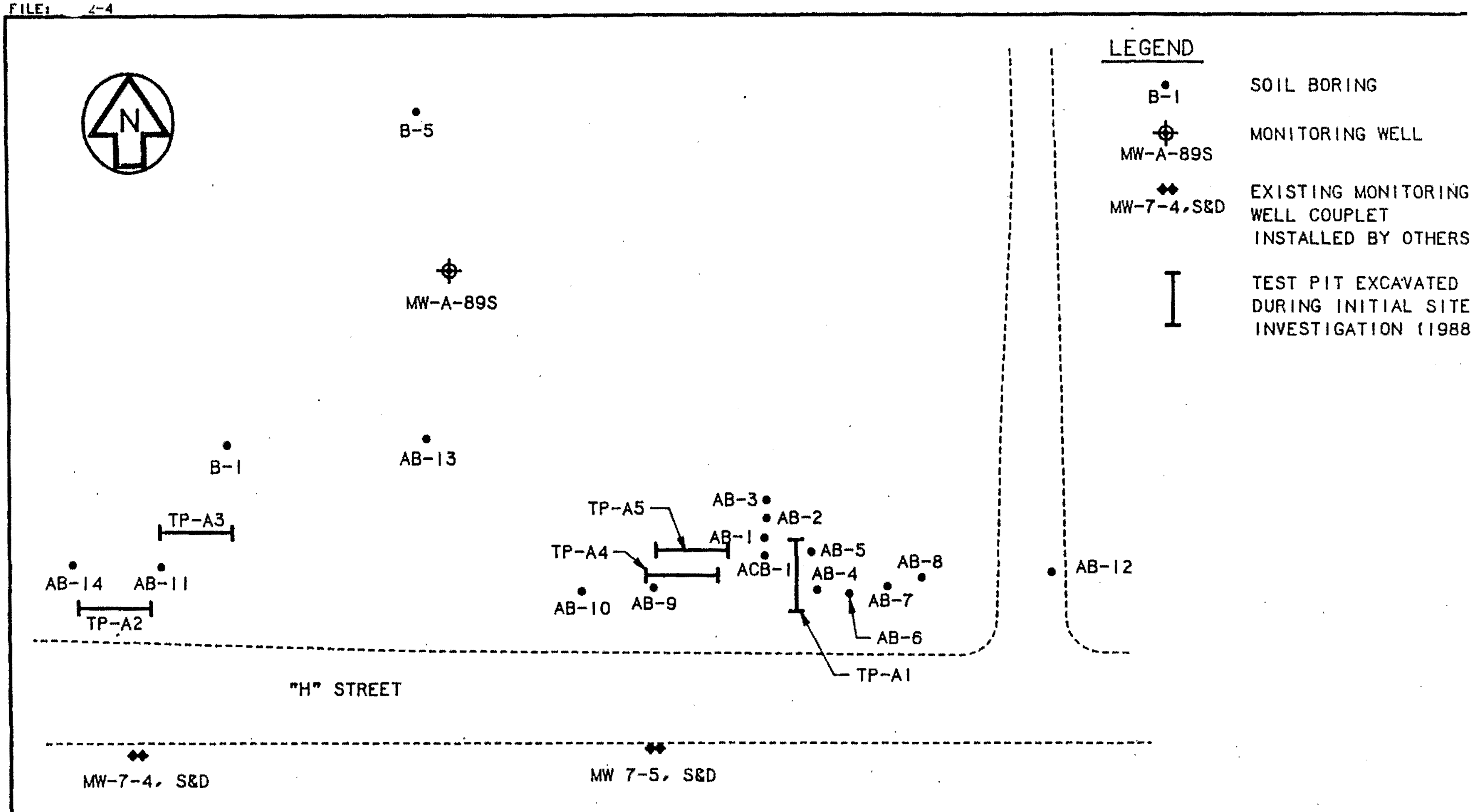
MAGNETIC ANOMALY - AREA A

FIGURE 2-12

ACRES

(ECOLOGY AND ENVIRONMENT, 198

KAB 6/''/90
P0834
FILE: 2-4

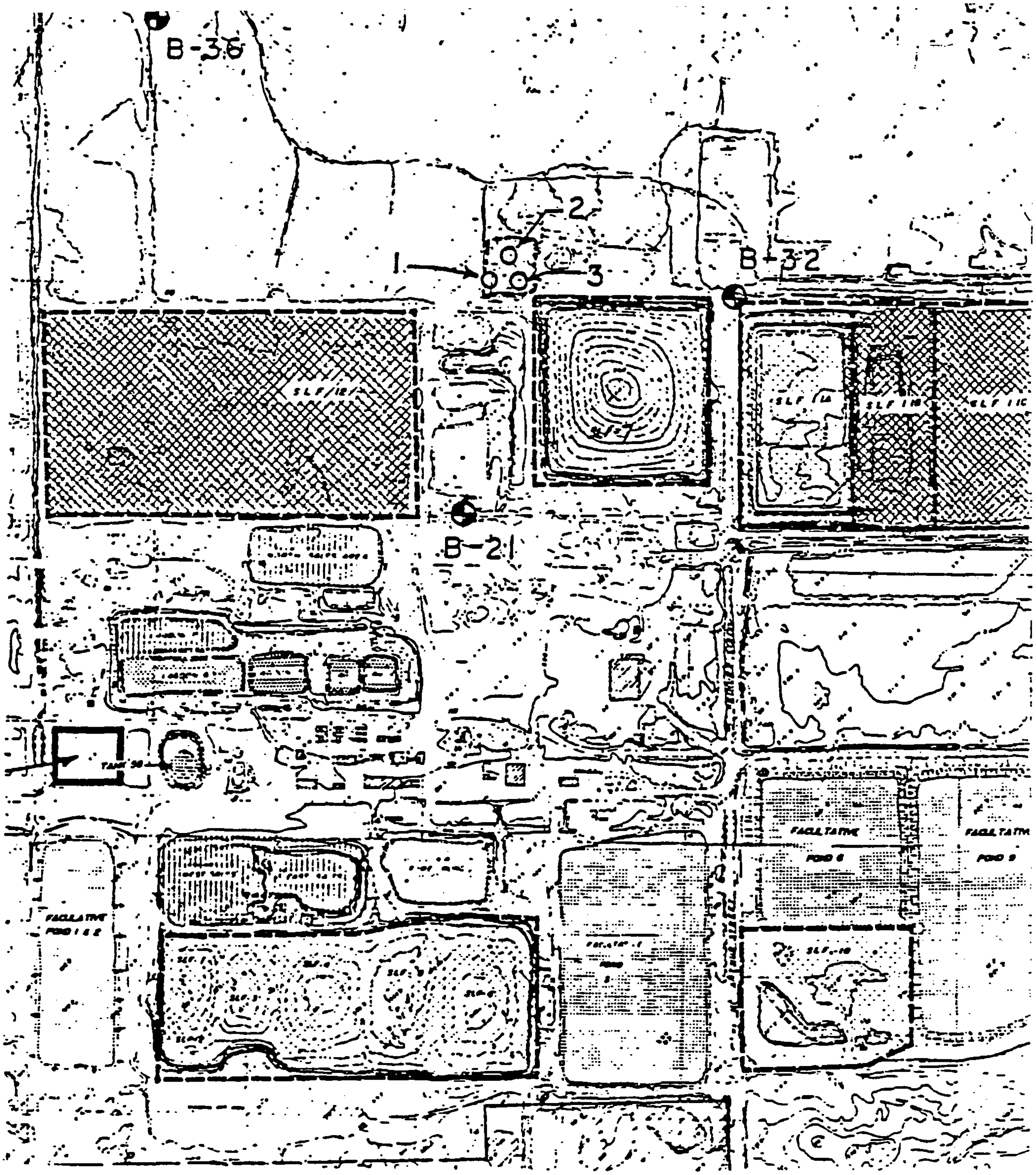


LAKE ONTARIO ORDNANCE WORKS
AREA A
SOIL BORING AND MONITORING WELLS
LOCATION PLAN

SCALE 0 40 80 FEET

FIGURE 2-13

ACRES



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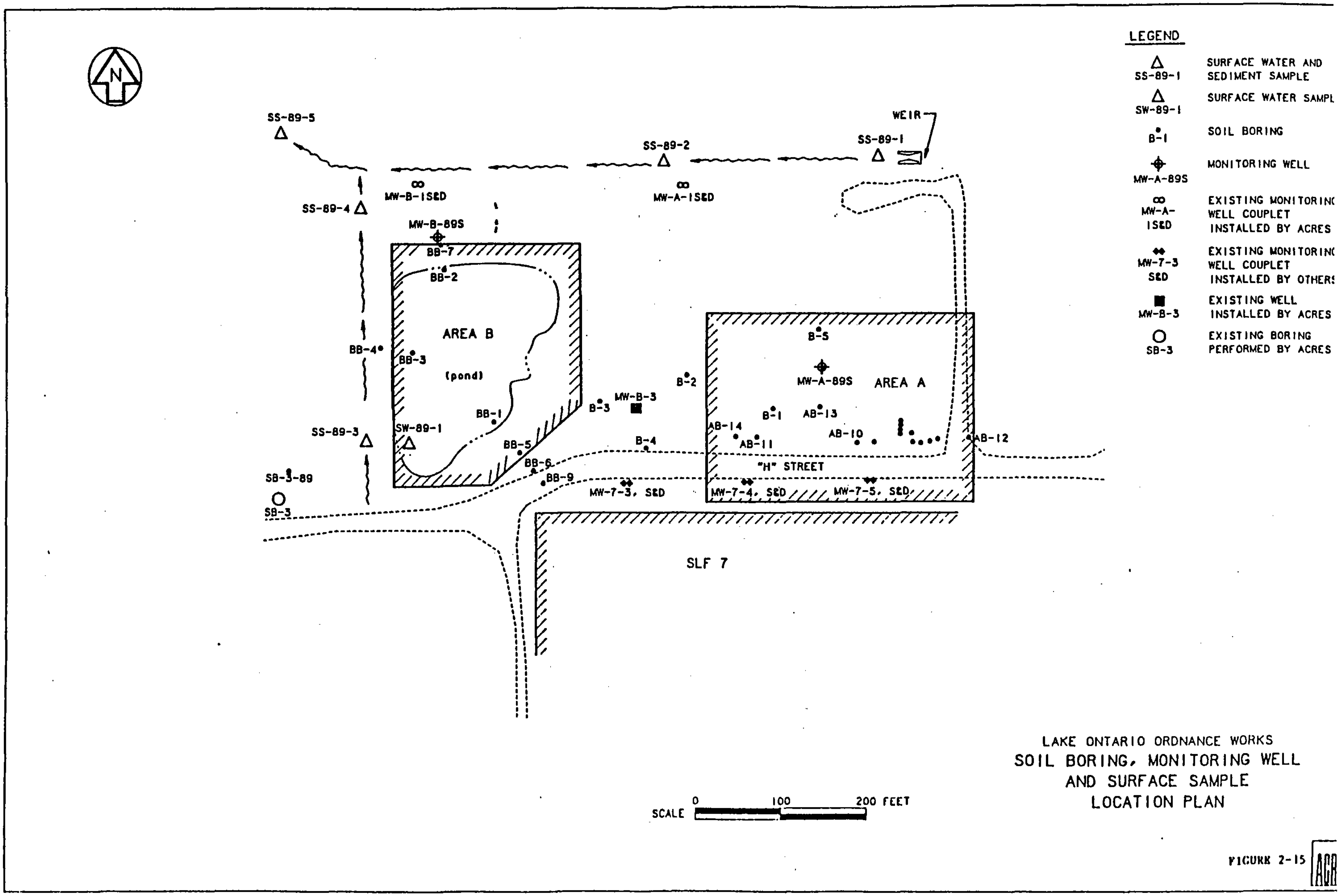
KANSAS CITY DISTRICT
CORPS OF ENGINEERS
OLIN BURN AREA
SOIL & GROUNDWATER SAMPLING LOCATIONS -1981

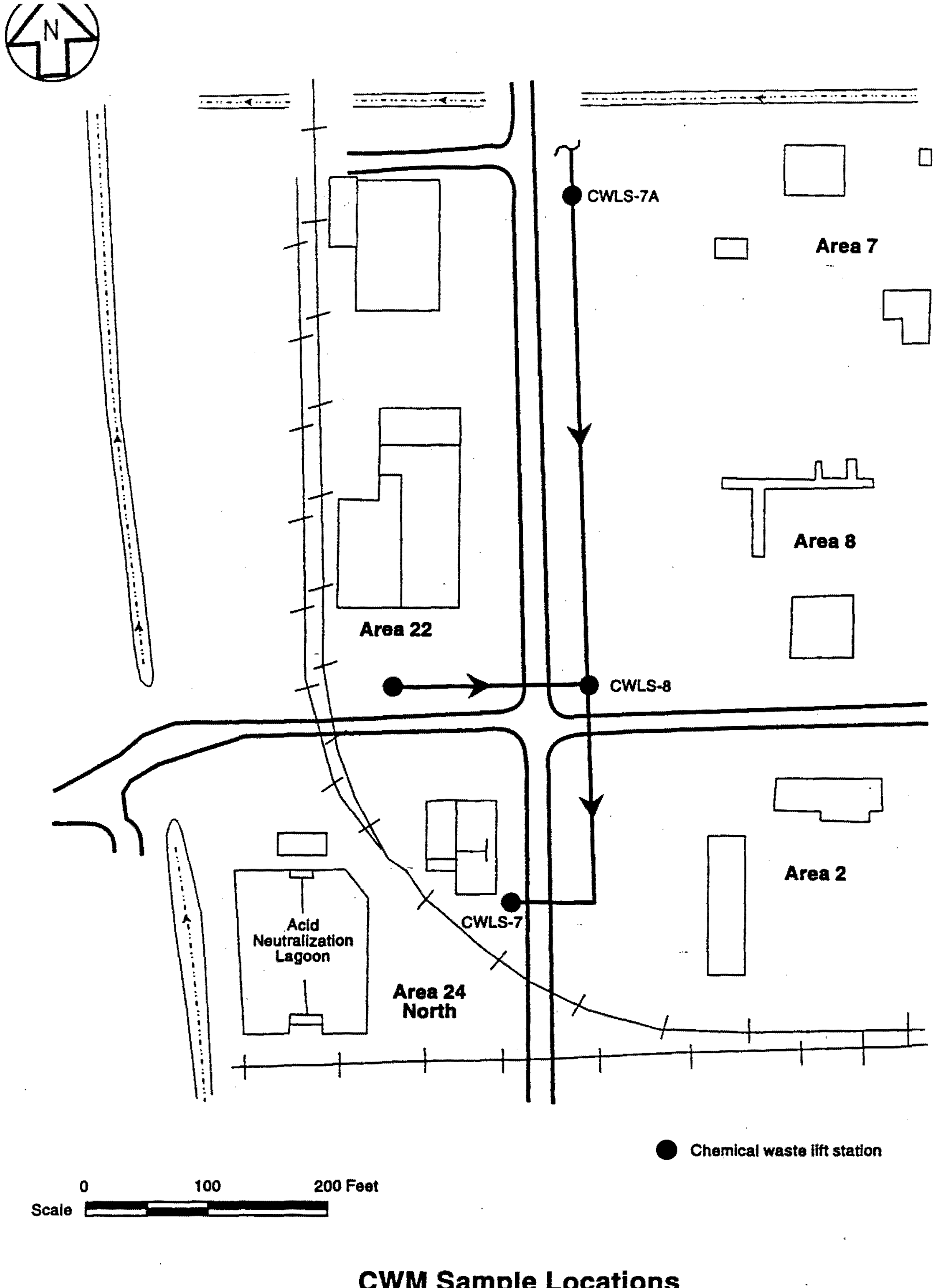
FIGURE 2-14

ACRES



LAKE ONTARIO ORDNANCE WORKS
SOIL BORING, MONITORING WELL AND SURFACE SAMPLE LOCATION PLAN

FIGURE 2-15



CWM Sample Locations

REF: Golder Associates 11/16/90

Figure 2-16

ACRES

KAB 6/13/90
P0834'
FILE: 4

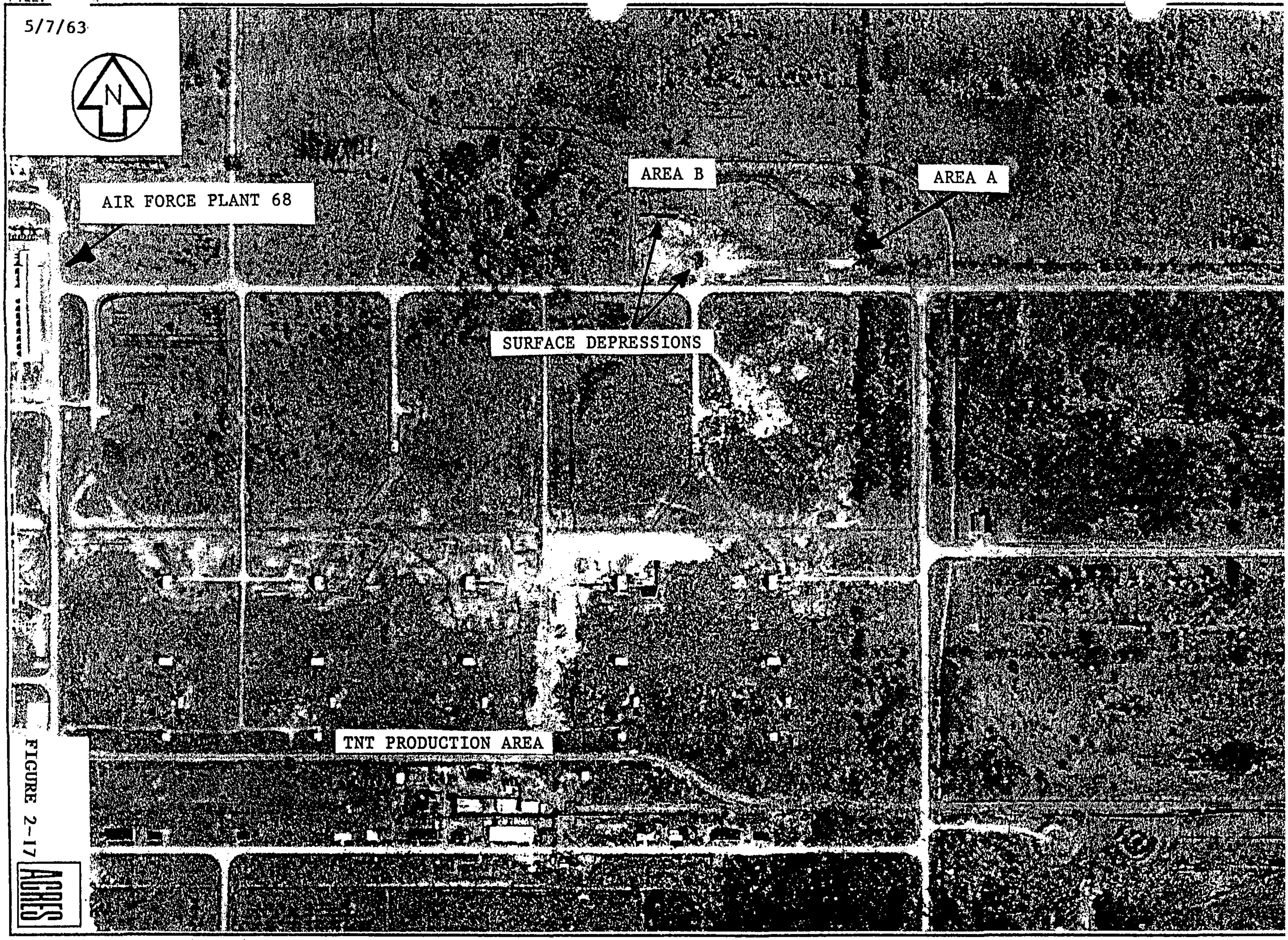
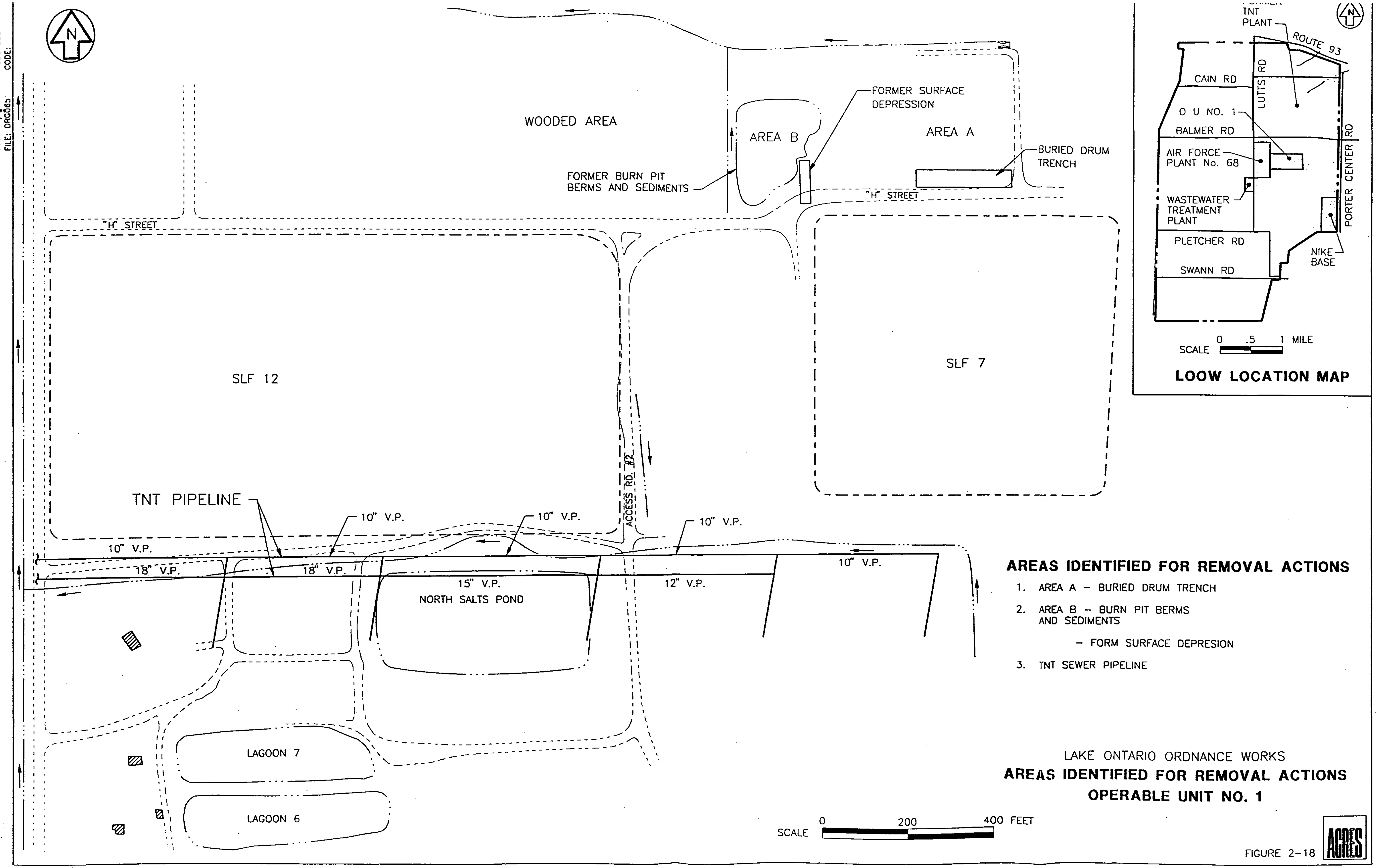


FIGURE 2-17

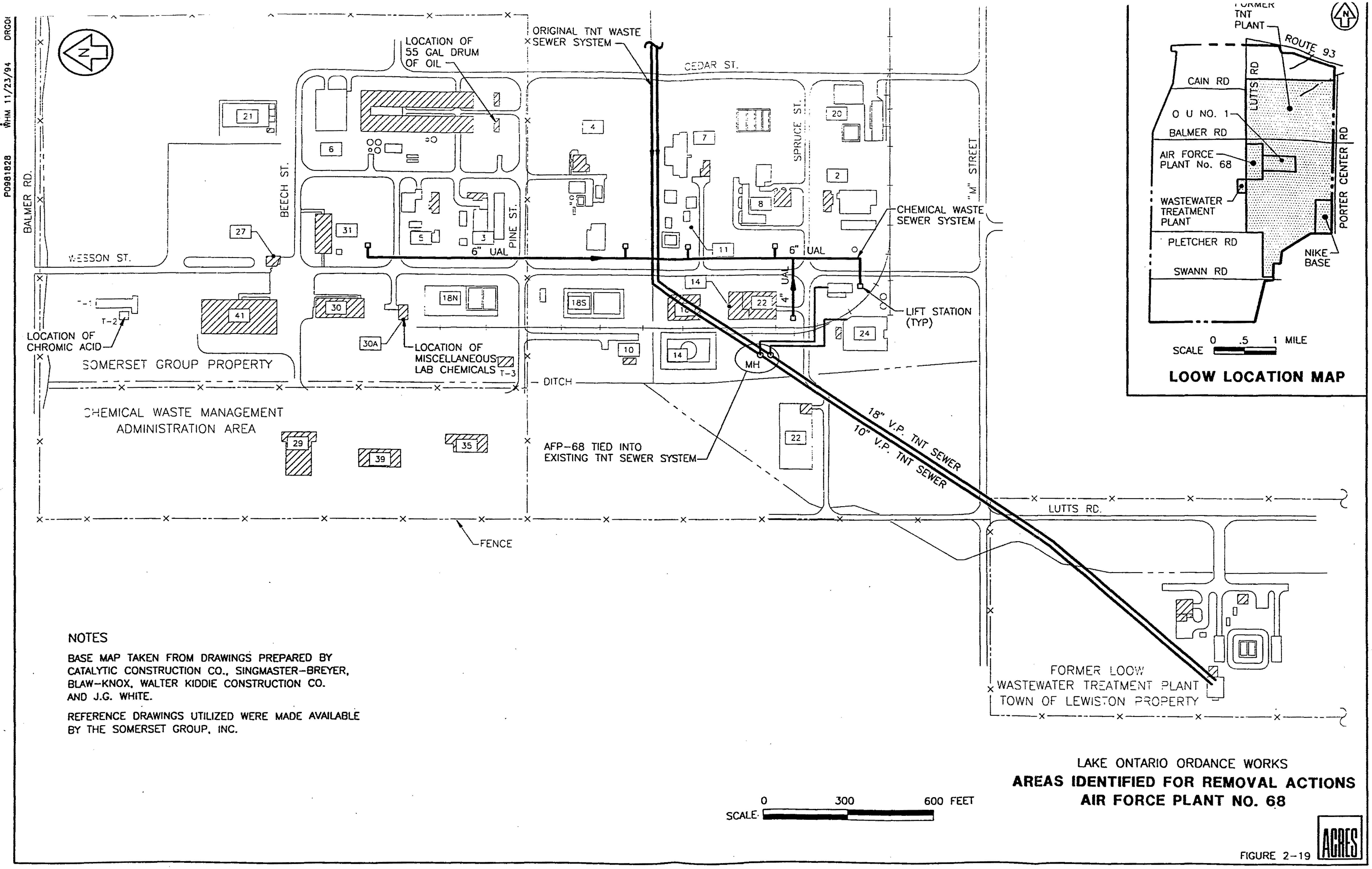


LAKE ONTARIO ORDNANCE WORKS

AREAS IDENTIFIED FOR REMOVAL ACTIONS

OPERABLE UNIT NO. 1

FIGURE 2-18



NOTES

BASE MAP TAKEN FROM DRAWINGS PREPARED BY CATALYTIC CONSTRUCTION CO., SINGMASTER-BREYER, BLAW-KNOX, WALTER KIDDIE CONSTRUCTION CO. AND J.G. WHITE.

REFERENCE DRAWINGS UTILIZED WERE MADE AVAILABLE BY THE SOMERSET GROUP, INC.

LAKE ONTARIO ORDANCE WORKS

AREAS IDENTIFIED FOR REMOVAL ACTIONS
AIR FORCE PLANT NO. 68

ACRES

FIGURE 2-19

P0981828 WHM 11/23/94 DRG0

3 Removal Action Goals, Objectives and Scope

The non-time critical removal action planned for the former LOOW site will reduce the threat of exposure and/or contaminant migration from several identified source areas and associated localized contaminated soil and groundwater. The proposed removal action is considered to be an interim action because it is anticipated that followup remedial actions will ultimately address the remaining areas of concern (e.g., TNT buildings, sanitary and storm sewers, etc.) identified during past OU1 and OU2 investigations.

The goals of the non-time critical removal action at the LOOW site are:

- To significantly lower the assessed risk to human health (the site properties are currently in use by the respective landowners) and the environment by expeditious removal of identified source areas; and

- To minimize the risk of contaminant migration via the various transport media (i.e., surface water, groundwater, air, etc.) by reducing the potential sources of the contamination.

These goals are consistent with Section 300.415(b) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) which defines the factors on which the determination of appropriateness of a removal action should be based.

Specific objectives for accomplishing these goals at the LOOW site have been defined as follows:

1. Removal of previously identified contaminated sediment, soil and drums from Area A, the drum trench, and Area B, the former burn pit area.

2. Removal of accumulated sludges and liquids in the chemical lift stations of the former chemical wastewater sewer system.

3. Removal of the former TNT waste pipeline system.

4. Dewatering of areas as needed to remediate subsurface contamination sources.

5. Removal of miscellaneous loose asbestos-containing material located on the Somerset Group property and miscellaneous containerized liquids and oils identified by previous investigations.

6. Proper treatment and/or disposal of all waste streams from the removal action.

7. Restoring of all disturbed areas to original conditions and implementation of erosion control measures in all backfilled areas.

8. Implementation of any post removal action monitoring that may be required.

3.1 Statutory Limits on Removal Actions

Section 104(c)(1) of CERCLA specifies statutory limits on all Superfund-financed removal actions. These limits require that obligations from the Fund shall not continue after $2,000,000 has been obligated for the removal action or after 12 months has elapsed from the date of initial response unless the removal action qualifies for an exemption.

The remedial investigations, feasibility studies, remedial designs, and any associated remedial responses at the former LOOW site are being conducted under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS). The funding for the site investigation and remediation activities is therefore obligated under the DERP-FUDS program and no funds will be utilized from the Superfund program. Consequently, the statutory limits of Section 64(c)(i) are not applicable to the removal action being considered at the former LOOW site. However, the EE/CA and implementation of the removal action will comply with all other applicable requirements of USEPA's "Guidance on Conducting Non-Time Critical Removal Actions under CERCLA," dated August 1993.

3.2 Removal Action Scope

The intent of the non-time critical removal action is to stabilize the immediate risks posed by the LOOW site until final remedial action is implemented. To this end, the scope of the removal action as defined by the COE in the Final Scope of Work dated July 18, 1994 will address the following source areas at the site which have been identified by investigations to date:

Operable Unit No. 1

1. Area A, the drum trench area, as previously defined by the FS which includes buried drums and associated contaminated soil covering an area approximately 220 ft long (east-west) by 40 ft wide by 10 ft deep.

2. Area B, the former burn pit area, consisting of contaminated sediments in a bermed pond area and soil and localized groundwater contamination associated with a buried surface depression.

3. The buried TNT waste pipeline system consisting of explosives contaminated sediment within the pipelines; contaminated piping materials, concrete encasing; and localized soil contamination in areas along the pipeline where the concrete casing has been broken and contaminant migration out of the pipeline has occurred.

Operable Unit No. 2

1. Contaminated sewage and sludge contained within the AFP-68 chemical waste sewer system.

2. Miscellaneous loose asbestos-containing materials (on the Somerset Group property). Such on-site materials to be removed include the bags of dry asbestos mortar mix; detached loose pieces of corrugated siding and roofing panels, many of which have been fragmented; asbestos-containing insulation both loose on the ground and along piping and covering hoppers and related mechanical equipment.

3. Miscellaneous containerized liquids and oils identified by previous site investigations including 55 gallons of oil (unidentified), 26 gallons of chromic acid, and miscellaneous containers of laboratory chemicals.

3.3 Removal Action Schedule

The proposed interim removal action is anticipated to be completed during 1996. The current project schedule indicates that the completion of the design/construction bid package, contract bidding and award for the removal action will be completed by the Spring 1996 and the removal action construction will be completed by the Fall 1996.

These schedule requirements have been factored into the formulation and evaluation of the removal action alternatives as part of the EE/CA. The alternative responses have been evaluated in terms of implementation time to meet the completion requirements and any required lead time associated with the alternative technologies.

3.4 Identification of Applicable or Relevant and Appropriate Requirements (ARARs)

Acres has identified the ARARs in this section on a site-specific basis. Neither the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), National Contingency Plan (NCP), nor New York State environmental policy provide across-the-board standards for determining whether a particular remedy will provide an adequate cleanup at a particular site. Rather, each regulation must be reviewed on context of the remedial action. US Environmental Protection Agency (EPA) policy in the NCP provides that removal actions under CERCLA Section 104 and pursuant to CERCLA Section 106 must be able to meet applicable or relevant and appropriate Federal or State environmental laws and public health requirements.

ARARs are defined as:

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

- Relevant and Appropriate Requirements, which are those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site.

The New York State Standards, Criteria and Guidelines (SCGs), as presented in DEC Technical and Administrative Guidance Memorandum (TAGM) # HWR-90-4030, Selection of Remedial Actions at Inactive Hazardous Waste Site (DEC, 1990), are analogous to ARARs under CERCLA. SCGs also include those Federal standards which are more stringent than the State standards. The DEC has also identified three types of SCGs: (1) chemical-specific, (2) location-specific, and (3) action-specific. Only State standards that are promulgated, identified by the State in a timely manner, and are more stringent than Federal requirements, may be applicable or relevant and appropriate. In addition to ARARs and SCGs, other guidelines, advisories, and guidance documents to be considered (TBC) where standards do not exist or to complement the use of ARARs may be applicable. In cases where ARARs and SCGs do not exist, TBCs may be the sole source in determining what is protective onsite or how to carry out certain removal actions or requirements.

Under CERCLA, the remedial action selected must meet all enforceable and applicable requirements unless a waiver from a specific requirement has been granted. A waiver from compliance with a specific ARAR can be granted for an alternative in the following circumstances:

- The alternative is an interim measure and will become part of a total remedial action that will meet ARARs;
- Compliance with the ARAR is technically impractical from an engineering perspective;
- Compliance with the ARAR will result in a greater risk to human health and the environment than other alternatives;
- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach; and
- With respect to a State ARAR, the State has not consistently applied, or demonstrated the intention to consistently apply the promulgated requirement in similar circumstances at other remedial actions within the state.

ARARs are divided into the following three categories:

- Chemical-Specific ARARs are health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants. These limits may take the form of cleanup levels or discharge levels.
- Location-Specific ARARs are restrictions on activities that are based on the characteristics of a site or its immediate environment; and
- Action-Specific ARARs are controls or restrictions on particular types of activities in related areas such as hazardous waste management or wastewater treatment.

The chemical-specific, location-specific, and action-specific ARARs assembled for this EE/CA are summarized in Tables 3.1, 3.2 and 3.3, respectively, and are described in more detail in the following subsections.

3.4.1 Chemical-Specific ARARs and SCGs

Chemical-specific requirements are health- or risk-based concentration limits or discharge limits of hazardous substances, pollutants, or contaminants for various media. These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or indicate a safe level of discharge that may be incorporated in a removal action. Chemical-specific ARAR and SCG values for the contaminants found in the areas of concern are presented in Table 3.4.

3.4.2 Location-Specific ARARs and SCGs

Location-specific standards or guidelines address requirements or set restrictions for certain types of activities based on site characteristics. These standards or guidelines are found in Table 3.2. In determining the use of these possible location-specific ARARs and SCGs for the selection of a remedial action, one must investigate the jurisdictional prerequisites of each of the regulations.

For the LOOW site, location-specific ARARs and SCGs that may be applicable or relevant and appropriate include guidelines that govern work on a RCRA facility. RCRA contains explicit limitations on where on-site storage, treatment, or disposal of hazardous wastes may occur. In addition, the Hazardous and Solid Waste Amendments (HSWA) mandate the development of location requirements concerning vulnerable hydrogeology. The HSWA also provides land disposal restrictions and treatment standards for wastes removed during the course of a remedial action. These restrictions will apply to all "newly generated" wastes removed as part of the remedial action.

3.4.3 Action-Specific ARARs and SCGs

Action-specific ARARs and SCGs are usually technology or activity-based requirements or limitations on actions taken with respect to site remediation. These requirements are triggered by the particular activities that are selected to accomplish the cleanup. Since different remedial actions will be employed for each area requiring cleanup, very different requirements can come into play. These action-specific requirements do not in themselves determine which remedial alternative is selected; rather, they specify how a selected alternative must be implemented.

Table 3-3 provides a matrix of action-specific requirements identified based on qualified cleanup technologies and come primarily from RCRA, CERCLA, HSWA, and the Clean Water Act (CWA). Remediation of the site may involve the following remedial actions:

- Excavation;
- Discharge of treatment system effluent;
- Discharge to Publicly Owned Treatment Works (POTW);
- Container storage;
- Consolidation between units;
- Closure with no post-closure care;
- Incineration (on-site);
- Placement of waste in a land disposal unit;
- Placement of liquid waste in a landfill;
- Treatment (in a unit);
- Treatment (when waste will be land disposed); and
- Tank storage (on-site).

3.4.4 To-Be-Considered (TBC) Criteria

In addition to legally binding laws and regulations, Federal and State environmental and public health programs develop and issue non-promulgated criteria, advisories, memoranda, guidance, and proposed standards. These documents and values are not legally binding, but provide useful information or recommended procedures that should be evaluated along with ARARs. Chemical-specific TBC values include health advisories or reference doses in the absence of or to supplement ARARs. The DEC has also published numerous Technical Administrative Guidance Memoranda (TAGM) that list chemical-specific TBC criteria. DEC TAGM 4046, Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994 was used to identify soil clean-up criteria for this EE/CA. Table 3-4 was generated based on this TAGM.

To-be-considered advisories, criteria, and guidelines should be used to set cleanup targets only if no ARARs address a particular situation or if existing ARARs do not ensure protectiveness. A list of federal and state criteria, advisories, and guidance to be considered for the LOOW site is found in Table 3-5.

Table 3-1

Potential Chemical-Specific ARARs and SCGs

FEDERAL

- Clean Air Act
- Federal Safe Drinking Water Act
  (National Interim Primary Drinking Water Standards)
- Resource Conservation and Recovery Act Requirements
- Toxic Substance Control Act

STATE

- NYS 6NYCRR Part 371 - Listing of Hazardous Wastes
- NYS 6NYCRR Part 700-705 - Water Quality Regulations
- NYS TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values
- NYS 6NYCRR Part 257 - Air Quality Standards
- DEC, Division of Hazardous Substances Regulations, #92-3028, "Contained-In Criteria for Environmental Media"
- DEC, Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment."
- DEC, Division of Hazardous Waste Remediation, TAGM HWR-92-4046, "Determination of Soil Cleanup Objectives and Cleanup Levels"
- DEC Division of Hazardous Waste Remediation, "Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels." TAGM HWR-94-4046.

Table 3-2

Potential Location-Specific ARARs and SCGs

FEDERAL

- National Historic Preservation Act
- Endangered Species Act
- Endangered and Non-Game Species Act
- Fish and Wildlife Coordination Act
- Protection of Wetlands (Executive Order 11990)
- Protection of Floodplains (Executive Order 11988)
- Federal Water Pollution Control Act
- Farmland Protection Policy Act
- Clean Water Act
- Water Quality Certification
- National Environmental Policy Act
- Resource Conservation and Recovery Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Toxic Substances Control Act
- Hazardous and Solid Waste Amendment

STATE

- Solid Waste Management Regulation, 6NYCRR Part 360
- Hazardous Waste Regulations, ECL 19, 27, 37, & 40
- State Pollution Discharge Elimination System, ECL 17
- Freshwater Wetlands Act, ECL 24
- Water Quality Certification, 6NYCRR Part 608
- Farmlands Protection, Agriculture and Markets Law, 305
- NYS Historic Preservation Act

Table 3-3
Potential Action-Specific ARARs and SCGs

SITE ACTION	CITATION	REQUIREMENTS FOR
Closure (with no post-closure care)	40 CFR 264.111	RCRA regulations governing the cleanup of listed or hazardous waste to health-based standards.
	40 CFR 264.111 40 CFR 264.178 40 CFR 264.197 40 CFR 264.288 40 CFR 264.258	RCRA regulations governing the removal and disposal or decontamination of equipment, structures, and soils.
	40 CFR 244.111	RCRA regulations governing the requirement that health-based levels must be met at the unit.
	6NYCRR Part 360	NYS criteria for solid waste management facilities.
	6NYCRR Part 376	Land disposal regulations.
	6NYCRR Part 371	Listed hazardous waste
Consolidation (between units)	Multiple	Regulations that apply to the movement of hazardous waste and placement into another unit. See container storage, treatment, incineration, etc.
Container Storage	40 CFR 264.178 40 CFR 264.50	Closure, decontamination, disposal. Storage of banned waste.
Corrective Actions	40 CFR 264 Subpart S	Corrective action management units.
Discharge of Treatment System Effluent	40 CFR 122.44(a)	Use of best available technology (BAT) for point source discharges to any water body or wetland.
	6NYCRR Parts 750-757	Implementation of NPDES program in NYS.
	40 CFR 122.44 6NYCRR Part 702	Federal and state water quality standards and discharge limitations.
	40 CFR 122.41 40 CR 136.1-136.4 40 CFR 125.100-.104	Discharge monitoring and operation and maintenance of the treatment system. Analytical test methods. Best management practices and procedures for management and control of wastes.
Discharge to POTW	40 CFR 403.5 6NYCRR Parts 750-757	Prohibitions to discharges to the local POTW. Pretreatment, reporting and monitoring requirements.

Table 3-3
Potential Action-Specific ARARs and SCGs

SITE ACTION	CITATION	REQUIREMENTS FOR
Discharge to POTW (cont'd)	40 CFR 270.60 6NYCRR Part 364	Transport of RCRA hazardous wastes to POTWs.
Excavation	40 CFR 268 (Subpart D) 6 NYCRR Part 376	Materials containing RCRA hazardous wastes are subject to land disposal restrictions when moved to a new location under the Hazardous and Solid Waste Amendments.
Incineration (on-site)	40 CFR 264.341 40 CFR 264.351 40 CFR 264.343 40 CFR 264.342 40 CFR 264.343 40 CFR 264.345 6NYCRR Parts 373, 617, 257, 201	RCRA regulations governing the incineration of hazardous waste. Requirements include the disposal of residues, performance standards, monitoring and emission controls.
Placement of Liquid Waste in Landfill	40 CFR 264.314	Restrictions on the RCRA disposal of liquid wastes.
	40 CFR 264.315 6NYCRR Part 376	Containers holding free liquids may not be placed in a landfill unless the liquid is mixed with absorbent or solidified.
	6NYCRR Part 360	Solid waste management facilities.
Placement of Waste in Land Disposal Unit	40 CFR 268 (Subpart D) 6NYCRR Part 376 6NYCRR Part 360	Land disposal treatment standards. Solid waste management facilities.
Tank Storage	40 CFR 264.10 40 CFR 264.34	Storage of RCRA hazardous waste for a temporary period before treatment, disposal, or storage elsewhere.
	40 CFR 264.195	Storage tank inspections and monitoring.
	6NYCRR Parts 373	NYS hazardous waste treatment, storage, and disposal facilities and requirements.
Treatment (when waste will be land disposed)	40 CFR 268.10 40 CFR 268.11 40 CFR 268.12 40 CFR 268.41 40 CFR 268 (Subpart D)	Treatment of waste subject to land disposal bans must attain levels through best demonstrated available treatment (BDAT) technologies.
	40 CFR 268.30 RCRA Sections 3004(d)(3), (e)(3) 6NYCRR Part 376	BDAT standards for solvents, wastes and dioxins.

Table 3-3
Potential Action-Specific ARARs and SCGs

SITE ACTION	CITATION	REQUIREMENTS FOR
Treatment (in a unit)	40 CFR 264.190-264.192 (tanks) 40 CFR 264.221 (surface impoundments) 40 CFR 264.251 (waste piles) 40 CFR 264.273 (land treatment units) 40 CFR 264.301 (landfills) 40 CFR 264.343-.345 (incinerators) 40 CFR 265.373 (Thermal treatment units) 40 CFR 264.601 (Miscellaneous treatment units)	Design and operating standards for units in which hazardous waste is to be treated.
Treatment (off-site)	6NYCRR Part 373-2.5	New York regulations regarding transporting and manifesting wastes.
Transportation	40 CFR 270 6NYCRR, Part 364, 37, and 373	Waste transportation requirements
Transportation	49 CFR 100-199	Hazardous Materials Transportation Act - DOT

Table 3-4
Chemical-Specific ARARs

Analyte	NYSDEC Recommended Soil Cleanup Objective (ppm)[1]
Volatile Organics[2]	
Acetone	0.2
Benzene	0.06
2-Butanane	0.3
Carbon Disulfide	2.7
Carbon Tetrachloride	0.6
Chlorobenzene	1.7
Chloroform	0.3
1,1-Dichloroethane	0.2
1,2-Dichloroethane	0.1
1,1-Dichloroethene	0.4
trans-1,2-Dichloroethene	0.3
1,2-Dichloroethene (total)	NA
1,2-Dichloropropane	NA
cis-1,3-Dichloropropene	NA
1,3-Dichloropropene (total)	0.3
Ethylbenzene	5.5
2-Hexanone	NA
4-Methyl 2-Pentanane	1.0
Methylene Chloride	0.1
Styrene	1.0*
1,1,2,2-Tetrachloroethane	0.6
Tetrachloroethene	1.4
1,1,1-Trichloroethane	0.8
1,1,2-Trichloroethane	0.3*
Trichloroethene	0.7
Toluene	1.5
Xylene (total)	1.2
Vinyl Chloride	0.2

Table 3-4
Chemical-Specific ARARs

Analyte	NYSDEC Recommended Soil Cleanup Objective (ppm)[1]
Semi-Volatile Organics[3]	
Acenaphthene	50
Acenaphthylene	41
Anthracene	50
Bis(2-ethylhexyl) pthalate	50
Benzo(a)anthracene	0.224 or MDL
Benzo(b)fluoranthene	1.1
Benzo(k)fluoranthene	1.1
Benzo(a)pyrene	0.061 or MDL
Benzoic Acid	2.7
Butylbenzyl phthalate	50
p-Chloro-m-cresol (4-Chloro-3-methylphenol)	0.240 or MDL
Chrysene	0.4
Di-n-Butylphthalate	8.1
Di-n-Octylphthalate	50
Dibenzofuran	6.2
1,4-Dichlorobenzene	8.5
2,4-Dichlorophenol	0.4
Diethylphthalate	7.1
2,4-Dimethylphenol	NA
Fluoranthene	50
Fluorene	50
Hexachlorobenzene	0.41
Hexachlorobutadiene	90*
Hexachlorocyclopentadiene	24*
Hexachloroethane	NA
2-Methylnaphthalene	36.4
2-Methylphenol	0.100 or MDL
4-Methylphenol	0.9
Naphthalene	13.0
N-Nitrosodiphenylamine	4.2*
Phenanthrene	50
Phenol	0.03 or MDL
Pyrene	50
1,2,4 trichlorobenzene	3.4

Table 3-4
Chemical-Specific ARARs

Analyte	NYSDEC Recommended Soil Cleanup Objective (ppm)[1]
Pesticides[4]	
Aldrin	0.041
alpha-BHC	0.11
delta-BHC	0.3
4,4'-DDE	2.1
4,4'-DDT	2.1
Dieldrin	0.044
Endosulfan I	0.9
Endrin	0.10
Endrin Ketone	NA
Heptachlor	0.10
Heptachlor epoxide	0.02
Methoxychlor	<10 ppm total pesticides
PCBs (total)	
Aroclor 1242	1.0 (surface soils); 10.0 (subsurface soils)
Aroclor 1248	see above
Aroclor 1254	see above
Aroclor 1260	see above
Nitroaromatics	
Cyclotetramethylenetetranitramine	NA
Cyclotrimethylenetrinitramine	NA
2,4-Dinitrotoulene	1.0
Trinitrobenzene	NA
2,4,6-Trinitrotoluene	NA
Trinitrotoulene	NA
Tetryl	NA

Table 3-4
Chemical-Specific ARARs

Analyte	NYSDEC Recommended Soil Cleanup Objective (ppm)[1]
Inorganics	
Antimony	Site background (SB)
Arsenic	7.5 or SB
Barium	300 or SB
Beryllium	0.16 or SB
Boron	NA
Cadmium	1 or SB
Chromium	10 or SB
Copper	25 or SB
Cyanide	Site Specific
Cyanide,amenable	Site Specific
Iron	2000 or SB
Lead	SB
Lithium	NA
Manganese	SB
Mercury	0.1
Nickel	13 or SB
Nitrate	NA
Potassium	SB
Selenium	2 or SB
Silver	SB
Sodium	SB
Sulfate	NA
Sulfide	NA
Zinc	20 or SB

NOTES:

(1) From DEC TAGM 94-4046.
(2) Total volatile organic compounds <10 ppm.
(3) Total semi-volatile organic compounds <500 ppm.
(4) Total pesticides <10 ppm.
• Calculated based on Note 1 above.
MDL Method Detection Limit.
NA Not Available.

Table 3-5

To-Be-Considered (TBC) State and Federal Criteria, Advisories, and Guidance

STATE

- DEC Division of Hazardous Waste Remediation (DHWR) TAGM #90-4030, "Selection of Remedial Actions at Inactive Hazardous Waste Sites."
- DEC DHWR TAGM #90-4038, "Remediation of Inactive Hazardous Waste Disposal Sites."
- DEC DHWR TAGM #90-4040, "Permitting Jurisdiction over Inactive Hazardous Waste Remediation."
- DEC DHWR TAGM #92-4046, "Determination of Soil Cleanup Objectives and Cleanup Levels.
- DEC DHWR TAGM #92-4042, "Interim Remedial Measures."
- DEC Division of Water #1.1.1, "Ambient Water Quality Standards and Guidance Values."
- DEC Division of Water #2.1.1, "Groundwater Contamination Remediation Strategy."
- DEC Division of Hazardous Substances Regulation #92-3028, "Contained-In Criteria for Environmental Media."
- DEC Draft Cleanup Policy and Guidelines - October 1991.
- DEC Division of Fish and Wildlife, November 1993, "Technical Guidance for Screening Contaminated Sediment."
- 6NYCRR Part 364 - Waste Transporter Permits.
- 6NYCRR Part 370 - Hazardous Waste Management System: General
  - Part 371 - Identification and Listing of Hazardous Wastes
  - Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities
- 6NYCRR Subpart 373-1 - Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements
  - 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
  - 373-3 - Interim Status Standards for Owners and Operators of Hazardous Waste Facilities
- 6NYCRR Part 374 - Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities.
- 6NYCRR Parts 705 - Water Quality Regulations.
- 6NYCRR Parts 750-757 - Implementation of NYSPDES Program in New York State.
- 6NYCRR Part 257 - Air Quality Standards.
- DEC Division of Air - Air Guide #1, "Guidelines for the Control of Hazardous Ambient Air Constituents."

- DEC Division of Air #92 - Air - 38 "Mobile Treatment Units."
- DEC Division of Solid Waste #2004, "Regulation of Asbestos Waste Transfer Stations."

FEDERAL

- Health Effects Assessments (HEAs) and Proposed HEAs, "Health Effects Assessment for Specific Chemicals," ECAO, USEPA 1985.
- Reference Doses (RFDs), "Verified Reference Doses of USEPA, "ECAO-CIN-475, January 1986. See also Drinking Water Equivalent Levels (DWELs), a set of medium specific drinking water levels derived from RFDs. (See USEPA Health Advisories, Office of Drinking Water, March 31, 1987).
- Carcinogen Potency Factors (CFPs) (e.g., Q1 Stars, Carcinogen Assessment Group [CAG] Values), (Table 11, "Health Assessment Document for Tetrachloroethylene (perchioroethylene)," USEPA, OHEA/6008-82/005F, July 1985).
- Pesticide and Food additive tolerances and action levels. Note: some tolerances and action levels may pertain and should therefore be considered in certain situations.
- Waste load allocation procedures, EPA Office of Water (40 CFR Part 125, 130).
- Public health criteria on which the decision to list pollutants as hazardous under Section 112 of the Clean Air Act was based.
- Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy.
- TSCA chemical advisories.
- Advisories issued by FWS and NWFS under the Fish and Wildlife Coordination Act.
- TSCA Compliance Program Policy, "TSCA Enforcement Guidance Manual-Policy Compendium," USEPA, OECM, OPTS, March 1985.
- OSHA health and safety standards that may be used to protect public health (non workplace).
- Health advisories, EPA Office of Water.
- EPA Water Quality Advisories, EPA Office of Water, Criteria and Standards Division.
- Interim Final Alternate Concentration Limit Guidance Part I: ACL Policy and Information Requirements (July 1987).
- Waste Analysis Plan Guidance Manual. (October 15, 1984). EPA/530-SW-84-012.
- Guidance Manual on Closure and Post-Closure Interim Status Standards.
- Guide to the Disposal of Chemically Stabilized and Solidified Waste (1982) EPA/530-SW-872.

Table 3-5

To-Be-Considered (TBC) State and Federal Criteria, Advisories, and Guidance

- Hazardous Waste Land Treatment. (April 1983) OSW-00-00-874.
- Test Methods for Evaluating Solid Wastes, third edition. (November 1986) SW-846.
- 304(g) Guidance Document Revised Pretreatment Guidelines (3 volumes).
- A Method for Determining the Compatibility of Hazardous Wastes. EPA/600-02-80-076.
- Guidance Manual on Hazardous Waste Compatibility.
- Developing Requirements for Direct and Indirect Discharges of CERCLA Wastewater, Draft. (1987).
- Draft Guidance Manual on the Development and Implementation of Local Discharge Limitations under the Pretreatment Program (1987).
- Water-related Environmental Fate of 129 Priority Pollutants (1979).
- Water Quality Standards Handbook (December 1983).
- Technical Support document for Water Quality-based Toxics Control (1983).
- NPDES Best Management Practices Guidance Manual (June 1981).
- Case studies on toxicity reduction evaluation (May 1983).
- Designation of a USDW (No. 7.1) October 1979.
- Elements of aquifer identification (No. 7.2) October 1979.
- Groundwater Protection Strategy (August 1984).
- Clean Water Act Guidance Documents.
- SW 846 methods - Laboratory analytic methods (November 1986).
- Lab protocols developed pursuant to Clean Water Act Section 304(h).
- U.S. Environmental Protection Agency (1992, December 1992) Water Quality Standards. 57 Federal Register, Final Rule.
- U.S. Environmental Protection Agency (1994, September 19, 1994). Land Disposal Restrictions Phase II - Universal Treatment Standards, and Treatment Standards for Organic Toxicity Characteristic Wastes and Newly Listed Wastes. Final Rule. 59 Federal Register, P. 47982-48110.
- U.S. Environmental Protection Agency (1994, December 6, 1994). Hazardous Waste Treatment, Storage, and Disposal Facilities and Hazardous Waste Generators; Organic Air Emission Standards for Tanks, Surface Impoundments, and Containers. Final Rule. 59 Federal Register, P. 62896-62953.

Table 3-5

To-Be-Considered (TBC) State and Federal Criteria, Advisories, and Guidance

- U.S. Environmental Protection Agency (1989). Methods for Evaluating the Attainment of Cleanup Standards - Volume 1: Solids and Solid Media (NTIS No. EPA 230/02-89-042; PB89-234959). Statistical Policy Branch, Office of Policy, Planning and Evaluation.

- U.S. Environmental Protection Agency (1991). Technical Support Document for Water Quality-based Toxics Control EPA/505/2-90-001; PB91-127415). Office of Water Enforcement and Permits, Office of Water Regulations and Standards. *(This guidance manual updates and supplants the Agency's 1985 guidance manual referenced in the Acres International Report.)*

- U.S. Environmental Protection Agency (1992). Methods for Evaluating the Attainment of Cleanup Standards - Volume 2: Ground Water (EPA 230-R-92-014). Environmental Statistics and Information Division, Office of Policy, Planning and Evaluation.

- U.S. Environmental Protection Agency (August 31, 1993). Hazardous Waste Management System; Testing and Monitoring Activities. Final Rule. 58 Federal Register P. 46040-46058. *(In this rule EPA adopted Revision 3 of Update I to SW-846, and put Proposed Update II out in draft form for public comment.)*

- U.S. Environmental Protection Agency (1993). Health Effects Assessment Summary Tables, Annual Update. (EPA/540-R-93-058; PB93-921199; OSWER Directive 9200.6-303(93-1)). Office of Solid Waste and Emergency Response.

- U.S. Environmental Protection Agency (1993). Health Effects Assessment Summary Tables, Supplement No. 1 to the March Annual Update. (EPA/540-R-93-058A; PB93-921101; OSWER Directive 9200.6-303(93-1)). Office of Solid Waste and Emergency Response.

- U.S. Environmental Protection Agency (1994). Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes. A Guidance Manual. (OSWER Directive 9938.4-03; PB94-963603). Office of Solid Waste and Emergency Response, and Office of Waste Programs Enforcement.

- U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) Online Database. Updated monthly and available from several different sources. (IRIS provides a listing of Agency consensus toxicity factors - Reference Doses (RfDs) for ingestion; Reference Concentrations (RfCs) for inhalation noncancer effects; Cancer Slope Factors (CSFs) for ingestion of carcinogens; and Unit Risk Values (URVs) for ingestion or inhalation of carcinogens.)

DEPARTMENT OF DEFENSE

- AR 200-1, Environmental Protection and Enhancement.
- AR 75-15, Responsibilities and Procedures for Explosive Ordnance Disposal.
- DA PAM 50-6, Chemical Accident and Incident Response Action Operations.
- DOD 6055.9-STD, Ammunition and Explosives Safety Standards.
- EM 385-1-1, US Army Corps of Engineers Safety and Health Requirements Manual.
- TM 9-1300-206, Ammunition and Explosives Standards.

4 Identification of Removal Action Alternatives

4.1 Introduction

In accordance with the EE/CA Scope of Work dated July 18, 1994, a minimum of three alternatives must be evaluated for each identified area of concern. This section presents a preliminary assessment of remedial alternatives for each identified area of concern. The most applicable remedial alternatives for each area of concern are retained for further evaluation in subsequent sections of this report. In order to effectively address the concerns for each area, it is presumed that the removal actions for each area will involve a physical removal of the contaminant sources.

For Areas A and B and the TNT sewers, the top three remedial alternatives for these areas as presented in the Advanced Final Feasibility Study (FS) for Operable Unit No. 1 were selected and included in the preliminary assessment to determine if the alternatives are still applicable.

The available remedial alternatives included in the preliminary assessment can be separated into four response actions categories: removal, treatment, disposal and recycling. Special consideration is also given for the remediation of any potentially explosive TNT-contaminated materials.

4.2 Removal

Removal can be divided into the following three categories:

4.2.1 Excavation

The physical removal of surface and subsurface materials would be performed using standard construction equipment such as backhoes, bulldozers and excavators. Areas where excavation is applicable are Area A, Area B and the buried TNT sewer system.

4.2.2 Pumping

Pumping applies to the removal of surface water, groundwater and sewage and sludge by mechanical pumps. Pumping is applicable for removal of surface water from Area B, groundwater collected in excavations in Area A, Area B and the TNT

4.3.1.1 Biological Treatment

Biological treatment methods are directed toward enhancing biochemical reactions to detoxify or decompose the contaminants in the soil, sediments and sludges. Biological treatment can be accomplished through composting, landfarming, or bioreactors.

Composting and landfarming are accomplished by spreading and oxygenating the waste material, adding nutrients using agricultural type equipment (e.g., plows) and installing an irrigation and drainage system. Native or specialized microbes are typically added to enhance biodegradation of the contaminants. The bioreactor process involves the slurrying of contaminated soil with water in an agitated tank. The tank is equipped with an agitation system to allow for contacting of the slurried soils with microorganisms, nutrients and catalysts which are replenished as needed. For application at LOOW, contaminated materials would be relocated to a designated area off-site for treatment.

The drawbacks of biological treatment include limited effect on some organic compounds and no effect on metals (such as those in the sludges from the chemical waste sewer system). In addition, the time required for complete treatment may easily exceed one year. Depending on the location of where this process is performed, the time requirement may impact the feasibility of implementing this alternative. For these reasons and the need for a designated area for treatment (land on CWM property is at a premium), biological treatment has been removed from further evaluation for Areas A and B. However, due to the low volume of materials requiring remediation, the proven effectiveness on degrading explosive compounds, and the possibility of being able to perform the bioremediation process across Balmer Road on the National Guard property, biological treatment is retained for consideration for the remediation of TNT-contaminated sediments from within the TNT pipeline.

4.3.1.2 Physical Treatment

Fixation: Fixation is a physical treatment process involving the immobilization of hazardous constituents in a solid matrix. Materials such as lime, cement, pozzolans, thermoplastics, or organic polymers are used as a medium to contain the waste contaminants. The selection of the bonding materials and reagents for use in the process is based upon laboratory evaluations of the soil/waste. The reliability of the process would be determined by the degree to which the samples collected represent true properties of the soil/wastes and the choice of fixing agents. The time for remediation using this option is estimated to be about 12 months.

Fixation was the third highest ranked alternative for Areas A and B in the Advance Final FS and is retained here for further evaluation.

4.3.1.3 Chemical Treatment

Chemical treatment can involve a variety of processes, two of which have been included in the preliminary review: solvent extraction and soil washing.

Solvent Extraction: Solvent extraction involves continuously washing the contaminated materials with solvents. The specific solvents selected depends upon the types of contaminants present. The contaminants within the soil/waste dissolve into the solution and are thus removed from the soil/waste matrix. The contaminated solvents are typically reclaimed, eliminating the need for large volumes of solvent. In a typical solvent extraction system, the cleaned soil is processed through a filter press or closed loop dryer system to remove excess solvents. The contaminants collected from the solvent washing are concentrated and pumped into drums for subsequent disposal.

The solvents used in the process are dependent upon the type of contamination present in the soil, etc. Because of the variety of contaminants present in the LOOW soils/wastes, several solvent extraction steps may be required. The solvent extraction process would still require the disposal of the concentrated contaminants. The solvent extraction treatment process was the second highest ranked remedial alternative in the Advance Final FS and is retained for further consideration as a potential removal action for contaminated soils from Areas A and B.

Soil Washing: Soil washing is similar to solvent extraction. In the soil washing process, soils are first segregated according to size. The soils are then vigorously scrubbed with water to remove heavy metals or organic contaminants. In some cases, water-soluble surfactants, chelating agents, acids or bases may be used to facilitate contaminant removal.

permitted. Off-site incineration is retained for further evaluation for the remediation of TNT-contaminated sediments and the chemical waste sewer system sludges.

Flaming: Open flaming ranked as an above average remedial technology for the treatment in the Advance Final FS of TNT-contaminated wastes. Based on past application at other ordnance works facilities, flaming is quick, relatively safe, and cost-effective.

In some instances, open detonation of explosive materials may be deemed more effective and safer than open flaming. The implementation of any open flaming or open detonation would be performed at a secure site off of CWM's property by qualified explosive ordnance disposal (EOD) experts. Open flaming and/or open detonation are retained alternatives for the treatment of TNT crystalline solids and explosives-contaminated sediments.

4.3.2 Disposal

Disposal alternatives include disposal of hazardous wastes at a RCRA landfill and/or disposal of non-hazardous wastes at a construction/demolition debris landfill permitted under Title 6, New York Codes, Rules, and Regulations Part 360 (6NYCRR Part 360). Some pretreatment of the waste (e.g., solidification, dewatering, etc.) may be required prior to disposal.

4.4 Removal Actions for Aqueous Matrix Wastes

The liquid fraction (free groundwater and sewage) present in the excavations and sewer systems would be collected and treated as part of the removal action. The ultimate fate of this liquid fraction would be addressed in one of three possible alternatives: off-site treatment at a local treatment facility, on-site treatment at the existing on-site permitted aqueous treatment facility, or preliminary treatment by a mobile carbon filtration or other system with discharge to the on-site surface drainage system. Figure 4-1 presents a conceptual schematic of the aqueous matrix remedial alternatives.

Discharge to the surface drainage system would require a SPDES permit and must meet all applicable discharge requirements. If the surface discharge occurs on CWM property, the discharge would also have to meet CWM's RCRA surface water discharge requirements.

4.5 Removal Action for Solids with Elevated TNT Content

Special consideration must be given to the treatment of any solids that are highly contaminated with explosive compounds that may be found within the TNT waste sewer system. Based on remedial actions conducted at other ordnance works facilities, to ensure safety, all potentially explosive crystalline TNT would have to be manually removed from the pipeline sections by qualified explosives specialists. The material would be placed in non-sparking containers and transferred to a designated, secure location until disposal. The TNT crystalline solids would then be treated by either open flaming/detonation or on-site incineration. Off-site site transport of crystalline TNT on public roads is not recommended as these materials would be considered unstable. Sediments with a high explosives content would also be handled in a similar manner but have other treatment options. The possible options of treating explosives-contaminated materials are further discussed in Section 5.2.3.

The remedial alternatives of on-site hot gas decontamination and off-site hot gas decontamination were two of the three highest ranking alternatives in the Advance Final FS but were not retained for further evaluation as these alternatives are no longer considered feasible alternatives for the small quantities estimated to need treatment at the LOOW site.

4.6 Asbestos-Containing Materials

Removal actions for asbestos-containing materials are limited to land disposal at a permitted landfill. Landfills permitted to accept asbestos-containing materials that were included in this evaluation include one existing on-site landfill and two existing off-site landfills. The evaluation of the removal actions for asbestos-containing materials includes assessing the disposal at each of these facilities.

4.7 Miscellaneous Liquids and Oils

Depending on the composition of the liquid or oil, these materials may be recycled, incinerated or chemically treated. Because of the low volume of materials involved (i.e., less than 100 gallons), it was decided that the removal action assessment would include assessing disposal costs by three qualified recycling/disposal service firms.

4.8 Summary of Potentially Applicable Removal Actions

4.8.1 Solid Matrix

Remediation of contaminated soil, sediment, and sludge could include one or more of the following actions:

- Excavation - Fixation - Disposal
- Excavation - Treatment - Disposal
- Excavation - Disposal*
- Pumping - Off-site incineration (applicable to chemical waste sewer system sludges only)

4.8.2 Aqueous Matrix

The final disposition of aqueous matrix materials removed during a removal action would consist of one of the following options:

- Pumping - Treatment at an existing on-site aqueous treatment facility
- Pumping - Treatment at an off-site aqueous treatment facility
- Pumping - Pre-treatment in an on-site treatment system with discharge to surface drainage system

4.8.3 TNT Contaminated Solids

The following treatment of TNT crystalline solids from the TNT sewer system has been retained for further consideration:

- Manual Removal - Open flaming/detonation (nearby - off CWM property)
- Manual Removal - On-site incineration (nearby - off CWM property)

Remedial action options for sediments with high TNT contamination are:

- Manual Removal - Off-site Incineration

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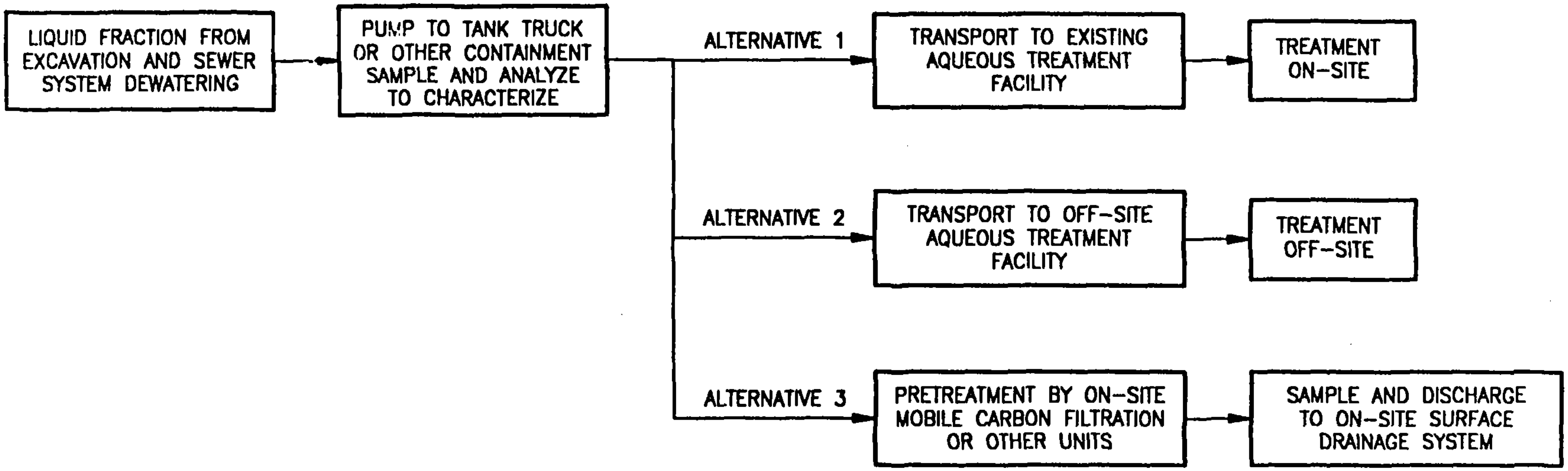
*Materials affected by Land Disposal Restrictions may require treatment prior to disposal. Treatment may include chemical or physical treatment or incineration. The costs for excavation and disposal actions in the following sections assume disposal of 50 percent of the material at a RCRA permitted landfill and 50 percent at a non-hazardous waste landfill.



AQUEOUS MATRIX ALTERNATIVES
(FOR ALL APPLICABLE AREAS)

FIGURE 4.1

AGRES

5 Analysis of Remedial Alternatives

5.1 Analytical Criteria

For each remedial action option for each media of concern, an analysis was performed to assess the following criteria:

5.1.1 Effectiveness - Consisting of:

A. Protectiveness - Addressing:

1. Threats to the surrounding community that may result from implementation of the action.
2. Threats to workers during implementation.
3. Extent to which the action reduces the identified risk on-site.
4. Time until protection is achieved.
5. Compliance with chemical- and location-specific ARARs.
6. Potential adverse environmental impacts that may result from implementation of the action.
7. Potential for future exposure to residuals on-site.
8. Long-term reliability.

B. Use of Alternatives to Land Disposal

C. Assessments of Risk from Remaining Residuals

5.1.2 Implementability - Consisting of:

A. Technical Feasibility - Addressing:

1. Ability to construct and run the technology.
2. Ability to meet action-specific ARARs.
3. Past demonstrated performance.
4. Potential impacts of environmental conditions such as climate.

B. Availability

1. An indication of the availability of necessary equipment, materials, and personnel.

2. An indication of availability of adequate treatment, storage and disposal capacity.
3. Post remediation controls that will be required.

C. Administrative Feasibility

1. Likelihood of public acceptance.
2. Need for coordination with other agencies.
3. Ability to obtain necessary permits and approvals.

5.1.3 Cost - In Total Present Worth Value

The cost will include indirect capital costs, direct capital costs, and any post remediation site control costs.

The following subsections present a narrative description of each of the above items for each potential remedial action option for each media of concern. Each criterion is discussed in the order presented above for each option. Itemized breakdowns of estimated costs are provided in Appendix B.

5.2 Solid Matrix

5.2.1 Area A

The remedial alternatives of excavation-fixation-disposal; excavation-treatment-disposal; and excavation-disposal were selected in the Advance Final FS as the three highest ranked alternatives for the remediation of the identified contamination in Area A. The following text presents a description of each alternative addressing and re-evaluating the above-mentioned criteria of effectiveness, implementability and cost.

A. Alternative 1: Excavation - Fixation - Disposal

Under this alternative, waste drums and soils would be excavated with a backhoe and transported by dump truck to a designated treatment area. Mixing of soils and fixing agents would take place in a hopper-fed ribbon blender, pug mills, or other heavy duty mixing equipment. The resultant material would be formed into blocks which, after solidification, would be replaced in the excavation. The resulting mass would reduce the mobility of the contaminants by chemical reaction, mechanical entrapment, or a combination of the two. Figure 5-1 presents a conceptual schematic of this alternative.

During the initial setup of this process, several composite samples of contaminated soil/waste material would be taken. The samples would be analyzed for organic content, moisture content, and contaminant levels. The analytical results would be used to specify the most effective additive and the appropriate solidification matrix.

Provisions for the disposal of solids that are too large for incorporation into the mix would be required (i.e., crushed or whole drums). These materials would most likely be overpacked if necessary and disposed in a landfill.

Site preparation would include surface drainage control and the construction of any necessary roads and temporary storage areas for mixing agents, daily production of solidified blocks, and short-term storage and curing of the solidified blocks.

The solidified blocks would be returned to the excavation. Additional soil volume would have to be removed from the excavation to allow for the expanded volume of material resulting from the fixation treatment process and for a 2 ft of cover over the buried solidified blocks. Alternately, the mixture could be pumped directly into the excavation and allowed to solidify prior to backfilling. The final cover would consist of backfilling and grading the excavated area for positive drainage, topsoiling, and seeding.

1. Effectiveness

   a. Protectiveness

      1. The process steps involved with fixation are similar to processes currently performed by CWM at the facility and would pose little or no threat to the surrounding community.

      2. Proper health and safety procedures such as organic vapor monitoring and upgrades of levels of personnel protective equipment, would be implemented as necessary to assure worker safety during operation of the action.

3. All contaminated soils would be removed to below cleanup criteria levels. However, because fixation only immobilizes but does not destroy the contaminants, the potential risk of exposure is still present.

4. The time required for completion of this option is estimated to be less than six months. This period includes the necessary sampling and laboratory studies.

5. The removal, treatment, and replacement of the contaminated materials may trigger land disposal restrictions regarding "placement" of hazardous wastes.

6. Degradation of the solidified masses may result in the release of contaminants to the environment.

7. Because the contaminants are not destroyed, there remains the potential for rerelease of the contaminants into the environment.

8. The reliability of the process would be determined by the degree to which the samples taken represent the true properties of the soils. Reliability is improved as additional areas are selected for sampling and testing. The effect of the freeze/thaw cycle on the shallow burial may result in degradation of the solidified blocks.

b. Alternative to Land Disposal

As the solidified material would be returned to the excavation trench, this is not an alternative to land disposal.

c. Assessment of Risk from Remaining Residuals

Because the contaminants are only stabilized and not destroyed, the potential risk would be reduced but not eliminated.

2. Implementability

a. Technical Feasibility

1. Soil fixation is a standard remedial action process with demonstrated successful applications. However, application of this technology at the CWM facility has several drawbacks. Area A is essentially located in the center of a permitted RCRA TSD facility where space is at a premium. At present, there is insufficient space in Area A to house the required components for this process. Use of any alternate location at the site would have to be coordinated with CWM. In addition, using the excavation trench or any other selected burial location on-site would significantly limit CWM's usability of the burial site.

2. The proper selection of reagents should effectively immobilize contaminants so that concentrations of any contaminants potentially leached from the solidified masses would be within groundwater standards. However, movement of the waste from the excavation to the treatment area and back into the excavation would trigger various RCRA requirements such as landfill ban, closure requirements, etc. If the waste is considered a RCRA hazardous waste, the applicable RCRA requirements may include the following:

   - Design and operating requirements in 40 CFR Part 264 for RCRA regulated processes that constitute disposal.

   - Closure requirements in 40 CFR Part 264; and

   - RCRA requirements in 40 CFR Part 268 pertaining to the land disposal of particular hazardous wastes (i.e., land disposal restrictions).

3. Fixation is an available technology with a growing number of successful applications. There is also ongoing research in the area of suitable reagent additives for a variety of waste components.

4. As previously mentioned, the potential impact of the freeze/thaw cycle on the solidified masses may result in the deterioration of the

masses and release of the contaminants. The effects of the freeze/thaw action could be reduced by increasing the depth of burial.

b. Availability

1. The fixation process involves relatively conventional construction equipment. The fixing agents, cement and pozzolans are readily available materials.

2. In regards to the availability of adequate treatment, storage and disposal capacity, it was previously mentioned that space is at a premium at the CWM facility. An area would have to be identified by CWM for construction of the temporary treatment system components.

   If the fixation process triggers RCRA requirements, it would be necessary to perform closure and post-closure care in accordance with 40 CFR Part 264. Provision of these services would be available through various qualified subcontractors.

3. Post remediation activities associated with this alternative would include groundwater monitoring to monitor the potential release of contaminants from the fixed masses, and maintenance costs associated with inspecting and maintaining the integrity of the final cover.

c. Administrative Feasibility

1. The CWM facility actively maintains communication with public interest groups in the community. The disposal of wastes generated through this option in a non-CWM landfill on this site may not be readily accepted by the public.

2. Implementation of this alternative would have to be coordinated with the EPA and the DEC. Because this is an active RCRA TSD facility, at least three DEC monitors are maintained on-site to oversee CWM activities.

3. If the waste is determined to be a RCRA hazardous waste, all associated RCRA permits for operation and construction of the alternative would be required. The RCRA permitting requirements for landfill construction, operation, and closure are often very lengthy procedures. Stockpiling of the waste for subsequent treatment may also require a DEC permit.

3. Cost

The estimated cost of implementing this alternative, excluding the treatment of groundwater encountered in the excavation trench, would be approximately \$1,386,000. Details regarding the remedial alternatives and associated costs for water treatment are provided separately in Section 5.3.

B. Alternative 2: Excavation-Treatment-Disposal

This alternative includes excavation of the contaminated materials with subsequent treatment by solvent extraction. Under this process, additional composite sampling would be performed to better define the physical state of the contamination. From this information, sieve sizes for separating fines, solvents for specific contaminants, and detergents for soil cleaning would be selected.

The contaminated materials would be excavated by backhoe and sieve separated. Large fractions (e.g., drums) would be separated, overpacked and disposed of in a permitted landfill. The soils would be washed with one or more solvents, depending on the nature of the contaminants, and then passed through a filter press or closed loop dryer system with the clean soils ultimately returned to the excavation. Some solvent extraction processes include a biological degradation step which further treats generated wastewater. The collected contaminants from the solvent extraction process can be concentrated several thousand times, reducing the volume and disposal costs. The concentrate would be pumped from the system into drums for subsequent conventional disposal (e.g., incineration). Figure 5-2 presents a conceptual schematic of this alternative.

1. Effectiveness

a. Protectiveness

1. The process steps involved in the solvent extraction treatment system are essentially self-contained and should pose no adverse effects to the surrounding community during implementation.

2. Similarly, adverse effects on workers would be minimized during implementation of this alternative by employing proper equipment operations and providing organic vapor monitoring and appropriate upgrades in PPE, as required.

3. Because this alternative essentially strips the contaminants from the soil matrix and subsequently disposes of them off-site, this process significantly reduces the risk associated with the contaminants in the buried drum trench. Proper verification sampling during excavation can assure that the entire extent of soil contamination is addressed.

4. All equipment should be available for the temporary setup at the site but may be of relatively low capacity (one to three tons per hour). Therefore, the estimated implementation time may be 6 months to 1 year.

5. Contaminated materials would be excavated to meet cleanup criteria levels. The available solvents utilized in the solvent extraction process are capable of reducing most of the organic contaminants in the soil matrix to non-detectable levels. As the treatment process would continue until the clean soil would be considered a non-hazardous waste, the treated material could be replaced in the excavation and the area restored for CWM's unrestricted use. The concentrated contaminants would require proper disposal as hazardous waste and would have to comply with RCRA disposal requirements.

6. There should be no adverse impacts on the environment if the waste and process materials are properly handled and managed. Extraction systems which utilize drying systems are closed to contain air emissions.

7. The solvent extraction process removes the contaminants from the soil matrix and therefore eliminates the potential for future exposure to residual contaminants.

8. The solvent extraction process has been used for many years and, with variations in the selection of solvents, has been proven to effectively remove contaminants to efficiencies of up to 99 percent. This process therefore has excellent long-term reliability.

b. Alternative to Land Disposal

With the exception of the disposal of bulk solids and concentrated contaminants, the solvent extraction treatment process is an alternative to land disposal. The resulting soils are clean and can be used as backfill in the original excavation.

c. Assessment of Risk from Remaining Residuals

The risk associated with remaining residuals is negligible due to the removal of the majority (up to 99 percent) of the contaminants. The resultant cleaned soils can be used as backfill and the remediated are restored for unrestricted use by CWM.

2. Implementability

a. Technical Feasibility

1. As with the soil/waste fixation alternative, the solvent extraction treatment process would require space for the temporary construction of the process equipment and storage of waste soil, treated clean soil and process materials. Land space at the CWM facility is at a premium and availability would have to be coordinated with CWM.

   The equipment required for the process should be available as a complete package from various vendors.

2. Because the contaminants will be removed from the soil matrix in the solvent extraction process, placement of the cleaned soils back into the excavation should not trigger RCRA requirements. Disposal

of the concentrated contaminants may require treatment prior to disposal in accordance with RCRA.

3. The solvent extraction process has a long history of successful applications. Recent research in the area of solvents has resulted in contaminant removal efficiencies of up to 99 percent for many types of organic and inorganic contaminants.

4. The effects of environmental conditions on the solvent extraction treatment process at LOOW is expected to be minimal. As with other alternatives, extreme cold weather may cause freezing problems within the process equipment.

b. Availability

1. Several vendors offer complete solvent recovery systems capable of treating a variety of contaminants. Availability of the process equipment would be dependent on the specific vendor to supply the required equipment, materials, and personnel.

2. The concentrated wastes generated by the solvent extraction process would require disposal. CWM's facility has sufficient landfill capacity to dispose of any acceptable wastes generated by the process. Off-site incineration capacity is also expected to be sufficient, if needed.

3. The site would require post-remediation monitoring to assure the contaminants have been removed (e.g., short-term, five-year monitoring).

c. Administrative Feasibility

1. The alternative of treating the contaminated waste by solvent extraction is expected to be accepted by the public because it removes the contamination from the site and involves the proper disposal of the concentrated contaminants.

2. As with Alternative 1, the solvent extraction alternative would have to be coordinated with the EPA and DEC.

3. Because solvent extraction is a proven, self-contained technology that involves removing the contamination from the site, acquisition of any necessary approvals and permits is expected to be relatively uncomplicated but may be time consuming.

3. Cost

Treatment cost for the solvent extraction process can range from $75 to $900 per ton with most processes costing around $250 per ton. With an estimated 6,800 tons of contaminated material from Area A requiring treatment, plus indirect costs for excavation, treatment of residuals, etc., the cost estimate for the remediation of Area A by solvent extraction would be approximately $2,279,000. This cost does not include the treatment of any groundwater encountered in the excavation (groundwater treatment costs are presented in Section 5.3).

C. Alternative 3: Excavation-Disposal

Under this disposal alternative, the materials in the Area A drum trench would be excavated by back hoe or excavator, loaded into roll-offs, and disposed of in a landfill. For estimating purposes, it is assumed that half the waste materials in Area A would be considered hazardous waste and would require disposal at a RCRA permitted facility, and the remaining half would be considered non-hazardous. As a result, the disposal process would consist of excavation, reducing the water content to acceptable levels, and segregation of hazardous and non-hazardous waste materials. The wastes would then be disposed of at the appropriate landfill. Verification of the removal of contaminated materials to soil cleanup criteria levels would be performed by sampling during the excavation process. The excavated area would be backfilled with clean material and regraded. Figure 5-3 presents a conceptual schematic of this alternative.

1. Effectiveness

a. Protectiveness

1. The excavation and disposal of materials from Area A should not pose a threat to the surrounding community.

2. Adverse effects on workers would be minimized during implementation of this alternative by employing proper equipment operations and providing organic vapor monitoring and appropriate upgrades in PPE, as required.

3. Because this alternative essentially transfers the waste from one location (i.e., Area A) to another (i.e., landfill), the potential threat posed by the contaminants is not entirely eliminated. However, the threat associated with the contamination at the site is removed.

4. The required time to excavate and landfill the material in Area A is estimated to be less than 2 months. Transportation is assumed to be negligible due to the proximity of the disposal site(s). Coordination and time of disposal is expected to be expedited as the landfill owner is also the present owner of the site needing remediation.

5. It is expected that the disposal alternative would comply with all ARARs. However, depending on the concentrations of the materials being disposed of, the materials may require treatment in accordance with land disposal restrictions.

6. This alternative involves the excavation and removal of the contaminated materials from the area with final disposition in a permitted landfill. There are no adverse environmental impacts anticipated during the implementation of this alternative.

7. As complete removal of the contamination would be confirmed by sampling during the removal process, there is little or no potential for future exposure to residuals on site.

8. This option has medium reliability. Sound remediation by relocation is argumentative. A secure hazardous waste landfill is a better place for the drums and contaminated soil than Area A. The level of cleanup at the site is superior. However, long-term reliability of landfilling is questionable.

b. Alternatives to Land Disposal

This is not an acceptable alternative to land disposal.

c. Assessment of Risk from Remaining Residuals

As previously mentioned, the level of cleanup at the site is expected to be superior with little or no risk associated with the remaining residuals.

2. Implementability

a. Technical Feasibility

1. Implementation of this alternative requires standard and readily available heavy construction equipment.

2. Disposal of the waste materials at a RCRA facility would require proper manifesting and disposal requirements in accordance with RCRA regulations. Depending on the concentrations of contaminants, the material may require treatment prior to landfilling in accordance with the land disposal restrictions.

3. Land disposal is a commonly practiced remedial option. Compliance with disposal requirements ensures proper implementation of the landfill option.

4. Environmental conditions would have little if any impact on implementation of this option.

b. Availability

1. All necessary equipment, materials, and personnel would be readily available to implement this option.

2. The on-site RCRA facility is approaching capacity in the current secure landfill (i.e., SLF-12), but is in the process of constructing a new landfill which would be able to provide the necessary storage capacity at the time of implementation of the removal action. Sufficient capacity is also available at the nearby solid-waste landfill or another non-hazardous waste landfill.

3. Minimal post-remediation monitoring is expected and will simply verify the completeness of the removal efforts. No post remediation site maintenance would be required. Any monitoring of the

disposed contaminated materials would be absorbed in the landfill disposal fee.

c. Administrative Feasibility

1. The landfill disposal of the contaminated material is not expected to be readily accepted by the public.

2. The implementation of this alternative would require coordination with the EPA and DEC.

3. All necessary approvals and permits should be easily obtainable for this alternative.

3. Cost

The estimated cost for disposal of the contaminated material by landfilling excluding treatment of any groundwater from the excavation, is approximately $1,905,000 (groundwater treatment costs are provided in Section 5.3).

5.2.2 Area B

The remedial alternatives of removal-fixation-disposal; removal-treatment-disposal; and removal-disposal were selected in the Advance Final FS as the three highest ranked alternatives for the remediation of the identified contamination in Area A. The following presents a description of each alternative addressing and re-evaluating the EE/CA criteria of effectiveness, implementability, and cost. Because of the similarities in the occurrence of contamination in Area B and Area A, some of the discussions of the criteria refer to descriptions previously provided in the appropriate sections for Area A alternatives. The most significant difference between Area A and Area B is that the volume of material identified for remediation in Area B (i.e., 20,400 tons) is three times greater than for Area A (i.e., 6,800 tons).

A. Alternative 1: Excavation-Fixation-Disposal

This alternative is similar to that for Area A except that the area of excavation is larger and the depth of excavation, for most of Area B, is shallower (i.e., approximately 3 ft). Because of the shallow depth of excavation, additional material would have to be removed in order to increase the depth of burial of the solidified masses to depths below the frost line.

If the excavation-fixation-disposal alternative is selected for both Areas A and B, the combined remediation could utilize the same storage, production and disposal areas.

1. Effectiveness

   The criteria relating to the effectiveness of the excavation-fixation-disposal alternative for Area B are the same as those discussed for Area A.

2. Implementability

   The criteria relating to the implementability of this alternative are similar to that for Area A. However, different fixation agents may be required to treat the contamination in Area B which were primarily semi-volatile organic compounds (e.g., 1,2,4-trichlorobenzene and hexachloroethane).

   If the excavation-fixation-disposal alternative was selected for both Areas A and B, it would be more feasible to utilize only one of the areas as the disposal site, thereby reducing construction, permit costs, etc.

3. Cost

   Due to the greater quantity of material in Area B, the cost associated with this alternative would be about $3,150,000.

B. Alternative 2: Excavation-Treatment-Disposal

The description of this alternative is the same as for Area A with the exception of the increased volume requiring treatment in Area B.

1. Effectiveness

   The discussion of the criteria for effectiveness is the same as for Area A.

2. Implementability

   The discussion of the criteria for implementability is the same as for Area A.

3. Cost

   For cost estimating purposes, it is estimated that half of the volume from Area B would be considered hazardous waste and the remaining half non-hazardous. The cost estimate for the excavation-treatment-disposal for the contaminated materials in Area B is approximately $6,121,000.

C. Alternative 3: Excavation-Disposal

The description of the excavation-disposal alternate for Area B is the same as Area A.

1. Effectiveness

   Same as for Area A.

2. Implementability

   Same as for Area A.

3. Cost

   The cost for excavation and disposal of the 12,000 cu yds (20,400 tons) of material in Area B would be approximately $4,449,000.

5.2.3 TNT Sewer Lines

The remedial alternatives of removal-flaming-disposal; removal-off-site hot gas decontamination-disposal; and removal-on-site hot gas decontamination-disposal were the three highest ranking remedial alternatives in the Advance Final FS for the explosives contaminated pipeline sediments, pipelines and adjacent soils. Recent studies have indicated that the most feasible and successful remedial alternatives for the remediation of explosives-contaminated wastes include rotary kiln incineration, biological treatment (e.g., composting) and open burning (i.e., flaming)/open detonation. These technologies are specifically applicable to wastes with a high explosive potential. Hot gas decontamination is no longer considered one of the more feasible alternatives for this site.

CWM's recent (i.e., 1990) encounter with excavated TNT pipelines and soils resulted in the determination that the materials were non-explosive. In addition, the waste materials were determined to be non-hazardous waste. As a result, the materials were disposed of without treatment at a 6NYCRR Part 360 permitted landfill.

In light of this, it is apparent that additional determinations must be made in identifying the proper remedial action for contaminated TNT pipelines and adjacent soils. Figure 5-4 has been prepared to present the viable determinations that must be made in this decision process.

The first determination to be made must be whether the excavated material is potentially explosive. Based on USATHAMA research findings, total nitroaromatic content of 10 percent has been determined to be a level above which the potential for detonation is of concern. Therefore, any material found to have a total nitro-aromatic content above 10 percent would have to be considered potentially explosive and treated accordingly. If the waste is determined to have a total nitro-aromatic content of less than 10 percent, it will be considered non-explosive and will be treated as a solid waste. A determination must then be made as to whether the solid material is a RCRA hazardous waste or a non-hazardous waste. Depending on the waste-type determination, the material will be treated/handled according to the applicable regulatory requirements.

In order to allow for provisions of the various wastes potentially encountered (i.e., explosive, non-explosive, hazardous, and non-hazardous) the following assumptions have been made:

1. It is assumed that all of the estimated 150 cu yds of materials within the pipelines are potentially explosive (i.e., total nitroaromatic content $\geq$ 10 percent). It is further assumed that of this material, 10 percent is crystalline TNT solids and the remaining 90 percent is explosives contaminated sediments.

2. It is assumed that the 10 percent of crystalline TNT would be considered unstable and would not be able to be transported on public roads.

3. It is assumed that the actual pipeline, concrete encasement and surrounding soils are non-explosive.

4. It is assumed that 10 percent of the pipeline construction materials and soils are considered RCRA hazardous wastes, and the remaining 90 percent is considered non-hazardous waste.

Based on the above assumptions, this subsection discusses the following possible remedial alternatives:

TNT crystalline solids:	manual removal - open flaming/detonation manual removal - on-site incineration
Explosive-contaminated pipeline sediments:	manual removal - open flaming manual removal - off-site incineration manual removal - biological treatment
TNT pipes, concrete encasement, and adjacent soils (RCRA hazardous waste):	excavation - disposal at a RCRA permitted landfill excavation - fixation - disposal excavation - treatment - disposal
TNT pipes, concrete encasement, and adjacent soils (non-hazardous waste):	excavation - disposal at 6NYCRR Part 360 permitted landfill

Figure 5-5 presents a conceptual schematic of the alternatives for removal actions for TNT-contaminated materials.

It should be noted that CWM will be implementing a corrective action at the North Salts area. Any removal action performed on the TNT pipelines by the government in this area will have to consider the potential impacts of CWM's corrective action.

5.2.3.1 Crystalline TNT

A. Alternative 1: Manual Removal-Open Flaming/Detonation

Under this alternative, crystalline TNT would be manually removed from the TNT pipes, placed in non-sparking (plastic) 2- to 3-cu. yd. containers, and transported to a nearby secure site. It is noted that no open-flaming operations will be performed on CWM property. It may be possible to perform the open flaming operation on National Guard property located north of Balmer Road. It may also be possible to utilize the original TNT magazines at this location for the temporary storage of the crystalline solids.

At the designated site, open flaming operations would be conducted in burning trays which are designed without cracks or angular corners to prevent the buildup of explosive residues. The depth of the explosive material in a tray should not exceed 3 inches, and the net explosive weight of materials in a tray should not exceed 1,000 lb. The actual flaming is performed by a remotely controlled flame thrower directed at and into the burning tray. The open flaming tray should not be inspected until 12 hours after the combustion of the burn, and a tray may not be reused until 24 hours after the conclusion of the burn or until all ash and residues have been removed from the tray. The resultant ash would be placed in drums for subsequent disposal. Figure 5-6 presents a conceptual schematic of this alternative.

If open detonation is selected, the wastes would be placed in a trench a minimum of four feet deep and covered by a minimum of two feet of soil. The detonation could be set off either by electric or burning ignition systems. In general, electric systems are preferable because they provide better control over the timing of the initiation.

After each detonation, the surrounding area would be searched for unexploded materials. Lumps of explosive material would be returned to the detonation pit.

1. Effectiveness

a. Protectiveness

1. The amount of crystalline solids is assumed to be 10 percent of the total volume of the sediments estimated to be within the pipeline (i.e., 10 percent of 150 cu yds). This relatively small amount of materials would be transported to the open flaming site in non-sparking, plastic 2 to 3 cu yds containers. The entire bulk of crystalline solids (assumed to be 15 cu yds) could be open flamed during one single operation. The actual open flaming operation has been demonstrated to be a safe disposal method and should not pose any potential harm to the surrounding community.

2. All handling and open flaming of crystalline TNT would be performed by explosive ordnance disposal (EOD) experts. All EOD personnel would have proper training and appropriate experience in handling potentially explosive materials.

3. Open flaming of crystalline TNT would result in the complete destruction of the explosive TNT, thereby eliminating associated explosion hazard risks.

4. The open flaming could be conducted in one single operation after all crystalline TNT solids have been removed from the pipeline system. Alternately, the open flaming could be performed as sufficient quantities of material become available. In either situation, excavation and completion of this effort is anticipated to be completed within 6 months.

5. Open flaming/detonation has been shown to be an effective method for the remediation of explosives contaminated materials and would achieve chemical specific ARARs. Open flaming/detonation operations cannot be performed on CWM property as these types of operations are not authorized under CWM's RCRA permit.

6. The open flaming of explosive materials would result in uncontrolled release of emissions from the flamed material.

Field tests at Dugway Proving Grounds in Utah indicate that open flaming/detonation operations can emit traces of organics and small quantities of soot in addition to CO_2, N_2, and H_2O. Modeling has been conducted to estimate the health risks associated with emissions of benzo(a)pyrene from open flaming/detonation of TNT. The model assumed a cancer potency of 1.7×10^{-3} for benzo(a)pyrene and an emission factor of 3.01×10^{-6} - the highest factor calculated in any emissions test trial (i.e., bang box study of Dugway Proving Ground in Utah). It was determined that 500 tons of TNT would have to be destroyed in open flaming/detonation operations to produce a 1 in 100,000 cancer risk from benzo(a) pyrene emissions. Since the assumed emission factor was very conservative, and the amount of material assumed to be treated at LOOW is relatively small (i.e., about 15 cu yds or 20 tons), the health risks associated with emissions from the open flaming operations would probably be minimal.

7. The potential for future exposure to residuals remaining on-site would be low as all visible crystalline TNT would be manually removed from the site.

8. The open flaming alternative has long-term reliability because it results in the complete destruction of the explosive wastes.

b. Alternative to Land Disposal:

This remediation method is an alternative to land disposal. However, a relatively small quantity of residual ash would still require disposal.

c. Assessment of Risk from Residuals:

The risk associated with residuals would be minimal as the open flaming operation results in the complete destruction of the explosive contaminants.

2. Implementability

a. Technical Feasibility

1. The open flaming/detonation operation is a simple procedure that can be easily set up by qualified personnel and maintained for the duration of the project.

2. The identified action specific ARARs associated with the open flaming operation include NYSDOT transport requirements and 6NYCRR Part 257 - Air Quality Standards. Obtaining necessary air emissions permits may be difficult but based on recent modeling results, the required permits should be obtainable.

3. Open flaming/detonation operations are permitted under the 6NYCRR Subpart 373-3.16(f) for wastes which have the potential to detonate. This part also has minimum distance requirements for opening flaming/detonation operations to the property of others.

4. Open flaming/detonation operations should not be performed during periods of excessive precipitation and/or winds. Temperature and terrain conditions should have no effect on this alternative.

b. Availability

1. Contracting qualified EOD personnel would be required for this operation. There are several qualified firms which could provide the required services.

   The equipment and material required for conducting the operation are relatively simple and, if not readily available, could easily be fabricated.

2. The most plausible and logical location to perform the open flaming operation would be on National Guard property located north of Balmer Road. It is likely that an existing munitions magazine could be utilized for the temporary secure storage of the explosive waste.

3. There would be no post-remediation site controls associated with this alternative.

c. Administrative Feasibility

1. Any operations involving "incineration" of waste materials would not be readily accepted by the public in the site vicinity. However, if it can be demonstrated that this operation would result in negligible emissions and similar practices (i.e., open detonation) by the Army have been and/or currently are performed at other sites, the public may be more willing to accept this alternative than the construction of an on-site (i.e., nearby, off CWM's property) incinerator.

2. Appropriate approvals and permits will be required from the EPA and DEC. The COE will also have to obtain internal approvals from within the DOD for the use of the National Guard property as the open flaming site and to coordinate the DOD's review and approval of the Site Work Plan and Safety Plan.

3. If the open flaming/detonation operation is to be performed across Balmer Road on the National Guard property, the NYSDOT shipping/transportation requirements may be able to be waived as the transportation of the waste would only consist of crossing the road. Acquiring the required air emissions permit may be more difficult but, based on recent modeling efforts, the required permits/approvals should be obtainable.

3. Cost

The estimated cost per open flaming/detonation of the TNT crystalline solids would be approximately $95,000.

B. Alternative 2: Manual Removal - On-site Incineration

Incineration is a Best Demonstrated Available Treatment Technology (BDAT) for the treatment of explosive-contaminated waste. Under this alternative, a mobile incinerator would be located at the site for the incineration of the crystalline TNT. As with the open flaming alternative, the mobile incinerator alternative would have to be set up and performed off of the CWM property.

The incineration alternative would be performed in a similar manner as the open flaming with the exception of the need for a more extensive mobilization, start up, and operation of the incinerator. Again, EOD specialists would be required to perform the manual removal and handling of the crystalline TNT. Figure 5-7 presents a conceptual schematic of this alternative.

1. Protectiveness

   a. Effectiveness

      1. The greatest concern associated with incineration of explosive materials stems from exposing explosive materials to an open flame in a semi-confined chamber.

         The rotary kiln incinerator treats off-gases in a secondary combustion chamber and subsequently through a scrubber and a series of baghouse filters. However, emission from the stack may contain nitrous oxides (NO_x) and products of incomplete combustion.

         Mitigative measures that may be taken would include a smaller feed volume in order to avoid potential explosions within the incinerator; shielding to reduce noise emissions; and modeling to predict the distribution of air emissions. For any explosives operation, the DOD should approve the incineration work plan and may require a hazards analysis and site safety plan.

      2. Hazards to workers are associated with erecting and operating the incinerator. As stated above, the DOD should be involved in work plan and safety plan review and approval.

      3. The incineration alternative results in the complete destruction of explosive contaminants and thereby eliminates risks associated with the contaminants on site.

4. The excavation, removal, and transport of crystalline TNT could be performed while the incinerator is being erected and tested. The stockpiled explosives could then be run through the incinerator in a semi-continuous basis. It is estimated that setup, testing and incineration of the crystalline TNT could be accomplished in 6 months to one year.

5. Incineration is capable of achieving a 99.99 percent organic destruction efficiency. Special permits in accordance with RCRA would be required to set up and operate the incinerator.

6. Incinerators at other cold climate sites have encountered problems with the feed system clogging due to cold, wet conditions. It has, therefore, been necessary to winterize incinerators for operation during adverse weather conditions.

   Another concern is noise. Incinerators are typically driven by a 400- to 500-hp fan which can generate substantial noise.

7. As all crystalline TNT would be manually removed from the pipelines and incineration results in almost the complete destruction of organic contaminants, this alternative effectively removes the potential for future residuals from the site.

8. This alternative offers a long-term reliability of continued protection because it removes the risk of exposure.

b. Alternative to Land Disposal

Incineration is an alternative to land disposal. Only a small volume of residual ash would require disposal.

c. Assessment of Risk from Remaining Residues

It is anticipated that any TNT crystalline solids would be present within the TNT pipelines. During all TNT-remediation-related activities, an EOD specialist will be present to ensure complete removal of explosives-contaminated materials.

The incineration process will achieve up to a 99.99 percent destruction efficiency, thereby eliminating any risk from remaining residuals.

2. Implementability

   a. Technical Feasibility

      1. Mobile incinerators are available as complete package units. However, before an incinerator can be used, it must pass a trial burn demonstrating that it can achieve a 99.99 percent destruction efficiency. Proper functioning of the incinerator may take an extended period of time. Incinerators also require large supplies of electricity and water, the availability of which would have to be determined prior to construction.

      2. Construction of a mobile incinerator would require appropriate permits for construction, operation, air emissions and water discharge.

      3. Mobile incinerators have been used to successfully treat explosives-contaminated soil and debris, explosives with other organics and metals, initiating explosives, bulk explosives, unexploded ordnances, and pyrotechnic waste. Incineration of explosives-contaminated wastes has been successfully performed at the Cornhusker Army Ammunition Plant in Grand Island, Nebraska, the Louisiana Army Ammunition Plant in Shreveport, Louisiana, the Savanna Army Depot in Savanna, Illinois, and the Alabama Army Ammunition Plant in Childersburg, Alabama. In general, rotary kiln incinerators have been used at these sites to treat explosives-contaminated soils. However, both the rotary kiln incinerator and another unit, referred to as a deactivation furnace (Army Peculiar Equipment, 1236), have been successfully used to destroy and/or deactivate large quantities of explosive materials.

      4. Operation of an incinerator during cold temperatures may require winterizing the unit.

b. Availability

1. Several mobile incinerators are available throughout the country. It may be possible to mobilize an incinerator recently used in 1993 at the Savanna Army Depot for the incineration of explosives-contaminated soils.

2. If a mobile incinerator is available, it may be possible to erect and operate the unit on National Guard property north of Balmer Road. An alternate, secure location in the area would be the US Air Force property located off the northeast corner of the CWM facility.

3. No post remediation controls would be required.

c. Administrative Feasibility

1. Even though it would be temporary, the public would probably be very hesitant to approve an incinerator in the area.

2. Coordination with the EPA, DEC and probably the DOT would be required for this alternative. Also, the COE would have to coordinate internally within the DOD for the use of other properties and to get assistance in the review, approval and implementation of this alternative.

3. Permits would be required for transport of hazardous/explosive wastes under both the RCRA and DOT regulations. Permits would also be required to construct and operate the incinerator and for air and water discharges.

3. Costs

Costs associated with this alternative include excavation, transport and incineration costs, contracting EOD specialists, and costs for applicable permits. Based on application at similar sites, it is estimated that mobilization of the incinerator would be on the order of $1,439,000.

5.2.3.2 Explosives-Contaminated Sediments

A. Alternative 1: Manual Removal-Open Flaming

This alternative would be performed in a similar manner as that for open flaming of crystalline TNT. However, where the crystalline TNT would essentially be pure TNT, the sediments are known to contain elevated concentrations of various volatile and semi-volatile organic contaminants which would contribute to air emissions generated during the flaming operation. Figure 5-8 presents a conceptual schematic of this alternative.

1. Effectiveness

   a. Protectiveness

      1. The presence of volatile and semi-volatile contaminants in the sediments may contribute to air emissions which would adversely affect air quality downwind of the open burning operation. It may be possible to construct a facility similar to that used at the Dugway Proving Grounds in Utah that is large enough to capture and treat the plume. However, this has never been attempted beyond a testing scale level.

      2. Threats to workers during implementation of this alternative would be similar to those previously discussed in Section 5.2.3.1 for open flaming of crystalline TNT.

      3. The reduction of identified risk at the site associated with this alternative is the same as for open flaming of crystalline TNT.

      4. Based on the greater quantity of sediments to be treated (i.e., 135 cu yds) it is anticipated that open flaming of this material would take longer than the crystalline TNT. However, it is expected that the entire operation could be completed within 6 months.

      5. It is expected that open flaming would meet chemical-specific ARARs for the TNT contamination. However, it is not expected that open flaming would reduce all organic contaminants to levels below the ARARs.

6. Open burning of the TNT pipeline sediments may result in the release of undesirable organic emissions from the variety of organic contaminants within the sediments. A method for effectively capturing the emissions from open flaming operations has never been attempted beyond the testing level.

7. By destroying the explosive compounds, the open flaming alternative eliminates the potential for future exposure to TNT residuals on-site.

8. The open flaming alternative offers long-term reliability because it destroys the explosive contaminants. However, it is not a proven technology for treatment of all the organic contaminants present within the sediment.

b. Alternative to Land Disposal

The open flaming of the pipeline sediments would not be considered a complete alternative to land disposal because it will not treat all contaminants present. The residual contamination would require landfill disposal.

c. Assessment of Risk from Remaining Residuals

Because this alternative includes the removal of all TNT-contaminated sediments from the pipeline system, it eliminates the risk from remaining residuals.

2. Implementability

a. Technical Feasibility

1. The ability to construct and operate this alternative would be the same as for any open flaming of crystalline TNT.

2. Action-specific ARARs associated with this alternative would be the same as for open flaming of crystalline TNT. It is expected that acquiring the necessary air emissions permits may be difficult.

3. Open flaming has been proven to be a safe and effective remedial alternative for the treatment of explosives- contaminated materials. However, it is not a proven alternative for treating all of the remaining organic contaminants present in the sediment.

4. The effects of environmental conditions on this alternative would be the same as for open flaming of crystalline TNT.

b. Availability

1. There are several firms across the country that can provide the required EOD services. The equipment necessary for implementing the actual open flaming should be readily available. The equipment required for the excavation, handling, and transport aspects of the alternative is standard construction equipment and should also be readily available.

2. As with the open flaming of crystalline TNT, implementation of the staging and open flaming portion of this alternative may be able to be performed on the National Guard property north of Balmer Road or on the US Air Force property northeast of CWM's facility.

3. This alternative requires no post-remediation site control measures.

c. Administrative Feasibility

1. Due to the potential air emission releases associated with this alternative, it is unlikely that open-flaming of the sediments would be readily accepted by the public.

2. This alternative will require coordination with the EPA, DEC and internally with the DOD in order to arrange the availability of the review and approval of the work plan and safety plan and for possible utilization of DOD property for implementing this alternative.

3. Obtaining the necessary permits for the release of air emissions from this action is anticipated to be difficult.

3. Cost

The cost associated with implementing this alternative only includes handling and transport of the waste, and performing the actual open flaming. The estimated cost for this alternative is approximately $733,000. This cost assumes that the TNT waste pipeline has already been excavated and staged at a temporary staging area.

B. Alternative 2: Manual Removal-Off-site Incineration

This alternative involves the excavation, transport and incineration of sediments from the TNT pipeline system at an off-site out of state incinerator. In order to reduce the explosivity of the sediments, this alternative includes the addition of clean soil to be blended with the sediments prior to transport and incineration. The incineration residues would then be disposed of in compliance with applicable regulations. Figure 5-9 presents a conceptual schematic of this alternative.

1. Effectiveness

a. Protectiveness

1. The excavation and off-site incineration of the TNT pipeline residues should not pose a threat to the surrounding community. However, transportation of the TNT and organics-contaminated wastes may pose a possible exposure and/or explosion threat to the public if an accident during transport occurs. In order to minimize the possible explosive threat, the pipeline residues would be mixed with clean soils and packed in non-sparking containers.

2. The primary threat to workers during the implementation of this alternative is the potential for explosion of the pipeline residues during excavation, removal and incineration. Excavation activities performed to date have indicated that the pipeline residues are saturated with water and have not posed an

explosion hazard. The contaminated materials would be blended with clean soils to reduce the explosion potential.

3. Implementation of the off-site incineration alternative will result in the elimination of hazards associated with the contaminants at the site.

4. The time required until protection is achieved would be the time required to excavate and remove the contaminants from the site. This is expected to be completed within 6 months.

5. Incineration is a BDAT for explosives-contaminated wastes and also for many organics. As such, incineration is capable of reducing contaminant levels to below chemical-specific ARARs.

   Because the incineration would be conducted off-site at an approved permitted facility, this alternative would also comply with location specific ARARs.

6. With proper handling, transportation and incineration of the waste, there should be no adverse environmental impacts as a result of implementing this alternative.

7. The potential for future exposure to residuals would be eliminated as the wastes would be removed from the site and destroyed.

8. Incineration has a long-term reliability because it is capable of achieving up to 99.99 percent destruction of most organic contaminants.

b. Alternative to Land Disposal

This is an accepted alternative to land disposal.

c. Assessment of Risk from Remaining Residuals

The risk associated with remaining residuals is eliminated by the complete removal and destruction of the contaminants.

2. Implementability

a. Technical Feasibility

1. Excavation, removal and transport of the wastes could be accomplished using standard construction practices. The wastes would be incinerated at one of few incinerators (e.g., Laidlaw in Louisiana) that accept explosives-contaminated soils.

2. Action specific ARARs would be met by complying with appropriate manifesting and transportation requirements and conducting the incineration at an approved, licensed facility.

3. Incineration is a BDAT for the treatment of explosives- and organics-contaminated wastes.

4. The potential impact of environmental impact such as climate on this alternative should be minimal, as it involves mostly standard construction and transportation practices. It is expected that the incinerator facility would be capable of performing the incineration in most weather conditions. During severe conditions, the operation would be stopped and resumed when conditions improve.

b. Availability

1. Several firms across the country are available to provide EOD services. The equipment required for the excavation, handling and transport of the wastes would consist of standard construction equipment.

2. An incinerator which accepts explosives-contaminated wastes is located at Colfex, Louisiana. This facility would be able to handle the volume of material generated by this action.

3. Post-remediation site control would not be required as the alternative would consist of removing and destroying all of the contamination.

c. Administrative Feasibility

1. Destruction of the contamination at an approved, licensed incineration facility should be readily accepted by the public. However, special consideration must be given to the safety aspects of transporting explosives-contaminated wastes.

2. Implementation of this alternative would require review and approval by both the EPA and DEC and compliance with DOT transportation requirements. The DOD would be involved in review and approval of project work plans and safety plans.

3. Any permits and approvals should be obtainable for this alternative if proper procedures regarding removal, transport and incineration are followed.

3. Cost

Costs associated with this alternative only includes the handling, transportation and incineration. It is estimated that the incineration of the estimated 135 cu yds of contaminated sediment plus an estimated 470 cu yds of clean soil blended to reduce the detonation potential (additional volume based on an assumed original TNT content of 35 percent by weight reduced to <10 percent) would be in excess of $1,903,000. It is assumed that the TNT waste pipeline has been excavated and staged in a temporary staging area.

C. Alternative 3: Manual Removal-Biological Treatment

Biological treatment would begin with the manual removal of the sediments from the pipelines and placement of the removed materials in non-sparking containers. The sediments would then be transferred to a designated, secure area for biological treatment. The sediments would be analyzed to determine the most appropriate micro-organisms to treat the contaminants present. At this point one of several applicable and similar biotreatment methods could be used. Most biological treatment technologies involve placing the materials to be treated on an impermeable liner or in a cell and providing aeration and/or moisture as needed.

The selected micro-organism(s) would be blended into the contaminated sediments along with any required nutrients or substrate (e.g., saw dust, straw, etc.), which are required to accelerate microbial growth. The treatment mass would be periodically sampled (e.g., ever 2 to 4 weeks) to monitor the treatment progress. More micro-organisms, nutrients, and/or substrate would be added to the mass to help complete the biological treatment progress. The treatment process would be considered complete when all contaminant levels are below cleanup criteria.

1. Effectiveness

   a. Protectiveness

      1. Transfer of the explosive sediments to the treatment area would pose a potential threat to the surrounding community. Precautions would be taken to properly containerize the sediments in order to reduce the explosive hazard. If the National Guard property north of Balmer Road could be utilized as the treatment area, the actual time that the explosive materials would be on public roads would be very minimal.

      2. Manual removal and implementation of the biotreatment alternative would be supervised and/or performed by EOD experts in order to assure worker safety.

      3. The removal of the explosive materials from the pipeline system would effectively reduce the risks associated with the pipeline. The implementation of the biological treatment process would further reduce the risks associated with the explosive sediments by destroying the contaminants.

      4. The time required for achieving actual protection associated with the alternative essentially consists of the time to remove the explosive waste from the pipeline. The time required for the actual biological treatment process will vary according to the types of contaminants present and the selection of appropriate micro-organisms. Complete degradation of the contaminants by biological treatment can vary from a few months to two years or more.

5. Removal of the contaminants from the pipeline system would effectively attain chemical-specific cleanup criteria. The degradation of contaminants to acceptable levels would be dependent upon the proper selection of appropriate micro-organisms.

6. The biological treatment process can be performed either in an enclosed structure or on an impermeable liner with a cover (i.e., tarp) placed over the treatment mass. Each type of system could be fitted with a drainage collection system to collect any leachate from the treatment mass.

7. The potential threat of the future exposure to residuals on-site would be eliminated as the contaminants would be removed from the site during the removal process.

8. Biological treatment has been proven to effectively destroy many organic contaminants. As such, biological treatment has excellent long-term reliability.

b. Alternative to Land Disposal

Biological treatment is considered an alternative to land disposal as the treated mass may be used for beneficial purposes.

c. Assessment of Risk from Remaining Residuals

The implementation of this alternative should result in the removal of risks associated with remaining residuals.

2. Implementability

a. Technical Feasibility

1. Biological treatment is a commonly practiced remedial alternative and can be easily implemented by qualified personnel.

2. It is assumed that the explosives-contaminated sediments would be considered a RCRA hazardous waste. As such the

transport and land treatment process would trigger action-specific ARARs associated with these activities. It is anticipated that compliance of these ARARs would be easily attained.

3. Various biological treatment processes (e.g., white rot fungus) have been successfully utilized for the treatment of explosive and other halogenated and non-halogenated organic contaminants. Biological treatment is not effective on metals.

4. Temperature can significantly affect the biological treatment process. Biological organisms may become dormant at temperatures below 40°F and may die off at temperatures above 120°F. Mechanical aeration (e.g., tilling) may help reduce temperature extremes and application of heat can help maintain the biological processes in cold weather.

b. Availability

1. Numerous firms offer biological treatment services and would be readily available. The Army Environmental Center (AEC) has also been involved in the biological remediation of explosives-contaminated soils.

2. It is assumed that there would not be available space on CWM's property to perform the biological treatment alternative. It is possible that the National Guard property north of Balmer Road could be used for this alternative.

3. No post-remedial monitoring would be required after implementation of this alternative.

c. Administrative Feasibility

1. Biological treatment should be readily accepted by the public.

2. Implementation of this alternative would require coordination with the EPA and DEC and internal coordination within the DOD for the review and approval of the work plan and safety plan, and to coordinate the useability of DOD property north of Balmer Road.

3. All necessary permits and approvals should be easily obtainable for this alternative.

3. Cost

The estimated cost for implementing this alternative would be approximately $406,000. This estimate assumes that the TNT waste pipeline has been excavated and placed in a temporary staging area.

5.2.3.3 RCRA Hazardous Explosives-Contaminated Soil/Concrete

In the previous subsections, it was assumed, for estimating purposes, that the sediment within the TNT pipeline system would have a total nitroaromatic content of ≥ 10 percent. In this and the following subsection it is assumed that the remaining pipeline, concrete encasement and an estimated 50 cu yds of adjacent soil are contaminated with nitroaromatics, but at concentrations below 10 percent and would therefore be considered non-explosive. It is also assumed, for estimating purposes, that 10 percent of the material would be considered RCRA hazardous waste and the remaining 90 percent non-hazardous. The costs for excavation and backfilling are included in the cost estimate for the non-hazardous waste disposal.

Based on these assumptions, the potential removal action alternatives selected for further analyses of the RCRA hazardous pipeline, concrete and soil materials include the following: excavation-fixation-disposal; excavation-disposal; and excavation-treatment-disposal. These alternatives are further discussed below.

A. Alternative 1: Excavation-Fixation-Disposal

This alternative would be similar to that described for Areas A and B. However, the fixation-alternative for the TNT pipeline system would include a crusher to mechanically reduce the vitreous clay piping and concrete encasement into sizes that could be included in the fixation-treatment process. Figure 5-11 presents a conceptual schematic of this alternative.

1. Effectiveness

   The criteria relating to the effectiveness of this alternative for the TNT pipeline system would be the same as for those discussed for Areas A and B.

2. Implementability

   The criteria relating to the implementability of this alternative would be the same as for those discussed for Areas A and B. However, only part of the excavation would be utilized as the disposal site for the treated waste. Also, if this alternative was used for Areas A, B and the TNT pipeline system, it would be more feasible to utilize only one of the areas as the disposal site. Also, the excavation process would have to be coordinated with CWM as the TNT pipeline runs through active CWM operations areas. However, based on the last site visit in Spring 1994, there were no noted active CWM processes or activities occurring directly on top of the TNT sewer line locations.

3. Cost

   The cost associated with this alternative would be approximately $173,000.

B. Alternative 2: Excavation-Treatment-Disposal

The treatment alternative of solvent extraction would not be applicable to the TNT-contaminated wastes because the process would result in producing potentially detonable concentrations of explosives. A treatment process that would have potential applicability to the TNT pipeline system would be soil washing. This process would consist of a water-based waste reduction process where the hazardous contaminants would be extracted and concentrated in a small residual portion of the original volume using physical and chemical methods. The cleaned portion could be redeposited in the excavation. The smaller volume of concentrated material would require subsequent treatment by an appropriate destructive or immobilizing process such as incineration, biodegradation, or solidification. Figure 5-12 presents a conceptual schematic of this alternative.

1. Effectiveness

a. Protectiveness

1. The process steps involved with soil washing are essentially self-contained and should pose no adverse effects to the surrounding community during implementation.

2. Adverse effects on workers would be minimized by employing proper organic vapor monitoring and upgrades in PPE, as required.

3. Because this process removes the contaminants from the soil and concrete matrix and subsequently disposes of them off-site, this process significantly reduces the risk associated with the contaminants in the TNT pipeline system and adjacent soils.

4. Components of the soil washing process are available as modules and can be easily mobilized on-site. The soil washing process for the hazardous waste portion of the TNT sewer system is estimated could be completed within six months.

5. The degree to which the soil washing process achieves site cleanup criteria is dependent upon the compatibility of the chemical additives which may include surfactants, chelating agents, oxidizers, coagulants, flocculants, pH modifiers, etc. Extensive bench testing would be required to obtain the proper selection of chemical additives.

6. Proper handling and management of the waste and process materials should have no adverse impacts on the environment as a result of implementation.

7. The soil washing process would remove the contaminants to below cleanup criteria levels and thereby would significantly reduce the potential for future exposure to residuals on-site. Proper disposition of the concentrated contaminants would also be required.

8. Because the alternative removes the contaminants from the soil matrix, it has long-term reliability.

b. Alternative to Land Disposal

Depending on the selected treatment of the concentrated residuals, this could constitute an accepted alternative to land disposal.

c. Assessment of Risks from Remaining Residuals

Because this alternative removed the contaminants from the site, there are no risks associated with the remaining residuals on-site.

2. Implementability

a. Technical Feasibility

1. The soil washing process is available as a complete modular package and could be supplied from one of several vendors. However, appropriate lead time would be required to ensure the availability of the necessary equipment.

2. Depending on the selected fate of disposal, the concentrated residuals may trigger RCRA requirements for disposal.

3. The soil washing process has been successfully employed at numerous sites with organic contamination, including nitroaromatics.

4. Extreme cold temperatures could have an adverse impact on the soil washing process by freezing of the liquid components of the system. As with other similar processes, it would be best to implement this alternative during warmer temperatures.

b. Administrative Feasibility

1. Because this alternative would remove the contaminants from the site and could constitute an alternate to land disposal, it should be readily accepted by the public.

2. This alternative would require coordination with the EPA and DEC.

3. Any necessary permits and/or approvals should be easily obtainable for this option.

3. Cost

Costs associated with the actual treatment of the contaminated materials would range from about $75 to $125 per ton. However, a minimum volume of several thousand tons would be required for treatment in order to justify the fixed costs of mobilization and demobilization. The estimated cost for implementing this alternative, excluding excavation and water treatment would be approximately $200,000.

C. Alternative 3: Excavation-Disposal

Under this alternative the excavated TNT pipeline and soils, which are assumed to be hazardous wastes, would be pretreated, if required for disposal, and transported to a permitted RCRA disposal facility. Figure 5-13 presents a conceptual schematic of this alternative.

1. Effectiveness

The criteria relating to the effectiveness of the excavation-disposal alternative would be the same as discussed for Areas A and B.

2. Implementability

The criteria relating to the effectiveness of the excavation-disposal alternative would be the same as for Areas A and B.

3. Cost

Costs associated with disposal of the contaminated materials would include costs related to the transportation, pretreatment (e.g., dewatering), if necessary, and disposal at a RCRA landfill. The cost for this option is estimated at $192,000.

5.2.3.4 Non-Hazardous Explosives-Contaminated Soil/Concrete

There are no identified beneficial uses for the TNT- and organics-contaminated soil/concrete from the TNT pipeline remediation. Therefore, the only removal action alternative considered is excavation and disposal at a solid, non-hazardous waste landfill. Figure 5-14 presents a conceptual schematic of this alternative.

In order to provide a fair assessment, the evaluation of this alternative consists of disposal at three different non-hazardous, solid waste landfills. All three options are essentially the same. Effectiveness and implementability variations in the options would arise due to the disposal capacity of the landfill and the ability of the landfill to accept the types of waste. Cost variations would arise from transportation requirements and direct disposal costs.

Under this alternative, disposal of the waste of the following three landfills was considered:

- An existing landfill located adjacent to CWM's property;
- Off-site landfill No. 1, and
- Off-site landfill No. 2.

The costs associated with disposal of the non-hazardous explosives contaminated concrete and soils range from a low of $55/ton at the on-site landfill (assuming access through CWM's back gate would be granted) to a maximum of $75/ton at an off-site landfill. The maximum cost for this alternative would be approximately $265,000.

Regardless of which removal action alternative is selected, the cost for excavation and backfilling of the TNT pipeline trench would be approximately $1,223,000.

5.2.4 Chemical Waste Sewer System Solids

The former AFP-68 chemical waste sewer system is estimated to contain approximately 25 cu yds of sludge contaminated with volatile and semi-volatile organics, pesticides, PCBs and various heavy metals. The removal action alternatives retained for further evaluation are: removal-fixation-disposal; removal-treatment-disposal; and removal-incineration. Each of these actions involves the removal of the contaminated sludge from the chemical waste sewer only; these alternatives do not include the physical removal of the sewer line and lift stations.

For each alternative, the removal of the contaminated sludge is assumed to consist of the removal of the majority of sludge by vacuum pumping followed by limited manual removal, where necessary and possible, of the remaining contamination. The most effective removal method is conventional sewer cleaning using high-pressure water jets and vacuum removal.

For this removal action only the main trunkline and chemical waste lift stations will be remediated. The cleaning sequence would initiate with sewage and sludge removal of the most upgradient chemical waste lift station location (i.e., Area 31) and progress downgradient. Once a lift station has been cleaned the inlet and outlet lines would be plugged. Cleaning and plugging the sewer system in this manner would prevent the movement of sewage and sludge into sections that have already been cleaned.

Chemical analyses show that the liquid (sewage) fraction in the chemical waste sewer system is relatively uncontaminated. In order to keep treatment costs at a minimum, it is anticipated that the remedial action at each lift station would begin with the vacuum removal of the majority of sewage from the lift station. The sewage removal would stop at a predetermined depth in order to avoid the mixing and removal of the more contaminated sludge. The removed sewage would be treated by one of the selected treatment alternatives for the aqueous matrix waste as described in Section 5.3.

Once the sewage is removed from the lift station, the sludge would be removed by similar vacuum extraction. When the majority of sludge is removed from the lift station the walls and floor of the lift station would be manually cleaned by high pressure water jets and vacuum extraction. The collected sludge and associated water would then be treated in accordance with the selected removal action alternative.

The main trunkline would be cleaned with a high-pressure flushing. It is assumed that mechanical methods will not be required to remove any sediment from the trunkline.

Upon complete removal of all contamination, which would be verified by confirmation sampling, each chemical waste lift station will be sealed at the ground surface in order to prevent any further ingress of water.

A. Alternative 1: Pumping-Fixation-Disposal

Under this alternative, the sludge will be treated by a fixation process in the same manner as discussed for Area A (see Section 5.2.1). However, due to the relatively high volatile organic contaminant content of the sewer sludge, a pretreatment step to off-gas the volatiles would be required. The off-gassing process would be performed in a controlled containment system where the organics would be off-gassed and either condensed or collected in a carbon absorption unit for subsequent recycling or disposal. The remaining solid fraction, now with a reduced volatile organic content, would be treated in the fixation process. Upon completion of the fixation process, the solidified waste would be disposed in a landfill. Figure 5-15 presents a conceptual schematic of this alternative.

1. Effectiveness

   a. Protectiveness

      1. Implementation of this alternative should not pose an adverse effect on the surrounding community.

      2. Implementation of this alternative in accordance with an established Health and Safety Plan should not pose an adverse impact on site workers. However, it would be necessary for confined-space activities to be performed which would increase the hazards to workers involved in these activities.

      3. Implementation of this alternative would significantly reduce the risk associated with the presence of contamination within the sewer system. However, all risks may not be eliminated as the removal effort may not remove all residual contamination that may be present within any cracks or seams in the pipeline or concrete lift

stations and any contamination that could have migrated to adjacent soils.

4. It is estimated that removal, pretreatment, and fixation of the chemical waste lift station sediments could be completed within three to six months.

5. Compliance with chemical-specific ARARs would not be able to be entirely determined because residual contamination may be present within any seams or breaks in the pipe and concrete structure and adjacent soils.

   Removal and fixation of the contaminated sludge would likely trigger RCRA requirements regarding final disposal of the solidified masses.

6. Adverse environmental impacts that may result from implementing this removal action alternative are expected to be minimal. The fixation process may result in the release of volatile contaminant emissions. It is anticipated that the emissions could be controlled by capturing emissions during the treatment process.

7. The potential for future exposure to residuals remaining on-site would be significantly reduced, but because all contamination may not be entirely removed from the sewer system, the risks would not be completely eliminated. Again, this is a function of the actual removal of contaminated materials from the sewer system, not as a result of the fixation process. Unlike the fixation process previously described for Areas A and B, the resultant solidified mass from the fixation of chemical sewer sludges would be disposed of at a landfill, thus removing any on-site risks associated with the treated materials.

b. Alternative to Land Disposal

This removal action does not entirely offer an alternative to land disposal as the solidified masses would be disposed of in a landfill.

c. Assessment of Risks from Remaining Residuals

The solidified materials would be disposed of in a landfill, thereby removing the risk associated with the fixation mass. A risk would still exist associated with any residual contamination in the physical pipeline sections, concrete lift stations and adjacent soils but due to the restricted nature of the site, the probability of exposure to the residual contamination is minimal.

2. Implementability

a. Technical Feasibility

1. Fixation is a standard remedial action process with demonstrated proven success. The actual success of applying the fixation process to the chemical waste sewer sludges would be dependent upon the effectiveness of fixing agents selected.

2. Because this alternative would consist of removal and disposal, it would most likely trigger RCRA disposal requirements. It is assumed that the fixation process would sufficiently bond the contaminants so that leaching of the contaminants would not occur.

3. Fixation has been successfully used as a treatment process for organic and inorganic wastes at other sites with similar contamination.

4. Implementation of this alternative in extreme cold weather would result in complications due to freezing. Also, any freeze-thaw action on the solidified masses may result in the degradation of the material.

b. Availability

1. Fixation and the pretreatment step are standard processes and would be readily implemented. Sufficient equipment, materials and personnel are all locally available.

2. The amount of material to be treated is relatively small (i.e., 25 cu yds) and should be able to be easily disposed of at either the on-site RCRA landfill or at an off-site location.

   As previously stated for Areas A and B, establishing an on-site location for the treatment process and temporary storage may prove difficult because of the limited available space on CWM's property.

3. The implementation of this alternative may not completely remediate contamination associated with the chemical waste sewer system. It would be necessary to perform additional investigations and monitoring to determine if contamination has spread from the sewer lines and lift stations.

c. Cost

The estimated cost associated with this alternative, excluding aqueous treatment, is approximately $262,000.

B. Alternative 2: Pumping-Treatment-Disposal

This alternative is similar to that previously stated for Area A (i.e., solvent extraction). However, the treatment material would be disposed of in a landfill, not returned to the sewer system. Also, a dewatering step may be required to reduce the aqueous content of the sludge in order to ensure a more effective treatment. Figure 5-16 presents a conceptual schematic of this alternative.

1. Effectiveness

The effectiveness of this alternative would be the same as for Area A. Additional process steps would probably be required to treat all the organic and inorganic contaminants.

2. Implementability

The implementability of this alternative would be the same as for Area A.

3. Cost

This cost estimate for this alternative, excluding aqueous treatment, is approximately $296,000.

C. Alternative 3: Pumping-Incineration

Implementing this alternative would consist of removal of the sludge from the sewer system and direct placement into a tanker truck. Because of the high content of organic contaminants and metals, it is assumed that the sludge would qualify as hazardous waste based on TCLP analyses. Therefore, the final disposition of the dewatered sludge would consist of incineration at a permitted off-site out-of-state facility.

Due to the elevated metals content in the sludge, it may be necessary to further treat the incinerator ash residues prior to final disposal. Figure 5-17 presents a conceptual schematic of this alternative.

1. Effectiveness

The effectiveness of the incineration of the chemical waste sewer system materials is similar to that previously stated for the off-site incineration of TNT contaminated sediments with the exception that the chemical waste system materials would not pose an explosive hazard.

2. Implementability

The implementability of the incineration of chemical waste sewer system materials would be the same as for the TNT-contaminated materials. However, identifying an incinerator facility that will accept the variety and concentrations of the contaminants may be difficult. The Laidlaw facility in Colfex, Louisiana has been identified as a possible acceptable location.

3. Cost

The estimated cost for implementing this alternative, excluding aqueous treatment, would be approximately $271,000.

5.2.5 Asbestos-Containing Materials

The options for the removal action for asbestos-containing materials are limited because landfilling is the only feasible alternative. Therefore, the assessment of the options for the remediation of asbestos-contaminated materials is limited to the evaluation of disposal costs at three different landfills.

- Disposal at one of two off-site landfills; and
- Disposal at an existing on-site landfill.

The disposal costs during the preparation of this EE/CA range from $35/ton at to $75/ton. The total maximum cost associated with this alternative would be approximately $135,000.

5.2.6 Miscellaneous Liquids and Oils

The materials to be addressed under this category include a 55 gallon open-top drum of oil; approximately sixteen 1-gallon containers of sodium hydroxide, hydrochloric acid, pentane, and several other non-identified liquid chemicals; and 26 gallons of chromic acid. It was deemed that the low volume of those materials did not warrant a complete and extensive evaluation of several remedial alternatives. Instead, cost estimates for removal and recycling, treatment or disposal were obtained from three firms offering these services.

The total cost for removal and disposal of all these materials range from $1,525 to $3,010. The total cost for this alternative should be about $11,000.

5.3 Aqueous Matrix

Aqueous materials anticipated to require some form of treatment as a result of the implementation of removal actions identified in this EE/CA consist of the free groundwater encountered during excavation activities in Areas A and B (estimated at 320,000 gallons); water present within the TNT pipeline system plus water generated as part of the removal process (estimated at 78,000 gallons); and water present in the AFP-68 chemical waste sewer system (estimated at 30,000 gallons). It is assumed that the aqueous matrix treatment alternatives will apply only to the aqueous materials removed at the time of the implementation of the removal action(s). Long-term recovery and treatment of the aqueous matrix is not assumed.

Insulation and heating of the unit would be required for use during the winter.

b. Availability

1. Mobile aqueous treatment systems are readily available from several vendors in the region.

2. The system would be provided with sufficiently sized holding tanks for batch treatment of the aqueous materials. The system to be utilized would have a 10 to 50 gallon per minute treatment capacity.

3. No post-remediation controls would be required.

c. Administrative Feasibility

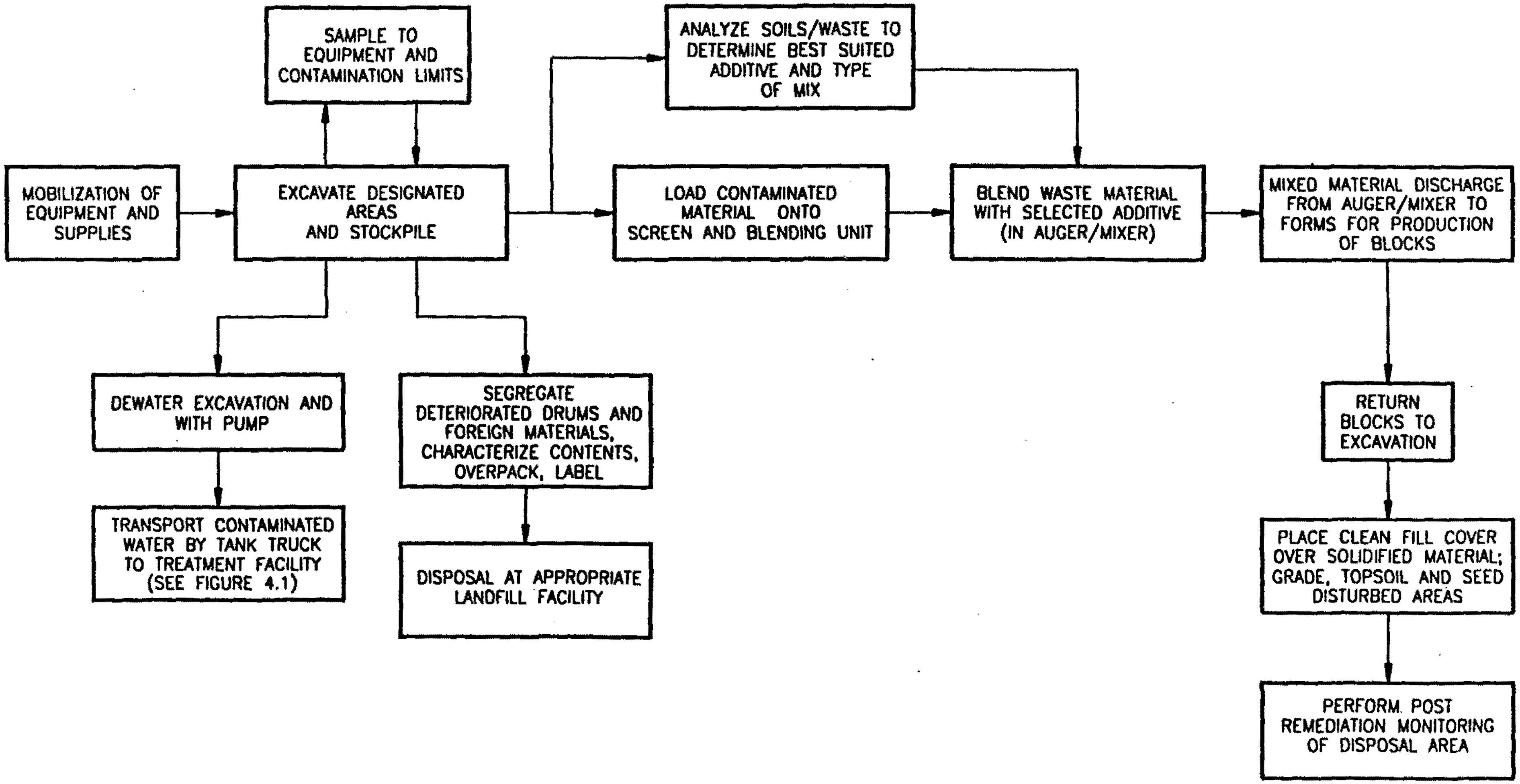
1. This alternative should be acceptable by the public but possibly not as readily as the use of an existing system.

2. The implementation of this alternative would require coordination with the EPA and DEC.

3. The necessary permits and approvals should be able to be obtained if it can be adequately demonstrated that the system will meet the treatment standards prior to startup.

3. Cost

The cost associated with constructing and operating an aqueous treatment system on-site would be approximately $334,000.



AREAS A AND B
ALTERNATIVE 1
REMOVAL/FIXATION/DISPOSAL

FIGURE 5.1 ACRES

RAK 2/21/ FILE: DRG044 P0981828 CODE: 28105

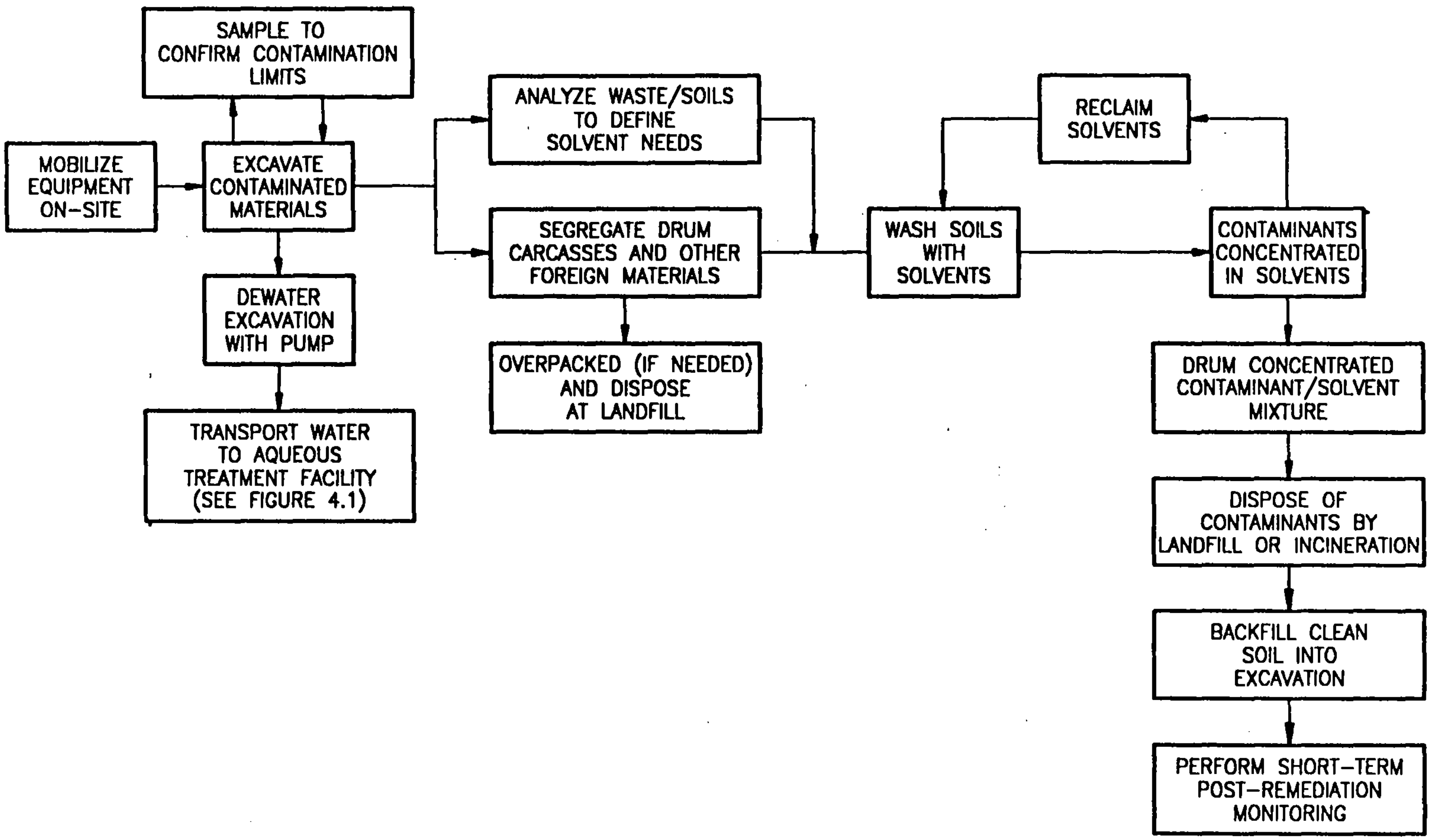
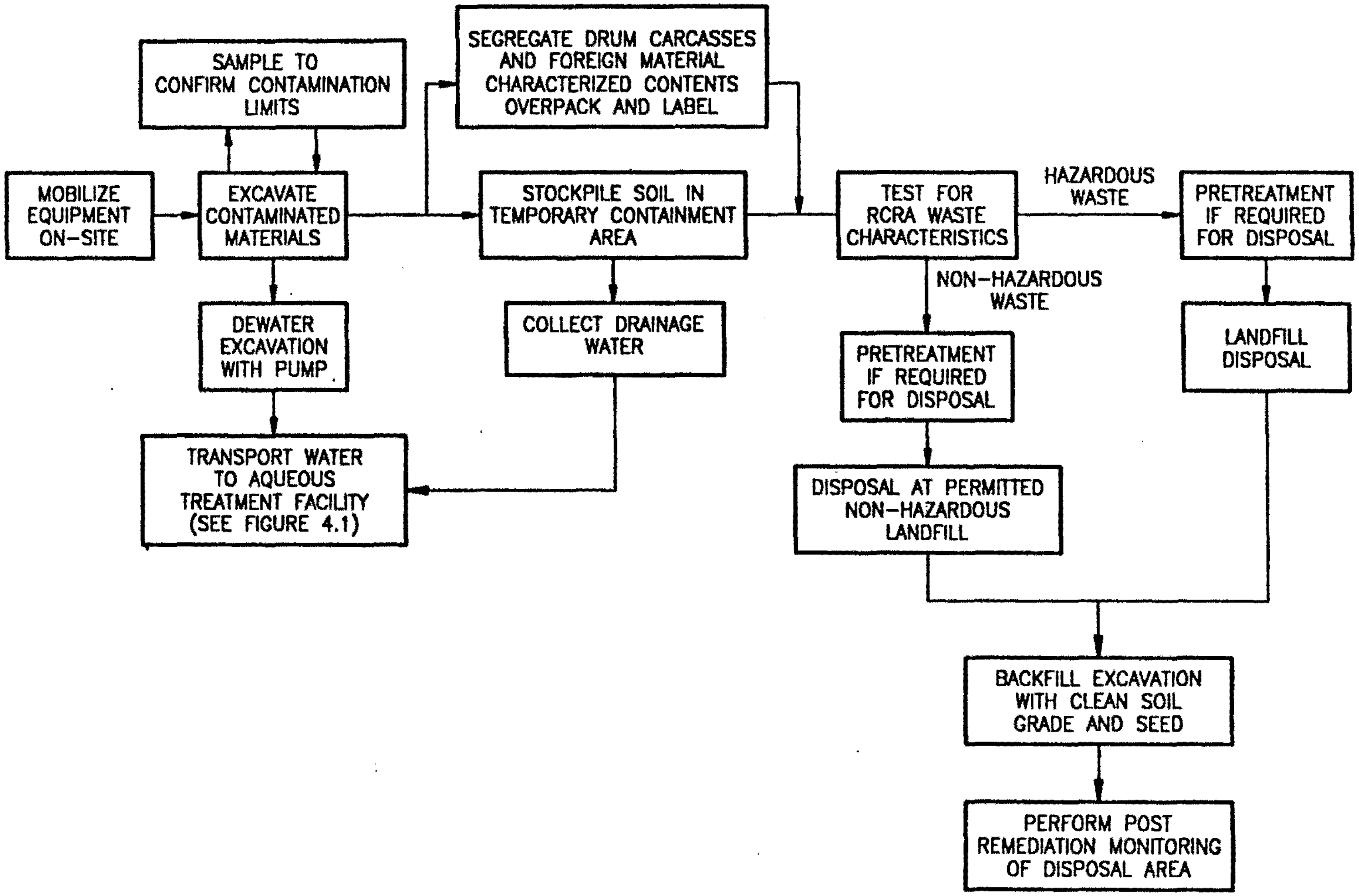


FIGURE 5.2

AREAS A AND B
ALTERNATIVE 2
EXCAVATION/SOLVENT EXTRACTION/DISPOSAL

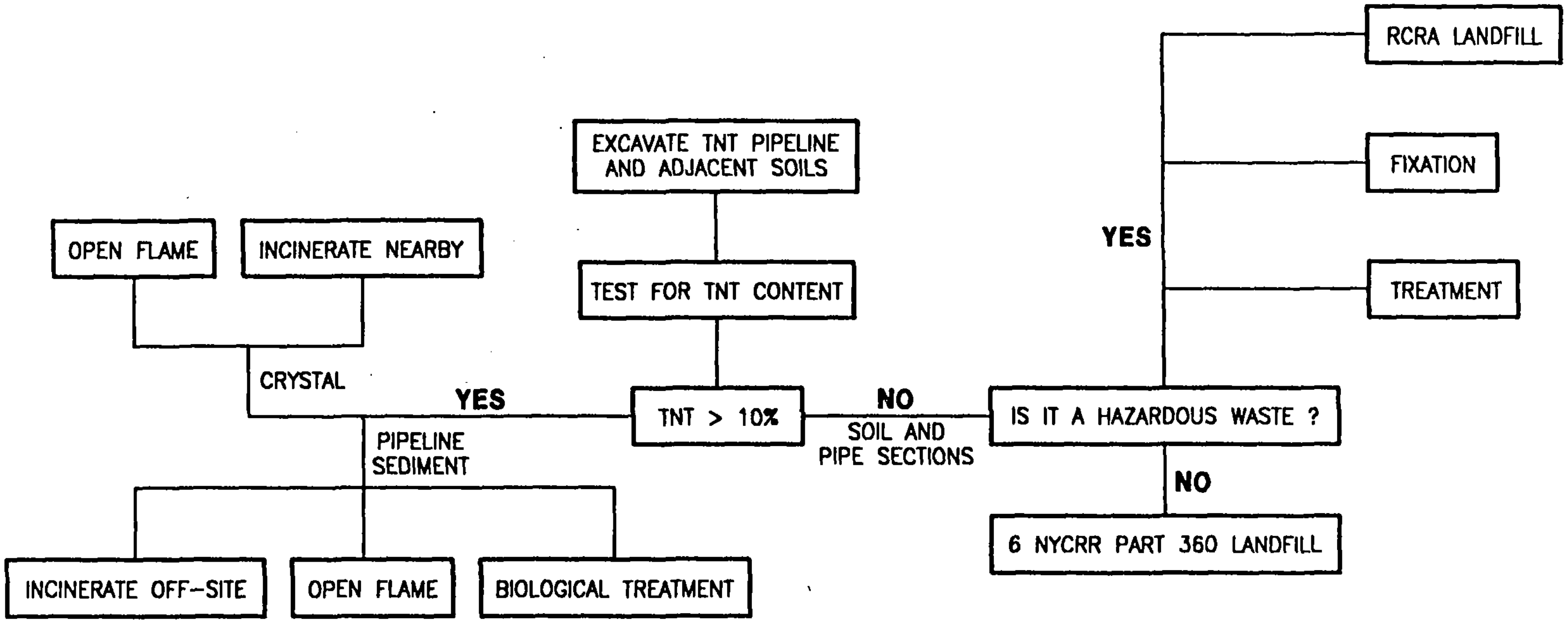


AREAS A AND B
ALTERNATIVE 3
EXCAVATE / DISPOSAL

FIGURE 5.3

ACRES

RAK 2/21 P0981828
FILE: DRG060 CODE: 28105



NOTE: FOR ESTIMATE PURPOSES ASSUME:

1. SEDIMENTS HAVE TNT CONTENT > 10% AND COMPOSED OF 10% CRYSTAL (26 TONS), 90% TNT CONTAMINATED SEDIMENTS (230 TONS).

2. SOIL AND PIPES HAVE TNT CONTENT <10% AND ARE COMPOSED OF 10% HAZARDOUS WASTE (445 TONS), 90% NON-HAZARDOUS WASTE (4005 TONS).

FIGURE 5.4

TNT PIPELINE REMEDIATION DECISION CHART

ACRES

WHM 11/18/94 FILE: DRG046 P0981828 CODE: 28105

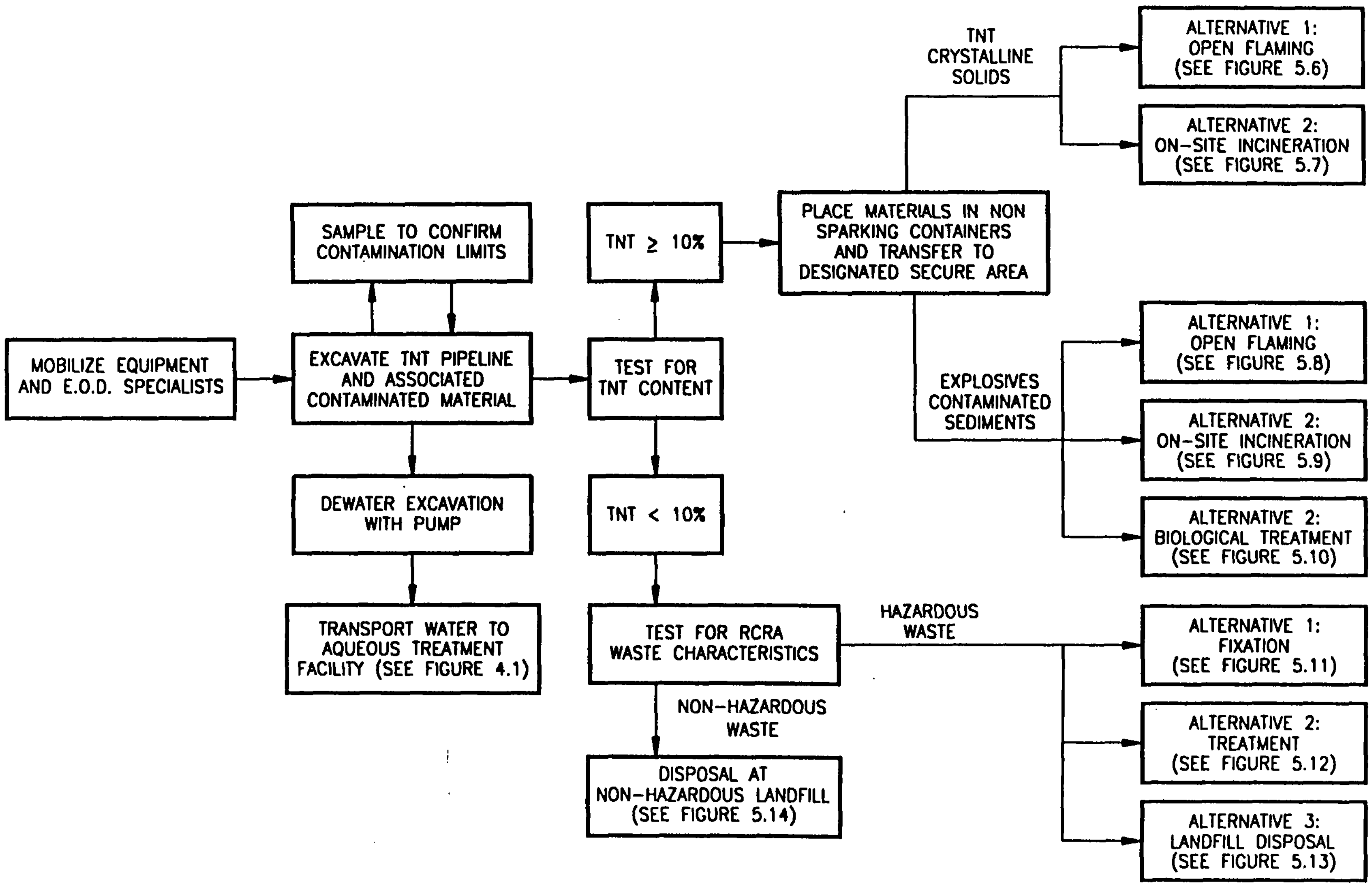
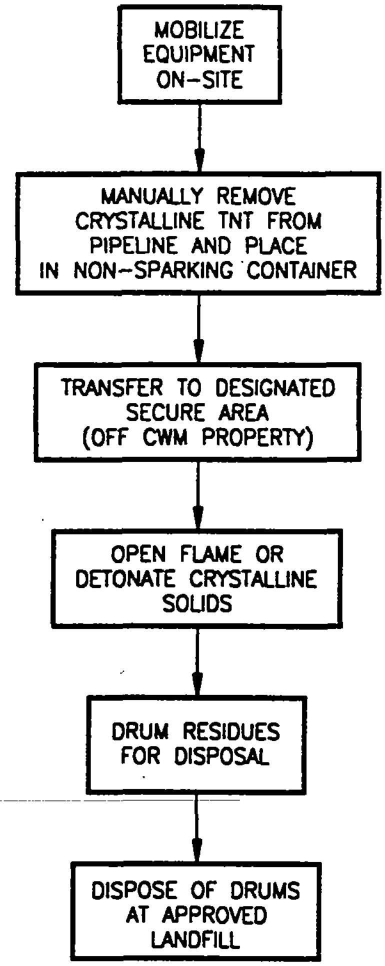


FIGURE 5.5

ALTERNATIVES FOR TNT SEWER SYSTEM

ACRES

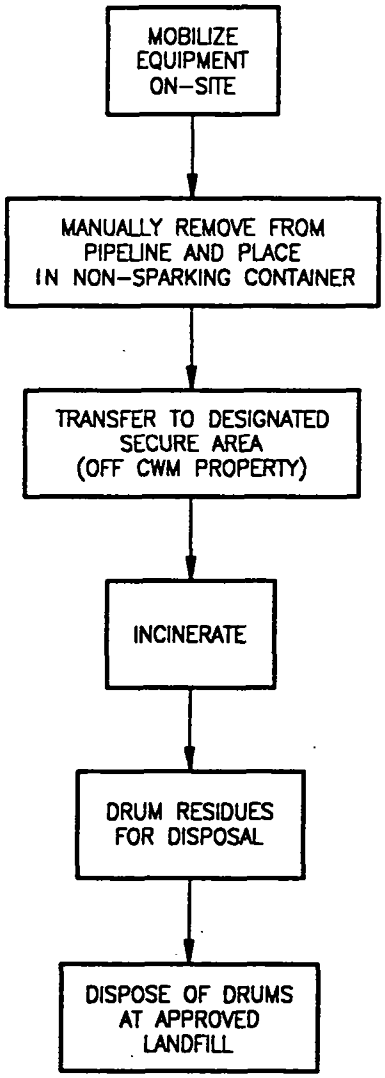
WHM 11/17/94 FILE: DRG047 P0981828 CODE: 28105



TNT CRYSTALLINE SOLIDS
ALTERNATIVE 1
OPEN FLAMING

FIGURE 5.6 ACRES

RAK 2/21/95
FILE: DRG048
381628
CODE: 28105

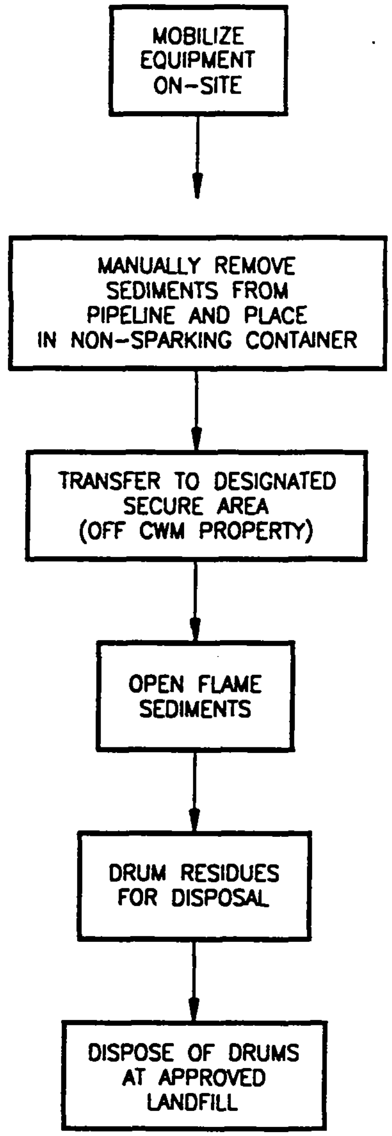


TNT CRYSTALLINE SOLIDS
ALTERNATIVE 2
ON-SITE INCINERATION

FIGURE 5.7

ACRES

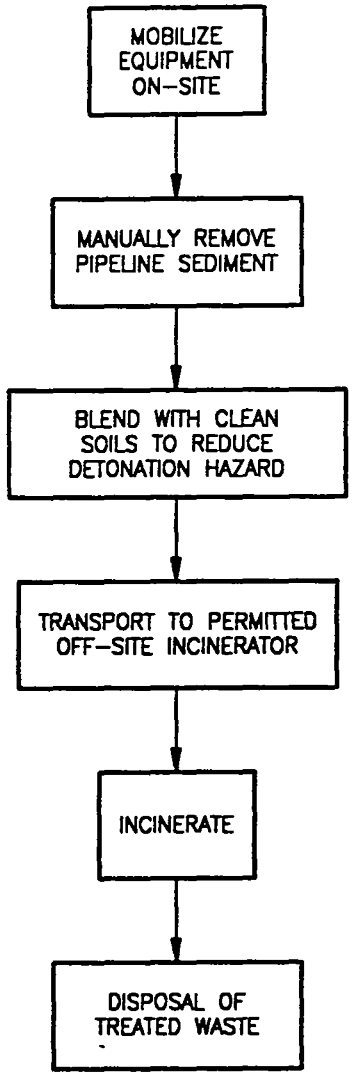
WHM 11/17/94 P0981828
FILE: DRG050 CODE: 28105



EXPLOSIVES CONTAMINATED SEDIMENTS
TNT > 10 %
ALTERNATIVE 1
REMOVAL / OPEN FLAMING

FIGURE 5.8 ACRES

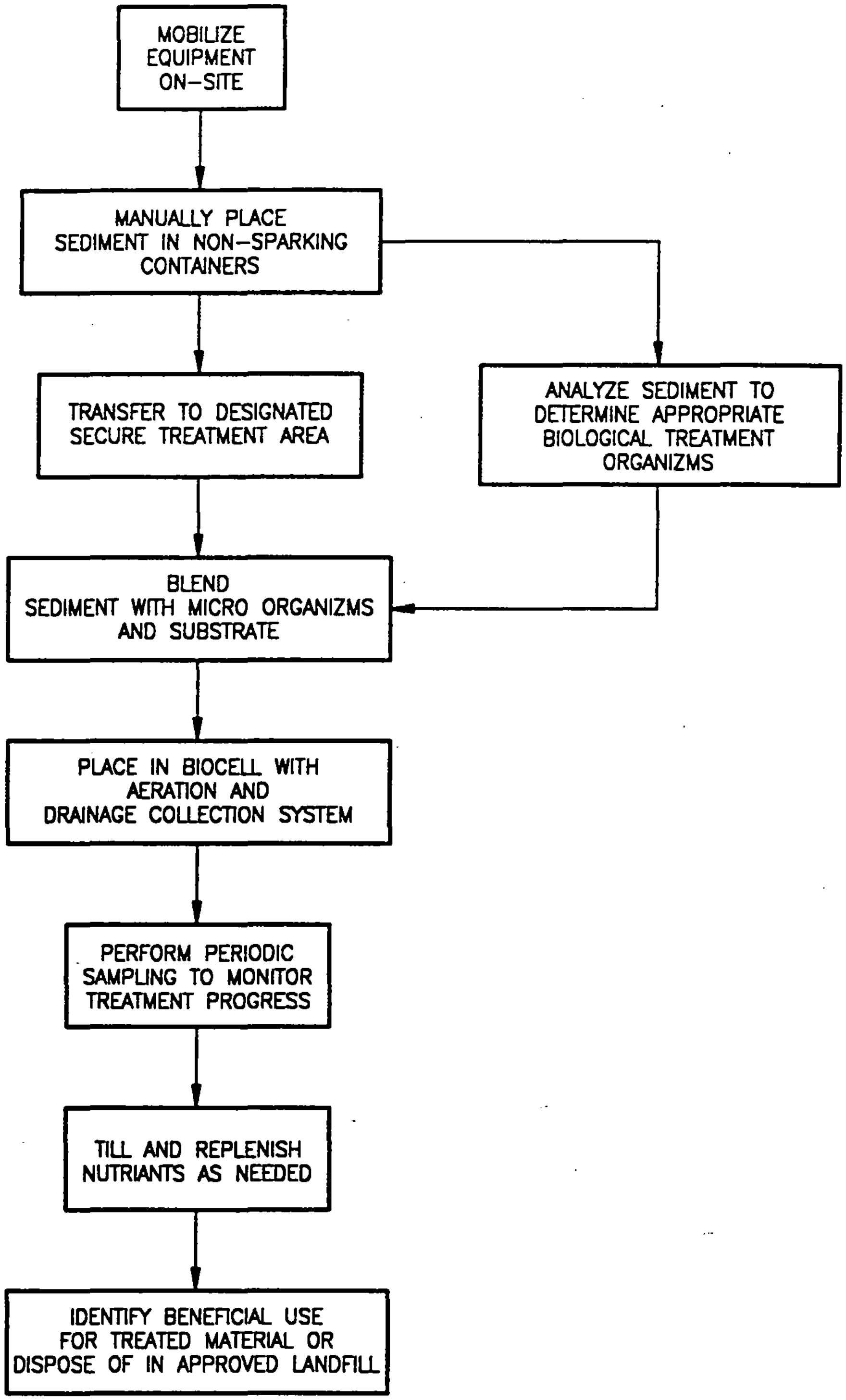
RAK 2/21/95 981628
FILE: DRG051 CODE: 28105



EXPLOSIVES CONTAMINATED SEDIMENTS
TNT > 10 %
ALTERNATIVE 2
REMOVAL / INCINERATION

FIGURE 5.9 ACRES

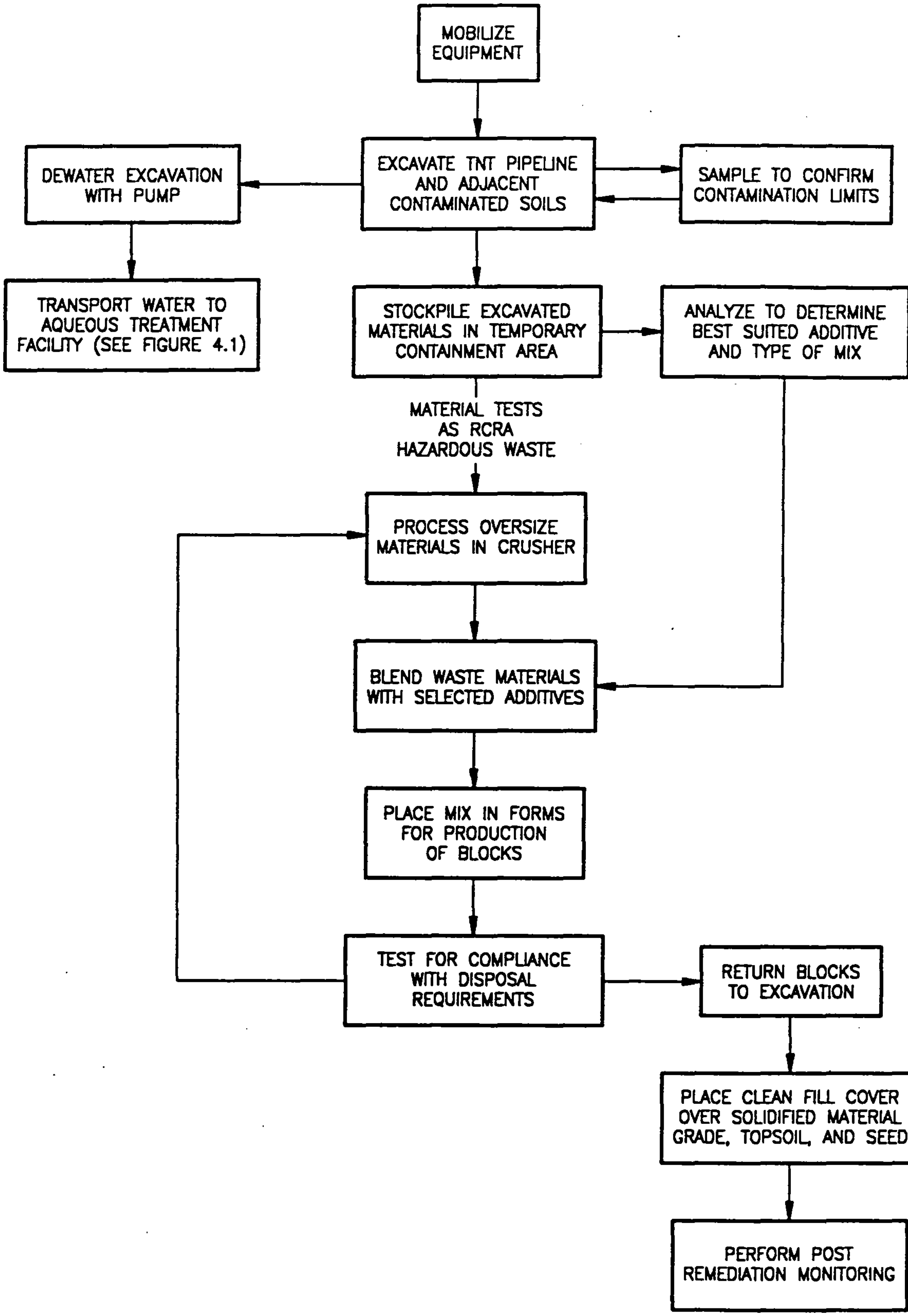
RAK 3/1/95
FILE: DRG052
81828
CODE: 28105



EXPLOSIVES CONTAMINATED SEDIMENTS
TNT > 10 %
ALTERNATIVE 3
REMOVAL / BIOLOGICAL TREATMENT

FIGURE 5.10

RAK 2/21/95 FILE: DRG053
981828 CODE: 28105



TNT PIPELINE, CONCRETE ENCASEMENT AND CONTAMINATED SOILS ALTERNATIVE 1 : HAZARDOUS WASTE EXCAVATION / FIXATION / DISPOSAL

FIGURE 5.11 ACRES

RAK 2/21/95 FILE: DRG054
981828 CODE: 28105

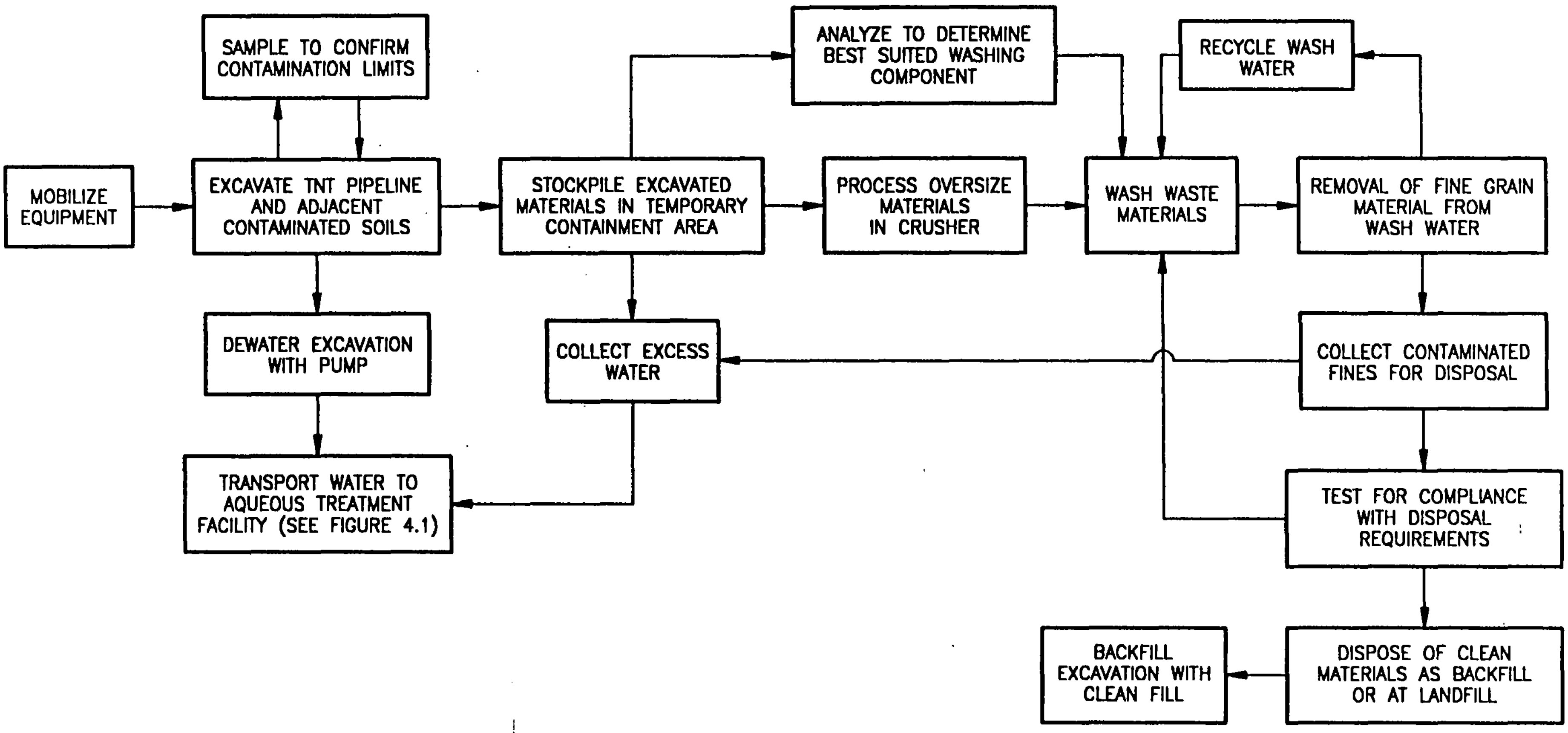
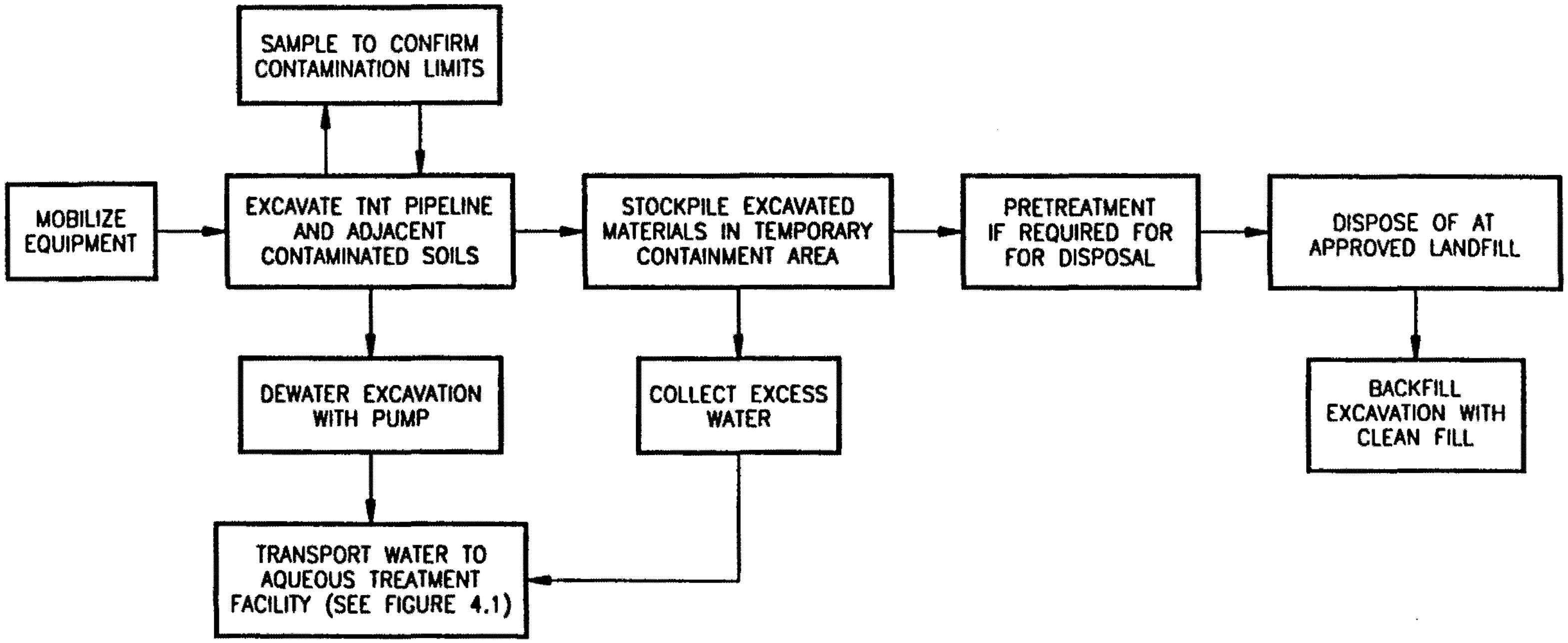


FIGURE 5.12

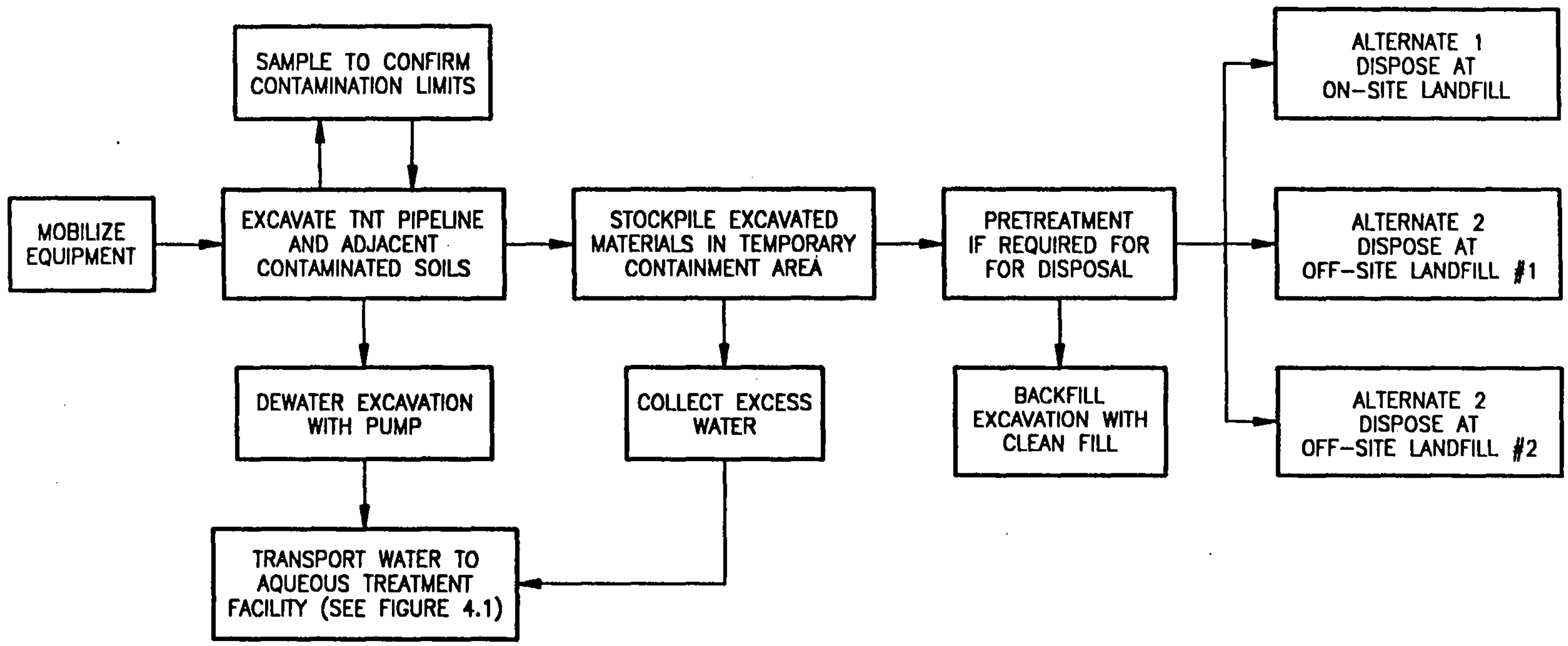
ACRES

TNT PIPELINE, CONCRETE ENCASEMENT AND CONTAMINATED SOILS ALTERNATIVE 2 : HAZARDOUS WASTE EXCAVATION / SOIL WASHING / DISPOSAL



TNT PIPELINE, CONCRETE ENCASEMENT AND CONTAMINATED SOILS ALTERNATIVE 3 : HAZARDOUS WASTE EXCAVATION / DISPOSAL

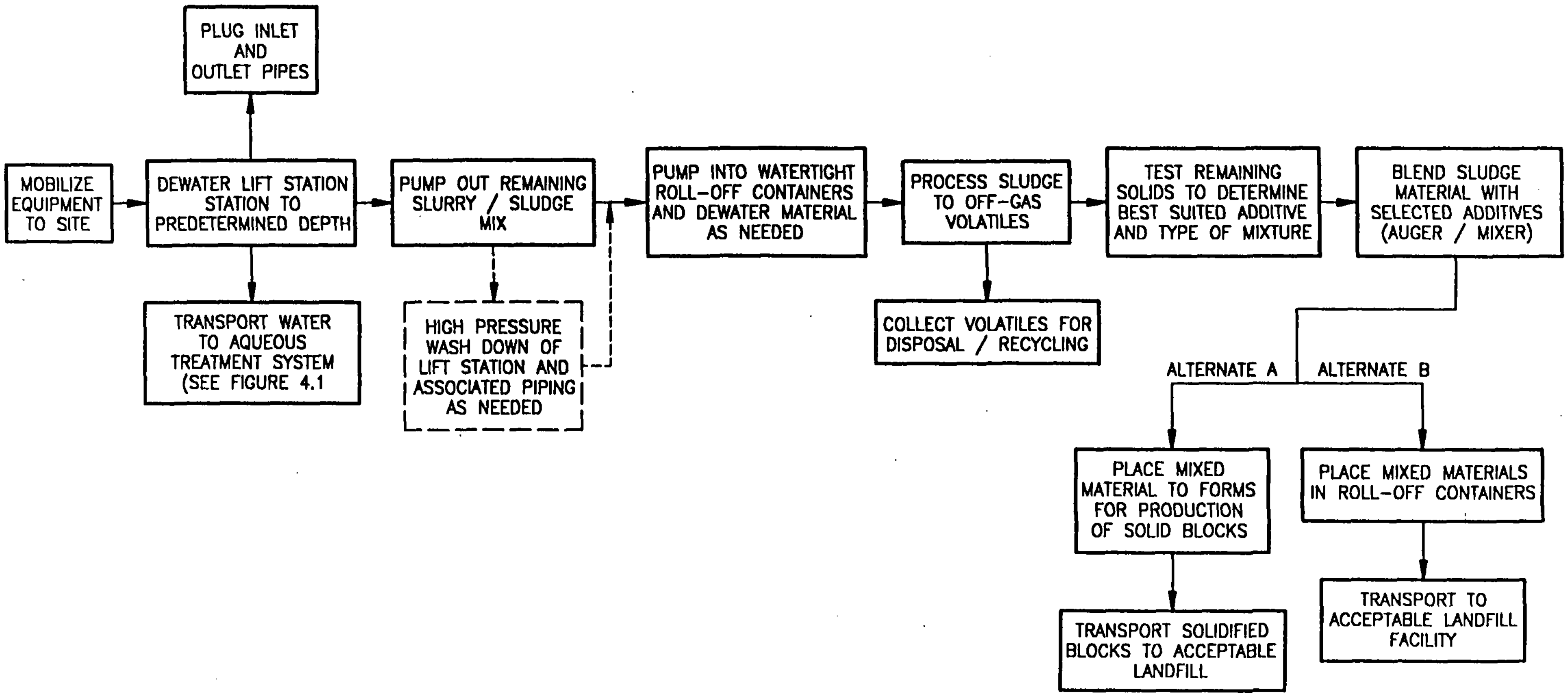
FIGURE 5.13



TNT PIPELINE, CONCRETE ENCASEMENT AND CONTAMINATED SOILS ALTERNATIVE 1, 2 AND 3 : NON-HAZARDOUS WASTE EXCAVATION / DISPOSAL

FIGURE 5.14

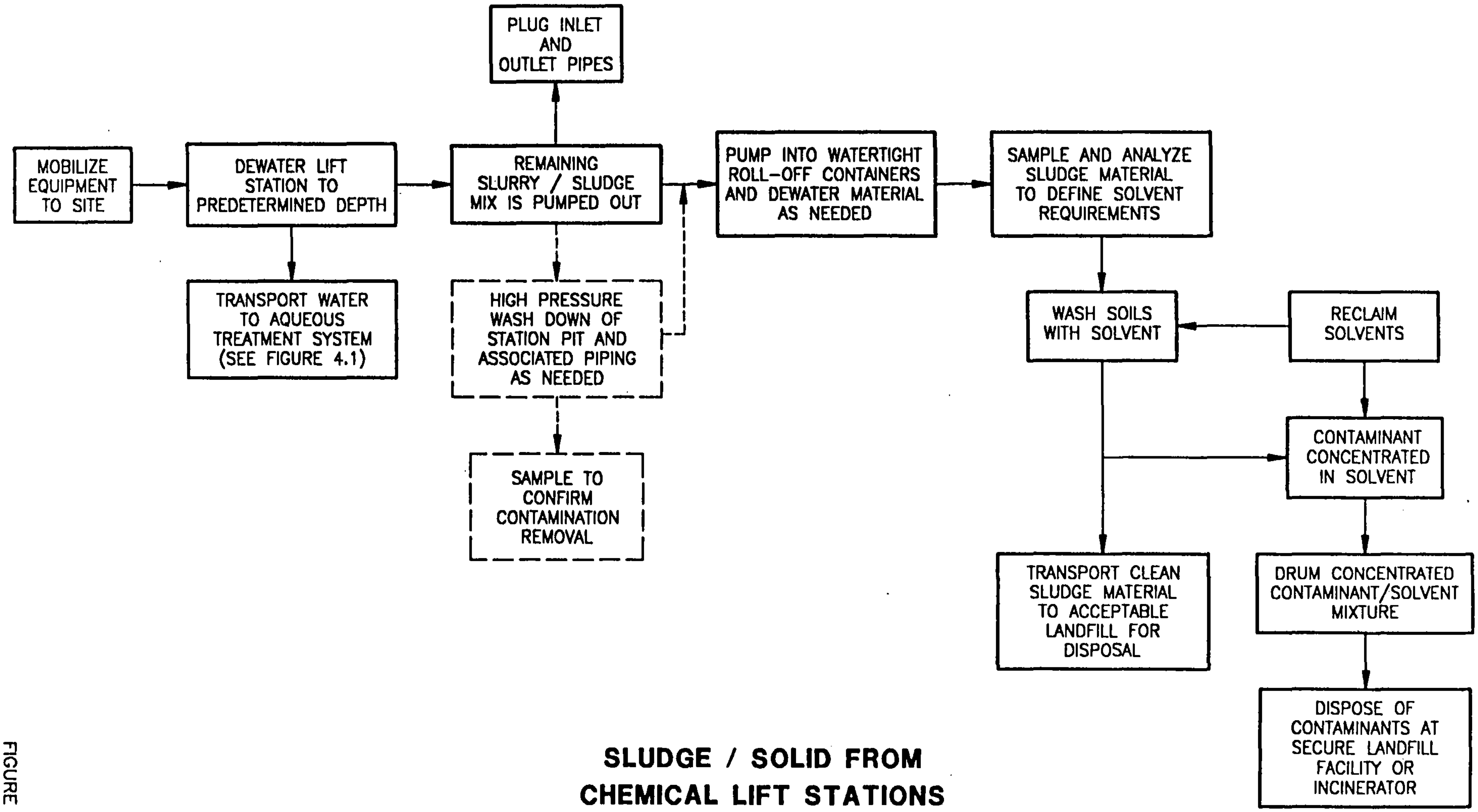
ACRES



SLUDGE / SOLID FROM CHEMICAL LIFT STATIONS ALTERNATIVE 1 FIXATION / LANDFILL

FIGURE 5.15

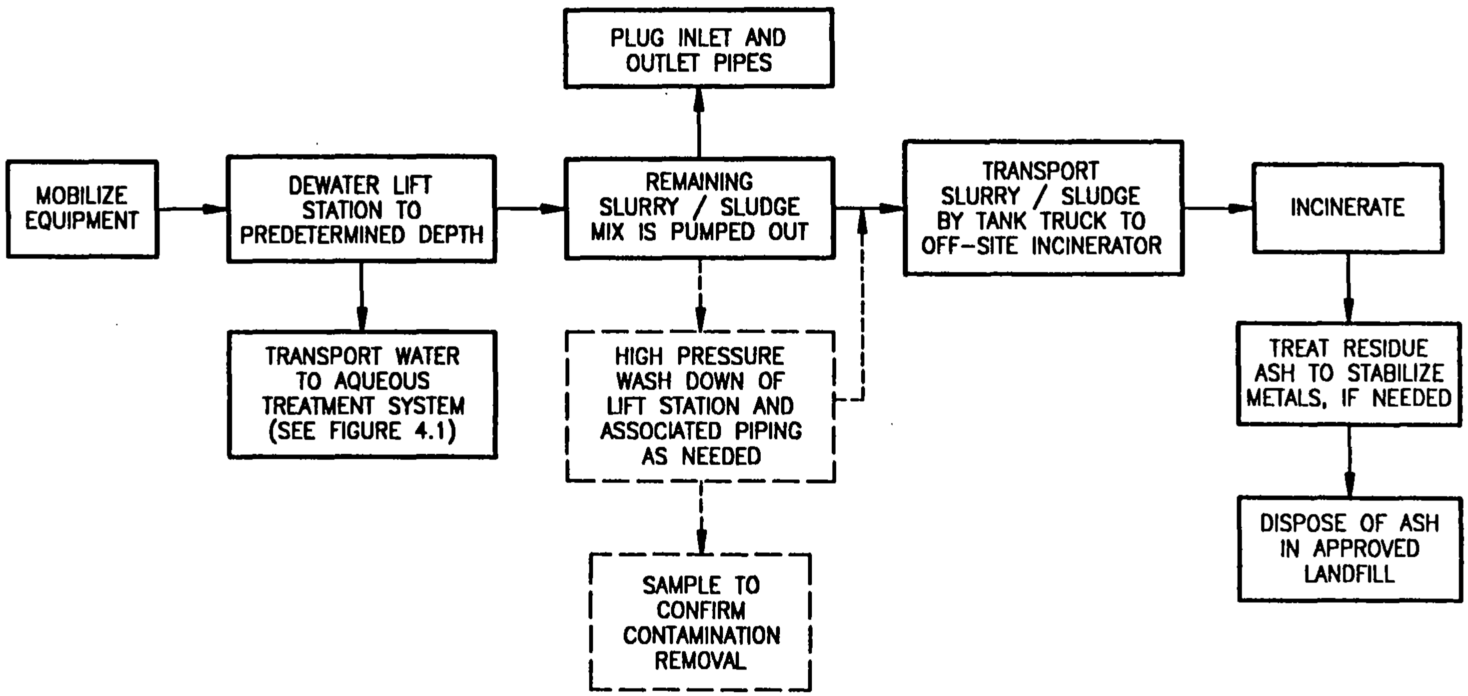
ACRES



SLUDGE / SOLID FROM CHEMICAL LIFT STATIONS ALTERNATIVE 2 REMOVAL / TREATMENT BY SOLVENT EXTRACTION / DISPOSAL

FIGURE 5.16

ACRES



CHEMICAL WASTE LIFT STATION SLUDGE
ALTERNATIVE 3
REMOVAL / INCINERATION

FIGURE 5.17

ACRES

6 Comparative Analysis

6.1 Evaluation Methodology and Criteria

The evaluation methodology consisted of a matrix-type comparative analysis of the alternatives for each source area based on the three general criteria of effectiveness, implementability, and cost, and associated subcriteria as referenced in Section 3 of the Final Scope of Work for the EE/CA dated July 18, 1994.

The following main criteria categories and associated weighting factors were used in the comparative analysis.

CRITERIA	WEIGHTING FACTOR	
1. Effectiveness		
- Protectiveness	11%	33%
- Use of alternatives to land disposal	11%	
- Assessment of risk after remediation	11%	
2. Implementability		
- Technical Feasibility	11%	33%
- Availability	11%	
- Administrative Feasibility	11%	
3. Cost	-	34%
		100%

A detailed description of each criteria category is presented in Section 5.1. The alternatives have been rated for each criterion on a scale of 1 to 3, with 1 being rated the best; 2 rated as better; 3 rated as good or lower. Each of the three general criteria categories were assigned approximately the same weighting (Effectiveness - 33%, Implementability - 33%, Cost - 34%) for the evaluation. A perfect score would result in a total rating of 100 while the poorest score would be 300.

The results of the comparative analysis are presented in Tables 6.2 through 6.8.

The matrix analysis provides an objective means to weigh each criterion and evaluate the alternatives for each identified source area. The alternative with the lowest overall score has been identified as the most appropriate removal action for that particular site area. The other remaining alternatives have also been ranked by overall score.

6.2 Cost Evaluation

The cost evaluation and comparison of alternatives have been based on an order-of-magnitude estimate of total costs developed for each alternative, including an estimate of direct capital costs, indirect capital costs and any post-remediation site control (PRSC) costs.

The cost estimates have been developed in accordance with the guidelines outlined in the USEPA Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA dated August 1993 and based on similar project costs, quotations and cost manuals. The cost estimating format adopted for purposes of the evaluation is presented in Table 6.1.

The estimates, as noted in Table 6.1 have included the following cost allowances:

1. A 15 to 20 percent contingency allowance depending on the number of unknowns associated with each alternative that could result in additional direct capital costs. A lower contingency was added to the cost for the more conventional removal action approaches while a higher contingency was included in the cost for alternatives utilizing an approach with limited performance history and/or greater potential for additional costs associated with unforeseen problems.

2. A typical allowance for engineering and design costs ranging from 5 to 10 percent of direct capital costs, depending on the estimated engineering effort that would be involved with each alternative. However, a larger percentage allowance had to be included for several of the small removal action operations (i.e., removal actions for the miscellaneous containerized liquids) to cover the specific level of effort required in preparing an adequate scope of work and specifications for these actions.

3. A typical allowance of 10 percent of total direct costs for any legal fees and licensing or permit costs that may be required. However, for the alternatives that utilize permitted off-site disposal facilities, these costs would be significantly lower and were therefore adjusted accordingly. For the small scale removal actions, these costs were anticipated to be significantly higher and the estimate, therefore, included a higher percentage allowance in a few cases.

An annual escalation rate of 4 percent was used to update the costs to current 1995 dollars.

It should be noted that the estimated costs have not included allowances for any additional costs that may result from delays caused by potential conflicts with CWM on-site operations or potential disruption of CWM operations. The potential for these cost impacts cannot be defined at this time. However, the close coordination of all removal action activities with CWM operations should be an important consideration during the detailed planning and design phase. Such planning should help to avoid any potential conflicts and resulting additional costs.

The estimated annual post-remediation site control (PRSC) costs were also developed and evaluated using present worth analysis based on an assumed annual rate of 5 percent, and a 5-year term of performance. These costs represent order-of-magnitude estimates.

6.3 Results of the Alternatives Evaluation

Tables 6.9 through 6.15 present the final rating scores and ranking of alternatives resulting from the comparative analysis. The itemized breakdown of estimated costs for each alternative and related cost backup are presented in Appendix B.

The main advantages and disadvantages of each alternative are qualitatively compared for each source area in Tables 6.16 through 6.21.

TABLE 6.1
COST ESTIMATING FORMAT

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1. DIRECT CAPITAL COSTS

   1.1 Remedial Construction/Removal Costs

   - Mobilization/Demobilization
   - Land and Site Acquisition Costs
   - Relocation Costs
   - Temporary Structures and Services (for removal action)
   - Field Office and Services
   - Excavation
   - Dewatering/Drainage Control
   - Pretreatment Costs (for excavated materials)
   - On-site Treatment Costs
   - Staging/Work Areas
   - Backfilling
   - Topsoiling/Seeding
   - Decontamination Costs
   - Health and Safety Plan/Monitoring
   - Post-excavation Sampling/Analyses

   1.2 Off-site Treatment/Disposal Costs
   - Testing/Analytical Costs
   - Transport Costs
   - Tipping Fees

   1.3 Contingencies - (+15% to 20%) (for unknown conditions)

*2. INDIRECT CAPITAL COSTS
   2.1 Construction Management
   Cost = $_______ /mo x ______ months
   2.2 Engineering & Design (+5% to 10% of total direct costs)
   2.3 Legal Fees and Licensing or Permit Costs (allowance of 10% of total direct costs)

*3. ANNUAL PRSC COSTS
   3.1 Post-Remediation Monitoring Costs
   3.2 Support Costs

   } ... Dependent on specific requirements of removal action alternative

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*NOTE: The following costs are not applicable to the removal action alternatives being evaluated for the LOOW site and have therefore been excluded from the above outlined format:

(1) Indirect costs for start-up and shakedown
(2) Annual PRSC costs for:
- O&M
- Auxiliary materials and energy
- Disposal of residuals

1 - Best
2 - Better
3 - Good

TABLE 6.2
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES AREA A

Alt. 1 Fixation	Rank	Alt. 2 Treatment	Rank	Alt. 3 Landfilling	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
1		1		1		1. Threats to surrounding community during implementation
2		3		2		2. Threats to workers during implementation
3		1		1		3. Extent to which action reduces identified risk (at site)
2		3		1		4. Time until protection is achieved
2		1		1		5. Compliance with ARARs (chemical and location specific)
3		2		2		6. Potential adverse environmental impacts from implementation
2		1		1		7. Potential for future exposure to residuals on site
2		1		2		8. Long-term reliability
17	3	13	2	11	1	Overall Protectiveness Score
3	3	2	2	3	3	B. Use of Alternatives to Land Disposal
2	2	1	1	1	1	C. Assessment of Risk from Remaining Residual (at site)
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
2		3		1		1. Ability to construct and run the technology
2		2		1		2. Ability to meet ARARs (action specific)
2		2		1		3. Past demonstrated performance
3		2		1		4. Potential impacts of environmental conditions such as climate
9	2	9	2	4	1	Overall Technical Feasibility Score
						B. Availability
2		3		1		1. Availability of necessary equipment, materials & personnel
2		2		1		2. Availability of adequate treatment, storage & disposal capacity
3		1		1		3. Post remediation controls required at site and availability
7	3	6	2	3	1	Overall Availability Score
						C. Administrative Feasibility
3		2		1		1. Likelihood of public acceptance
2		2		2		2. Need for coordination with other agencies
3		3		1		3. Ability to obtain necessary permits & approvals
8	3	7	2	4	1	Overall Administrative Feasibility Score
1	1	3	3	2	2	5.1.3 Cost Evaluation

1 - Best
2 - Better
3 - Good

TABLE 6.3
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
AREA B

Alt. 1 Fixation	Rank	Alt. 2 Treatment	Rank	Alt. 3 Landfilling	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
1		1		1		1. Threats to surrounding community during implementation
2		3		2		2. Threats to workers during implementation
3		1		1		3. Extent to which action reduces identified risk (at site)
2		3		1		4. Time until protection is achieved
2		1		1		5. Compliance with ARARs (chemical and location specific)
3		2		2		6. Potential adverse environmental impacts from implementation
2		1		1		7. Potential for future exposure to residuals on site
2		1		2		8. Long-term reliability
17	3	13	2	11	1	Overall Protectiveness Score
3	3	2	2	3	3	B. Use of Alternatives to Land Disposal
2	2	1	1	1	1	C. Assessment of Risk from Remaining Residual (at site)
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
2		3		1		1. Ability to construct and run the technology
2		2		1		2. Ability to meet ARARs (action specific)
2		2		1		3. Past demonstrated performance
3		2		1		4. Potential impacts of environmental conditions such as climate
9	2	9	2	4	1	Overall Technical Feasibility Score
						B. Availability
2		3		1		1. Availability of necessary equipment, materials & personnel
2		2		1		2. Availability of adequate treatment, storage & disposal capacity
3		1		1		3. Post remediation controls required at site and availability
7	3	6	2	3	1	Overall Availability Score
						C. Administrative Feasibility
3		2		1		1. Likelihood of public acceptance
2		2		2		2. Need for coordination with other agencies
3		3		1		3. Ability to obtain necessary permits & approvals
8	3	7	2	4	1	Overall Administrative Feasibility Score
1	1	3	3	2	2	5.1.3 Cost Evaluation

1 - Best
2 - Better
3 - Good

TABLE 6.4
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
TNT - CRYSTALLINE SOLIDS

Alternative 1 Open Flame (nearby)	Rank	Alternative 2 Incineration (nearby)	Rank	Analytical Criteria
				5.1.1 Effectiveness Evaluation
				A. Protectiveness
3		2		1. Threats to surrounding community during implementation
3		3		2. Threats to workers during implementation
1		1		3. Extent to which action reduces identified risk (at site)
1		3		4. Time until protection is achieved
1		1		5. Compliance with ARARs (chemical and location specific)
2		2		6. Potential adverse environmental impacts from implementation
1		1		7. Potential for future exposure to residuals on site
1		1		8. Long-term reliability
13	1	14	2	Overall Protectiveness Score
1	1	1	1	B. Use of Alternatives to Land Disposal
1	1	1	1	C. Assessment of Risk from Remaining Residual (at site)
				5.1.2 Implementability Evaluation
				A. Technical Feasibility
1		3		1. Ability to construct and run the technology
2		3		2. Ability to meet ARARs (action specific)
1		1		3. Past demonstrated performance
2		3		4. Potential impacts of environmental conditions such as climate
6	1	10	2	Overall Technical Feasibility Score
				B. Availability
1		3		1. Availability of necessary equipment, materials & personnel
1		3		2. Availability of adequate treatment, storage & disposal capacity
1		1		3. Post remediation controls required (at site) and availability
3	1	7	2	Overall Availability Score
				C. Administrative Feasibility
3		3		1. Likelihood of public acceptance
3		3		2. Need for coordination with other agencies
3		3		3. Ability to obtain necessary permits & approvals
9	1	9	2	Overall Administrative Feasibility Score
1	1	3	3	5.1.3 Cost Evaluation

1 - Best
2 - Better
3 - Good

TABLE 6.5
COMPARATIVE ANALYSIS OF
REMOVAL ACTION ALTERNATIVES
TNT SEDIMENTS (≥10% CONCENTRATIONS)

Alt. 1 Open Flame (Nearby)	Rank	Alt. 2 Incinerate Off-site	Rank	Alt. 3 Bio-Treatment (Nearby)	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
3		3		2		1. Threats to surrounding community during implementation
3		3		2		2. Threats to workers during implementation
1		1		1		3. Extent to which action reduces identified risk (at site)
1		1		3		4. Time until protection is achieved
3		1		2		5. Compliance with ARARs (chemical and location specific)
3		2		3		6. Potential adverse environmental impacts from implementation
1		1		1		7. Potential for future exposure to residuals on site
3		1		3		8. Long-term reliability
18	3	13	1	17	2	Overall Protectiveness Score
2	2	1	1	2	2	B. Use of Alternatives to Land Disposal
1	1	1	1	1	1	C. Assessment of Risk from Remaining Residual (at site)
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
1		2		2		1. Ability to construct and run the technology
3		1		3		2. Ability to meet ARARs (action specific)
2		1		2		3. Past demonstrated performance
2		1		3		4. Potential impacts of environmental conditions such as climate
8	2	5	1	19	3	Overall Technical Feasibility Score
						B. Availability
1		1		2		1. Availability of necessary equipment, materials & personnel
1		1		2		2. Availability of adequate treatment, storage & disposal capacity
1		1		1		3. Post remediation controls required (at site) and availability*
3	1	3	1	5	2	Overall Availability Score
						C. Administrative Feasibility
3		1		2		1. Likelihood of public acceptance
3		3		3		2. Need for coordination with other agencies
3		1		2		3. Ability to obtain necessary permits & approvals
9	3	5	1	7	2	Overall Administrative Feasibility Score
2	2	3	3	1	1	5.1.3 Cost Evaluation

*everything disposed of at site

1 - Best
2 - Better
3 - Good

TABLE 6.6
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES HAZARDOUS SOLIDS (≤10% CONCENTRATIONS)

Alt. 1 Fixation	Rank	Alt. 2 Treatment	Rank	Alt. 3 Landfill	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
1		1		1		1. Threats to surrounding community during implementation
2		3		2		2. Threats to workers during implementation
3		1		1		3. Extent to which action reduces identified risk (at site)
2		3		1		4. Time until protection is achieved
2		1		1		5. Compliance with ARARs (chemical and location specific)
3		2		2		6. Potential adverse environmental impacts from implementation
2		1		1		7. Potential for future exposure to residuals on site
2		1		2		8. Long-term reliability
17	3	13	2	11	1	Overall Protectiveness Score
3	3	2	2	3	3	B. Use of Alternatives to Land Disposal
2	2	1	2	1	1	C. Assessment of Risk from Remaining Residual (at site)
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
3		3		1		1. Ability to construct and run the technology
2		2		1		2. Ability to meet ARARs (action specific)
2		2		1		3. Past demonstrated performance
3		2		1		4. Potential impacts of environmental conditions such as climate
10	3	9	2	4	1	Overall Technical Feasibility Score
						B. Availability
3		3		1		1. Availability of necessary equipment, materials & personnel
3		3		1		2. Availability of adequate treatment, storage & disposal capacity
3		1		1		3. Post remediation controls required and availability
9	3	7	2	3	1	Overall Availability Score
						C. Administrative Feasibility
3		2		1		1. Likelihood of public acceptance
2		2		2		2. Need for coordination with other agencies
3		3		1		3. Ability to obtain necessary permits & approvals
8	3	7	2	4	1	Overall Administrative Feasibility Score
2	2	3	3	1	1	5.1.3 Cost Evaluation

1 - Best
2 - Better
3 - Good

TABLE 6.7
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES CHEMICAL LIFT STATIONS - SLUDGE/SOLIDS

Alt. 1 Fix/Landfill	Rank	Alt. 2 Treatment	Rank	Alt. 3 Incinerate Off-site	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
1		1		1		1. Threats to surrounding community during implementation
3		3		3		2. Threats to workers during implementation
1		1		1		3. Extent to which action reduces identified risk (at site)
3		3		1		4. Time until protection is achieved
1		1		1		5. Compliance with ARARs (chemical and location specific)
2		2		2		6. Potential adverse environmental impacts from implementation
1		1		1		7. Potential for future exposure to residuals on site
1		1		1		8. Long-term reliability
13	2	13	2	11	1	Overall Protectiveness Score
3	3	2	2	1	1	B. Use of Alternatives to Land Disposal
1	1	1	1	1	1	C. Assessment of Risk from Remaining Residual
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
3		3		1		1. Ability to construct and run the technology
2		2		2		2. Ability to meet ARARs (action specific)
2		2		1		3. Past demonstrated performance
2		2		2		4. Potential impacts of environmental conditions such as climate
9	2	9	3	6	1	Overall Technical Feasibility Score
						B. Availability
2		3		1		1. Availability of necessary equipment, materials & personnel
2		2		1		2. Availability of adequate treatment, storage & disposal capacity
1		1		1		3. Post remediation controls required and availability
5	2	6	3	3	1	Overall Availability Score
						C. Administrative Feasibility
1		1		1		1. Likelihood of public acceptance
3		3		3		2. Need for coordination with other agencies
3		3		2		3. Ability to obtain necessary permits & approvals
7	2	7	2	6	1	Overall Administrative Feasibility Score
1	1	3	3	2	2	5.1.3 Cost Evaluation

1 - Best
2 - Better
3 - Good

TABLE 6.8
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES AQUEOUS MATRIX (ASSUMED NONHAZARDOUS)

Alt. 1 Existing On-site	Rank	Alt. 2 Off-site	Rank	Alt. 3 On-site	Rank	Analytical Criteria
						5.1.1 Effectiveness Evaluation
						A. Protectiveness
1		2		3		1. Threats to surrounding community during implementation
3		3		3		2. Threats to workers during implementation
1		1		1		3. Extent to which action reduces identified risk (at site)
1		2		3		4. Time until protection is achieved
1		1		1		5. Compliance with ARARs (chemical and location specific)
2		2		3		6. Potential adverse environmental impacts from implementation
1		1		1		7. Potential for future exposure to residuals on site
1		1		1		8. Long-term reliability
11	1	13	2	16	3	Overall Protectiveness Score
1	1	1	1	2	2	B. Use of Alternatives to Land Disposal
1	1	1	1	1	1	C. Assessment of Risk from Remaining Residual (at site)
						5.1.2 Implementability Evaluation
						A. Technical Feasibility
1		1		3		1. Ability to construct and run the technology
1		1		2		2. Ability to meet ARARs (action specific)
1		1		2		3. Past demonstrated performance
2		2		3		4. Potential impacts of environmental conditions such as climate
5	1	5	1	10	2	Overall Technical Feasibility Score
						B. Availability
1		1		2		1. Availability of necessary equipment, materials & personnel
1		1		2		2. Availability of adequate treatment, storage & disposal capacity
1		1		1		3. Post remediation controls required (at site) and availability
3	1	3	1	5	2	Overall Availability Score
						C. Administrative Feasibility
1		1		2		1. Likelihood of public acceptance
1		1		2		2. Need for coordination with other agencies
1		1		3		3. Ability to obtain necessary permits & approvals
3	1	3	1	7	2	Overall Administrative Feasibility Score
2	2	3	3	1	1	5.1.3 Cost Evaluation (based on total cost for all areas)

TABLE 6.9
FINAL RANKING OF ALTERNATIVES - AREA A (SOLID MATRIX)

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS: PROTECTIVENESS (WF = 11)		EFFECTIVENESS: USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)		EFFECTIVENESS: ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)		IMPLEMENTABILITY: TECHNICAL FEASIBILITY (WF = 11)		IMPLEMENTABILITY: AVAILABILITY (WF = 11)		IMPLEMENTABILITY: ADMINISTRATIVE FEASIBILITY (WF = 11)		COST (WF = 34)		TOTAL WEIGHTED SCORE	RANK
1. Fixation	3	33	3	33	2	22	2	22	3	33	3	33	1	34	210	2
2. Treatment - Solvent Extraction	2	22	2	22	1	11	2	22	2	22	2	22	3	102	223	3
3. Landfilling	1	11	3	33	1	11	1	11	1	11	1	11	2	68	156	1
a. Hazardous materials to RCRA facility																
b. Non-hazardous - to Part 360 facility																

WF = Weighting Factor

TABLE 6.10
FINAL RANKING OF ALTERNATIVES - AREA B (SOLID MATRIX)

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS: PROTECTIVENESS (WF = 11)		EFFECTIVENESS: USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)		EFFECTIVENESS: ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)		IMPLEMENTABILITY: TECHNICAL FEASIBILITY (WF = 11)		IMPLEMENTABILITY: AVAILABILITY (WF = 11)		IMPLEMENTABILITY: ADMINISTRATIVE FEASIBILITY (WF = 11)		COST (WF = 34)		TOTAL WEIGHTED SCORE	RANK
1. Fixation	3	33	3	33	2	22	2	22	3	33	3	33	1	34	210	2
2. Treatment - Solvent Extraction	2	22	2	22	1	11	2	22	2	22	2	22	3	102	223	3
3. Landfilling	1	11	3	33	1	11	1	11	1	11	1	11	2	68	156	1
a. Hazardous materials to RCRA facility																
b. Non-hazardous to Part 360 facility																

WF = Weighting Factor

TABLE 6.11
FINAL RANKING OF ALTERNATIVES - TNT PIPELINES
(Solid Matrix)

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS						IMPLEMENTABILITY									
	PROTECTIVENESS (WF = 11)		USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)		ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)		TECHNICAL FEASIBILITY (WF = 11)		AVAILABILITY (WF = 11)		ADMINISTRATIVE FEASIBILITY (WF = 11)		COST (WF = 34)		TOTAL WEIGHTED SCORE	RANK
A. Crystalline Solids																
1. Open Flame/Detonate (Nearby)	1	11	1	11	1	11	1	11	1	11	1	11	1	34	100	1
2. Incinerate Nearby (Nearby Mobile Unit)	2	22	1	11	1	11	2	22	2	22	2	22	3	102	212	2
B. Sediments/Soils with ≥10% Concentrations																
1. Open Flame (Nearby)	3	33	2	22	1	11	2	22	1	11	3	33	2	68	200	2
2. Incinerate (off site)	1	11	1	11	1	11	1	11	1	11	1	11	3	102	168	1
3. Bio-Treatment (Nearby)	2	22	2	22	1	11	3	33	2	22	2	22	1	34	166	1
C. Hazardous Solids (<10%)																
1. Fixation	3	33	3	33	2	22	3	33	3	33	3	33	2	68	255	3
2. Treatment	2	22	2	22	1	11	2	22	2	22	2	22	3	102	223	2
3. Landfill	1	11	3	33	1	11	1	11	1	11	1	11	1	34	122	1
D. Nonhazardous Solids																
1. Landfill at Part 360 facility	Only feasible alternative - cost comparison for alternative facilities only.															1

WF = Weighting Factor

TABLE 6.12
FINAL RANKING OF ALTERNATIVES - CHEMICAL WASTE SEWER SYSTEM

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS: PROTECTIVENESS (WF = 11)		EFFECTIVENESS: USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)		EFFECTIVENESS: ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)		IMPLEMENTABILITY: TECHNICAL FEASIBILITY (WF = 11)		IMPLEMENTABILITY: AVAILABILITY (WF = 11)		IMPLEMENTABILITY: ADMINISTRATIVE FEASIBILITY (WF = 11)		COST (WF = 34)		TOTAL WEIGHTED SCORE	RANK
A. Sludge/Solids																
1. Fixation/Landfill	2	22	3	33	1	11	2	22	2	22	2	22	1	34	166	2
2. Treatment (solvent extraction & dispose of residual)	2	22	2	22	1	11	2	22	2	22	2	22	3	102	223	3
3. Incinerate	1	11	1	11	1	11	1	11	1	11	1	11	2	68	134	1

WF = Weighting Factor

TABLE 6.13
FINAL RANKING OF ALTERNATIVES - AQUEOUS MATRIX
(From all areas)

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS: PROTECTIVENESS (WF = 11)		EFFECTIVENESS: USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)		EFFECTIVENESS: ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)		IMPLEMENTABILITY: TECHNICAL FEASIBILITY (WS = 11)		IMPLEMENTABILITY: AVAILABILITY (WF = 11)		IMPLEMENTABILITY: ADMINISTRATIVE FEASIBILITY (WF = 11)		COST (WF = 34)		TOTAL WEIGHTED SCORE	RANK
1. Treatment at existing on-site facility	1	11	1	11	1	11	1	11	1	11	1	11	2	68	134	1
2. Treatment at off-site facility	2	22	1	11	1	11	1	11	1	11	1	11	3	102	179	3
3. Pretreatment/Discharge to surface	3	33	2	22	1	11	2	22	2	22	2	22	1	34	166	2

WF = Weighting Factor

TABLE 6.14
FINAL RANKING OF ALTERNATIVES - ASBESTOS MATERIALS

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS: PROTECTIVENESS (WF = 11)	EFFECTIVENESS: USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)	EFFECTIVENESS: ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)	IMPLEMENTABILITY: TECHNICAL FEASIBILITY (WF = 11)	IMPLEMENTABILITY: AVAILABILITY (WF = 11)	IMPLEMENTABILITY: ADMINISTRATIVE FEASIBILITY (WF = 11)	COST (WF = 34)	TOTAL WEIGHTED SCORE	RANK
Landfill disposal at:									
1. Disposal at on-site landfill			Cost comparisons for alternatives only.				1	--	1
2. Disposal at off-site landfill #1							2	--	2
3. Disposal at off-site landfill #2							3	--	3

WF = Weighting Factor

TABLE 6.15
FINAL RANKING OF ALTERNATIVES - MISCELLANEOUS OILS, LIQUIDS, ETC.

REMOVAL ACTION ALTERNATIVES	EFFECTIVENESS			IMPLEMENTABILITY					
	PROTECTIVENESS (WF = 11)	USE OF ALTERNATIVES TO LAND DISPOSAL (WF = 11)	ASSESSMENT OF RISK AFTER REMEDIATION (WF = 11)	TECHNICAL FEASIBILITY (WF = 11)	AVAILABILITY (WF = 11)	ADMINISTRATIVE FEASIBILITY (WF = 11)	COST (WF = 34)	TOTAL WEIGHTED SCORE	RANK
Removal - Treatment/ Recycling by:									
1. Treatment Facility #1 $1200 + analytical work ($2000)							1	--	1
2. Treatment Facility #2 $2500 - $3500			Cost comparison for alternatives only.				2	--	2
3. Treatment Facility #3 NA							3	--	3

WF = Weighting Factor

TABLE 6.16
SUMMARY OF ADVANTAGES/DISADVANTAGES
REMOVAL ACTION ALTERNATIVES - AREAS A AND B

ALT #1 - FIXATION (Ranked 2nd)	ALT #2 - TREATMENT (by Solvent Extraction) (Ranked 3rd)	ALT #3 - LANDFILLING (Ranked 1st)
Advantages		
(1) Least expensive alternative. (2) Reduces mobility of the contaminants, but does not eliminate them.	(1) Contaminants are eliminated with proper treatment which in turn reduces the potential risk. (2) Full compliance with ARARs. (3) Offers an alternative to land disposal. (4) Rated the best of the 3 alternatives in long-term reliability.	(1) Straight forward technology that is widely used. No unique equipment or methods are required for implementation. (2) This approach will most likely expedite the permitting/approval process since the material is being transferred to an existing permitted facility.
Disadvantages		
(1) With presence of drums (in Area A) the fixation process may be less effective in terms of immobilizing all contaminants. (2) Lower rated in terms of ability to obtain permitting and approvals. (3) Offers a semi-permanent solution compared to the other alternatives. (4) Not an alternative to land disposal; rather a modification of land disposal. (5) Post-remediation monitoring and/or controls will most likely be requested. (6) Least acceptable by the present property owners and possibly the general public.	(1) Most costly of the 3 alternatives. (2) Threat to workers during implementation primarily due to potential exposure to solvent extract used in the treatment process. (3) Ranked lowest in terms of equipment availability, and ease of construction and operation when compared with other alternatives. (4) Will require additional space on CWM property during implementation.	(1) Contaminated materials are only moved to another location; contaminant concentrations are not reduced or eliminated. (2) Contrary to regulatory agency preference for a permanent solution and an alternate to landfilling. (3) As the generator, the Department of Defense will still maintain some liability for the contaminated materials.

TABLE 6.17
SUMMARY OF ADVANTAGES/DISADVANTAGES
REMOVAL ACTION ALTERNATIVES - TNT-CRYSTALLINE SOLIDS

ALT #1 - OPEN FLAME (Ranked 1st)	ALT #2 - INCINERATION (NEARBY) (Ranked 2nd)	
Advantages (1) Lowest estimated cost. (2) Proven technology at other similar sites. (3) Relatively short period of time required for implementation.	(1) Most complete destruction of contaminants.	
Disadvantages (1) Rated low in terms of public acceptance.	(1) Higher estimated cost. (2) Also rated low in terms of public acceptance. (3) Permitting and approval time will be significantly longer.	

TABLE 6.18
SUMMARY OF ADVANTAGES/DISADVANTAGES ,
REMOVAL ACTION ALTERNATIVES - TNT SEDIMENTS (≥10% CONCENTRATIONS)

ALT #1 - OPEN FLAME (NEARBY) (Ranked 3rd)	ALT #2 - INCINERATION (OFF-SITE) (Ranked Close 2nd)	ALT #3 - BIOTREATMENT (NEARBY) (Ranked 1st)
Advantages		
(1) Proven technology at other similar sites.	(1) Most complete destruction of contaminants.	(1) Least expensive of the three alternatives.
(2) Relatively short period of time required for implementation.	(2) Performed at a permitted facility already in operation with proven performance.	
	(3) Least impacted by climate.	
	(4) Alternative will most likely be publicly acceptable with incineration performed at an offsite facility.	
Disadvantages		
(1) Uncontrolled release of contaminants (volatile organics) during flaming operation.	(1) Most expensive of the alternatives.	(1) The biotreatment process takes time to reduce contaminant concentrations to below the cleanup criteria.
(2) The operation does not necessarily destroy all contaminants.	(2) Very limited number of facilities that are able to accept the TNT contaminated materials; possibly only one that will accept concentrated levels of TNT waste materials.	(2) The ability of the process to effectively treat all identified contaminants is questionable.
	(3) Blending of the material with clean soil is required prior to transporting off-site.	(3) Climate and other site conditions can have potential impacts on the process.
		(4) Specialized tools are required for tilling of the contaminated materials to prevent sparking.

TABLE 6.19
SUMMARY OF ADVANTAGES/DISADVANTAGES
REMOVAL ACTION ALTERNATIVES - HAZARDOUS SOLIDS ($\leq$10% CONCENTRATIONS)

ALT #1 - FIXATION (Ranked 3rd)	ALT #2 - TREATMENT (By Soil Washing) (Ranked 2nd)	ALT #3 - LANDFILLING (Ranked 1)
Advantages		
(1) No significant advantages over the other alternatives were noted.	(1) Treatment process will reduce the volume of material that has to be landfilled.	(1) Highest rating for reducing risk. (2) Least amount of time until protection is achieved. (3) This alternative will utilize an existing permitted facility located nearby. (4) Past demonstrated performance. (5) Rated higher, relative to other alternatives, in terms of public acceptability. (6) Will have the least permitting/approvals required for implementation. (7) Lowest estimated cost.
Disadvantages		
(1) Does not eliminate or destroy the contaminants; contaminants are only mobilized. (2) Climate could have impacts on the final performance of this alternative. (3) Post-remediation monitoring will be required. (4) This alternative is least likely to be publicly accepted.	(1) Potential threat to workers during implementation. (2) More time required than other alternatives for construction and implementation. (3) Highest estimated cost. (4) Required equipment may not be readily available and some lead time may therefore be required.	(1) Not an alternate to land disposal.

TABLE 6.20
SUMMARY OF ADVANTAGES/DISADVANTAGES
REMOVAL ACTION ALTERNATIVES - CHEMICAL WASTE SEWER SYSTEM

ALT #1 - FIXATION/LANDFILL (Ranked 2nd)	ALT #2 - TREATMENT (By Solvent Extraction) (Ranked 3rd)	ALT #3 - INCINERATE (Offsite) (Ranked 1st)
Advantages (1) Lowest cost. (2) Relatively simple technology for this type of application.	(1) Reduces the contaminant levels below cleanup criteria. (2) Alternate to land disposal.	(1) Achievement of destruction of contaminant compounds and permanent reduction in risk. (2) Alternate to land disposal except for residual materials remaining after incineration, which will have to be disposed of. (3) Utilizes permitted offsite facilities that are in operation and readily available. (4) Shortest schedule for implementation.
Disadvantages (1) Not an alternate to land disposal. (2) Implementation will require on-site areas for the processing of material. (3) Although this method will reduce the chemical mobility, elimination of the contaminant compounds and associated potential risks will not be achieved. (4) Requires a pretreatment off-gassing step to decrease volatile organic content.	(1) Highest cost. (2) More time required for achieving protection as compared with the other alternatives. (3) Lower rated in terms of availability of equipment required, and mobilization, set-up and start-up requirements for the treatment system. (4) More likely to be impacted by climate conditions. (5) Lower rated in terms of permitting and approvals that may be required.	(1) Relatively high transport and disposal costs. (2) Generation of mercury vapors may be a problem.

TABLE 6.21
SUMMARY OF ADVANTAGES/DISADVANTAGES
REMOVAL ACTION ALTERNATIVES - AQUEOUS MATRIX (FOR ALL AREAS)

ALT #1 - TREATMENT AT EXISTING ON-SITE FACILITY (Ranked 1st)	ALT #2 - TREATMENT AT OFF-SITE FACILITY (Ranked 3rd)	ALT #3 - ON-SITE TREATMENT/DISCHARGE (Ranked 2nd)
Advantages		
(1) Least impact to the community because the facility is located on the property.	(1) Existing operating and permitted treatment system with proven performance.	(1) Overall lowest estimated cost compared with the other alternatives.
(2) Proven technology presently in operation and permitted.		(2) Treatment rate and volume can be controlled by on-site storage and treatment capacity provided.
(3) Facility is available and in close proximity to the various removal action areas.		
Disadvantages		
(1) Subject to acceptance of the wastewater based on testing and available capacity.	(1) Involves hauling the wastewater by truck over public roads. Greater risk for accidents, spills, and exposure to the public.	(1) Most threat to workers and the public due to risk of possible discharging contaminated water to the environment.
	(2) Subject to acceptance of the wastewater based on testing and available capacity.	(2) Additional time will be required for implementation, permitting for discharge, etc., compared with the other alternatives.
	(3) Most expensive alternative based on estimated costs.	(3) Poorest score for construction and operation because of land space and equipment mobilization requirements.
		(4) Will be impacted by climate conditions; may have to be winterized.

7 Recommended Remediation Alternatives

Table 7.1 summarizes the results of the completed comparative analysis of the removal action alternatives for each of the main source areas. Based on this comparison, the alternative having the best overall score for effectiveness, implementability, and cost was ranked No. 1 and recommended as the preferred removal action approach for each source area.

The recommendations regarding removal action in each source area are as follows.

7.1 Preferred Removal Action - Areas A and B

The highest ranked removal action for both Areas A and B is the removal-landfilling disposal alternative. This action, described in Section 5.2, would consist of the excavation and removal of the contaminated sediment and soils (and drums for Area A) from the two source areas. The excavated material would be transferred by truck to the operating CWM secure landfill located on the property. Any necessary dewatering of localized surface water or groundwater during the excavation operation would be accomplished by pumping the accumulated water into a tank truck and transferring the contaminated water to the on-site CWM aqueous treatment facility.

A final soil sampling would be conducted within the excavation limits in Areas A and B to verify that complete contaminated soil/sediment removal has been achieved and contaminant concentrations in the residual in-situ soil are in compliance with the designated cleanup criteria limits.

After verification sampling, the excavations would be backfilled with clean fill. The backfill would be placed and compacted following standard procedures in order to minimize settlement of the material. The backfilled areas and associated disturbed areas would then be graded, topsoiled, and seeded, and made available for use by CWM.

7.2 Preferred Removal Action - TNT Waste Pipelines

The preferred plan for remediation of the TNT waste pipelines consists of the following component removal actions:

- **Removal and open flaming/detonation of the crystalline TNT solids**

  The crystalline TNT solids would be manually removed from the excavated TNT pipeline sections, placed in non-sparking (plastic) 2 to 3 cubic yard containers, and transported to a nearby secure site for treatment by open flaming. One suggested location for the open flaming operation is the National Guard property located north of Balmer Road.

  Open flaming operations would be conducted in burning trays following procedures established at other similar sites by utilizing a remotely controlled flame thrower directed at and into the burning tray. The resultant ash would be placed in drums for subsequent disposal.

  An alternative disposal method for use at a relatively remote location (such as the National Guard property) is open detonation. This method would include the burying of the TNT crystalline solids in an excavated trench and detonating the material using an electric or burning ignition system.

- **Removal and biotreatment of the explosives-contaminated pipeline sediments and soils with greater than 10 percent concentration of nitroaromatics**

  The sediments removed from the excavated pipelines would be placed in non-sparking containers and transferred to a designated secure area for biological treatment. The National Guard property located north of Balmer Road is again a location to be considered for this operation.

  Samples of the sediment material would be analyzed to determine the type of microorganisms that are best suited for treatment of the contaminants present. The selected microorganism(s) would be blended with the contaminated sediments along with any required additives to accelerate microbial growth. The blended material would be placed in a lined bed or cell and the aeration and moisture content of the treatment mass would be monitored and controlled to maintain optimum conditions for microbial growth. The treatment process would be considered complete when final sampling of the treated material indicates contaminant concentrations below the cleanup criteria.

- **Removal of all TNT pipeline materials, concrete encasing, and adjacent soils characterized as a hazardous waste and disposal at a permitted RCRA landfill.**

  Based on sampling and analyses, the removed construction materials and soils would be characterized as hazardous or nonhazardous and segregated accordingly. The hazardous materials (with $\leq 10\%$ nitroaromatics) would be loaded into roll-offs, pretreated if required for disposal, and transported to a permitted RCRA disposal facility (either the on-site CWM facility or other off-site facility).

- **Removal of the remaining nonhazardous soils and pipeline construction materials and transport to a 6NYCRR Part 360 permitted landfill for disposal. Under this alternative, the material would be transferred by truck to one of several off-site permitted landfills.**

All excavated areas would be backfilled with clean fill. The backfill would be placed and compacted following standard procedures and all associated disturbed areas would be graded, topsoiled, and seeded.

7.3 Preferred Removal Action - Chemical Waste Sewer System

The preferred removal action plan for the chemical waste sewer system and lift stations consists of the following components:

- Initial vacuum extraction (or pumping) of the accumulated water from each lift station and connecting sewer trunklines to a tank truck. The sewage removal would stop at a predetermined depth to avoid the mixing and removal of the more contaminated bottom sludge. The removed sewage would be sampled and analyzed to determine treatment requirements. The removed sewage would then be transferred to the existing on-site aqueous treatment facility as described in Section 7.4 below.

- Removal of the sludge from each lift station by similar vacuum extraction to a tank truck. The removed sludge would be transferred to an existing permitted incinerator for thermal destruction. The incinerator residues would be disposed of in accordance with regulatory disposal requirements.

- After the majority of the sludge is removed from the lift stations, the pit bottom and walls would be manually cleaned by high-pressure water jets. The main chemical waste sewer trunkline would also be flushed in a similar manner. The sludge/ wastewater mixture from the cleaning operation would be vacuumed into a tank truck and transferred to the existing on-site aqueous treatment facility.

- Upon complete removal of all contaminated sediments, each chemical lift station would be sealed at the ground surface.

7.4 Preferred Removal Action - Aqueous Matrix (for all areas)

The liquid fraction including accumulated surface water, groundwater, pipeline sewage, etc. present in the excavations, pipeline systems and lift stations would be collected as part of the removal action and pumped into a tank truck. The water would be sampled and analyzed to determine specific treatment requirements. All contaminated water would be transferred and treated at the existing on-site aqueous treatment facility.

7.5 Preferred Removal Action - Miscellaneous Containerized Liquids/Oils, etc.

The recommended action for the containerized liquids and oils identified on-site (55 gallon drum of oil; 26 gallons of chromic acid, and containers of other laboratory chemicals) would consist of the transfer of the liquids to tight containers, as needed, and transport by truck to a permitted off-site facility for cost-effective recycling, treatment, or alternative disposal method.

7.6 Preferred Removal Action - Asbestos Containing Materials

The recommended action for the asbestos-containing materials consists of the removal by a licensed asbestos contractor and transfer to one of several local permitted 6NYCRR Part 360 landfill facilities for disposal.

The combined measures, as described in 7.1 through 7.6 above, comprise the recommended interim removal action program to address the designated Operable Unit Nos. 1 and 2 source areas at the LOOW site.

7.7 Estimated Costs for Preferred Removal Actions

Order-of-magnitude costs were estimated for each of the alternatives evaluated. A comparison of the estimated costs is presented in Table 7.2. The itemized cost estimate breakdown and associated backup are contained in Appendix B.

The following summarizes the estimated order-of-magnitude costs for implementing the preferred removal action for each of the identified source areas including any estimated post-remediation site control costs.

Identified Source Area	Direct Capital Costs	Indirect Capital Costs	PRSC Costs	Total Present Worth
Area A				
(Solids Matrix)	$1,738,00	$167,000	0	$1,905,000
(Aqueous Matrix)	0	0	0	183,000
	183,000			
Total For Area A	1,921,000	167,000		2,088,000
Area B				
(Solids Matrix)	4,164,000	285,000	0	4,449,000
(Aqueous Matrix)	110,000	0	0	110,000
Total For Area B	4,274,000	285,000		4,559,000
TNT Waste Pipeline System				
(Solid Matrix)	1,911,000	269,000	0	2,180,000
(Aqueous Matrix)	259,000	0	0	259,000
Total TNT Pipelines	2,170,000	269,000		2,439,000
Chemical Lift Stations				
(Solids Matrix)	231,000	40,000	0	271,000
(Aqueous Matrix)	29,000	0	0	29,000
Total Chemical Lift Stations	260,000	40,000	0	300,000
Miscellaneous Oils, Liquids, etc.	7,000	4,000	0	11,000
Asbestos-Containing Materials	110,000	24,000	0	135,000
Total Estimated Cost for All Preferred Removal Actions			$0	$9,532,000

TABLE 7.1
SUMMARY OF COMPARATIVE ANALYSIS RESULTS

Identified Source Area	Removal Action Alternatives	Weighted Score				Ranking
		Effectiveness	Implementability	Cost	Total	
1. Area A (Solid Matrix)	Alt 1. - Fixation	88	88	34	210	2
	Alt. 2 - Treatment (by solvent extraction)	55	66	102	223	3
	Alt. 3 - Landfilling	55	33	68	156	1*
2. Area B (Solid Matrix)	Alt. 1 - Fixation	88	88	34	210	2
	Alt. 2 - Treatment (by solvent extraction)	55	66	102	223	3
	Alt. 3 - Landfilling	55	33	68	156	1*
3. TNT Waste Pipeline System						
A. Crystalline solids	Alt. 1 - Open flaming/detonation	33	33	34	100	1*
	Alt. 2 - Incinerate nearby (mobile unit)	44	66	102	212	2
B. Sediments/soils (≥10% concentrations)	Alt. 1 - Open flaming	66	66	68	200	2
	Alt. 2 - Incinerate (offsite)	33	33	102	168	1**
	Alt. 3 - Biotreatment (offsite)	55	77	34	166	1*
C. Hazardous Solids (<10% concentrations)	Alt. 1 - Fixation	88	99	68	255	3
	Alt. 2 - Treatment (by soil washing)	55	66	102	223	2
	Alt. 3 - Landfill	55	33	34	122	1*
D. Non-hazardous Solids	Alt. 1 - Landfill at 6NYCRR Part 360 Permitted Facility				***	1*
4. Chemical Lift Stations						
Sludge/ solids	Alt. 1 - Fixation and landfill	66	66	34	166	2
	Alt. 2 - Treatment (solvent extraction) and disposal of residual	55	66	102	223	3
	Alt. 3 - Incinerate (offsite)	33	33	68	134	1*

TABLE 7.1
SUMMARY OF COMPARATIVE ANALYSIS RESULTS

Identified Source Area	Removal Action Alternatives	Weighted Score				Ranking
		Effective-ness	Implement-ability	Cost	Total	
5. Aqueous Matrix (applicable to all areas)	Alt. 1 - Treatment at existing on-site facility	33	33	68	134	1*
	Alt. 2 - Treatment at offsite facility	44	33	102	179	3
	Alt. 3 - Pretreatment onsite/ discharge to surface drainage system	66	66	34	166	2

* Preferred removal action alternative
** Alt. 3 is preferred over Alt. 2 because of the significant difference in costs
*** Only feasible alternative; therefore, the evaluation consisted of a cost comparison of alternative offsite facilities

8 References

1. Acres International Corporation, Final Remedial Investigation Report, PD-8, August 1990, prepared for the Kansas City District Corps of Engineers.

2. Acres International Corporation, Supplement to Final Remedial Investigation Report, PD-8a, July 1990, prepared for the Kansas City District Corps of Engineers.

3. Acres International Corporation, Advance Final Feasibility Study Report, PD-10, September 1990, prepared for the Kansas City District Corps of Engineers.

4. Acres International Corporation, Preliminary Contamination Assessment Report, Operable Unit No. 2., December 1992, prepared for the Kansas City District Corps of Engineers.

5. Golder Associates Inc., Hydrogeologic Characterization, Chemical Waste Management, Inc.; Model City, New York Facility, Volumes I through IV, March 1985.

6. Golder Associates Inc., Interim Report on Syms Area, Model City TSDR Facility Volumes I through III, January 1991.

7. United States Environmental Protection Agency, Handbook, Approaches for he Remediation of Federal Facility Sites Contaminated with Explosives or Radioactive Wastes, EPA/625/R-93-013, September, 1993.

ACRES	**Calculations** SUBJECT: Volume Calculations of Contaminated Materials	Project No. P99182E File No. ____ Calc. By KC Date 11/17/94 Ck'd. By AK Date 11/19/94 App. By ____ Date ____ Calc. No. ____ Sheet 1 Of 7

1. Area A

A. Soil: The following dimensions of the buried drum trench are based on geophysics, drilling and test pit data:

220 ft long × 40 ft wide × 10 ft deep = 88000 cu ft or 3259 cu yd

Say 4000 cu. yd

B. Free Groundwater: It is assumed that the groundwater table occurs at 3 ft below ground surface. It is also assumed that the drum trench materials have a porosity of 40%. Based on these assumptions, the following liquid volume is estimated to be present within the buried drum trench:

1) 220 ft long × 40 ft wide × 7 ft saturated = 61,600 cu ft

2) 61,600 cu ft × 40% = 24,640 cu ft. of water

3) 1 cu ft water = 7.481 gal. water

$\therefore$ 24,640 cu. ft. × $\frac{7.481 \text{ gal.}}{1 \text{ cu. ft.}}$ = 184,332 gallons

Say 200,000 gallons

ACRES	**Calculations**	Project No. P931828	File No.
	SUBJECT: Volume Calculations of Contaminated Materials	Calc. By KC	Date 11/17/94
		Ck'd. By AK	Date 11/19/94
		App. By	Date
		Calc. No.	Sheet 2 Of 7

2. Area B

A. Soil/Sediments: The contaminated soils and sediment in Area B include the pond sediments, contaminated to a depth of 3 ft; contaminated berm materials, estimated at an average height of 5 ft; contaminated mounded sediment and soil within the pond area, estimated at an average height of 5 ft and contaminated soils within the former surface depression. The contamination within the former surface depression is estimated to occupy an area of 100 ft long by 25 ft wide by 18 feet deep. Based on review of aerial photographs and drilling data.

Based on approximate area measurements taken from the attached figure, the following volume of contaminated soil/sediment is estimated for Area B.

1.) Sediment: 24,500 sq ft × 3 ft deep = 73,500 cu.ft.

2) Berms: 33,000 sq ft × 5 ft high = 165,000 cu.ft.

3) Mounded Soils: 7150 sq.ft. × 5 ft high = 35,750 cu.ft.

4) Surface Depression: 100 ft long × 25 ft. wide × 18 ft deep = 45000 cu ft

319250 cu.ft.

or 11824 cu.yds.

Say 12000 cu. yds

Calculations SUBJECT: Volume Calculations of Contaminated Materials	Project No. P981828 File No.
	Calc. By KC Date 11/17/94
	Ck'd. By AIC Date 11/19/94
	App. By Date
	Calc. No. Sheet 3 Of 7

2. Area B (Cont'd)

B. Free Groundwater: It is assumed that the groundwater table occurs at 3ft below groundsurface. Therefore groundwater would be encountered only during the excavation of the buried surface depression. It is assumed that the saturated materials within the buried surface depression have a porosity of 40%. Based on these assumptions the following liquid volume is estimated to be present within the buried surface depression.

1.) 100 ft long by 25 ft wide by 15 ft saturated = 37,500 cu.ft

2.) 37,500 cu.ft × 40% porosity = 15,000 cu.ft. of water

3) 1 cu.ft. = 7.481 gallons of water

$$\therefore 15,000 \text{ cu.ft.} \times \frac{7.481 \text{ gal}}{1 \text{ cu.ft}} = 112,215 \text{ gallons}$$

Say 120,000 gallons

3. TNT Sewer System Pipeline, Sediments and Soils

A. Lineal feet of pipeline

The following dimensions are indicated on site drawings:

Size	Length	Volume	Total Volume
10 in v.p.	2379 ft	0.55 cuft/ft	1308.4 cuft
12 in vp	473 ft	0.78 cuft/ft	368.9 cuft

ACRES	**Calculations** SUBJECT:	Project No. P98128	File No.
		Calc. By KC	Date 11/17/94
		Ck'd. By AK	Date 11/19/94
		App. By	Date
		Calc. No.	Sheet 4 Of 7

3. A - Lineal feet of pipeline (cont'd)

Size	Length	Volume	Total Volume
15 in. V.P	475 ft	1.23 cu ft/ft =	584.2 cu ft
18 in V.P	949 ft.	1.77 cu ft./ft =	1679.7 cu.ft
Total: -	4276 ft		3941.2 cu ft

The following measurements are based on pipeline layouts shown on site drawings but without actual dimensions indicated:

Size	Length	Volume	Total Volume
10 in V.P	2960 ft	0.55 cu ft/ft	1628 cu ft
18 in V.P.	2952 ft	1.77 cu ft/ft	5225 cu ft
Total: -	5912 ft.		6853 cu.ft.

B. Volume of sediment within Pipeline:

Based on past investigations, assume that the pipelines are 1/3 full of sediments. Therefore, the total volume of sediments within the pipeline system is:

1. 3941. cu.ft + 6853 cu ft = 10.794 cu ft

2. 10.734 cu ft × 33% = 3562 cu ft sediment
or 132 cu yd
say 150 cu yd

ACRES **Calculations** SUBJECT:	Project No. P0818.28 File No. ___ Calc. By KC Date 11/17/94 Ck'd. By AK Date 11/19/94 App. By ___ Date ___ Calc. No. ___ Sheet 5 Of 7

3. C. Volume of Water within TNT pipeline:

Based on past investigations, assume the pipelines are 1/2 full of water, the total volume of water estimated to be present within the pipeline system is.

1. 10794 cu-ft × 50% full of water = 5397 cu ft

2. 5379 cu ft × $\frac{7.481 \text{ gal}}{1 \text{ cu ft}}$ = 40375 gal

Say 45,000 gal

4. Chemical Waste Sewer System

A. Lift Stations

The following estimates of sewage and sludge levels are based upon measurements recorded during the Reconnaissance Survey performed in October 1988. These levels were found to be consistent at the time of sample collection during the Preliminary Contamination Assessment performed in the Fall of 1991. All lift stations have the approximate dimensions of 10.0 ft. × 10.0 ft. × 11.0 ft. deep.

Lift Station	Depth of Water/Sludge	Volume
4	2.5 ft	250 cu.ft
7	6.75 ft	675 cu.ft
8	6.75 ft	675 cu ft
22	10.5 ft	1050 cu.ft
24 (oil/water Sep.)	4.7 ft	470 cu ft.
31	6.75 ft.	675 cu ft.
		3795 cu.ft.

ACRES

Calculations
SUBJECT:

Project No. P98128	File No.
Calc. By KC	Date 11/17/94
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1. Volume of sewage present within lift stations

3795 cu. ft. × 7.481 gal/cu.ft = 28390 gal

2 Volume of sludge present assuming 1ft depth / lift station

6 stations @ 100 cuft /station = 600 cu.ft.

3. Volumes of sewage and sludge present in the inter-connecting pipes based on the dimensions provided on site drawings:

a. Area 4 to Area 7: 6 in pipe - 144ft @ 0.2 cuft/ft = 28.8 cuft

b. Area 7 to Area 8: 6 in. pipe - 372 ft @ 0.2 cuft/ft = 74.4 cuft

c. Area 8 to Area 2: 6 in. pipe - 190 ft @ 0.2 cu.ft/ft = 38.0 cu.ft

d. Area 2 to Area 24N: 6 in. pipe - 50 ft @ 0.2 cuft./ft = 10.0 cu ft

e Area 22 to Area 8: 4 in. pipe - 160 ft @ 0.09 cuft/ft = 14.4 cu ft

f. Area 31 to Area 24N: 6 in pipe 1800 ft @ 0.2 cuft/ft = 360 cu.ft

Total 525.6 cuft

It is assumed that the pipes are 1/4 full of sediment and 3/4 full of liquid.

1. Sludge volume:

525.6 cuft × 0.25 = 131.4 cu ft

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ACRES **Calculations** SUBJECT:	Project No. P98/428 File No. ______ Calc. By RC Date 11/17/80 Ck'd. By ______ Date ______ App. By ______ Date ______ Calc. No. ______ Sheet 7 Of 7

2. Sewage Volume :

525.6 cft × 0.75 = 394.2 cu ft
or 2949 gal

A The combined sewage volume from the chemical waste lift stations and the interconnecting pipeline would be:

Lift stations : 28,390 gal
Interconnecting Pipes: 2949 gal

31339 gal : say 30000 gal

B. The combined sludge volume from the chemical waste lift stations and the interconnecting pipelines would be:

Lift stations : 600 cu ft
Interconnecting pipes : 131 cu ft

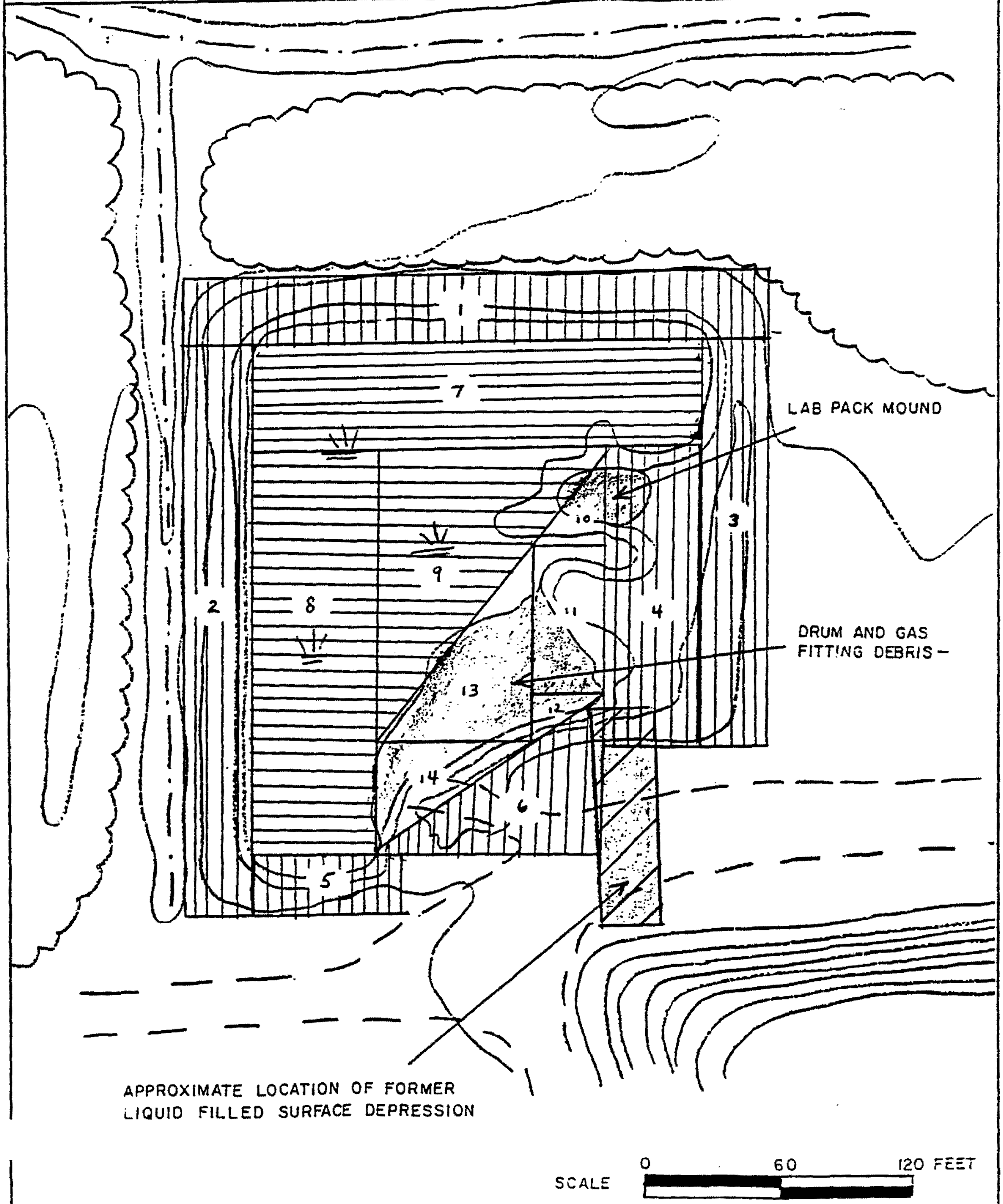
731 cu ft
or 27 cu yds say 25 cu. yds.

Project No. P134101	File No.
Calc. By KC	Date 8/30/90
Ck'd. By	Date
App. By	Date
Calc. No.	Sheet 1 Of 2

ACRES

Calculations

SUBJECT:



FORM AIC-417 6.83

ACRES	**Calculations** SUBJECT: Area B - Contaminated Volume Calculations	Project No. P 834105 File No. ____ Calc. By KL Date 8/20/90 Ck'd. By ____ Date ____ App. By ____ Date ____ Calc. No. ____ Sheet 2 Of 2

Area B - Berms:

1	260' × 30' × 5'	=	39000 ft^3	
2	250 × 30 × 5	=	37500	
3	180 × 30 × 5	=	27000	
4	130 × 50 × 5	=	32500	
5	60 × 30 × 5	=	9000	
6	100 × 80 × .5 × 5	=	20000	
			165,000 ft^3	165000

Sediment:

7	200' × 50' × 3'	=	30000 ft^3	
8	170 × 50 × 3	=	25500	
9	100 × 120 × .5 × 3	=	18000	
			73,500 ft^3	73500

Mounded Sediments:

10	40' × 40' × 5'	=	8000 ft^3	
11	40 × 50 × .5 × 5	=	5000	
12	40 × 30 × .5 × 5	=	3000	
13	60 × 50 × .5 × 5	=	7500	
14	70 × 70 × .5 × 5	=	12250	
			35,750 ft^3	35750

Trench:

	100 × 25 × 18	=	45000	
			45000	45000
				319250 ft^3
			or	11824 yds^3
			Say	12,000 yds^3

Preface

The attached cost estimates have been separated in this appendix by specific areas, namely:

Area A - Alternatives for Both Solids and Aqueous Materials

Area B - Alternatives for Both Solid and Aqueous Materials

TNT Pipeline -Alternatives for Both Solids and Aqueous Materials

AFP 68 Chemical Waste Lift Station - Alternatives for Both Solid and Aqueous Materials

Asbestos

Oil, Chemicals and Chromic Acid

Prior to each group of detailed cost estimates is a summary table for the specific area.

Area A

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Solid	Excavation/Disposal/(Landfill)	1,738,180	166,430	0	1,904,610
Solid	Excavation/Fixation/Disposal	1,156,150	188,430	41,115	1,385,695
Solid	Excavation/Treatment/Disposal	1,932,590	304,890	41,115	2,278,595
Aqueous	Pumping/Treatment at existing On-site facility	182,480	0	0	182,480
Aqueous	Pumping/Treatment On-Site	98,400	0	0	98,400
Aqueous	Pumping/Treatment Off-Site	260,680	0	0	260,680

ACRES

ESTIMATE

Title: Area A - Excavation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

Job No. P09818.28
File No.
Sheet 1 of 3
By LDZ Date 11/23/94
Chkd RET Date 2/28/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				20,000		allowance mobilize equipment
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				10,000		allowance for decon facility, clear and grub
	• Field Office and Services	1	mo	1,700/mo	1,700		
	• Temporary Sheet Piling	5,060	sf	9.50/sf	48,000		
	• Excavation	4,000	cy	9/cy	36,000		
	• Dewatering/Drainage Control				----		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,020	tons	10/ton	10,200		15% materials (600 cy) are drums or drum remnants
	• On-site Treatment Costs	5,780	tons	10/ton	57,800		stabilize wet materials from excavation increase volume 30%
	• Staging/Work Areas				20,000		preparation access, drum staging, segregation
	• Backfilling	3,100	cy	12/cy	37,200		includes supplying material
	• Backfill	600	cy	3/cy	1,800		push stockpiles soil back into excavation to compact
	• Topsoiling/Seeding	220	cy	21.36/cy	4,700		
	• Decontamination Costs	1	mo	15,000	15,000		
	• Health and Safety Plan/Monitoring	24	days	600/day	14,400		
	• Post-excavation Sampling Analyses	24	ea	500	12,000		
	• Monitoring Wells				0		
	Subtotal				288,800		

ACRES	**ESTIMATE** Title: Area A - Excavation/Disposal	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 2/28/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						~50% hazardous, 50% non hazardous
	• Treatment/Analytical Costs	30	ea	1,500	45,000		
	• Transport Costs	8,534	tons	(see remarks)	129,540		$10/ton x 4,114 tons, $20/ton x 4,420 tons
	• Tipping Fees	8,534	tons		1,048,120		$27/ton x 4,114, $212/ton x 4,420 (including taxes)
	Subtotal				1,222,660		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				226,720		
	DIRECT CAPITAL COST					1,738,180	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1	mo	10,000/mo	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				139,050		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 1% of total direct costs)				17,380		
	Subtotal				166,430		
	INDIRECT CAPITAL COST					166,430	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Area A - Excavation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					1,904,610	
	1995 TOTAL					1,980,794	4% escalation for 1995

ACRES

ESTIMATE

Title: Area A - Excavation/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				50,000		contractor quote
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				10,000		mixing bldg, clear and grub
	• Field Office and Services	1.5	mo	1,700/mo	2,550		
	• Temporary Sheet Piling	5,060	sf	9.50/sf	48,000		
	• Excavation	4,000	cy	9/cy	36,000		
	• Dewatering/Drainage Control				----		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,020	tons	10/ton	10,200		15% drums present, segregation, handling
	• On-site Treatment Costs	5,780	tons	103/ton	595,340		
	• Staging/Work Areas				40,000		Access, work platform, foundations, controls
	• Backfilling	3,800	cy	5/cy	19,000		200 cy displaced by topsoil
	• Topsoiling/Seeding	220	cy	21.36/cy	4,700		
	• Decontamination Costs	1.5	mo	15,000/mo	22,500		
	• Health and Safety Plan/Monitoring	35	days	600/day	21,000		
	• Post-excavation Sampling Analyses	24	ea	500/ea	12,000		
	• Monitoring Wells	4	ea	10,000/ea	40,000		
	Subtotal				911,290		

	ESTIMATE Title: Area A - Excavation/Fixation/Disposal	
ACRES	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 2/28/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs	4	ea	1,500/ea	6,000		
	• Transport Costs	2,380	tons	10/ton	23,800		drums and excess stabilized material
	• Tipping Fees	2,380	tons	27/ton	64,260		drums and excess stabilized material
	Subtotal				94,060		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				150,800		
	DIRECT CAPITAL COST					1,156,150	Sum of 1.1, 1.2 and 1.3
2.0	INDIRECT CAPITAL COSTS						
2.1	• Construction Management Cost	1.5	mo	10,000/mo	15,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				115,620		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				57,810		
	Subtotal				188,430		
	INDIRECT CAPITAL COST					188,430	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Area A - Excavation/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs	16	ea	500/ea	34,635		present worth analytical, quarterly for 5 years
3.2	• Support Costs	4	ea	500/ea	6,480		collect and report
	Subtotal				41,115	41,115	
	TOTAL					1,385,695	
	1995 TOTAL					1,441,120	4% escalation for 1995

ACRES

ESTIMATE

Title: Area A - Excavation/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				100,000		estimate to mobilize equipment components
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				55,000		construction of enclosure for system
	• Field Office and Services	1.5	mo	1,700/mo	2,550		
	• Temporary Sheet Piling	5,060	sf	9.50/sf	48,000		
	• Excavation	4,000	cy	9/cy	36,000		
	• Dewatering/Drainage Control				----		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,020	tons	10/ton	10,200		(600 cy of drums-10% materials)
	• On-site Treatment Costs	5,780	tons	200/ton	1,156,000		
	• Staging/Work Areas				40,000		staging area, drum handling, cleaning area
	• Backfilling	3,800	cy	see remarks	21,800		includes $5/cy x 3,400 cy + $12/cy x 400 cy
	• Topsoiling/Seeding	220	cy	21.36/cy	4,700		
	• Decontamination Costs	1.5	mo	15,000/mo	22,500		
	• Health and Safety Plan/Monitoring	35	days	600/day	21,000		
	• Post-excavation Sampling Analyses	24	ea	500/ea	12,000		
	• Monitoring Wells	4	ea	10,000/ea	40,000		
	Subtotal				1,569,750		

ACRES

ESTIMATE

Title: Area A - Excavation/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	2	ea	1,500	3,000		
	• Transport Costs	1,020	tons	10/ton	10,200		
	• Tipping Fees	1,020	tons	27/ton	27,540		Includes taxes
	Subtotal				40,740		
1.3	**Contingencies**						
	(+ 20%) (for unknown conditions)				322,100		
	DIRECT CAPITAL COST					1,932,590	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1.5	mo	10,000/mo	15,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				193,260		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				96,630		
	Subtotal				304,890		
	INDIRECT CAPITAL COST					304,890	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Area A - Excavation/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs	16	ea	500/ea	34,635		present worth quarterly sampling, 5 years
3.2	• Support Costs	4	ea	500/ea	6,480		collect and report
	Subtotal				41,115	41,115	
	TOTAL					2,278,595	
	1995 TOTAL					2,369,740	4% escalation for 1995

Area B

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Solid	Excavation/Disposal/(Landfill)	4,163,530	284,800	0	4,448,330
Solid	Excavation/Fixation/Disposal	2,671,700	392,300	86,400	3,150,400
Solid	Excavation/Treatment/Disposal	5,300,800	734,100	86,400	6,121,300
Aqueous	Pumping/Treatment at existing On-Site facility	109,700	0	0	109,700
Aqueous	Pumping/Treatment On-Site	79,200	0	0	79,200
Aqueous	Pumping/Treatment Off-Site	156,630	0	0	156,630

ACRES

ESTIMATE

Title: Area B - Excavation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

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1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				20,000		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				10,000		allowance decon facility, clear and grub
	• Field Office and Services	3.5	mo	1,700/mo	6,000		
	• Temporary Sheet Piling	5,632	sf	9.50/sf	53,500		Z22 sheets, 22 ft long
	• Excavation	12,000	cy	9/cy	108,000		
	• Dewatering/Drainage Control				----		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,700	tons	10/ton	17,000		8% soil contains drums, other materials, require extra handling
	• On-site Treatment Costs	3,740	tons	10/ton	37,400		20% of remaining soil must be stabilized, expanded by 10%
	• Staging/Work Areas				20,000		allowance for access road, staging area
	• Backfilling	10,120	cy	12/cy	121,440		
	• Roadway replacement	505	sy	40/sy	20,200		incl. 750 cy common fill
	• Topsoiling/Seeding	1,140	cy	18.29/cy	20,850		topsoil, seed and mulch
	• Decontamination Costs	3.5	mo	15,000/mo	52,500		
	• Health and Safety Plan/Monitoring	79	days	600/day	47,400		
	• Post-excavation Sampling Analyses	70	ea	1,000/ea	70,000		
	• Monitoring Wells				0		
	Subtotal				604,300		

ACRES

ESTIMATE

Title: Area B - Excavation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						~50% hazardous and 50% non hazardous
	• Treatment/Analytical Costs	37	ea	1,500/ea	55,500		
	• Transport Costs				320,200		$10/ton x 9,540 + $20/ton x 11,240 tons (20,400 t + 380 t = 20,780)
	• Tipping Fees				2,640,460		$27/ton x 9,540 tons + $212/ton x 11,240 tons
	Subtotal				3,016,160		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				543,070		
	DIRECT CAPITAL COST					4,163,530	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	3.5	mo	10,000/mo	35,000		
2.2	• Engineering and Design (5% of total direct costs)				208,200		5% because it is basically disposal
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 1% of total direct costs)				41,600		1% because it is dig and dispose
	Subtotal				284,800		
	INDIRECT CAPITAL COST					284,800	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Area B - Excavation/Disposal

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3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0	0	
	TOTAL					4,448,330	
	1995 TOTAL					4,626,000	4% escalation for 1995

ACRES

ESTIMATE

Title: Area B - Excavation/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				50,000		contractor quote
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				10,000		allowance mixing bldg., clear and grub
	• Field Office and Services	4.5	mo	1,700/mo	7,700		
	• Temporary Sheet Piling	5,632	sf	9.50/sf	53,500		Z22 sheets 22' long
	• Excavation	12,000	cy	9/cy	108,000		
	• Dewatering/Drainage Control				----		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,700	tons	10/ton	17,000		8% materials are drum remnant, requiring extra handling
	• On-site Treatment Costs	18,770	tons	75/ton	1,407,750		material expands by 30% or 1.31 t/cy
	• Staging/Work Areas			allowance	40,000		staging area, drum handling, cleaning area
	• Backfilling	10,120	cy	5/cy	50,600		
	• Roadway Replacement	505	sy	40/sy	20,200		incl. 750 cy common fill
	• Topsoiling/Seeding	1,140	cy	18.29/cy	20,850		topsoil, seed and mulch
	• Decontamination Costs	4.5	mo	15,000/mo	67,500		
	• Health and Safety Plan/Monitoring	101	days	600/day	60,600		
	• Post-excavation Sampling Analyses	70	ea	1,000/ea	70,000		
	• Monitoring Wells	6	ea	10,000/ea	60,000		
	Subtotal				2,043,700		

ACRES	**ESTIMATE** Title: Area B - Excavation/Fixation/Disposal	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 2/28/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	<u>Off-Site Treatment/Disposal Costs</u>						
	• Treatment/Analytical Costs	8	ea	1,500/ea	12,000		
	• Transport Costs	7,230	tons	10/ton	72,300		offsite disposal of drum (1,700 t) and excess stabilized material (5,530 t)
	• Tipping Fees	7,230	tons	27/ton	195,200		
	Subtotal				279,500		
1.3	<u>Contingencies</u>						
	(+ 15%) (for unknown conditions)				348,500		
	DIRECT CAPITAL COST					2,671,700	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	4.5	mo	10,000/mo	45,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				213,700		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				133,600		
	Subtotal				392,300		
	INDIRECT CAPITAL COST					392,300	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Area B - Excavation/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs	24	ea	750/ea	77,760		present worth quarterly sampling, 5 years
3.2	• Support Costs	4	ea	500/ea	8,640		present worth collecting and reporting results
	Subtotal				86,400	86,400	
	TOTAL					3,150,400	
	1995 TOTAL					3,276,500	4% escalation for 1995

ACRES

ESTIMATE

Title: Area B - Excavation/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

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1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				100,000		estimate to mobilize equipment components
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				55,000		allowance includes enclosure for system
	• Field Office and Services	4.5	mo	1,700/mo	7,700		
	• Temporary Sheet Piling	5,632	sf	9.50/sf	53,500		Z22 sheets, 22' long
	• Excavation	12,000	cy	9/cy	108,000		
	• Dewatering/Drainage Control				–		see alternative for aqueous treatment
	• Pretreatment Costs (for excavated materials)	1,700	tons	10/ton	17,000		(1,000 cy of drums-8% materials)
	• On-site Treatment Costs	18,770	tons	200/ton	3,754,000		
	• Staging/Work Areas				40,000		staging area, drum handling, cleaning area
	• Backfilling	10,120	cy	5/cy	50,600		
	• Roadway Replacement	505	sy	40/sy	20,200		topsoil, seed & mulch
	• Topsoiling/Seeding	1,140	cy	18.29/cy	20,850		
	• Decontamination Costs	4.5	mo	15,000/mo	67,500		
	• Health and Safety Plan/Monitoring	101	days	600/day	60,600		
	• Post-excavation Sampling Analyses	70	ea	1,000/ea	70,000		
	• Monitoring Wells	6	ea	10,000/ea	60,000		
	Subtotal				4,485,000		

ACRES

ESTIMATE

Title: Area B - Excavation/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	4	ea	1,500/ea	6,000		
	• Transport Costs	3,200	tons	10/ton	32,000		drum disposal, plus 1,500 t excess excavation
	• Tipping Fees	3,200	tons	27/ton	86,400		drum disposal, plus 1,500 t excess excavation
	Subtotal				124,400		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				691,400		
	DIRECT CAPITAL COST					5,300,800	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	4.5	mo	10,000/mo	45,000		
2.2	• Engineering and Design (8% of total direct costs)				424,100		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				265,000		
	Subtotal				734,100		
	INDIRECT CAPITAL COST					734,100	Sum of 2.1, 2.2 and 2.3

ACRES	**ESTIMATE** Title: Area B - Excavation/Treatment/Disposal	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 3 of 3 By LDZ Date 11/23/94 Chkd RET Date 2/28/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs	24	ea	750/ea	77,760		present worth quarterly sampling, 5 years
3.2	• Support Costs	4	ea	500/ea	8,640		collect and report
	Subtotal				86,400	86,400	
	TOTAL					6,121,300	
	1995 TOTAL					6,366,000	4% escalation for 1995

TNT Pipelines

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Solid	Removal/Backfilling (common to any alternative)	1,094,000	129,400	0	1,223,400
Aqueous	Pumping/Treatment at existing On-Site Facility	259,200	0	0	259,200
Aqueous	Pumping/Treatment On-Site	102,200	0	0	102,200
Aqueous	Pumping/Treatment Off-Site	161,900	0	0	161,900
Crystalline Solid	Manual/Removal/Open Flame Detonation	80,300	14,500	0	94,800
Crystalline Solid	Manual/Removal/Incineration On-Site	1,217,000	221,560	0	1,438,560
Solid	Manual Removal/Biotreatment	337,565	67,900	0	405,465
Solid	Manual Removal/Incineration Off-Site	1,681,480	221,070	0	1,902,550
Solid	Manual Removal/Open Flaming	635,000	97,500	0	732,500
Solid	Hazardous Solid Disposal (Landfill)	173,846	18,150	0	191,996
Solid	Hazardous Solid Treatment/Disposal	174,600	25,200	0	199,800
Solid	Hazardous Solid Fixation/Disposal	150,350	22,000	0	172,400
Solid	Nonhazardous Solid Disposal (Landfill)	225,200	39,300	0	264,500

ACRES

ESTIMATE

Title: TNT Lines Removal/Backfilling Same for all alternatives — Treatment options discussed under each option

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

Job No. P09818.28
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				20,000		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				50,000		facilities and enclosures for temporary storage
	• Temporary Sheet Piling	11,000	sf	9.50/sf	104,500		Z22 sheets, 22' long
	• Field Office and Services	4	mo	1,700/mo	6,800		
	• Excavation	18,000	cy	25/cy	450,000		includes removal of liquids and solids from pipeline, stabilization of solids and removal of concrete encased pipe from trench
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				–		
	• On-site Treatment Costs				–		
	• Staging/Work Areas		LS		40,000		segregation, handling, earthwork
	• Backfilling	16,890	cy	see remarks	70,200		$3.50/cy x 15,725 cy plus $13 cy x 1,165 cy
	• Topsoiling/Seeding	1,110	cy	18.29/cy	20,300		topsoil, seed, & mulch
	• Roadway Crossings	8	ea	5,000/ea	40,000		(6 road crossings, 2 drainage ditch crossings)
	• Decontamination Costs	4	mo	15,000/mo	60,000		
	• Health and Safety Plan/Monitoring	24	day	600/day	14,400		
	• Post-excavation Sampling Analyses	100	ea	750	75,000		
	• Monitoring Wells						
	Subtotal				951,200		

ACRES	ESTIMATE	Title: TNT Lines Removal/Backfilling Same for all alternatives	Treatment options discussed under each option
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS	TYPE OF ESTIMATE +50% to -30%	Job No. P09818.28
			File No.
	PROJECT EE/CA AT LOOW SITE	APPROVED BY K. Litfin	Sheet 2 of 3
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs				–		
	• Transport Costs				–		
	• Tipping Fees				–		
	Subtotal				0		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				142,700		
	DIRECT CAPITAL COST					1,094,000	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	2	mo	10,000	20,000		
2.2	• Engineering and Design (5% of total direct costs)				54,700		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				54,700		
	Subtotal				129,400		
	INDIRECT CAPITAL COST					129,400	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines Removal/Backfilling Same for all alternatives

Treatment options discussed under each option

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs				–		
3.2	• Support Costs				–		
	Subtotal				0		
	TOTAL					1,223,400	
	1995 TOTAL					1,272,000	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - Treatment On-Site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						45,000 gallons in situ, 33,000 gallons from excavation process
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	78,000	gal	0.04/gal	3,120		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)						
	• On-site Treatment Costs						
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				3,120		

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - Treatment On-Site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	<u>**Off-Site Treatment/Disposal Costs**</u>						
	• Treatment/Analytical Costs	9	ea	1,000/test	9,000		One test/9,200 gal
	• Transport Costs	78,000	gal	0.24/gal	18,700		
	• Tipping Fees	78,000	gal	2.50/gal	195,000		
	Subtotal				222,700		
1.3	<u>**Contingencies**</u>						
	(+ 15%) (for unknown conditions)				33,400		
	DIRECT CAPITAL COST					259,200	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost				0		included in removal portion of options
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE Title: TNT Sewers - Aqueous Matrix - Treatment On-Site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					259,200	
	1995 TOTAL					269,600	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	DIRECT CAPITAL COSTS						45,000 gallons
1.1	Remedial Construction/Removal Costs						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	78,000	gal	0.04/gal	3,120		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)	78,000	gal	0.02/gal	1,560		sand filter
	• On-site Treatment Costs	78,000	gal	1.08/gal	84,200		carbon treatment and regeneration, testing
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				88,900		

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs				0		
	• Transport Costs				0		
	• Tipping Fees				0		
	Subtotal				0		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				13,300		
	DIRECT CAPITAL COST					102,200	Sum of 1.1, 1.2 and 1.3
2.0	INDIRECT CAPITAL COSTS						
2.1	• Construction Management Cost				0		Included in TNT line removal
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					102,200	
	1995 TOTAL					106,300	4% escalation for 1995

ACRES	**ESTIMATE** Title: TNT Sewers - Aqueous Matrix - Treatment Off-Site	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 1 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	DIRECT CAPITAL COSTS						45,000 gallons in situ, 33,000 gallons process
1.1	Remedial Construction/Removal Costs						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	78,000	gal	0.04/gal	3,120		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)						
	• On-site Treatment Costs						
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				3,120		

ACRES	ESTIMATE Title: TNT Sewers - Aqueous Matrix - Treatment Off-Site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	9	ea	1,000/test	9,000		
	• Transport Costs	78,000	gal	0.19/gal	14,800		
	• Tipping Fees	78,000	gal	1.50/gal	117,000		
	Subtotal				140,800		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				21,100		
	DIRECT CAPITAL COST					161,900	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost				0		included in TNT line removal
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Sewers - Aqueous Matrix - Treatment Off-Site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					161,900	
	1995 TOTAL					168,400	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines Crystalline Materials - Manual Removal/Open Flame Detonation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				3,000		personnel and equipment mobilization
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				20,000		allowance for isolated bermed area
	• Field Office and Services				0		
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)	15	cy	1,350/cy	20,250		manual removal from pipe sections occuring during excavation activities
	• On-site Treatment Costs	15	cy	1,000/cy	15,000		open flaming
	• Staging/Work Areas				0		
	• Backfilling				0		
	• Topsoiling/Seeding				0		
	• Decontamination Costs	1/4	mo	15,000	3,750		
	• Health and Safety Plan/Monitoring	5	day	600	3,000		
	• Post-excavation Sampling Analyses	6	ea	50	300		
	• Monitoring Wells						
	Subtotal				65,300		

ACRES	**ESTIMATE** Title: TNT Lines Crystalline Materials - Manual Removal/Open Flame Detonation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS
PROJECT EE/CA AT LOOW SITE
TYPE OF ESTIMATE +50% to -30%
APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs	1	ea	1,500	1,500		90% reduction in volume to 1.5 cy
	• Transport Costs	2.6	tons	10 ton	30		} Assume can be added to another load of material so no surcharge
	• Tipping Fees	2.6	tons	27/ton	70		
	Subtotal				1,600		
1.3	Contingencies						
	(+ 20%) (for unknown conditions)				13,400		
	DIRECT CAPITAL COST					80,300	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				8,000		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				4,000		
	Subtotal				14,500		
	INDIRECT CAPITAL COST					14,500	Sum of 2.1, 2.2 and 2.3

ACRES	**ESTIMATE** Title: TNT Lines Crystalline Materials - Manual Removal/Open Flame Detonation	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 3 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					94,800	
	1995 TOTAL					98,600	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines Crystalline Materials - Manual Removal/Incineration On-site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				1,000,000		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		included in mobilization
	• Field Office and Services				0		no field office presumed necessary
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)	15	cy	1,350/cy	20,250		manual removal from pipes
	• On-site Treatment Costs	26	tons	1,400/t	36,400		
	• Staging/Work Areas				0		included in mobilization
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs (5% staging)				–		
	• Health and Safety Plan/Monitoring				–		
	• Post-excavation Sampling Analyses				–		
	• Monitoring Wells				–		
	Subtotal				1,056,650		

ACRES

ESTIMATE

Title: TNT Lines Crystalline Materials - Manual Removal/Incineration On-site

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						90% reduction in volume
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	2.6	tons	10/ton	30		
	• Tipping Fees	2.6	tons	27/ton	70		
	Subtotal				1,600		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				158,750		
	DIRECT CAPITAL COST					1,217,000	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8% of total direct costs)				97,360		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 10% of total direct costs)				121,700		10% may be low
	Subtotal				221,560		
	INDIRECT CAPITAL COST					221,560	Sum of 2.1, 2.2 and 2.3

	ESTIMATE	Title: TNT Lines Crystalline Materials - Manual Removal/Incineration On-site
ACRES	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 3 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**				0		
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs						
	Subtotal				0		
	TOTAL					1,438,560	
	1995 TOTAL					1,496,100	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines Sediments/Soils - Manual Removal/Biotreatment

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				20,000		mobilize equipment & chemicals
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				10,000		potential need for enclosure for year round use
	• Field Office and Services				0		no field office presumed necessary
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)	135	cy	1,350/cy	182,250		
	• On-site Treatment Costs	135	cy	91/cy	12,285		materials, enhancement
	• Staging/Work Areas				20,000		prepare area, install piping network
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs	1/2	mo	15,000/mo	7,500		
	• Health and Safety Plan/Monitoring	12	mo	2,000/mo	24,000		not full time
	• Post-remediation Sampling Analyses	10	ea	750/ea	7,500		
	• Monitoring Wells						
	Subtotal				283,535		

ACRES	ESTIMATE Title: TNT Lines Sediments/Soils - Manual Removal/Biotreatment	
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	230	tons	10/ton	2,300		
	• Tipping Fees	230	tons	27/ton	6,200		
	Subtotal				10,000		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				44,030		
	DIRECT CAPITAL COST					337,565	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	12	mo	2,000/mo	24,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				27,000		8%
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				16,900		
	Subtotal				67,900		
	INDIRECT CAPITAL COST					67,900	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines Sediments/Soils - Manual Removal/Biotreatment

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					405,465	
	1995 TOTAL					421,700	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines Sediments/Soils - Manual Removal/Incineration Offsite

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				0		mobilization under crystalline removal
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		
	• Field Office and Services				0		no office presumed necessary
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)	135	cy	1,350/cy	182,250		manual removal during excavation activity
	• On-site Treatment Costs	805	tons	$15/ton	12,075		blending materials to reduce TNT from 35% to <10% by weight
	• Staging/Work Areas				0		costs under excavation and crystalline material separation
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1/4	mo	15,000	3,750		
	• Health and Safety Plan/Monitoring	10	days	600/day	6,000		
	• Post-excavation Sampling Analyses				0		
	• Monitoring Wells						
	Subtotal				204,075		

ESTIMATE

Title: TNT Lines Sediment/Soils - Manual Removal/Incineration Offsite

ACRES

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	805	tons	161/ton	129,605		Includes $6/t taxes
	• Tipping Fees	805	tons	1,400/ton	1,127,000		
	Subtotal				1,258,105		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				219,300		
	DIRECT CAPITAL COST					1,681,480	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				134,500		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				84,070		
	Subtotal				221,070		
	INDIRECT CAPITAL COST					221,070	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines Sediment/Soils - Manual Removal/Incineration Offsite

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0	0	
	TOTAL					1,902,550	
	1995 TOTAL					1,978,650	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines Sediments/Soils - Manual Removal/Open Flaming

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				3,000		personnel & equipment mob also part of crystalline materials option
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		for isolated bermed area, use crystalline material option location
	• Field Office and Services				0		see materials disposal segments
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)	135	cy	1,350/cy	182,250		manual removal during excavation activities
	• On-site Treatment Costs	135	cy	2,000/cy	270,000		open flaming (2 crews)
	• Staging/Work Areas				10,000		air emission controls
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1.5	mo	15,000	22,500		
	• Health and Safety Plan/Monitoring	35	days	600/day	21,000		
	• Post-excavation Sampling Analyses	15	ea	750/ea	11,250		
	• Monitoring Wells				0		
	Subtotal				520,000		

ACRES	ESTIMATE Title: TNT Lines Sediments/Soils - Manual Removal/Open Flaming
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						10% reduction in volume 122 cy remain
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	207	ton	10/ton	2,070		
	• Tipping Fees	207	ton	27/ton	5,600		
	Subtotal				9,170		
1.3	**Contingencies**						
	(+ 20%) (for unknown conditions)				105,800		
	DIRECT CAPITAL COST					635,000	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1.5	mo	10,000/mo	15,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				50,800		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				31,700		
	Subtotal				97,500		
	INDIRECT CAPITAL COST					97,500	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines Sediments/Soils - Manual Removal/Open Flaming

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					732,500	
	1995 TOTAL					761,800	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						Addresses 10% of concrete, pipe and soil (458 ton total) assumed hazardous
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				–		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				–		see removal of TNT lines
	• Field Office and Services				–		
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				0		
	• On-site Treatment Costs				0		
	• Staging/Work Areas				–		
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1/4	mo	15,000	3,750		
	• Health and Safety Plan/Monitoring	5	days	600/day	3,000		
	• Post-excavation Sampling Analyses				–		
	• Monitoring Wells				0		
	Subtotal				6,750		

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	458	tons	32/ton	14,656		10% of 4,500 tons concrete/pipe and 85 tons of soil
	• Tipping Fees	458	tons	280/ton	128,240		
	Subtotal				144,396		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				22,700		
	DIRECT CAPITAL COST					173,846	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8% of total direct costs)				13,900		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				1,750		1%
	Subtotal				18,150		
	INDIRECT CAPITAL COST					18,150	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					191,996	
	1995 TOTAL					199,700	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				50,000		mobilization of equipment
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				–		see removal of TNT lines
	• Field Office and Services				–		
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				–		
	• On-site Treatment Costs	458	tons	90/ton	41,220		soil washing reduce volume by 90% to nonhazardous
	• Staging/Work Areas				20,000		allowance to set up work area
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1/4	mo	15,000	3,750		
	• Health and Safety Plan/Monitoring	7	days	600/day	4,200		
	• Post-excavation Sampling Analyses				–		
	• Monitoring Wells				–		
	Subtotal				119,170		

ACRES	**ESTIMATE** Title: TNT Lines - Hazardous Solids - Treatment/Disposal
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin
	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	2	ea	1,500	3,000		
	• Transport Costs	458	tons	see	5,600		46 tons x $32/ton + 412 x $10/ton
	• Tipping Fees	458	tons	remarks	24,000		46 tons x $280/ton + 412 x $27/ton
	Subtotal				32,600		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				22,800		
	DIRECT CAPITAL COST					174,600	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				14,000		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				8,700		
	Subtotal				25,200		
	INDIRECT CAPITAL COST					25,200	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					199,800	
	1995 TOTAL					207,800	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						458 tons of material are hazardous
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				50,000		mobilization charge for pugmill, other ancillary equipment & chemicals
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				–		see remedial costs
	• Field Office and Services				–		
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				–		
	• On-site Treatment Costs	458	tons	75/ton	34,350		
	• Staging/Work Areas				20,000		allowance to set up work area
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1/4	mo	15,000	3,750		
	• Health and Safety Plan/Monitoring	7	days	600/day	4,200		
	• Post-excavation Sampling Analyses				–		
	• Monitoring Wells				–		
	Subtotal				112,300		

ACRES	**ESTIMATE** Title: TNT Lines - Hazardous Solids - Fixation/Disposal
	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	458	tons	10/ton	4,580		} Disposal of fixed material at nonhazardous landfill
	• Tipping Fees	458	tons	27/ton	12,370		
	Subtotal				18,450		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				19,600		
	DIRECT CAPITAL COST					150,350	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/4	mo	10,000	2,500		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				12,000		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				7,500		
	Subtotal				22,000		
	INDIRECT CAPITAL COST					22,000	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines - Hazardous Solids - Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					172,400	
	1995 TOTAL					179,300	4% escalation for 1995

ACRES

ESTIMATE

Title: TNT Lines - Nonhazardous Solids Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				0		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		
	• Field Office and Services	1	mo	1,700/mo	1,700		
	• Excavation				–		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				–		
	• On-site Treatment Costs				–		
	• Staging/Work Areas				–		part of excavation/backfill cost
	• Backfilling				–		
	• Topsoiling/Seeding				–		
	• Decontamination Costs	1	mo	15,000	15,000		
	• Health and Safety Plan/Monitoring	24	days	600/day	14,400		
	• Post-excavation Sampling Analyses				–		
	• Monitoring Wells				0		
	Subtotal				31,100		

ACRES

ESTIMATE

Title: TNT Lines - Nonhazardous Solids Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						4,127 tons of piping & soils
	• Treatment/Analytical Costs	8	ea	1,500	12,000		
	• Transport Costs	4,127	tons	10/ton	41,270		
	• Tipping Fees	4,127	tons	27/ton	111,430		
	Subtotal				164,700		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				29,400		
	DIRECT CAPITAL COST					225,200	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1	mo	10,000	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				18,000		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				11,300		
	Subtotal				39,300		
	INDIRECT CAPITAL COST					39,300	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: TNT Lines - Nonhazardous Solids Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					264,500	
	1995 TOTAL					275,100	4% escalation for 1995

AFP68 Chemical Waste Lift Stations

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Solid	Pumping/Fixation/Disposal (Landfill)	223,000	39,000	0	262,000
Solid	Pumping/Incineration/Disposal	230,650	40,000	0	270,650
Solid	Pumping/Treatment/Disposal	253,300	43,000	0	296,300
Aqueous	Treatment at existing On-Site Facility	28,635	0	0	28,635
Aqueous	Treatment On-Site/Discharge	54,855	0	0	54,855
Aqueous	Treatment Off-Site	40,365	0	0	40,365

ACRES

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

Job No. P09818.28
File No.
Sheet 1 of 3
By LDZ Date 11/23/94
Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				5,000		mixing will occur without pugmill on site
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		none required
	• Field Office and Services	1	mo	1,700/mo	1,700		
	• Excavation - removal from sewers	25	cy	2,000/cy	50,000		
	• Dewatering/Drainage Control				–		see aqueous treatment
	• Pretreatment Costs (for excavated materials)	14,300	lbs	5/lb	71,500		off gas treatment of VOC, cost per lb recovered contaminants
	• On-site Treatment Costs	43	tons	100/ton	4,300		extra materials required because of the fine wet materials
	• Staging/Work Areas				10,000		area in which to perform fixation
	• Backfilling				0		
	• Topsoiling/Seeding				0		
	• Decontamination Costs	1	mo	15,000	15,000		
	• Health and Safety Plan/Monitoring	24	days	600	14,400		
	• Post-excavation Sampling Analyses	10	ea	750	7,500		
	• Monitoring Wells				0		
	Subtotal				179,400		

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Fixation/Disposal

ACRES

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

Job No. P09818.28
File No.
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						Increase volume by 30% with fixation
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	56	tons	20/ton	1,120		
	• Tipping Fees	56	tons	212/ton	11,872		Includes taxes
	Subtotal				14,492		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				29,100		
	DIRECT CAPITAL COST					223,000	Sum of 1.1, 1.2 and 1.3
2.0	INDIRECT CAPITAL COSTS						
2.1	• Construction Management Cost	1	mo	10,000	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				17,800		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				11,200		
	Subtotal				39,000		
	INDIRECT CAPITAL COST					39,000	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Fixation/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					262,000	
	1995 TOTAL					272,500	4% escalation for 1995

ACRES

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Incineration/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				5,000		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		
	• Field Office and Services	1	mo	1,700/mo	1,700		
	• Excavation - removal from sewers	25	cy	2,000/cy	50,000		
	• Dewatering/Drainage Control				–		see aqueous treatment
	• Pretreatment Costs (for excavated materials)				0		
	• On-site Treatment Costs				0		
	• Staging/Work Areas				0		
	• Backfilling				0		
	• Topsoiling/Seeding				0		
	• Decontamination Costs	1	mo	15,000	15,000		
	• Health and Safety Plan/Monitoring	24	days	600	14,400		
	• Post-excavation Sampling Analyses	10	ea	750	7,500		
	• Monitoring Wells				0		
	Subtotal				93,600		

ACRES	**ESTIMATE** Title: AFP-68 Sludges/Soils - Pumping/Incineration/Disposal	
	CLIENT: DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT: EE/CA AT LOOW SITE TYPE OF ESTIMATE: +50% to -30% APPROVED BY: K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						Assume 21 tons of water will be added to 43 tons of sludge in the removal process.
	• Treatment/Analytical Costs	1	ea	1,500/ea	1,500		
	• Transport Costs	64	tons	248/ton	15,870		Includes $18/ton taxes
	• Tipping Fees	64	tons	1,400/ton	89,600		
	Subtotal				106,970		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				30,100		
	DIRECT CAPITAL COST					230,650	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1	mo	10,000	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				18,500		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				11,500		
	Subtotal				40,000		
	INDIRECT CAPITAL COST					40,000	Sum of 2.1, 2.2 and 2.3

ACRES	**ESTIMATE** Title: AFP-68 Sludges/Soils - Pumping/Incineration/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS	TYPE OF ESTIMATE +50% to -30%	Job No. P09818.28
PROJECT EE/CA AT LOOW SITE	APPROVED BY K. Litfin	File No.
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					270,650	
	1995 TOTAL					281,500	4% escalation for 1995

ACRES

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				100,000		mobilization of equipment
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		
	• Field Office and Services	1	mo	1,700/mo	1,700		
	• Excavation - removal from sewers	25	cy	2,000/cy	50,000		
	• Dewatering/Drainage Control				–		
	• Pretreatment Costs (for excavated materials)				0		
	• On-site Treatment Costs	43	tons	200/ton	8,600		
	• Staging/Work Areas				20,000		work area, staging platform
	• Backfilling				0		
	• Topsoiling/Seeding			0	0		
	• Decontamination Costs	1	mo	15,000	15,000		
	• Health and Safety Plan/Monitoring	24	days	600	14,400		
	• Post-excavation Sampling Analyses	10	ea	750	7,500		
	• Monitoring Wells				0		
	Subtotal				217,200		

	ESTIMATE Title: AFP-68 Sludges/Soils - Pumping/Treatment/Disposal	
ACRES	CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS PROJECT EE/CA AT LOOW SITE TYPE OF ESTIMATE +50% to -30% APPROVED BY K. Litfin	Job No. P09818.28 File No. Sheet 2 of 3 By LDZ Date 11/23/94 Chkd RET Date 3/6/95

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						Material presumed nonhazardous after treatment
	• Treatment/Analytical Costs	1	ea	1,500	1,500		
	• Transport Costs	43	tons	10/ton	430		
	• Tipping Fees	43	tons	27/ton	1,160		
	Subtotal				3,090		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				33,000		
	DIRECT CAPITAL COST					253,300	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1	mo	10,000	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				20,300		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				12,700		
	Subtotal				43,000		
	INDIRECT CAPITAL COST					43,000	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: AFP-68 Sludges/Soils - Pumping/Treatment/Disposal

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					296,300	
	1995 TOTAL					308,200	4% escalation for 1995

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations-Treatment at CWM

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

Job No. P09818.28
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						200,000 gallons
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	30,000	gal	0.04/gal	1,200		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)						
	• On-site Treatment Costs						
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				1,200		

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations-Treatment at CWM

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

APPROVED BY K. Litfin

Job No. P09818.28

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs	5	ea	600/test	3,000		
	• Transport Costs	30,000	gal	0.19/gal	5,700		
	• Tipping Fees	30,000	gal	0.50/gal	15,000		
	Subtotal				23,700		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				3,735		
	DIRECT CAPITAL COST					28,635	Sum of 1.1, 1.2 and 1.3
2.0	INDIRECT CAPITAL COSTS						
2.1	• Construction Management Cost				0		included in sediment removal costs
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations-Treatment at CWM

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS
PROJECT EE/CA AT LOOW SITE
TYPE OF ESTIMATE +50% to -30%
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0	0	
	TOTAL					28,635	
	1995 TOTAL					29,800	4% escalation for 1995

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						200,000 gallons
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	30,000	gal	0.04/gal	1,200		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)	30,000	gal	0.03/gal	900		sand filter
	• On-site Treatment Costs	30,000	gal	1.52/gal	45,600		carbon treatment, regeneration, testing
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				47,700		

ACRES	ESTIMATE Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs				0		
	• Transport Costs				0		
	• Tipping Fees				0		
	Subtotal				0		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				7,155		
	DIRECT CAPITAL COST					54,855	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost				0		included under sediment removal
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations - On-site Treatment/Discharge

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0	0	
	TOTAL					54,855	
	1995 TOTAL					57,000	4% escalation for 1995

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68-Chemical Waste Lift Stations-Treatment at CECOS

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						200,000 gallons
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization						
	• Land and Site Acquisition Costs						
	• Relocation Costs						
	• Temporary Structures and Services (for removal action)						
	• Field Office and Services						
	• Excavation						
	• Dewatering/Drainage Control	30,000	gal	0.04/gal	1,200		cost to get water into transport vehicles
	• Pretreatment Costs (for excavated materials)						
	• On-site Treatment Costs						
	• Staging/Work Areas						
	• Backfilling						
	• Topsoiling/Seeding						
	• Decontamination Costs (5% staging)						
	• Health and Safety Plan/Monitoring						
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				1,200		

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations-Treatment at CECOS

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	5	ea	600/test	3,000		
	• Transport Costs	30,000	gal	0.19/gal	5,700		
	• Tipping Fees	30,000	gal	0.84/gal	25,200		
	Subtotal				33,900		
1.3	**Contingencies**						
	(+ 15%) (for unknown conditions)				5,265		
	DIRECT CAPITAL COST					40,365	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost				0		cost included in sediment removal
2.2	• Engineering and Design (+8 to 10% of total direct costs)				0		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				0		
	Subtotal				0		
	INDIRECT CAPITAL COST					0	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Aqueous Matrix - AFP-68 - Chemical Waste Lift Stations-Treatment at CECOS

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

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TYPE OF ESTIMATE +50% to -30%

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0	0	
	TOTAL					40,365	
	1995 TOTAL					42,000	4% escalation for 1995

Asbestos

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Asbestos	Removal/Disposal	110,200	24,300	0	134,500

ACRES

ESTIMATE

Title: Asbestos Remediation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				0		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				5,000		enclosures for work areas
	• Field Office and Services				0		
	• Excavation				0		
	• Dewatering/Drainage Control				0		
	• Pretreatment Costs (for excavated materials)				0		
	• On-site Treatment Costs				0		
	• Staging/Work Areas				28,000		removal of asbestos materials
	• Backfilling				0		
	• Topsoiling/Seeding				0		
	• Decontamination Costs	22	days	100	2,200		
	• Health and Safety Plan/Monitoring	30	days	600	18,000		monitoring required for each calendar day
	• Post-excavation Sampling Analyses				0		
	• Monitoring Wells				0		
	Subtotal				53,200		

ACRES	**ESTIMATE** Title: Asbestos Remediation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS	TYPE OF ESTIMATE +50% to -30%	Job No. P09818.28
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	Off-Site Treatment/Disposal Costs						
	• Treatment/Analytical Costs				0		
	• Transport Costs	1,152	tons	10/ton	11,500		Modern Disposal Services
	• Tipping Fees	1,152	tons	27/ton	31,100		
	Subtotal				42,600		
1.3	Contingencies						
	(+ 15%) (for unknown conditions)				14,400		
	DIRECT CAPITAL COST					110,200	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1	mo	10,000/mo	10,000		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				8,800		
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				5,500		
	Subtotal				24,300		
	INDIRECT CAPITAL COST					24,300	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Asbestos Remediation

CLIENT: DEPT OF THE ARMY CORPS OF ENGINEERS	TYPE OF ESTIMATE: +50% to -30%	Job No. P09818.28
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	ANNUAL PRSC COSTS						
3.1	• Post-Remediation Monitoring Costs					0	
3.2	• Support Costs					0	
	Subtotal					0	
	TOTAL					134,500	
	1995 TOTAL					140,000	4% escalation for 1995

Oil, Chemicals and Chronic Acid Remediation

Matrix	Alternatives	Direct Costs	Indirect Costs	PRSC Costs	Total
Aqueous	Removal/Disposal	6,920	4,450	0	11,825

ACRES

ESTIMATE

Title: Oil, Chemicals and Chromic Acid Remediation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

TYPE OF ESTIMATE +50% to -30%

PROJECT EE/CA AT LOOW SITE

APPROVED BY K. Litfin

Job No. P09818.28
File No.
Sheet 1 of 3
By LDZ Date 11/23/94
Chkd Date

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.0	**DIRECT CAPITAL COSTS**						
1.1	**Remedial Construction/Removal Costs**						
	• Mobilization/Demobilization				0		
	• Land and Site Acquisition Costs				0		
	• Relocation Costs				0		
	• Temporary Structures and Services (for removal action)				0		
	• Field Office and Services				0		
	• Excavation				0		
	• Dewatering/Drainage Control				0		
	• Pretreatment Costs (for excavated materials)				0		
					0		
	• On-site Treatment Costs						
	• Staging/Work Areas				1,000		container condition inventory, centralizing of materials for pickup
	• Backfilling				0		
	• Topsoiling/Seeding				0		
	• Decontamination Costs				100		allowance
	• Health and Safety Plan/Monitoring				100		monitoring
	• Post-excavation Sampling Analyses						
	• Monitoring Wells						
	Subtotal				1,200		

ACRES

ESTIMATE

Title: Oil, Chemicals and Chromic Acid Remediation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS	TYPE OF ESTIMATE +50% to -30%
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Sheet 2 of 3
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NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
1.2	**Off-Site Treatment/Disposal Costs**						
	• Treatment/Analytical Costs	8	ea	425/ea	3,400		
	• Transport Costs	1	ea	100	100		one truck load
	• Tipping Fees				1,070		$85 oil and $285 acid and $700 chemicals
	Subtotal				4,570		
1.3	**Contingencies**						
	(+ 20%) (for unknown conditions)				1,150		necessity to overpack one or more containers
	DIRECT CAPITAL COST					6,920	Sum of 1.1, 1.2 and 1.3
2.0	**INDIRECT CAPITAL COSTS**						
2.1	• Construction Management Cost	1/22	mo	10,000	450		
2.2	• Engineering and Design (+8 to 10% of total direct costs)				2,000		30% to prepare scope and specifications
2.3	• Legal Fees and Licensing or Permit Costs (allowance of 5% of total direct costs)				2,000		30% due to small direct cost
	Subtotal				4,450		
	INDIRECT CAPITAL COST					4,450	Sum of 2.1, 2.2 and 2.3

ACRES

ESTIMATE

Title: Oil, Chemicals and Chromic Acid Remediation

CLIENT DEPT OF THE ARMY CORPS OF ENGINEERS

PROJECT EE/CA AT LOOW SITE

TYPE OF ESTIMATE +50% to -30%

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Sheet 3 of 3

By LDZ Date 11/23/94

Chkd Date

NO.	DESCRIPTION	QUANTITY	UNIT	COST/ UNIT ($)	AMOUNT ($)	TOTALS ($)	REMARKS
3.0	**ANNUAL PRSC COSTS**						
3.1	• Post-Remediation Monitoring Costs				0		
3.2	• Support Costs				0		
	Subtotal				0		
	TOTAL					11,370	
	1995 TOTAL					11,825	4% escalation for 1995