US Army Corps of Engineers®
Buffalo District

PROJECT WORK PLAN
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY

FOR THE TONAWANDA LANDFILL FUSRAP SITE

TONAWANDA, NEW YORK

SEPTEMBER 14, 2000

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PROJECT WORK PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

TOWN OF TONAWANDA LANDFILL FUSRAP SITE
TONAWANDA, NY

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Ac-229	Actinium-229
Am-241	Americium-241
AEC	Atomic Energy Commission
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing Materials
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHP	Certified Health Physicist
CIH	Certified Industrial Hygienist
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
COPEC	Contaminants of Potential Ecological Concern
CQC	Chemical Quality Control
Cs-137	Cesium-137
CSF	Cancer Slope Factor
DOD	Department of Defense
DOE	Department of Energy
DQO	Data Quality Objective
ECWA	Erie County Water Authority
EC&HS	Environmental Compliance and Health and Safety
EEMG	Engineering and Environmental Management Group
ERA	Ecological Risk Assessment
FS	Feasibility Study
FSP	Field Sampling Plan
FUSRAP	Former Utilized Site Remedial Action Program
GRA	General Response Action
HEAST	Health Effects and Assessment Summary Tables
HI	Hazard Indices
HQ	Hazard Quotients
HTRW	Hazardous, Toxic, Radiological Waste
IAEA	International Atomic Energy Agency
IDW	Investigation Derived Waste
IRIS	Integrated Risk Information System
ITR	Independent Technical Review
K-40	Potassium-40
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MED	Manhattan Engineer District
NCP	National Contingency Plan
NCR	Non-Conformance Report
NEPA	National Environmental Protection Act
NMPC	Niagara Mohawk Power Company
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OEW	Ordinance and Explosive Waste
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
Pb-210	Lead-210

pCi	Picocuries
PP	Proposed Plan
PRG	Preliminary Remediation Goals
Pa-231	Protactinium-231
QA	Quality Assurance
QAAP	Quality Assurance Administrative Plan
QAP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
QCP	Quality Control Plan
QF	Quality Factor
Ra-226	Radium-226
RAO	Remedial Action Objectives
RAGS	Risk Assessment Guidance for Superfund
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROC	Radionuclides of Concern
ROD	Record of Decision
SAIC	Science Application International Corporation
SAP	Sampling and Analysis Plan
SOW	Scope of Work
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TBD	To Be Determined
T&E	Threatened and Endangered
Th-228	Thorium-228
Th-230	Thorium-230
Th-232	Thorium-232
TPP	Technical Project Planning
TPPW	Technical Project Planning Workshop
U-238	Uranium-238
U-234	Uranium-234
U-235	Uranium-235
USACE	U.S. Army Corps of Engineers
USEPA	Environmental Protection Agency
UCL	Upper Confidence Limit
UTL	Upper Tolerance Limit
WWTP	Waste Water Treatment Plan

1. PROJECT DESCRIPTION

1.1 PURPOSE AND SCOPE OF THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

A Proposed Plan for the Tonawanda Site in Tonawanda, New York was prepared by the United States Department of Energy (DOE) in September 1993 under its authority to conduct the Formerly Utilized Sites Remedial Action Program (FUSRAP). The 1993 Proposed Plan for the Tonawanda Site addressed remediation of radioactive contamination at the four (4) locations in the Town of Tonawanda that comprised the Tonawanda Site as defined at that time: the Linde (now Praxair) Site; the Ashland 1 Site; the Ashland 2 Site; and the Seaway Site. Radioactive contamination at the sites is a result, in part, of various ore processing activities conducted in the 1940's under Manhattan Engineer District (MED) authorization. The Tonawanda Landfill (Landfill) site was designated a FUSRAP Vicinity Property site in December, 1992. (DOE 1992)

On October 13, 1997, the Energy and Water Development Appropriations Act, 1998 was signed into law as Public Law 105-62. Pursuant to this law, FUSRAP was transferred from the DOE to the United States Army Corps of Engineers (USACE). As a result of this transfer the responsibility for this project was transferred to USACE. The Energy and Water Development Appropriation Act for Fiscal Year 2000, Public Law 106-60, provides authority to USACE to conduct restoration work on FUSRAP Sites and Vicinity Property Sites subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code 9601 et seq., as amended. Therefore, USACE is conducting this project in accordance with CERCLA.

This Work Plan summarizes tasks to be performed during the RI/FS proposed for the Landfill. The purpose of the RI/FS is to evaluate the nature and extent of MED-related radiological contamination at the Landfill and identify and evaluate several practical alternatives to address the contamination in accordance with the requirements of CERCLA. The intent of the additional investigation at the site is to more accurately delineate the extent of MED-related contamination and associated risks. Previous investigations do not provide enough information to identify the affected areas with a high degree of certainty.

The Landfill was designated as a FUSRAP vicinity property in 1992 based on field sampling and gamma survey results that indicate the presence of MED-like material at several locations in the now non-operational landfill (ORNL 1992). The MED-like material detected in the Landfill is believed to have been generated at the former Linde Air Products (Linde) Site, Tonawanda, NY and ended up being placed in the Landfill as part of a by-product of wastewater treatment, waste handling, and dredging activities (DOE 1994a, 1994b). Contaminants associated with MED activities for this project consist of radionuclides generated during uranium processing activities at the former Linde site between 1942 - 1948. Contaminants of concern at the Landfill are primarily uranium-238 (U-238), thorium-230 (Th-230), and radium-226 (Ra-226). Based on the historical use of the Landfill, radiological and/or chemical contaminants unrelated to MED activities may also be present at the site, but may only be remediated by USACE if mixed with MED constituents. Previous investigations at the Landfill have indicated a minimum of two locations where MED–like material may be present at the site. (ORNL 1992)

1.2 PROJECT GOALS

The principal goal of the RI is to determine the nature and extent of MED-related radiological contamination present at the Tonawanda Landfill FUSRAP site. The principal goal of the FS is to evaluate various alternatives for addressing radiological contamination. As part of this work, the following project goals will be met:

- determine the extent of MED-related constituents in onsite soils and groundwater, if determined to have been impacted;
- acquire information to describe the fate and transport of contaminants within and from the site;
- collect data that will be of sufficient quality and quantity to be legally defensible under regulatory requirements;
- gather sufficient information to complete a baseline risk assessment (BRA), including an assessment of both human health and ecological risk;
- determine whether MED-related contaminants present constitute a threat to human health or the environment and are at levels exceeding project Applicable or Relevant and Appropriate Requirements (ARARS);
- prepare an FS to develop, identify, and recommend alternatives to address MED-related contamination posing unacceptable risks to human health and/or the environment.

1.3 ORGANIZATION OF WORK PLAN

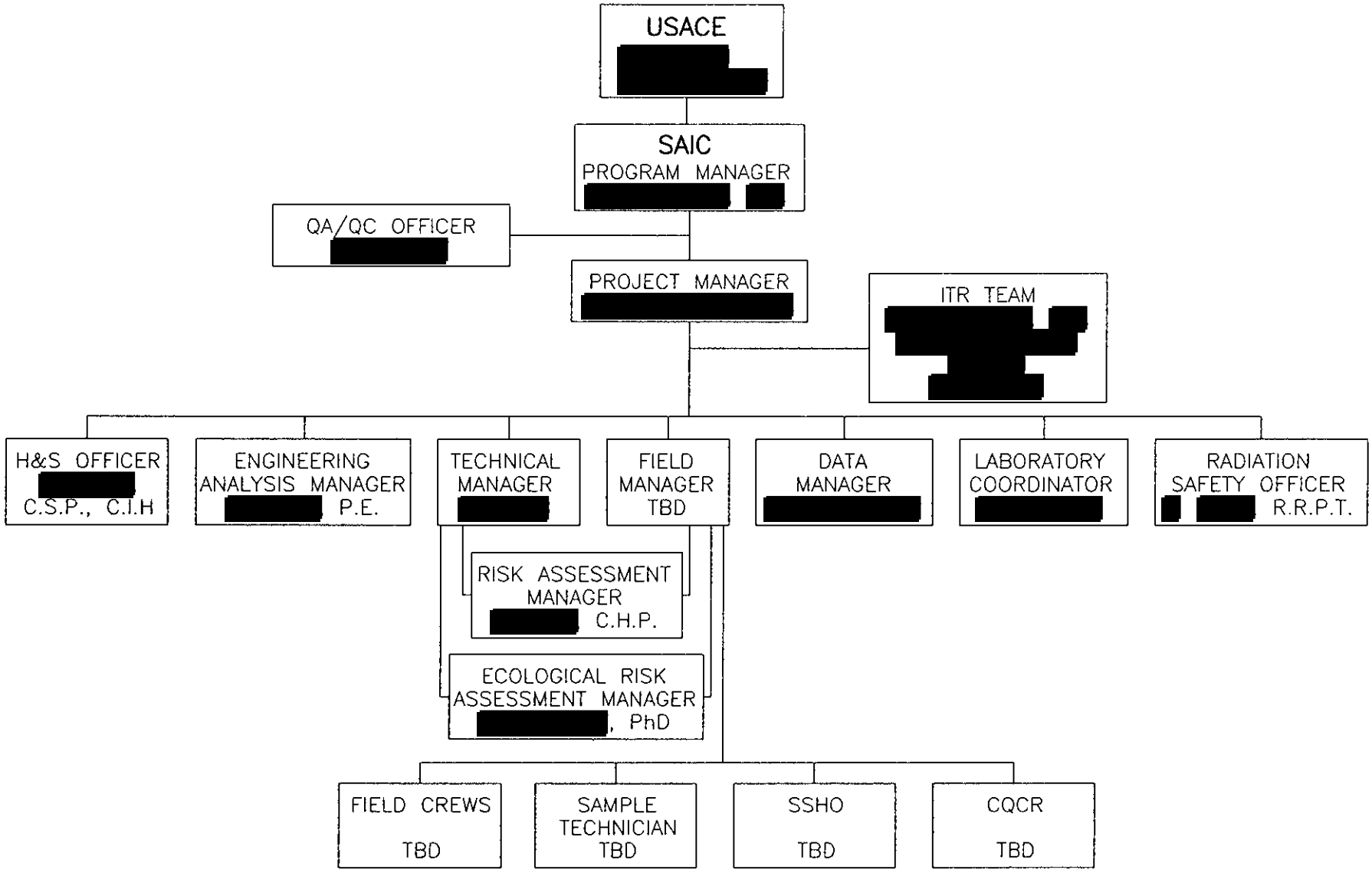
This RI/FS Project Work Plan is organized into four sections. The remaining portion of Section 1 provides an overview of the project organization and personnel responsibilities and qualifications for the RI/FS process at the Landfill. Section 1 also contains information on the procedures for communications and reporting arrangements, and the project schedule. Section 2 provides a brief description and history of operations at the Landfill , a summary of the site's current physical conditions, and a summary of the results of prior investigations. Section 3 provides a description and the methodology to be used in conducting each of the 14 tasks listed in the Scope of Work (SOW) (USACE 1999a). Section 3 also contains subsections detailing personnel responsibilities for each task. Section 4 is a list of references used in producing this work plan.

1.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

This work plan details the activities necessary to complete the RI/FS at the Landfill. This portion of the Work Plan represents the Project Management Plan for activities to be performed by Science Applications International Corporation (SAIC), under contract to USACE, associated with the Tonawanda Landfill FUSRAP Site. This plan designates key SAIC and subcontractor personnel anticipated at this time to be participating in the project and provides a summary of their responsibilities. Task-specific responsibilities for key project personnel are presented in Section 3 of this plan.

The organization chart illustrated in Figure 1-1 outlines the management structure that will be used to implement the project. The functional responsibilities of key personnel are described in the following parts of this plan. The assignment of personnel to each project position is based on a combination of (1) experience in the type of work to be performed, (2) experience working with USACE personnel and procedures, (3) a demonstrated commitment to high quality and timely job performance, and (4) staff availability. Key project personnel have been tentatively assigned based upon the minimum education and qualification requirements for each assigned position, as shown in Table 1-1.

FIGURE 1-1
FUSRAP-TONAWANDA LANDFILL SITE
RI/FS
ORGANIZATION CHART



Project Assignment	Education Background	Relevant Experience
Technical Manager [redacted]	M.S. Environmental Engineering B.S. Civil Engineering	11+ years of experience in HTRW projects including management of field projects for site investigations, remedial investigations, and related environmental evaluations/studies.
RAD Safety Officer [redacted], R.R.P.T.	High School Diploma	15+ years of radiation protection and health physics support. Registered Radiological Protection Technologist
Chemical Quality Control Representative TBD	A.S. in Science or Engineering Technology or related field or equivalent field work experience	3+ years of experience in HTRW projects including soil and groundwater sampling, and monitoring well installation.
Sampling Technicians TBD	A.S. in Science or Engineering Technology or related field or equivalent field work experience	3+ years of experience in HTRW projects including soil and groundwater sampling, and monitoring well installation.
Primary ITR (Engineer) [redacted], P.E.	M.E. Civil Engineering B.S. Civil Engineering	18+ years of experience in HTRW and FUSRAP projects including site investigations and related environmental evaluations/studies.
ITR (Hydrogeology) [redacted]	Ph.D. Geology	5+ years of experience in FUSRAP and HTRW projects including management of field projects for site investigations, remedial investigations, hydrogeological and geological studies, and related environmental evaluations/studies.
ITR (Health Physicist) [redacted], C.H.P.	B.S. Health Physics	15+ years of experience relating to radiological contamination and radiation protection programs.
ITR (Risk Assessor) [redacted]	M.S. Environmental Policy/Public Health	18+ years of experience in HTRW projects including risk assessment, site investigations, air quality assessments and related environmental evaluations/studies.

In the event that personnel identified in Figure 1-1 and Table 1-1 must be replaced after issuance of this document, SAIC will provide the names and resumes for the replacement individuals to the USACE - Buffalo District Project Manager.

1.4.1 Key Personnel Responsibilities

This section describes the general responsibilities of the key SAIC personnel to conduct work on the Tonawanda Landfill Site. Task-specific responsibilities are described in Section 3.0

1.4.1.1 SAIC Program Manager

The SAIC Program Manager manages the overall performance and quality of SAIC projects for the USACE - Buffalo District. This individual will oversee the SAIC Project Manager in meeting project goals and objectives in a high-quality and timely manner. Quality assurance issues will be addressed by this individual, in coordination with the SAIC Project Manager and Quality Assurance/Quality Control (QA/QC) Officer, including identification of nonconformances and verification of corrective action.

1.4.1.2 SAIC Project Manager

The SAIC Project Manager has responsibility for oversight of all project activities, including work plan development, field activities, data management, and data reporting. This individual will also provide the overall financial management of the project, and serve as the point of contact with the USACE-Buffalo District Project Manager ([redacted] and USACE-Buffalo District Project Engineer ([redacted]). The SAIC Project Manager will also develop, monitor, and fill project staffing needs, delegate specific responsibilities to project team members, and coordinate with administrative staff to maintain a coordinated and timely flow of project activities and submittals. The SAIC Project Manager reports directly to the SAIC Program Manager.

1.4.1.3 SAIC Health and Safety Officer

The SAIC Health and Safety Officer is responsible for confirming that health and safety procedures designed to protect personnel are maintained throughout the field activities conducted for the project. This will be accomplished by strict adherence to the project Site Safety and Health Plan (SSHP). This individual, in coordination with the SAIC Site Safety and Health Officer (SSHO), will have the authority to halt field work if health and/or safety issues arise that are not immediately resolvable in accordance with the project SSHP. The SAIC Health and Safety Officer reports directly to the SAIC Project Manager, but will inform the SAIC Field Manager of all information and decisions reported.

1.4.1.4 SAIC Data Manager

The SAIC Data Manager, and data management personnel, will be responsible for managing the field and analytical data generated during the project. The data management team will be responsible for the accumulation, control, reduction, validation, documentation, and storage of project data in accordance with the Data Management Plan. The SAIC Data Manager will also assist the SAIC QA/QC Officer in the review of laboratory procedures, if required. The SAIC Data Manager reports directly to the SAIC Project Manager.

1.4.1.5 SAIC Quality Assurance/Quality Control Officer

The SAIC QA/QC Officer is responsible for the project QA/QC in accordance with the requirements of the project Quality Assurance Program Plan (QAPP), other work plan documentation, and appropriate management guidance. This individual, in coordination with the SAIC Chemical Quality Control (CQC) Representative, will be responsible for participating in the project field activity readiness review; approving variances during field activities before work continues; approving, evaluating, and documenting the disposition of Nonconformance Reports (NCRs); overseeing and approving any required project training; and designing audit/surveillance plans followed by supervision of these activities. The SAIC QA/QC Officer and CQC Representative report directly to the SAIC Project Manager, but will inform the SAIC Field Manager of all information and decisions reported.

quantity and quality of technical data required for project success. The SAIC Technical Manager will have site knowledge and history required to make technical decisions for the addition, deletion or relocation of sample locations and/or numbers. The SAIC Technical Manager reports directly to the SAIC Project Manager, but will coordinate field decisions with the SAIC Field Manager and USACE Project Manager.

1.4.1.11 SAIC Radiation Safety Officer

The SAIC Radiation Safety Officer is responsible for confirming that radiation safety procedures designed to protect personnel are maintained throughout the field activities conducted for the project. This will be accomplished by strict adherence to the project SSHP, which will be presented in the project SAP. This individual, in coordination with the SAIC SHSO, will have the authority to halt field work if health and/or safety issues, as they apply to radiological issues, arise that are not immediately resolvable in accordance with the project SSHP. The SAIC Radiation Safety Officer reports directly to the SAIC Project Manager, but will inform the SAIC Field Manager of all information and decisions reported.

1.5 COMMUNICATIONS AND REPORTING ARRANGEMENTS

Communications between the USACE and SAIC will consist of the following:

- During field activities Field Managers shall submit to the USACE onsite representative a daily quality control report including work activities performed and content of safety briefings summarized, corrective actions taken, etc.
- During field activities weekly memorandum or e-mail communication summarizing work performed in the previous week, work being performed that week, work to be performed the following week, issues/concerns, and any other pertinent information. This schedule may be modified based on the level of effort for the project each week. The weekly memorandum will be prepared by the Field Manager and submitted to the USACE Project Manager
- Bi-weekly teleconference call between USACE and SAIC to discuss project progress and issues.
- Monthly Cost/Schedule Reports.
- Project decisions will be documented in correspondence between the SAIC Program/Project Managers and the USACE Project Engineer/Project Manager. This correspondence will be issued no later than 5 days after a decision has been made.

The main individuals involved in this communication include:

- USACE Project Manager: [redacted]
- USACE Project Engineer: [redacted]
- SAIC Program Manager: [redacted]
- SAIC Assistant Program Manager: [redacted]
- SAIC Project Manager: [redacted]
- SAIC Field Manager: TBD

1.6 PROJECT SCHEDULE

The project schedule for the Tonawanda Landfill FUSRAP Site is presented in Table 1-2. Successful completion of this schedule will require close coordination of all parties. SAIC will attempt to minimize impacts to this schedule as a result of external project delays. This schedule will be re-baselined as necessary or when requested by USACE.

FUSRAP - Tonawanda Landfill
Contract No. DAHA90-94-D-0007-DN05

Date: July, 2000
By: DPC

Table 1-2
Proposed Project Schedule

Task Number	Task	Start Date	Completion Date	USACE Required Completion Date	Number of Days from Prev. Task
	Notice to Proceed (NTP)	3/7/00	3/7/00		
1	Sitewalk	3/20/00	3/20/00	3/21/00	14 days from NTP
2	QC Plan and ITR	3/28/00	3/28/00	3/28/00	21 days from NTP
3	Work Plan	3/28/00	8/21/00	08/21/2000 (AWP)	
	SAIC Prep of Draft	3/28/00	5/4/00		35 days from NTP
	USACE Review	5/5/00	5/30/00		21
	SAIC Prep of 1st Revision	5/31/00	7/7/00		14
	NYSDEC Review	7/8/00	8/7/00		30
	SAIC Prep of Final Rev./Submission (AWP)	8/8/00	8/21/00		14
4	Records Review and Evaluation	8/17/00	9/6/00	9/11/00	21 days from AWP
5	ARARs Identification	8/17/00	8/26/00	9/25/00	35 days from AWP
6	Data Needs Determination	8/27/00	8/29/00	8/10/00	42 days from AWP
10	Fate and Transport Analysis	8/27/00	9/14/00	8/24/00	56 days from AWP
7	HASP/Rad Safety Plans (HASP)	8/30/00	12/11/00	12/11/2000 (HASP)	
	SAIC Prep of Draft	8/30/00	9/26/00		70 days from AWP
	USACE Review	9/27/00	10/17/00		21
	SAIC Prep of 1st Revision	10/18/00	10/27/00		14
	NYSDEC Review	10/28/00	11/26/00		30
	SAIC Prep of Final Rev./Submission	11/27/00	12/11/00		14
8	Field Sampling/QA Plan (FSP)	8/30/00	12/11/00	12/11/2000 (FSP)	
	SAIC Prep of Draft	8/30/00	9/26/00		70 days from AWP
	USACE Review	9/27/00	10/17/00		21
	SAIC Prep of 1st Revision	10/18/00	10/27/00		14
	NYSDEC Review	10/28/00	11/26/00		30
	SAIC Prep of Final Rev./Submission	11/27/00	12/11/00		14
9	Field Investigation (FI)	12/11/00	02/25/2001**	2/25/01	
	Plan Approval Period	12/11/00	1/8/01		28
	Gamma Walkover Survey*	12/14/00	12/21/00		
	Install/Develop Monitoring Wells	1/9/01	1/15/01		28 days from HASP/FSP
	Soil Borings	1/11/01	1/31/01		28 from start of fieldwork
	Sample Collection/Analysis	1/11/01	2/25/01		
11	Baseline Risk Assessment	2/20/01	3/20/01	N/A	
12	RI/FS Report	2/26/01	7/9/01	7/17/01	
	SAIC Prep of Draft	2/7/01	5/17/01		98 days from end FI
	USACE-PT Review	5/17/01	6/7/01		21
	SAIC Prep of 1st Revision	6/8/01	6/18/01		14
	USACE-CX Review	6/19/01	7/7/01		21
	SAIC Prep of Final Rev./Submission	7/8/01	7/17/01		14
13a	Proposed Plan	7/10/01	12/28/01	12/28/01	
	SAIC Prep of Draft	7/17/01	8/14/01		28 days from RI/FS
	USACE-PT Review	8/15/01	9/5/01		21
	SAIC Prep of 1st Revision	9/6/01	9/17/01		14
	USACE-CX Review	9/18/01	10/8/01		21
	SAIC Prep of 2nd Revision	10/9/01	10/15/01		14
	NYSDEC Review	10/16/01	11/14/01		30
	SAIC Prep of 3rd Revision	11/15/01	11/28/01		14
	Public Comment (PC)	11/29/01	12/28/01		30
13b	Responsiveness Summary (RS)	12/29/01	1/27/02	1/27/02	21days from PC
13c	Record of Decision	2/2/02	6/4/02	6/4/02	
	SAIC Prep of Draft	1/28/02	2/10/02		14 days from RS
	USACE-PT Review	2/11/02	3/3/02		21
	SAIC Prep of 1st Revision	3/4/02	3/17/02		14
	USACE-CX Review	3/18/02	4/7/02		21
	SAIC Prep of 2nd Revision	4/8/02	4/21/02		14
	NYSDEC Review	4/22/02	5/21/02		30
	SAIC Prep of Final Rev./Submission	5/22/02	6/4/02		14
14	Community Relations	3/7/00	6/4/02	N/A	
15	Technical Support	3/7/00	6/4/02	N/A	

* = Assumes gamma walkover can be performed during 28 day approval period.
** = Fieldwork done 1/31/01. End date represents add'l time for lab analysis.

2. SITE DESCRIPTION AND HISTORY

2.1 SITE DESCRIPTION

The Tonawanda Landfill Site (Site) is located approximately 1.5 miles north of the Linde (Praxair) FUSRAP Site in the Town of Tonawanda, New York. It is comprised of two main parcels – the Town of Tonawanda Landfill (Landfill) and the Mudflats. The Landfill parcel is located at the northern end of East Park Drive and is bounded by the residential developments to the north and northwest, a railroad line to the east, and a right of way owned by the Niagara Mohawk Power Company (NMPC) to the south. The Mudflats portion of the property is located on the opposite side of the NMPC right of way that borders the Landfill. The Mudflats parcel is approximately 115 acres and is bordered by the NMPC right-of-way to the north, a railroad line to the east, on the west by the former Town of Tonawanda incinerator, and to the south by the New York State Thruway property. A 48-inch diameter Erie County Water Authority (ECWA) water transmission line traverses through the NMPC easement. ECWA also has another easement for a second parallel 48-inch line through the NMPC right-of-way, for future use. Both properties are owned by the Town of Tonawanda, NY and the area is essentially zoned as commercial/ industrial except for the bordering residential areas referenced above. A site locus plan (Figure 2-1), a plan showing Tonawanda FUSRAP sites (Figure 2-2), and a Landfill site plan (Figure 2-3) are included. Due to geographical separation of the two areas and their different physical characteristics, they will be addressed, as necessary, as separate operable units (OUs).

The NCP defines an OU to mean "a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of release, or pathway of exposure. The cleanup of the site can be divided into a number of OUs, depending on the complexity of the problems associated with the site. OUs may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time that are concurrent but located in different parts of a site."

2.2 SITE HISTORY

The Landfill was operated as a municipal landfill by the Town of Tonawanda (Town) from the mid-1930's through October 1989. The primary waste streams for the landfill were ash generated by the incinerators, construction/demolition debris, and yard refuse (leaves, branches, etc.) collected from town residents. On occasion, the landfill did accept municipal solid waste and wastewater sludges, but only when the incinerators were temporarily inoperable.

The incinerators, operated by the Town between the 1940s and early 1980s, were used to burn municipal solid waste and sludges generated by the Town's wastewater treatment plant (WWTP). The incinerators are located at the western edge of the Mudflats area. Other than the incinerators, the Mudflats have always remained vacant.

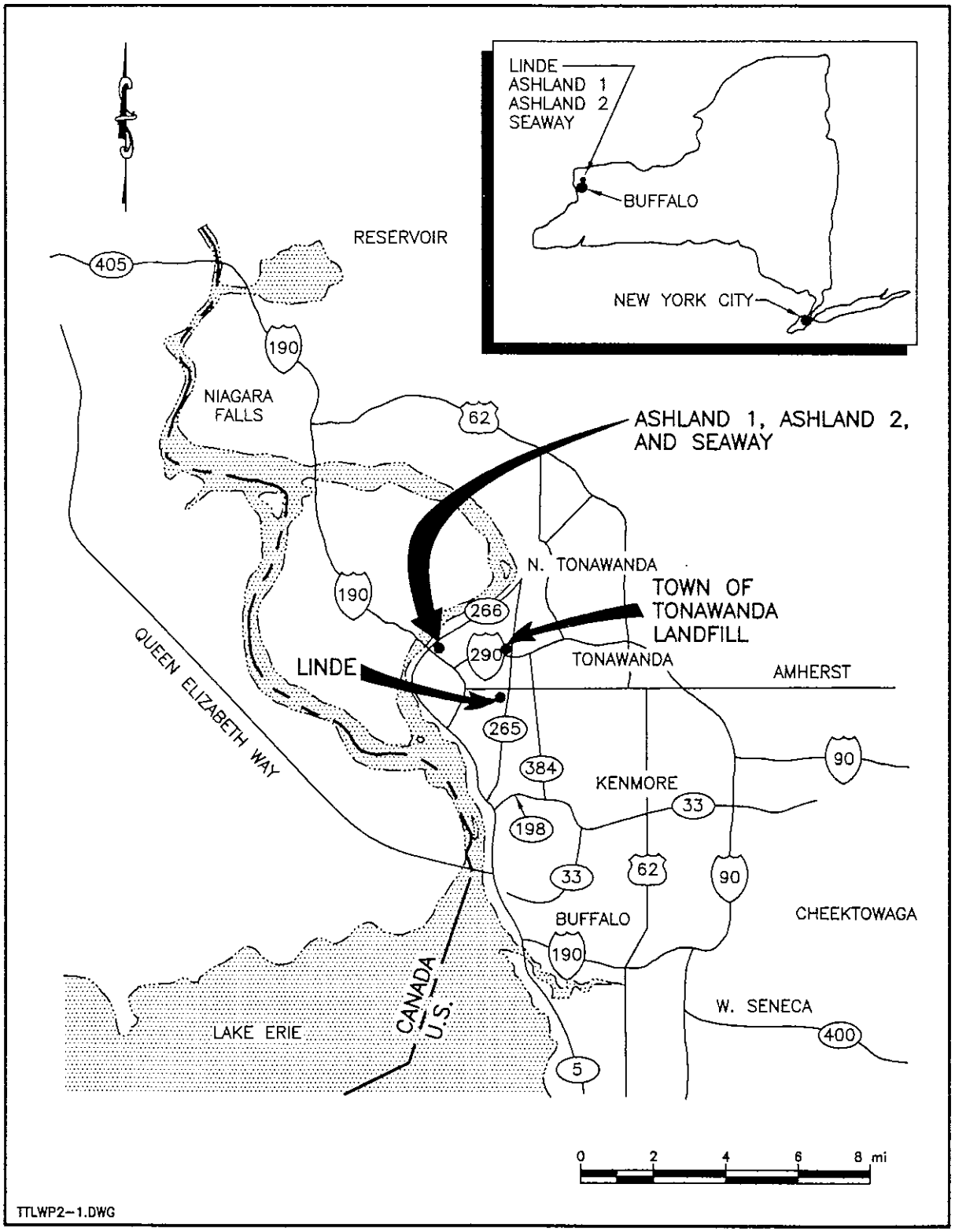
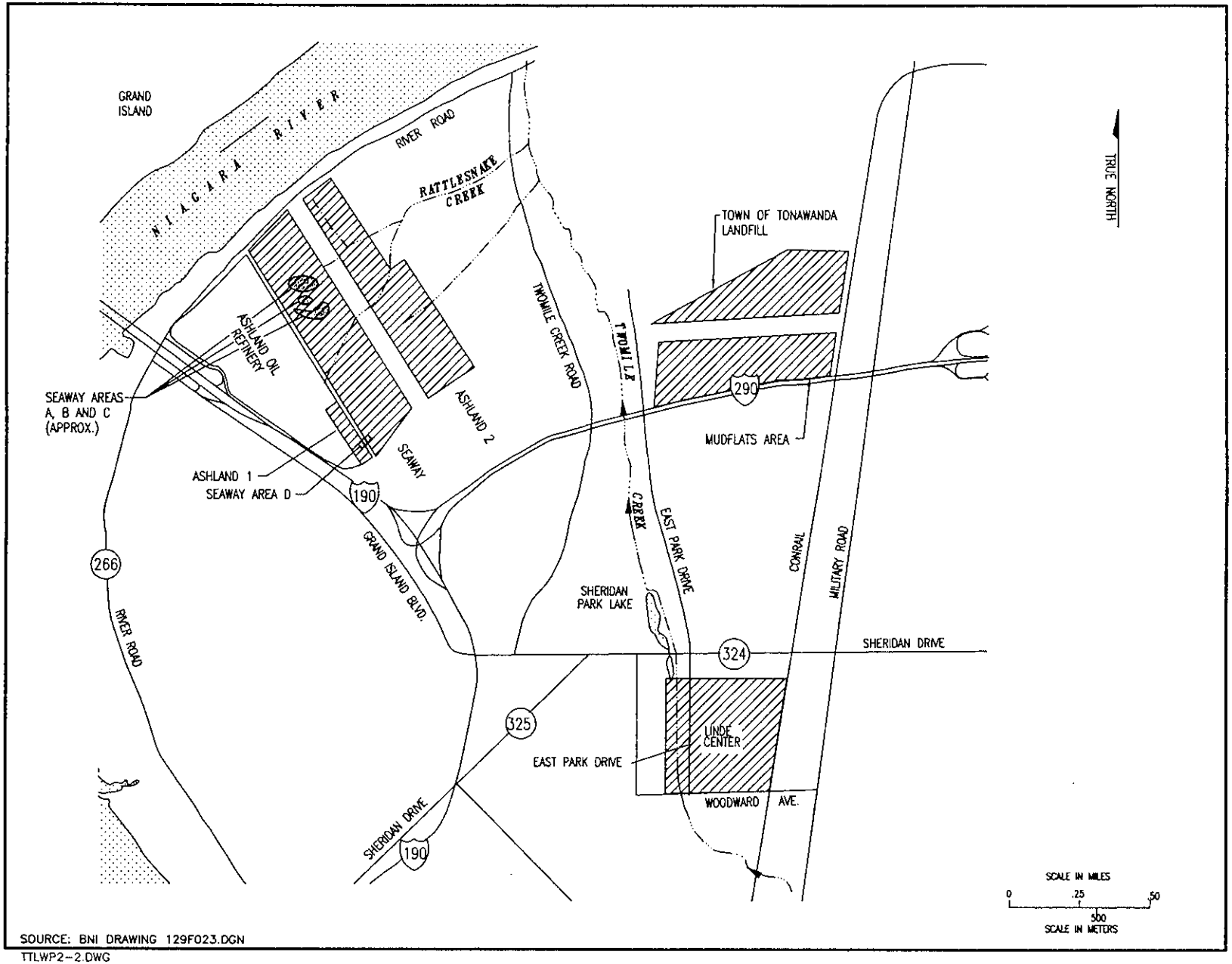


FIGURE 2-1

REGIONAL LOCATION OF THE TOWN OF TONAWANDA, NEW YORK AND THE ASHLAND 1, ASHLAND 2, SEAWAY, LINDE AND THE TOWN OF TONAWANDA LANDFILL SITES



SOURCE: BNI DRAWING 129F023.DGN
TTLWP2-2.DWG

FIGURE 2-2
LOCATIONS OF ASHLAND 1, ASHLAND 2,
SEAWAY, LINDE AND THE TOWN OF TONAWANDA LANDFILL SITES

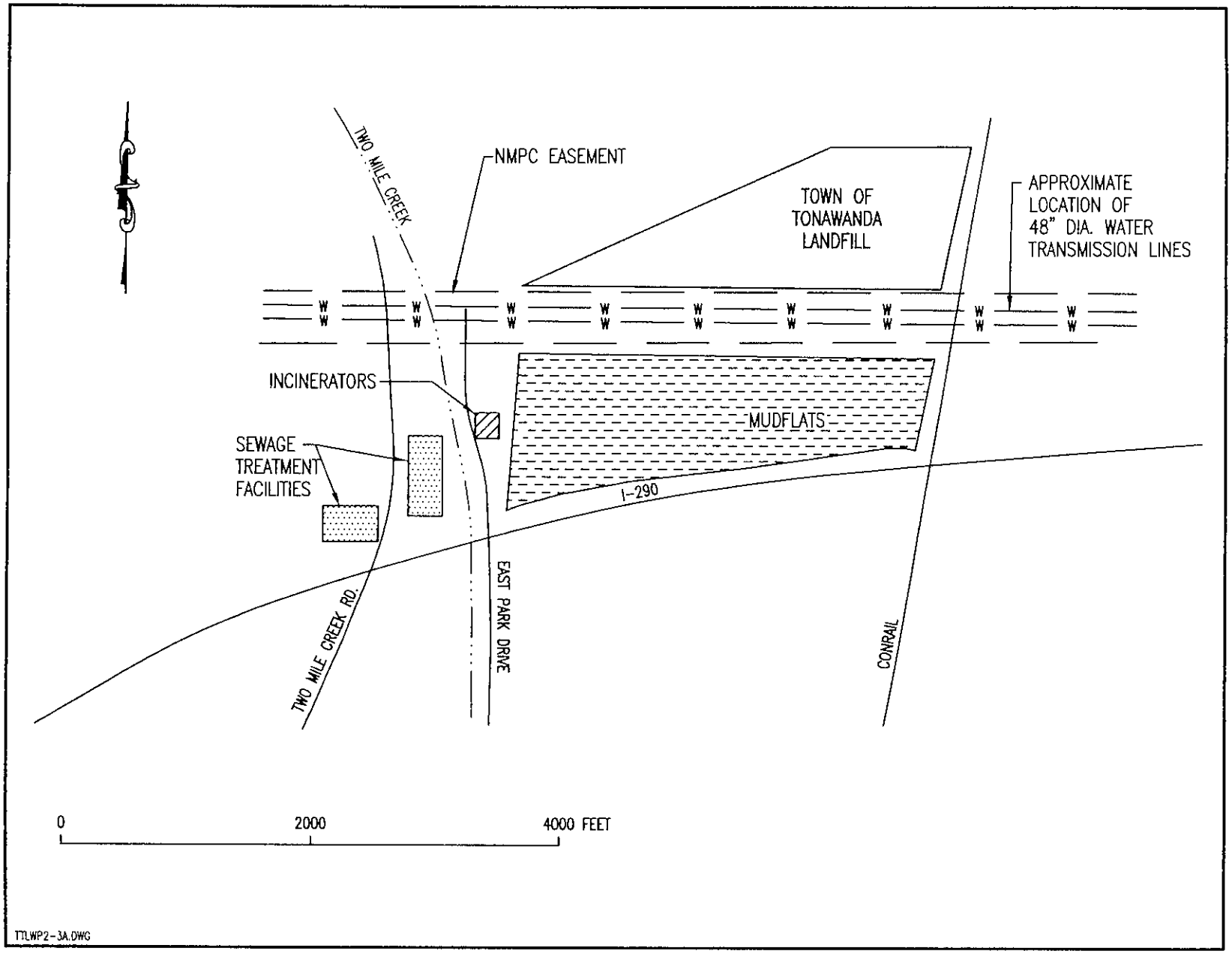


FIGURE 2-3
TOWN OF TONAWANDA LANDFILL APPROXIMATE LOCATIONS

Although neither the Landfill or Mudflats were directly involved with activities normally covered under the FUSRAP program, the Site was designated a FUSRAP Vicinity Property (DOE 1992) due to the potential for MED-related material from the Linde Site having been placed in the Landfill. The Linde Site is the former location of ore processing activities by the Linde Air Products Division (Linde) of the Union Carbide Corporation of Tonawanda, New York. Linde performed these activities under contract to the MED and Atomic Energy Commission (AEC) between 1942 and 1948. Processing activity byproducts consisted mainly of solid filter cake and liquid filtrate. Between 1942 and 1944, the liquid filtrate was discharged directly to the municipal sanitary sewer collection system for treatment by the Town WWTP. Sludges generated by the WWTP were placed in the Landfill (USACE 1999a).

Direct discharge of liquid filtrate from the Linde Site to the sanitary sewer collection system was stopped in April 1944. After that, liquid filtrate disposal was completed via on-site deep well injection. However, during periods when the injection wells were backed up or unusable, liquid filtrate was discharged to a nearby storm sewer or drainage ditch located adjacent to the Linde facility. Liquids directed to the storm sewer and drainage trench ultimately discharged into Twomile Creek. Twomile Creek is shown in Figure 2-3.

2.2.1 Previous Investigative Studies

Initial radioactive material surveys for the presence of MED-related contaminants at the Landfill and Mudflats were conducted by the DOE in 1990 as part of the Linde FUSRAP Site investigation. The intent of the survey was to assess whether any radioactive material had been transported and disposed of off-site in the general area surrounding the Linde facility. The preliminary survey was completed using a mobile gamma scanning van. An anomaly in the survey detected in the Mudflats during the mobile scanning activities was verified using handheld gamma screening devices. Subsequent soil samples collected from the area around the anomaly indicated elevated levels of U-238 and Ra-226 - two isotopes consistent with material expected to be in ore processing byproducts generated at the Linde Site (ORNL 1990).

A limited radiological survey was conducted by DOE in September, 1991 (ORNL 1992). The survey focused on the Landfill and Mudflats and consisted of gamma walkover and scans, measurement of radiation levels, and the collection and analysis of systematic and biased soil samples. The results of the survey detected soils in the Landfill and Mudflats exceeding the radionuclide guideline standards established by the DOE. Laboratory results received indicated some soil samples exhibited characteristics similar to the MED product formerly produced at the Linde facility and others were consistent with the by products of the refinery process conducted at the same Linde facility. The Landfill and Mudflat were subsequently designated as a Vicinity Property of the Linde FUSRAP Site (DOE 1992).

DOE conducted additional soil sampling activities at the Landfill and Mudflats in 1994 to determine the vertical extent of the radiological contamination at the site. Analytical results obtained for subsurface soil, sediment, surface water, and groundwater samples indicated the radiological contamination was essentially limited to the upper 1.5 feet of soil. However, contamination was detected in one sample collected 11.5 feet below existing grade (BNI 1995).

The USACE completed a Radiological Human Health Assessment for the Landfill and Mudflats site in February, 1999. After reviewing several closure scenarios and the radiation doses and health risks associated with each alternative, the USACE concluded that if the Landfill was closed with radiologically impacted soil left in place and if the Landfill is properly maintained after closure, risk of exposure to the public would be well within the acceptable CERCLA risk range. The assessment also concluded that if the Mudflats area is developed for industrial use it could pose a public health risk. Closure scenarios for

the Landfill addressed during the assessment included capping the contaminated soil in place and excavation and removal of the impacted soil. Closure alternatives evaluated for the Mudflats area included no action, covering the impacted area with clean soil, and excavation and removal of impacted soil (USACE 1999b).

In addition to the potential MED-related material identified in the Landfill and Mudflats areas of the site, a previous investigation conducted by the DOE in 1984 indicated the presence of a non MED-related radionuclide, Am-241, contaminated material in two locations in the Landfill portion of the site (DOE 1984). The source of the Am-241 was found to be a nearby former radioactive components manufacturing facility that discharged Am-241 contaminated material to the sanitary sewer which ultimately ended up in the wastewater sludge generated by the municipal water treatment plant. Wastewater sludge was commonly brought to the incinerator for incineration and then interned at the Landfill. The Am-241 material in the Landfill was attributed to the spread of contaminated ash generated by the incinerators (DOE 1984). Subsequent investigations by the Town of Tonawanda (TMA/Eberline 1988) and others confirmed the presence of Am-241 contaminated material in the Landfill. A subsequent report also confirms the presence of a third area of Am-241 contaminated material (TMA/Eberline 1988). To date, there have been no removal or remedial actions associated with the Am-241 contaminated material identified in the Landfill. However, the Town and NYSDEC have determined that the material will remain in the landfill, first covered with 3 feet of compacted fill followed by construction of the final cover system.

2.3 ENVIRONMENTAL SETTING

2.3.1 Topography/Structures

The Tonawanda Landfill site is approximately 170 acres in size and is divide into two parcels – the former Town of Tonawanda Landfill (55 acres) and the Mudflats (115 acres). Both parcels are owned by the Town of Tonawanda. Preliminary grading by the Town of Tonawanda of the landfill portion of the site in preparation for closure was ongoing as of March, 2000.

The landfill portion of the site is located north of the Mudflats area on the opposite side of the NMPC power line easement and bordered by a residential subdivision to the north and northwest, a railroad easement to the east, the NMPC easement to the south. The western portion of the landfill parcel has some hilling and mounding but is mostly sloping towards the west/northwest. Vegetative cover in the western portion of the landfill is limited to grass, scrub trees, and bushes. The eastern portion of the landfill parcel is more heavily vegetated than the western portion. Several large willow trees and brush consistent with wetlands overgrowth are present over a majority of the eastern half of the site. Portions of the western half of the landfill adjacent to the residential abutters have been maintained as lawn with a substantial grass base. The eastern portion of the landfill is gently sloping to the north/northeast with plateaued regions along the southern border of the parcel adjacent to the NMPC easement. A small stream was noted near the northern boundary of the parcel. Maximum change in elevation over the landfill parcel is estimated to be 20 feet.

The Mudflats portion of the parcel is located south of landfill on the opposite side of the NMPC easement. The parcel is bordered to the east by a railroad easement, the former Town of Tonawanda incinerator facility to the west, and the New York Thruway to the south. The Mudflats cover approximately 115 acres with very little topographic relief. Soil mounding was observed along the northern boundary the Mudflats parcel near the NMPC easement. Vegetative cover over the area mainly consists of overgrown grass, brush, and small scrub trees. A bank of large trees was noted along the southern border of the property. Ephemeral streams and ponding were noted at several locations at the site. The only building on the Mudflats parcel is the former Tonawanda incinerator structure.

2.3.2 Regional Hydrogeology

The Tonawanda Landfill site lies within the Erie-Ontario Lowlands Physiographic Province. Topography in the region is considered relatively low lying with little relief. Bedrock in the area is the Camillus Shale of Silurian Age. Regional bedrock slopes in southeasterly direction and is comprised of shale layers and nodules. Upper regions of the shale are highly weathered and pervious with high water yields. Glacial events over the past 10,000 years have left unconsolidated deposits over the bedrock (Wehran 1994).

The Niagara Falls End Moraine passes through a portion of the site in a northerly direction and consists of ablation and lodgment till. Lodgment till is noted to be more compact and less permeable than the ablation till. Till noted in the area consists mainly of silt, clay with some gravel and sand inclusions. Lacustrine deposits are also present in the area and consist of silt, sand, and clay. They are thinly bedded to massive and generally have a greater permeability in the horizontal direction along bedding planes than in the vertical direction. (Wehran 1994)

2.3.3 Site Geology and Hydrogeology

Previous test borings at the site indicate unconsolidated soil deposit depths between 56 and 95.5 feet. The deposits increase in thickness in an east to west direction over the site. Three geologic units have been noted during boring advancement at the site. The uppermost layer is composed of red/brown silty clay glacial till with layered thickness between 48 to 63 feet. Lacustrine silt and clay was encountered beneath the silty clay till layer in some locations throughout the site. Lacustrine silt and clay lenses ranged up to 25 feet in thickness. Several other locations where Lacustrine material was not detected indicated layers of silty sand and gravel ranging between 8 and 12 feet thick. (Wehran 1994)

The red brown glacial till is mainly comprised of silt and clay size particles with some sand and gravel. The material is generally stiff and its layers were not continuous throughout the site. Tests on soil samples indicated mean hydraulic conductivity results of 7.5×10^{-6} cm/sec in the Landfill and 3.7×10^{-6} cm/sec in the Mudflats. (Wehran 1994)

Lacustrine deposits were gray in color and consisted mainly of clay with some silt and a trace of fine sand and gravel. Vertical hydraulic conductivity was measured at 2×10^{-8} cm/sec for a sample collected from this material. (Wehran 1994)

The silty sand and gravel layer consisted of sand and gravel with some silt and a trace of clay. Field permeability tests indicate a hydraulic conductivity of approximately 3×10^{-5} cm/sec. (Wehran 1994).

Bedrock is made up of Camillus Shale and slopes towards the west. The elevation of the bedrock ranges between 512 feet to 550 feet above mean sea level. Thin seams of gypsum were visible in core samples collected from one location. (Wehran 1994)

Groundwater flow in the glacial till at the site was found to be generally in a southerly direction. A groundwater mound was encountered in the landfill area due to increased infiltration through the landfill material resulting in higher water levels and lowered hydraulic gradients for this area. Depth to water was measured at 5 feet around the landfill and 5–10 feet in the Mudflats portion of the site. Horizontal groundwater gradients were measured at 0.003 feet/feet and 0.02 feet/feet in the Landfill and Mudflats, respectively. Average linear velocity of groundwater flow was 3.5 feet/year and 1.4 feet/year in the Landfill and Mudflats, respectively. (Wehran 1994)

The regional direction of deep groundwater flow in both the sand and gravel layers and bedrock were found to be in a generally northward direction toward the Niagara River. Average linear velocities in the sand and gravel layer was estimated at 2 feet/year. (Wehran 1994)

3. DESCRIPTION AND METHODOLOGY FOR CONDUCTING EACH TASK

Work under this project has been divided into fifteen separate tasks. A description of each task and personnel responsibilities associated with each task are provided below.

3.1 TASK 1: VISUAL SITE INSPECTION

On March 20, 2000 representatives of USACE-Buffalo District, SAIC, EnSol, Inc. (Consultant retained by Town of Tonawanda for Landfill Closure) attended a site walk at the Tonawanda Landfill FUSRAP Site. The purpose of the site walk was to familiarize project personnel with the existing site conditions and to view the areas in which MED-like material was detected during previous investigations. Topics of discussion at the meeting were site features, status of closure activities at the Landfill portion of the site, historical usage and information pertaining to both the Mudflats and Landfill portions of the site, and results of previous site investigative work by others.

3.1.1 Task 1: Personnel Responsibilities

As described, the Project Manager (F. Stevenson), Technical Manager (D. Cobb), Assistant Program Manager (G. Butterworth), and Engineering Analysis Manager (A. Davis) traveled to the Tonawanda Landfill site to conduct the visual site inspection and attend the Technical Project Planning Workshop (TPPW). The Program Manager's involvement included an administrative role and receiving a debriefing from the Project Manager and Engineering Analysis Manager regarding the site inspection.

3.2 TASK 2: QUALITY CONTROL PLAN (QCP) AND INDEPENDENT TECHNICAL REVIEW (ITR)

On April 25, 2000 a final draft of the QCP was submitted to the USACE-Buffalo District. It describes how deliverables will be produced and the steps that will be taken to control product quality. It was patterned after the list of items appearing in Appendix A of the December 1999 SOW provided to SAIC by USACE (USACE 1999). The first revision of the final QCP that incorporates USACE comments on QCP will be submitted in early May, 2000.

Also, as part of this task, SAIC will perform an ITR of all products and deliverables specified in the SOW. The ITR team will consist of professional engineers, a certified health physicist (CHP), and a risk assessment specialist. If necessary, SAIC can make additional staff personnel available in the event site conditions warrant reviews in other technical disciplines that are not included in the original SOW. A Statement of Independent Technical Review and Certification of Independent Technical Review will be included with all draft and final products submitted for this project to the USACE. Templates of these documents were included in the QCP.

3.2.1 Task 2: Personnel Responsibilities

The Program Manager, Project Manager, and Technical Manager worked together in developing the QCP. The Assistant Program Manager and members of the ITR team performed the ITR on the QCP.

As part of this task, the ITR team presented in Table 1-1 will conduct ITRs for all draft and final documents and deliverables under this contract. ITR team members will be selected on a project document by document basis dependent upon each members field(s) of expertise and knowledge of FUSRAP policy and management procedures.

3.3 TASK 3: PROJECT WORK PLAN

This document is the Project Work Plan. It addresses all tasks in the SOW (USACE 1999a) except for the field sampling activities.

3.3.1 Task 3: Personnel Responsibilities

The Project Work Plan was primarily prepared by the Program Manager, Project Manager, Technical Manager, and Risk Assessment Manager (also a CHP). Additional technical support was provided by a senior hydrogeologist, senior ecologist, and senior engineer. An environmental engineer and professional personnel aided in development of the Fate, Transport, and Exposure Analysis, and the Health, Safety, and Radiation Protection Plan Sections.

An ITR of this document was performed by members of the proposed ITR team prior to submission of the draft and final editions of the document.

3.4 TASK 4: RECORDS REVIEW AND EVALUATION

Investigation and evaluation as to the presence of radiologically contaminated material at the Tonawanda Landfill site and the surrounding area began in 1979. Existing data regarding the site history, geology, wastes and contaminants, and stakeholder opinions and preferences will be consolidated and catalogued for completeness. These documents and existing files (in the possession of USACE, New York State Department of Environmental Conservation [NYSDEC], the Town of Tonawanda and SAIC) will be reviewed to ensure a complete and accurate historical account is presented in the RI Report. Deficiencies or gaps in the site history and activities will be recorded. Current site information, available Town operating information, and existing Town and NYSDEC site investigation files will be reviewed and used in the remedial investigation and analysis of site conditions.

The data in the documents will be reviewed to evaluate the concentrations and distribution of previously detected radionuclides in soils. These data will be combined with the current FUSRAP electronic database as referenced in Task 6. Pertinent data and information also will be included in the RI report.

A list of data and documents identified during the records review and evaluation will be submitted to the USACE. Copies of additional pertinent information and/or reports will be added to the Administrative Record.

3.4.1 Task 4: Personnel Responsibilities

The initial Records Review and Evaluation will be performed by the project personnel with involvement by Technical Manager and Project Manager. This task will involve travel to Buffalo for project personnel to obtain additional records and project information and compilation of outstanding documents, data, and relevant information on the Tonawanda Landfill Site. Acquired data will be organized into databases that will be used to assist in decision-making throughout the duration of the project.

The list of data and documents generated during Task 4 will be subjected to an ITR for accuracy and completeness prior to submission to the USACE.

3.5 TASK 5: IDENTIFY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Remedial actions for cleanup of hazardous substances, as specified in CERCLA Section 121, must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured. Actual ARARs are identified on a site-specific basis and will depend on the specific constituents at a site, the proposed remedy selection, and the site characteristics and location. The process of ARAR identification is iterative as the remediation process progresses.

The requirements that must be complied with are those that are applicable or relevant to the hazardous substances, pollutants or contaminants at a site. "Applicable requirements" are those cleanup standards and other environmental protection requirements or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location or other circumstance at the site. "Relevant and appropriate requirements" are those cleanup standards, other environmental protection requirements or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, remedial action, location, or other circumstance at a site, address problems or situations similar to those encountered at the site, and whose use is well suited to the particular site. The relevance and appropriateness of a requirement can be judged by comparing a number of factors, including the characteristics of the remedial action, the substances in question, and the physical circumstances of the site. Whereas the applicability determination is a legal one, the determination of relevancy and appropriateness relies on professional judgement, considering the environmental and technical factors at the site.

USACE, as the lead agency in this action, will identify potential federal and state ARARs for the Tonawanda Landfill FUSRAP Site OUs and explain the reasons why they should be included. The ARARs identified will be used as a starting point and will be evaluated to determine if changes in circumstances have effected their applicability to the site. SAIC will compile a preliminary list of available federal chemical-, location-, and action-specific ARARs that might be considered in connection with the remediation process at the Tonawanda Landfill site. NYSDEC and United States Environmental Protection Agency (USEPA) will be contacted to provide a potential list of ARARs, as well. ARARs will be used in the proposal of remedial action objectives and preliminary identification of remedial alternatives. SAIC will be available to participate in USACE discussions with federal and state regulatory agencies during negotiations for final ARAR determination and cleanup goals. USACE guidance pertaining to the establishment of cleanup criteria will be used as appropriate.

3.5.1 Task 5: Personnel Responsibilities

The process of ARAR identification is an iterative one led by the Project Manager and directly assisted by the Technical Manager and the Assistant Program Manager. The Engineering Analysis Manager, Technical Manager, and Project Manager and other technical staff , as necessary, will assist in interpreting appropriate ARARs to be used in the proposal of remedial action objectives and preliminary identification of remedial alternatives.

3.6 TASK 6: DATA SUMMARY AND DATA NEEDS DETERMINATION

3.6.1 Data Summary

Existing data identified during the performance of Task 4 of the Tonawanda Landfill Site RI/FS will be summarized as part of this task. It is anticipated that narrative summaries will be prepared that will address the following types of site-specific information:

- site history;
- dates of operation;
- ownership;
- operational history;
- process description and site activities,
- materials used;
- wastes generated (by MED material contributors);
- waste disposal (procedures and locations);
- potential contaminants (both MED related and others, if encountered);
- historical information (drawings documents, and photographs);
- physical setting;
- surface topography;
- geology (bedrock/unconsolidated, soil description);
- hydrogeology (depth to groundwater, flow direction, aquifer properties);
- hydrology (surface water drainage system, storm drains, transport pathways);
- infrastructure (buildings, roads, utilities, process structures);
- adjacent properties/physiographic features;
- stakeholders opinions/interests; and
- remedial preferences.

Any maps, diagrams, or photographs considered to be essential to the narrative summaries will be referenced and included as figures or attachments.

Available analytical data will be summarized in tabular format where possible. The source, activity, date, and method of generation for each data set will be identified as well as any limitations relating to the uncertainty of each data set. Maps or diagrams that indicate analytical sample collection locations will be referenced and included as figures or attachments.

3.6.2 Data Needs Determination

The need for additional data for the Tonawanda Landfill Site RI/FS will be based on an evaluation of all available data summarized above and the overall project specific objectives. The data needs determination will be conducted in accordance with Phase II of the Technical Project Planning (TPP) Process (EM-200-1-2) (USACE 1998a) and will identify data required to complete project objectives and document specific data requirements. If available information does not provide the data required to meet all project objectives, then recommendations for the collection of additional data will be made.

3.6.2.1 Existing Data Evaluation

The usability of available data will be evaluated to determine if the respective collection, analytical, and QA/QC procedures used during data generation resulted in sufficient data quality and quantity. Also, the quantitation limits associated with available analytical data will be evaluated to determine if the data is suitable for use in a quantitative or qualitative manner. The usability of available analytical data will depend on the specific requirements of each project data need identified during the data needs definition activity that follows.

3.6.2.2 Data Needs Identification

It is anticipated that analytical data needs for the Tonawanda Landfill Site RI/FS may include the concentrations/activities of radiological constituents present in soil and groundwater at the site. The identification of project-specific data needs will consider the following four general types of data:

- Risk Data
  - preliminary risk determination/screening,
  - safety and health monitoring for site workers,
  - fate and transport analysis,
  - baseline risk assessment,

- Compliance Data
  - compliance with ARARs,
  - investigation derived waste (IDW) management and characterization,
  - adherence to applicable orders, permits, or agreements,

- Remedy Data
  - waste characterization for remedy development,
  - remedy evaluation and screening,

- Responsibility Data
  - identify responsible state or federal entity if a response action is required, and
  - presentation during legal proceedings.

The total number of analytical samples required for each of the four data types also will be identified. Several approaches for determining the number of analytical samples may be used including probabilistic (random) methods, classical or geo-statistical methods, and/or best professional judgement. The specific approach required to satisfy each data need may vary between different data types.

Several different data collection approaches will be considered during the identification of data needs including:

- phased approach
  - conducting two or more non-related project activities concurrently (must ensure that no single activity results in an adverse effect on another),

- expedited site characterization
  - observational approach,
  - includes real-time data analysis,
  - allows for flexible data collection approach based on in-progress results,

- structured approach
  - all data collection planned in advance,
  - no flexibility in determining sample collection locations or number of samples,
  - requires thorough knowledge of site conditions.

One or more of the above approaches may be utilized to streamline additional data collection and to meet the requirements of each specific data need. Specific requirements of an individual data need may preclude the use of one or more of the above approaches.

In addition to the requirements of specific data needs, the costs associated with each data collection approach also will be considered. In the event that more than one data collection approach is determined to satisfy a specific data need, the cost of each approach will be evaluated to determine the effect that adopting a particular approach will have on project cost, scheduling, and the allocation of resources.

3.6.3 Data Needs Documentation

Upon completion of the data needs determination, a summary will be developed to document the requirements of each data need identified. Each summary will clearly identify the following items:

- Intended Data Use(s):
  (1) Project objective(s) satisfied.

- Data Need Requirements:
  (2) Data user perspective(s) (i.e., risk, compliance, remedy, or responsibility) satisfied;
  (3) Contaminant or characteristic of interest identified;
  (4) Media of interest identified;
  (5) Required sampling areas or locations and depths identified;
  (6) Number of samples required (e.g., fixed number or dynamic estimate; probabilistic or non-probabilistic basis); and
  (7) Reference concentration of interest or other performance criteria (e.g., action level, compliance standard decision level, design tolerance) identified.

- Appropriate Sampling and Analysis Methods:
  (8) Sampling method (e.g., discrete or composite sample; sampling equipment and technique; quality assurance/quality control samples) identified; and
  (9) Analytical method (e.g.; sample preparation, laboratory analysis method detection limit and quantitation limit, laboratory quality assurance/quality control) identified.

The information generated during the completion of Task 6 will be used to develop the project SAP required by Task 8.

3.6.4 Task 6: Personnel Responsibilities

Existing data identified during Task 4 of the Tonawanda Landfill Site RI/FS will be summarized as part of this task by project personnel. It is anticipated that narrative summaries will be prepared and reviewed by the Risk Assessment Manager, Engineering Analysis Manager, and Technical Manager. Visual tools and models will be enhanced by information identified and collected in this task. ITRs will be performed on project required submittals as needed.

3.7 TASK 7: HEALTH, SAFETY, AND RADIATION PROTECTION PLAN

SAIC maintains a corporate Environmental Compliance and Health and Safety (EC&HS) program that meets 29 CFR 1910.120(b) requirements. SAIC's EC&HS program document, together with SSHP, present the requirements for safely performing work. A specific SSHP will be prepared by a SAIC Certified Industrial Hygienist (CIH) and CHP. This document will be approved prior to beginning field work and will, at a minimum, satisfy the requirements of:

- Appendix B to ER 385-1-92, "Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OEW) Activities" (USACE 1994a),
- Requirements of EM 385-1-1, "U.S. Army Corps of Engineers Safety and Health Requirements Manual" (USACE 1996a),
- Relevant Occupational Safety and Health Administration (OSHA) regulations,
- 10 CFR 20, and
- SAIC EC&HS Manual.

The SSHP will address the significant known site hazards and establish the minimum requirements for safe project execution. It will set forth the basic procedures required to protect SAIC and subcontractor personnel involved in the field phase of this project. It also will establish practices to protect the public and the immediate environment from hazards caused by this work. Information in the SSHP will include:

- Site Description,
- Activity Hazard Analysis (prepared in accordance with EM 385-1-1, Figure 1-1, page 3),
- Information on the Potential Exposures,
- Staff Organization, Qualifications, and Responsibilities,
- Training,
- Personal Protective Equipment,
- Medical Surveillance,
- Exposure Monitoring,
- Standard Operating Safety Procedures,
- Radiation Protection Program,
- Site Control Measures,
- Personal Hygiene and Decontamination,
- Emergency Procedures and Equipment, and
- Log, Reports, and Record Keeping.

A SAIC CHP will prepare a site radiation risk evaluation and develop a Radiation Protection Program to be included in the SSHP. The radiation protection program will be developed, documented, and implemented in a manner that ensures the program is commensurate with the scope and extent of

activities and is sufficient to ensure compliance with applicable standards. The CHP will be available to site personnel for consultation and emergencies during field work.

SAIC will comply with all applicable regulations including: 29 CFR 1910.120, Hazardous Waste and Emergency Response; 10 CFR 20, Standards for Protection Against Radiation; 49 CFR 172, Hazardous Materials, and any other appropriate and applicable regulations. The plan will also comply with the provisions set forth the in the USACE-Buffalo District Radiation Protection Program.

3.7.1 Task 7 Personnel Responsibilities

The SSHO and Radiation Safety Officer will lead the effort of developing the Site Safety and SSHP. The Program Manager and Project Manager will provide oversight of document development. The SSHO will review and approve the completion of this document. CHP services will also be provided in the preparation of this document as specified in the SOW.

An ITR on this document will be performed by the CHP and other ITR personnel experienced in this field.

3.8 TASK 8: FIELD SAMPLING PLAN (FSP) AND QUALITY ASSURANCE PROJECT PLAN (QAPP)

The Field Sampling Plan (FSP) and QAPP comprise the SAP for the collection of environmental data. The FSP and QAPP will be reviewed and approved by the USACE before work commences. SAIC will use the USACE publication, "Requirements for the Presentation of Sampling and Analysis Plan, EM 200-1-3" (USACE 1994b) and MARSSIM (DOD 1997) as guidance in preparing the FSP and the QAPP.

The FSP will describe the field investigation activities proposed for characterization of the Tonawanda Landfill FUSRAP Site. This will include, but is not limited to, plans for mobilizing to the site, sampling criteria for each of the media to be investigated, any related decision making criteria and logic, labeling instructions, packing and shipping details, analytical information, and plans for disposal of investigative waste IDW. Potential limiting constraints or other factors that may impact site characterization activities that are foreseen during the field activities will be addressed in the FSP.

The QAPP portion of the SAP addresses the laboratory data quality objectives, specific QA and QC activities, and laboratory activities designed to achieve the laboratory data quality goals of the project.

The general approach in preparing a SAP is to first review data collected from previous investigation(s) and remedial project(s) to roughly delineate areas of contamination and determination of additional data to properly characterize the nature and extent of contamination. Potentially impacted areas have already been identified at the two Tonawanda Landfill FUSRAP Site OUs, however, additional characterization relating to the extent of site MED-related contamination is warranted. The number of samples taken may change depending on results of the earlier sampling or changing field conditions. Whether or not to change the number of samples will be determined by the professional judgment of the Technical or Field Manager. Any change to the number of samples will be subject to approval by USACE. The intent of the field sampling activities is to determine the horizontal and vertical extent of soil contaminated with MED-related radionuclides at the site.

Based on what is already known of the site hydrogeology and properties of known contaminants, it is not expected that the radiological contamination will pose a threat in groundwater at the site. To confirm this, additional groundwater samples will be collected in conjunction with ongoing compliance sampling

events conducted by the Town of Tonawanda as part of landfill closure procedures. This sampling was suggested by the USACE at the TPPW and will be performed by SAIC. It may be determined that a potential for the radiological soil contamination to impact groundwater exists after the Fate, Transport, and Exposure Analysis has been performed and field sampling results have been received and analyzed.

3.8.1 Task 8: Personnel Responsibilities

The Project Manager will be responsible for the overall preparation of the FSP and QAPP. The Technical Manager will be in charge of the direct preparation of the plans and will work in conjunction with staff personnel experienced in the field of expertise required to develop the document. The FSP will be developed using previously established data acquisition requirements and needs as a basis for sampling activities. The Risk Assessment Manager, Radiation Safety Officer, and Laboratory Coordinator will be consulted in the preparation of the SAP.

An ITR on this document will be performed by members of the ITR team experienced in this field of expertise. The Health Physicist will be a member of the ITR team that reviews this project document because of precautions associated with the presence of radionuclides at the site.

3.9 TASK 9: SPECIFICATION AND ACQUISITION OF FIELD DATA

The policies, procedures, sampling locations, data quality objectives, and QA/QC protocols for the acquisition of field data will be described in detail in the FSP and QAPP. Overall guidance for the data collection activities shall be ER 1110-1-263, Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities (USACE 1998b), and MARSSIM (DOD, 1997).

3.9.1 Task 9: Personnel Responsibilities

The Project Manager will be responsible for the overall supervision of the field sampling activities in both a technical and administrative capacity and will ensure compliance with approved FSP. The Field Manager will be on-site on a full time basis during the Field Data Acquisition portion of this project and will be responsible for compliance with the approved FSP and the direct supervision of the sampling activities. The Radiation Safety Officer and SSHO will be on site as needed during field work to assure the safety of all personnel working on the site. Geologists/field engineers will be on-site to oversee geoprobe and drilling activities so that all field work can be completed in the specified USACE allotted time frame. Monitoring well installation (if necessary) and geoprobe activities will occur simultaneously. The field engineer will also oversee all geoprobing, sampling, monitoring well drilling (if necessary), developing, IDW monitoring, and general site maintenance. As field data is gathered, the Data Manager and Data Validator will begin compilation, organization, and validation of the data. The Program Manager and Project Manager will interface with the regulatory agencies and USACE as needed during the field effort.

3.10 TASK 10: FATE, TRANSPORT, AND EXPOSURE ANALYSIS

A fate, transport, and exposure analysis model will be developed for the Site including consideration of differences between the two OUs. Due to the nature of the contaminants and the media at the site, analytic modeling rather than numeric modeling will be performed. The movement of contaminants in the environment will be modeled conceptually from primary source(s) to media which human and/or ecological receptors are exposed. The conceptual site model is a description of site attributes impacting how receptors are exposed to site-related contaminants. The conceptual and exposure analysis models will be presented in tabular as well as graphic form in the RI Report. The model developed for the RI Report will be developed utilizing useful data including previous reports and data collected during field

sampling activities and modified as additional site specific physical, chemical, and geological data becomes available.

A preliminary fate, transport, and exposure analysis model will be developed using existing data (Tasks 4 and 6) prior to field sampling activities. This "draft" model will be submitted to the USACE as a Technical Memorandum. Data collected during the field activities (Task 9) will be incorporated into the "final" model presented in the RI Report.

The contaminants, primarily radioactive material attributable to MED related activities will be evaluated as to their persistence in the environment, release and transport mechanisms, and the media in which they may impact potential receptors. Media to be evaluated will include, soil, surface water (if applicable), groundwater (if applicable), and air. Contaminant release mechanisms at the Tonawanda Landfill site include but are not restricted to, erosion by wind, erosion by water, biological uptake, and dissolution. Potential transport mechanisms include wind, surface water runoff, infiltration, groundwater flow, and inadvertent mechanical means.

The exposure analysis will determine feasible exposure pathways. Dermal contact, external radiation, ingestion, and inhalation pathways will be evaluated. These pathways will be evaluated in the risk assessment during the exposure assessment. The analysis fate, transport, and exposure will be coordinated with the risk assessment to ensure relevant media, mechanisms, and pathways are evaluated and presented in the conceptual model for the Tonawanda Landfill site. The Superfund Exposure Assessment Manual (USEPA 1988a) will be followed where applicable.

Based on previous information on the site, there is a potential for chemical contaminants of concern (metals and organic compounds) to be present at the site commingled with MED generated materials. Task 9 provides for the collection and analysis of soil and groundwater samples for TCL/TAL parameters as part of the proposed radionuclide sampling program. It may be necessary to include chemical contaminant fate and transport analyses with that of the radioactive material should field sampling results indicate the presence of chemical contaminants at elevated concentrations commingled with radioactive contaminants.

3.10.1 Task 10: Personnel Responsibilities

The Project Manager, and Senior Hydrogeologist will oversee the development of the Fate, Transport, and Exposure Analysis. The following technical staff are also expected to contribute in the preparation of documents under this task and may include: Senior Ecologist, Staff Geologist, Risk Assessment Manager, Biologist/Ecologist, and Health Physicist.

The technical memorandum and subsequent fate and transport documents will be subjected to an ITR by the proposed ITR Team. The CHP assigned to the ITR will be one of the members evaluating portions of the fate and transport analysis associated with radioactive material.

3.11 TASK 11: BASELINE RISK ASSESSMENT

3.11.1 Introduction

The scope of the risk assessment at the Tonawanda Landfill site is to characterize the risk to human and ecological receptors. Results of the risk assessment will be used to determine the need for remedial action at the site and to evaluate remedial alternatives in the site Feasibility Study, as appropriate. The risk assessment will examine the presence of MED related constituents in areas under investigation, the

potential routes of exposure to human and ecological receptors, and the likelihood of adverse effects following contact with the MED/AEC-related contaminants.

The methods presented in this work plan provide a general outline of the procedures that will be used to conduct the risk assessment at the Tonawanda Landfill site. The methods used to characterize risk will be consistent with USEPA and USACE guidance documents. Guidance documents include, but are not limited to:

- United States Army Corps of Engineers Risk Assessment Handbook, Vol. I, Human Health Evaluation. Engineer Manual, EM 200-1-4 (USACE 1999c)
- United States Army Corps of Engineers Risk Assessment Handbook, Vol. II: Environmental Evaluation. Engineer Manual, EM 200-1-4 (USACE 1996b)
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (USEPA 1989a)
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part B and Part C) (USEPA 1991a)
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part D) (USEPA 1998)
- Exposure Factors Handbook (USEPA 1997a)
- Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure, Preliminary Review Draft (USEPA 1993a)
- Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final (USEPA 1989b)
- Proposed Guidelines for Ecological Risk Assessment, Risk Assessment Forum (USEPA 1996c)
- Soil Screening Guidance, Technical Manual, (USEPA 1996a)
- Ecological Risk Assessment Guidance for Superfund (ERAGS) (USEPA 1997b)

The methodology for the Tonawanda Landfill site will be consistent with that used at other USACE Buffalo District FUSRAP sites such as the Luckey, Ohio and Painesville, Ohio sites.

3.11.2 Human Health Risk Assessment

The primary goal of human health risk assessment is to quantify the risk to current and potential future receptors at the Tonawanda Landfill site OUs. The assessment process includes an evaluation of site data including data screens designed to eliminate non-MED/AEC-related contaminants or contaminants that do not pose an unacceptable risk/hazard to human health. Three screens will be used including a background screen, a preliminary remediation goal (PRG) risk screen, and a weight-of-evidence screen. Contaminants that pass through these early screens are designated as contaminants of potential concern (COPCs). COPCs are then included in site-specific risk calculations to determine which, if any, of the COPCs pose an unacceptable risk (total risk above the CERCLA risk range of 10^{-4} to 10^{-6}) or hazard (hazard index greater than 1.0) to current or potential future human receptors. COPCs that are estimated to pose an unacceptable risk/hazard are identified as contaminants of concern (COCs). As a final step in the assessment, a list of revised PRGs will be presented for each COC to cover a range of potential cleanup goals. Both risk-based and radiological dose-based values will be presented. The dose-based values may be used for comparison to regulatory limits that tend to focus on radiological dose rather than risk.

Chemical contaminants of concern (metals and organic compounds) may be present at the site commingled with MED generated materials. As previously stated, Task 9 provides for the collection and analysis of soil and groundwater samples for TCL/TAL parameters as part of the proposed sampling

program. It may be necessary to include chemical contaminants of concern along with radioactive material as part of the Baseline Risk Assessment (BRA) should field sampling results indicate the presence of chemical contaminants at elevated concentrations commingled with radioactive contaminants. Chemical contaminants of concern will only be included in the BRA if the compounds are found to be commingled with MED related material and/or fall under the jurisdiction of FUSRAP.

3.11.2.1 Identification of Contaminants of Potential Concern (COPCs)

The following sections summarize the process through which the data will be evaluated to identify COPCs for the Tonawanda landfill site.

3.11.2.2 Initial Data Reduction

The data set used in the risk assessment will consist of sample results verified and validated using methodology described in the QAPP. Data collected during previous investigations will be evaluated to determine the usability of the data for the risk assessment. This data must meet the data quality objectives (DQOs) set forth in the QAPP. Only data that meet DQOs will be used in the quantitative risk assessment.

All available and appropriate sampling data will be compiled for use in the risk assessment. Newer data will be used to supplement, rather than supercede older data except where older data describes materials that had subsequently been removed from the area. In this case, the older data no longer represent site conditions and would, therefore, not be used in the risk assessment.

One of the likely MED/AEC-related constituents at the Tonawanda Landfill site are members of the naturally occurring uranium, thorium, and actinium decay series. Because cancer slope factors (CSFs) are limited to radionuclides with half-lives of six months or longer, the primary list of potential radiological constituents is limited to long-lived radionuclides in these series (short lived decay products are included in slope factors so that they need not be included explicitly). The list of long-lived radionuclides includes U-238, U-234, Th-230, Ra-226 and Lead-210 (Pb-210) from the uranium series; Th-232, Ra-228 and Th-228 from the thorium series; and U-235, Protactinium-231 (Pa-231) and Actinium-227 (Ac-227) from the actinium series. When data for each individual long-lived radionuclide are not available, the intimate relationship between radionuclides in these series is used to estimate the total source term. Specifically:

- radionuclides in the thorium series are assumed to be in secular equilibrium assuming sufficient time has passed since constituent processing, if any;
- because the site history indicates that identified uranium was neither enriched nor depleted, uranium isotopes are assumed to be present in natural abundance (i.e., the concentration ratios for U-238:U-235:U-234 = 1.0:0.046:1.0);
- if undetected, Pa-231 or Ac-227 are assumed to be in equilibrium with U-235; and
- Pb-210 is assumed to be in equilibrium with its closest long-lived parent, Ra-226.

As with non-radionuclides, radionuclides may be identified in the site database that are not site related and may not be related to site activities or disposal practices (USEPA 1989a). Risks from all radionuclides will be evaluated. While only radionuclides from the uranium, thorium, and actinium series are most likely to be identified as COPCs, other radionuclides ubiquitous in nature (e.g., K-40 or Cs-137) or statistical anomalies of spectral analyses will likely be screened out during the background and weight-of-evidence screens. For example, spectral data on occasion report the existence of short-lived fission products or other exotic radionuclides. These anomalies are likely due to statistical fluctuations or improper screening during sample analysis and will not be included in risk calculations.

3.11.2.3 Background Screening

The background screen consists of comparing the maximum detected radionuclide concentrations against background criteria. If the maximum detected concentration is below background criteria, the radionuclide is not a COPC. However, if the radionuclide is present at concentrations above background criteria, that radionuclide is retained as a COPC. For this assessment, the background criterion is the upper 95% tolerance limit on background concentrations, with 95% coverage (referred to as the UTL).

Media-specific background data will be used in the remedial investigation to evaluate the nature and extent of contamination and in the risk assessment to select human health COPCs.

3.11.2.4 Risk Screening Using Preliminary Remediation Goals (PRGs)

PRGs will be tabulated from the Internet site (often used by USEPA) titled ***Risk Assessment Tools and Information*** at *http://risk.lsd.ornl.gov/prg/prg_document.shtml*.[1] PRGs are risk-based values based on exposure pathways for which generally accepted methods, models, and assumptions have been developed. The risk screen will include comparison against both carcinogenic risk and non-carcinogenic hazard PRGs, although uranium is likely the only constituent with a non-carcinogenic PRGs. If uranium is identified as the only non-carcinogenic COPC, the risk-based screening will be conducted using the whole of the non-carcinogenic PRG value. If other non-carcinogenic COPCs are identified, screening will be conducted at one tenth (0.1) the PRG values to allow for cumulative risk levels that exceed the target level of 1.0. Since the National Contingency Plan (NCP) provides a target cancer risk range of 1 in a million to a few in 10,000 for carcinogenic risk, carcinogenic screening will use the whole PRG value.

3.11.2.5 Weight-of-Evidence Screening

Because of problems inherent in applying a single statistical tool to data sets that have different characteristics, an additional screening step will be applied to the data after they have been screened against background concentrations. This screening step is referred to as a weight-of-evidence screening; that is, multiple types of evidence are considered to determine whether a constituent is MED/AEC-related or naturally occurring. This screening will be applied to constituents that are not screened out during the background or risk screens. The following weight-of-evidence screening techniques will be used to further evaluate the data.

Constituents infrequently detected may be eliminated as COPCs if they are detected in less than five percent of the samples from a given medium, unless their presence is expected based on historical site information or is likely to identify the existence of a 'hot spot'.

Because the UTL represents the 95th percentile of the data (not the full range), it is possible to observe occasional hits above the UTL that are still within the range of background. A review of the analytes with a low frequency of detection above the background criteria will be performed. If a single detection is greater than the UTL or the constituent is detected at levels that are only slightly above the background screening value, the constituent will be evaluated as to whether it is significantly above background or within the expected range of variation of the data set.

[1] USEPA Region 2 often uses the PRGs developed by Region 9, but Region 9 does not provide PRGs for radionuclides. While the Region 9 non-carcinogenic-risk-based PRGs for uranium will still be used, carcinogenic-risk-based PRGs for radionuclides will be taken from the referenced Internet site.

3.11.2.6 Exposure Assessment

The exposure assessment will be performed in two steps. The first step will be to identify any potentially complete pathways between the contaminant source and potential receptors. The second step in the exposure assessment will be to quantify the exposure for each receptor resulting from contact with contaminated media. Step one involves identifying potential current and future receptors, release mechanisms through which contamination may come in contact with the receptors, and the routes of exposure through which the receptors may be exposed. Current and future receptors will be identified based on the current and projected future use of the site and surrounding land use. Receptors will be identified based on activities that occur or may occur at the site and will consider accessibility to the site and proximity of surrounding population groups. Current and projected land use within the boundaries of the Tonawanda Landfill site is industrial for both OUs. However, the surrounding land use includes residential use. Table 3-1 is a preliminary list of potential receptors, media and exposure pathways for the Tonawanda Landfill site. These receptors and pathways will be reevaluated once site data is collected and analyzed.

The second step in the exposure assessment will be to quantify the exposure for each receptor resulting from contact with contaminated media. In order to quantify exposure for each receptor, an exposure point concentration, or the MED-related contaminant concentration a receptor is likely to come in contact with over the duration of exposure, will be estimated. Receptors may be exposed to MED-related contaminant by contact with site media or as the result of migration away from the source into other media or through external exposure to radiation fields.

For direct contact pathways, the exposure point concentration is the concentration source term (USEPA 1989a, 1992a) and is represented by data collected at the site. Site-specific data will be used to determine exposure parameters for the risk assessment, when available. If site-specific data is not available, exposures will be estimated using standard exposure equations and standard parameter values identified for various exposure conditions (USEPA 1989a, 1992b, 1993a, 1997a).

Exposure pathways that incorporate MED-related contaminant migration to a secondary media (groundwater, surface water, sediments, air, and biota) or to an off-site receptor will be referred to as indirect contact pathways. Where available, site-specific data will be used to determine exposure point concentrations for indirect contact pathways. Where site-specific data are unavailable and for future exposures, the exposure point concentrations for the secondary media may be determined using mathematical models. Mathematical models that take into consideration radionuclide-specific, contaminant-specific, and media-specific properties to estimate the contaminant concentration in the secondary exposure media may be used to predict future or off-site exposures.

3.11.2.7 Toxicity Assessment

Toxicity criteria that will be used in the risk assessment will be obtained from the most current update of the USEPA Integrated Risk Information System (IRIS) or, if the information is not available in IRIS, the USEPA Health Effects and Assessment Summary Tables (HEAST). IRIS is an electronic database containing the most current descriptive and quantitative U.S. USEPA regulatory information on chemical and radiological constituents. Chemical files maintained in IRIS contain information related to non-carcinogenic and carcinogenic health effects. HEAST is a published reference, updated quarterly by USEPA. It contains toxicity information and values for chemicals from health and environmental effects documents and profiles.

With the exception of uranium, the toxicity criteria for radionuclides are limited to carcinogenic risk. That is, only uranium is considered as both a potential carcinogenic and non-carcinogenic hazard. To estimate radiological risk, HEAST CSF values will be utilized through the RESRAD computer code. These slope factors are presented in units of risk per picoCurie (pCi) (internal pathways) or risk per year per pCi/gram (external pathway). RESRAD also utilizes conversion factors from USEPA Federal Guidance Reports 11 and 12 (USEPA 1988b and USEPA 1993a) to estimate radiological dose.

Note that while the human health risk assessment focuses on risk-based criteria, it is conceivable that radiological dose-based limits may be selected for the site. The two primary differences in risk and dose estimates include the following:

Risks are presented as lifetime estimates while doses are yearly estimates; and CSFs convert an exposure to risk (e.g., risk per pCi uptake), while dose factors convert an exposure to radiological dose (e.g., millirem/yr per pCi uptake).

Otherwise, risk and dose calculations are identical. The RESRAD code simultaneously calculates risk and dose for comparison against appropriate limits.

For non-carcinogenic COPCs, the reference doses (RfDs) from IRIS and HEAST will be utilized consistent with USEPA guidance (USEPA 1989a).

3.11.2.8 Risk Characterization

After narrowing the total list through a series of screens, identified appropriate exposure pathways and receptors, and completing the appropriate toxicity information, site-specific risk calculations will be performed using the COPCs and appropriate models. The risk assessment for radiological contaminants in soil and sediment will be conducted utilizing the most recent (approved) version of the RESRAD computer code (current version 5.95). While estimating radiological risks with RESRAD uses methods consistent with those presented in the (Risk Assessment Guidance for Superfund) RAGS, the code presents several advantages over standard RAGS methods, including the following:

- RESRAD models future conditions, taking into account source removal by radiological decay, leaching, erosion, etc., and radiological ingrowth[2];
- RESRAD considers site-specific variables, such as rainfall, soil density, etc., that may impact results;
- RESRAD considers source geometry, taking into account the thickness and surface area of soil contamination;
- RESRAD is an integrated code that accounts for all potential exposure pathways with a single calculation or "run"; and
- RESRAD provides both carcinogenic risk and radiological dose estimates for comparison to appropriate regulatory limits.

[2] Ingrowth occurs when a radionuclide decays into a decay product. For example, Th-230 decays into Ra-226. Starting with a pure source of Th-230, ingrowth of Ra-226 will occur over time as the Th-230 decays.

Table 3-1. Preliminary Tonawanda Landfill Site Exposure Assumptions

Area of Concern	Receptor	Environmental Media	Pathway	Assumptions
Onsite (present use, both OUs)	Adult Worker, Recreational, Transient	Soil	Incidental Ingestion External Radiation Inhalation	Workers may come in contact with contaminated media while on-site via direct (incidental ingestion) or indirect contact (inhalation of fugitive dust or radon)
		Sediment Surface Water	Incidental Ingestion External Radiation	Workers may contact contaminants in sediment and surface water while on-site
		Groundwater	Ingestion	On-site groundwater is not currently used for potable use. However, it could potentially be used in the future.
Offsite and Hypothetical Future Onsite (both OUs)	Residents (Adults and Children), Recreational	Soil	Incidental Ingestion External Radiation Inhalation	If contaminated soils are discovered off-site, or if the site is used for residential use in the future, residents have the potential to contact soil via direct or indirect contact
		Sediment Surface Water	Incidental Ingestion External Radiation	If contaminated surface water or sediments are discovered off-site, or if the site is used for residential use in the future, nearby residents have the potential to contact these media.
		Groundwater	Ingestion (household use)	If groundwater is found to be contaminated and if it has migrated or has the potential to migrate to off-site potable wells, or if the site is used for residential use in the future, residents may be exposed via the groundwater pathway

For groundwater and surface water, equations similar to those presented in RAGS will be used to estimate risk from ingestion. RESRAD does contain a model that estimates the risks from radionuclides leaching into groundwater from soil. However, the model will not be used as it is considered overly conservative, generic, and highly uncertain. For surface water and groundwater, intakes will be estimated using equations similar to those found in RAGS. Intake (in pCi of radionuclide) will be calculated as follows:

$$\text{Intake (pCi of radionuclide "I")} = C_I \times IR \times EF \times ED$$

Where:

C_I = concentration of radionuclide "I" in surface water or groundwater (pCi/L);
IR = ingestion rate (L/day);
EF = exposure frequency (days/year); and
ED = exposure duration (years).

All radionuclides are identified as carcinogens. Some radionuclides like uranium, however, are also known to have non-carcinogenic hazardous properties when ingested or inhaled (e.g., uranium is a kidney toxin independent of radiological characteristics). Non-carcinogenic risks will be evaluated consistent with the RAGS methodology (USEPA 1989a).

Pathway-specific intakes and exposure to soil and sediment will be estimated by the RESRAD code as outlined by Argonne National Laboratories [(ANL) 1993 and ANL 1998]. Units for constituent concentration will be expressed as picocuries per gram (pCi/g). The RESRAD code also requires inputs that describe the physical characteristics of the contaminated media. Certain site-specific data such as evapotranspiration coefficients are limited. Site-specific parameter values will be used when available. The preference will be to use site-specific data first, use values recommended or otherwise employed by USEPA second, and use RESRAD defaults last.

Radiological dose will also be estimated using the RESRAD code for soil and sediment or the equations similar to those listed above for water media. These dose estimates may be required for comparison to regulatory limits and for remedial alternative evaluation.

RESRAD will also be used to estimate potential radon emissions emanating from MED related material encountered at the site. The radon pathway, modeled by the RESRAD code, will be used for comparison to regulatory guidelines.

3.11.2.9 Uncertainty Assessment

The uncertainty assessment will be a qualitative evaluation of the uncertainties associated with the exposure assessment, the toxicity information used in the risk assessment and the risk characterization. If results of the risk assessment and a sensitivity analysis indicate that risk management decisions could potentially benefit from a quantitative analysis of uncertainty, a probabilistic analysis will be considered. Prior to conducting the analysis, SAIC will prepare a work plan for USACE approval.

3.11.2.10 Identification of Contaminants of Concern

As described in Section 3.11.2.8, a site-specific risk calculation will be performed for those MED-related contaminants that pass through the background, PRG, and weight of evidence screens and are identified as COPCs. The site-specific assessment will be conducted as follows:

- If the calculated *total* risk from exposure to radionuclides is greater than 10^{-4} for a given receptor and medium, COCs will be identified from those *individual COPCs* that contribute a risk greater than 10^{-6}.
- If the total risk is less than 10^{-4}, no COCs will be identified.
- If the total non-carcinogenic hazard is greater than 1.0 for a given receptor and medium, COCs will be identified from those *individual COPCs* that contribute a hazard greater than 0.1.
- If the total hazard is less than 1.0, no COCs will be identified.

ARARs for the Tonawanda Landfill site will also be considered when selecting the list of COCs, to ensure that contaminants for which there are numeric standards will be included as COCs. Contaminants identified as COCs represent the main contributors to human health risks at the Tonawanda Landfill site that will need to be evaluated for potential remedial action. Risks calculations using the COCs identified for the site will be included in the baseline risk assessment report.

3.11.2.11 Revised Preliminary Remediation Goals

Revised PRGs will be developed in the human health risk assessment for all COCs. These PRGs will be consistent with the methods used to conduct the risk assessment and will replace the PRGs presented previously. These revised PRGs will be used to guide remedial alternative development and will cover a range of potential cleanup goals. Both risk-based and dose-based values will be presented. The dose-based values may be used for comparison to regulatory limits that tend to focus on radiological dose rather than risk. Revised PRGs for carcinogenic COCs will be developed using the RESRAD code and based on the guidance set forth in RAGS Part B (USEPA 1991a). Revised PRGs for noncarcinogenic COCs will also be developed using the guidance set forth in RAGS Part B (USEPA 1991a).

3.11.3 Ecological Risk Assessment

Ecological risk assessments (ERAs) identify and evaluate the current and future risk to biota exposed to MED-related contaminants and physical and biological hazards under existing (baseline) conditions. Risk is the likelihood of experiencing adverse effects. The ERA for the Tonawanda Landfill Site will focus on evaluating the potential of harmful effects on plants and animals as a result of exposure to MED-related contaminants. Regulatory guidance for ecological risk assessments (ERAs) is contained in USEPA's *Risk Assessment Guidance for Superfund, Vol. II, Environmental Evaluation Manual, Interim Final* (USEPA 1989b) and *Ecological Risk Assessment for Superfund, Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997b) and *Guidelines for Ecological Risk Assessment* (USEPA 1998b).

A discussion of the scientific basis for assessing ecological effects is found in *Ecological Assessments of Hazardous Waste Sites: a Field and Laboratory Reference Document* (USEPA 1989c) and *Tri-Service Procedural Guidelines for Ecological Risk Assessments* (Wentsel et al. 1996 and LaPoint et al. 1996). Other guidance is provided in USEPA's ECO Update Intermittent Bulletins (1991a and 1996b) and numerous USEPA Region V Ecological Risk Assessment Bulletins.

The ERA for the Tonawanda Landfill site will be structured according to a general framework for ERAs (USEPA 1992c). According to this framework, the ERA will comprise four interrelated activities: ecological hazard identification or "problem formulation", followed by the exposure and effects assessment, which is synthesized in the risk characterization. These activities are described below.

3.11.4 Scope and Objectives of the Ecological Risk Assessment

The scope of the ERA is to characterize the risk to plant and animal populations and habitats. It will assess the risk to terrestrial ecological (rather than human) receptor. The ERA will focus on populations or groups of interbreeding individuals of a species, unless the species requires special protection, such as threatened and endangered (T&E) species protected under the Endangered Species Act.

The objective of the ERA is to assess the risk of harmful effects on ecological receptors from exposure to MED-related contamination. Some of these contaminants are called contaminants of potential ecological concern (COPECs). When it has been demonstrated that ecological COPECs cause risk, they are called contaminants of ecological concern (COECs).

The exposure units to be evaluated in the ERA will include terrestrial habitats present at or near the Tonawanda Landfill site. Industrial areas that provide only marginal or no habitat may be excluded from detailed evaluation in the ERA. Media of concern will include surface soil which may be contacted directly by ecological receptors or may result in the accumulation of contaminants in plants and animals which can cause animals ingesting those biota to be exposed. Surface soil should be defined based on the depth of biological activity and history of processes resulting in contamination of the site. Surface soils

are expected to be defined as 0-0.6 meters (0-2 feet) in depth. Sediment and surface water will be evaluated by comparing observed concentrations to published benchmarks (Bechtel Jacobs 1998). Groundwater is generally not evaluated for ecological risk, but any groundwater outcropping to the surface will be evaluated quantitatively. A screening level ERA will be performed, using standard dose limits for an exceedance/no exceedance answer. Any exceedances will be further analyzed in a baseline ERA, using hazard quotients for a gradient answer.

3.11.5 Problem Formulation

The problem formulation establishes the scope and focus of the assessment according to the overall objectives of the investigation. The conceptual site model will be presented, including a habitat description, likely ecological receptors, including T&E species, and the pathways by which receptors are likely exposed to site radiological contaminants. The problem formulation section defines the site-specific assumptions of the ERA in concordance with the conceptual site model and the scope. Assessment endpoints will be chosen for selected receptor populations, termed 'endpoint receptors.' The result of problem formulation will be a clearly defined analysis plan and scope for the ERA.

3.11.6 Identification of Ecological Radionuclides of Potential Concern

Radiological COPECs will be those COPCs identified in the preliminary screening steps described in Sections 3.11.2.2 through 3.11.2.3. Only COPECs will be evaluated further in the risk assessment.

Chemical contaminants of concern (metals and organic compounds) will only be included in the ecological risk assessment if determined to be relevant as described in Section 3.11.2.

3.11.7 Conceptual Site Model

The conceptual site model is a description of those attributes of the site that are known or assumed to influence what receptors may be exposed to site radionuclides and how those receptors are potentially exposed. The species most likely to be exposed to site MED related contaminants are those that reside or forage at the site, which is determined by the nature of the habitats at the site and the life histories and behaviors of species. Pathways by which receptors are potentially exposed to site radionuclides are also described. Pathways will identify the source media, release mechanisms, exposure media, and exposure routes. Quantitative emphasis will be given to internal exposure by ingestion (food and abiotic media) and both internal and external radiation by direct contact exposure routes. Dermal and airborne routes are expected to be minor and to be treated qualitatively or dismissed as incomplete routes. The conceptual site model will be further developed in the ERA and finalized based on the findings of the ecological site survey.

3.11.7.1 Habitat Description

A description of the ecological resources including plants, animals, threatened and endangered species, and sensitive habitats at the Tonawanda Landfill site OUs will be prepared following an aerial map reconnaissance for these resources. The site walkover will include classification of locations where vegetation is characterized as barren, single species, and retarded growth and where animals signs or the presence of animals are noted. To facilitate the development of a conceptual site model, the ecological reconnaissance information will be used to prepare a simple habitat map.

3.11.7.2 Identification of Ecological Receptors

After characterization of the ecological resources, receptors species will be specified in the conceptual model. The ecological receptors for the ERA will be selected from plant and animal species likely found in terrestrial habitats at and near the Tonawanda Landfill site. It is expected that the following types of receptors, either directly or indirectly, will be used:

Soil

- vegetation (grasses, bushes, trees)
- soil-dwelling invertebrates (earthworms)
- herbivores (cotton-tail rabbits, deer)
- mid-level predators (shrews, robins)

3.11.7.3 Ecological Assessment and Measurement Endpoints

Protection of the environment and ecological resources, such as the species of plants and animals and habitats, is mandated by a variety of legislation and government agency policies [e.g., CERCLA, NEPA]. Statements of key aspects of ecological protection are presented as policy goals (goals established by legislation or agency policy). These assessment endpoints and measurement endpoints will be developed and evaluated per the decision rule in the ERA report.

3.11.7.4 Analysis Plan

The analysis plan is the final stage of problem formulation. The plan includes three categories of measures to evaluate risk in the conceptual site model: (1) measures of exposure (also termed measurement endpoints); (2) measures of effect, and (3) measures of receptor characteristics. The plan consolidates exposure and effects information and defines how this information will be used in effects assessment and risk characterization.

3.11.8 Exposure Assessment

Exposure assessment estimates the magnitude of exposure of biota to MED-related contaminants at the site (USEPA 1991a). The exposure assessment will evaluate potential exposure pathways and identify the major quantifiable pathways, i.e., those that are expected to result in exposures to endpoint receptors that are large relative to other pathways and that can be quantified. For the major pathways, the ecological ROPC concentrations to which receptors are exposed will be estimated from site measurements.

3.11.8.1 Identification of Exposure Pathways

Possible pathways of exposure to radiological COPECs in source media at the Tonawanda Landfill Site will be briefly diagrammed, evaluated, and discussed. Complete exposure pathways will be distinguished from incomplete pathways. Complete pathways will be evaluated in the ERA as distinguished from incomplete pathways that will not be evaluated because they are thought to result in inconsequential exposure at the sites or cannot be quantified. As stated earlier, complete pathways are expected to be ingestion of various food and material and direct contact. By contrast, dermal and inhalation pathways are not expected to be complete pathways or associated with unacceptable risk. The assessment endpoints for the ERA will be quantitatively evaluated for the major complete pathways resulting in exposure of endpoint receptors.

3.11.8.2 Quantification of Exposure

The exposure of an endpoint receptor to a COPEC in surface soil or biota will be quantified. For some receptors, exposure may be quantified by multiplying an estimate of the COPEC concentration in the media by factors representing the dilution and/or magnification of contaminant concentrations that potentially occur in nature along the pathways from soil to the exposed organism. For example, if the receptor's food bioaccumulates the contaminant four times over the soil concentration, and the receptor absorbs 100 percent of the contaminant in the food, then the measured concentration would be adjusted by a factor of 4 x 1.0 = 4 for that contaminant to estimate the exposure for that receptor.

Exposure factors will be based on published information about diets of receptors and bioavailability and bioaccumulation potential of COPECs (e.g., USEPA 1993b). Bioaccumulation factors will be an integral part of each exposure; they will be used for soil to plant as well as plant to animal transfers. The internal total-body dose rate to a terrestrial receptor from exposure to a single COPEC in soil is:

$$R_{ijk} = CFa \times [Co_{ijk} \times (QF \times \Phi_\alpha \times E_\alpha n_\alpha + QF \times \Phi_\beta \times E_\beta n_\beta + QF \times \Phi_\gamma \times E_\gamma n_\gamma)];$$

the external total-body dose rate to a terrestrial receptor from below-ground exposure to a single COPEC is:

$$R_{ijk} = 1.05 \times F_{below} \times CFa \times C_{jk} \times QF \times (\Phi_\beta \times E_\beta n_\beta + \Phi_\gamma \times E_\gamma n_\gamma);$$

and the external total-body dose rate to a terrestrial receptor from above-ground exposure to a single COPEC is:

$$R_{ijk} = F_{above\,i} \times F_{rutk} \times CFb \times C_{jk} \times DCFs_j \times h_i$$

where:

R_{ijk}	=	total-body dose to subsurface receptor *i* from exposure to COPEC *j* in soil at location *k* (rem/day)
CFa	=	unit conversion factor from pCi/g x MeV/disintegration to rad/day = 5.11 x 10-5 rad/day/[(pCi MeV/(g soil x disintegration)]
Coijk	=	concentration of COPEC j in the tissue of receptor i at location k (pCi/g)
QF	=	quality factor to account for relative effectiveness of radiation types: 1 rem/rad for β and γ radiation, 20 for α radiation
Φ_m	=	absorbed fraction of energy emitted by α, β, or γ radiation (unitless), where m = α, β, or γ
E_m	=	average effective energy emitted by α, β, or γ radiation (MeV/disintegration)
n_m	=	proportion of disintegrations producing α, β, or γ radiation (unitless)
1.05	=	conversion factor to account for immersion in soil rather than water
F_{below}	=	fraction of time receptor *i* spends below ground in tunnels or burrows (unitless)
C_{jk}	=	concentration of COPEC *j* in soil at location *k* (pCi/g)
$F_{above\,i}$	=	fraction of time receptor *i* spends on the ground surface (unitless)
F_{rutk}	=	dose rate reduction factor accounting for roughness of the ground surface at location *k* = 0.7 (unitless)
CFb	=	unit conversion factor from Sv/s per Bq/m3 to rem/d per pCi/g = 5.12 x 1011 (rem/day per pCi/g) / (Sv/s per Bq/m3)
C_{jk}	=	concentration of COPEC *j* in soil at location *k* (pCi/g)

$DCFs_{jk}$ = dose coefficient for COPEC *j* in soil contaminated to a depth of 15 cm at location *k* (Sv/s per Bq/m^3) (Eckerman and Ryman 1993, Table III.6)

hi = factor to adjust for height of receptor i above the ground surface

It is assumed that n is contained along with E (as $E_\gamma n_\gamma$, $E_\beta n_\beta$, and $E_\alpha n_\alpha$) n the decay energy terms from Table A.1 of *External Exposure to Radionuclides in Air, Water, and Soil, Federal Guidance Report No. 12* (Eckerman and Ryman 1993). The values of Φ_β and Φ_γ come from *Methodology for Estimating Radiation Dose Rates to Freshwater Biota Exposed to Radionuclides in the Environment* (Blaylock et al. 1993) or *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al. 1997). The value of Φ_α is 1.0 for all radionuclides (Blaylock et al. 1993).

The exposures of endpoint receptors to COPECs in surface soil or biota will be estimated by multiplying exposure factors by the central tendency of the distribution of radionuclide concentrations in the media. Central tendency refers to either the mean or the geometric mean, depending on the type of data distribution. The particular concentration of COPECs to which endpoint receptors are directly or indirectly exposed will be estimated by the reasonable maximum exposure (RME) concentration. The RME is an arbitrary upper bound of the estimated mean or geometric mean, and it is generally the 95% UCL of the mean or geometric mean or, arbitrarily, the maximum observed value if the maximum is less than the 95% UCL. The RME is a conservative estimate of the central tendency of the distribution of radionuclide concentrations in the samples, especially in those cases where the maximum detected concentration is the RME. Individual organisms are potentially exposed to the maximum concentrations at a site, which may be the maximum detected concentration. However, only T&E species at the Tonawanda Landfill site would warrant characterizing risk to individuals exposed to concentrations at particular sample locations, as opposed to an average or expected concentration.

3.11.9 Effects Assessment

An effects assessment defines the type of adverse effects on receptors associated with contaminants (USEPA 1991a). The effects assessment will rely on published information concerning contaminant toxicity for organisms similar to Tonawanda Landfill site receptors. Effects assessment sections of the ERA will describe the appropriate effects-threshold concentration dose limits derived from published information.

3.11.9.1 Toxicity

Chronic radiation toxicity of COPECs is the primary concern at the Tonawanda Landfill site exposure units. During the site reconnaissance survey and during normal site work, visual inspection of vegetation (absence, stunted, necrotic) and animals (absence, apparent sickness) will be observed to confirm this impression. If stress is apparent, signs of non-radionuclide stressors will also be looked for and evaluated.

3.11.9.2 Radiation Dose Limits

The benchmark values for radiation given by International Atomic Energy Agency (IAEA 1992) are 0.1 rad/d for terrestrial mammals and birds and 1 rad/d for plants, invertebrates, and aquatic biota. These benchmarks are confirmed in Effects of Ionizing Radiation on Terrestrial Plants and Animals: A workshop Report (Barnthouse 1995, ORNL/TM-13141) and DOE order 5400.5. Alpha radiation has a much higher effect on biological tissue than beta and gamma radiation because of the large mass of the alpha particle. When internal exposure is being evaluated, it is particularly important to consider the relative effectiveness of the radiation by including a quality factor (QF rem/rad or sievert/gray) for the

greater damage done by alpha particles than by beta and gamma radiation. The IAEA report states that quality factors were used in the evaluation of ecological radiation exposures for setting benchmarks. Inclusion of QF results in the calculation of effective dose in units of rem/day rather than absorbed dose in units of rad/day. Therefore, for this evaluation, radiological benchmarks for biota will be restated in units of rem/day rather than rad/day.

3.11.10 Risk Characterization

Risk characterization integrates the findings of the exposure and effects assessments to estimate the likelihood that receptors experience adverse effects as a result of exposure to COPECs (USEPA 1991a). The risk to ecological receptors at the Tonawanda Landfill site will be characterized by calculating hazard quotients (HQs) and hazard indices (HIs). An HQ compares the estimated exposure concentration of an ecological ROPC and the radiation dose limits for receptor organisms exposed to the ROPC. The HI is the sum of HQs.

3.11.10.1 Calculation of Risk Quotients

For the Tonawanda Landfill site, HQs will be calculated for endpoint receptors. The exposure of endpoint receptors to COPECs in soil, surface water, sediment or biota will be estimated as the product of the measured environmental concentration and the exposure factors estimating the external dose and the internal dose form the fraction of the diet that is ingested from the sites, bioaccumulation, as well as the fraction of what is ingested that is absorbed (assumed to be 100 percent). The estimated total dose is divided by the radiation dose limit number (i.e., benchmark dose or published dietary limit for the receptor and COPECs) to give the HQ. That is,

$$HQ = \frac{\textit{Internal plus external radiation dose}}{\textit{Radiation dose limit}}$$

HQs will be tabulated for COPECs listed and will be summed in a hazard index (HI).

3.11.10.2 Summary of COPECs with HIs > 1

Because of uncertainties in quantifying exposure and effects, the exposure and effects assessments will be designed to produce HIs that minimize the probability of falsely concluding that there is no risk when in fact there is. Therefore, COPECs with HQs that indicate little to no likelihood of risk to the endpoint receptors and all COPECs when HI is less than 1.0 will not be discussed. To minimize the probability of falsely concluding there is risk when there is none, the risk characterization will evaluate in greater depth the exposure estimates and effects thresholds for those COPECs with HQs indicating potential risk.

3.11.11 Uncertainty Assessment

Uncertainties in the ERA will be discussed. Uncertainties in each of the four interrelated activities of the ecological risk assessment process will be addressed qualitatively, with an indication of whether the effect of method of treatment of the uncertainty results in an under or over estimate of risk as quantified by the HQs and HIs. Risk characterization may include the following distinctions: off-unit risk, cumulative risk, future risk, and background risk.

3.11.11.1 Weight-of-Evidence Analysis

COECs will be identified from those COPECs with risk quotients sufficiently large to overcome known conservatism and uncertainties in the exposure and effects parameters. Based on the quantitative

assessment of risk using HQs and HIs and qualitative assessment of uncertainty, any COECs will be identified. The development of professional judgement criteria for weight of evidence will incorporate various types of information into such principles as:

- temporal association of the radionuclide and the receptors and their predicted response,
- spatial association of the radionuclide and the receptors and their predicted response,
- strength of dose response association of the exposure and the effects data, and
- biological plausibility of the risk being predicted at its hazard quotient levels.

Weight of evidence analysis will include such technical matters as the results of the habitat reconnaissance, the quality and quantity of the exposure data, the quality and quantity of the effects information, the magnitude of the HQ (the higher the more likely the risk is real). Thus, COPECs are those contaminants for which the weight of evidence indicate remedial action is required to reduce risks to receptors to acceptable levels.

3.11.12 Ecological Preliminary Remediation Goals

Ecological PRGs will be developed in the ERA for all COPECs that are identified as COPECs based on the weight of evidence analysis. These PRGs will be consistent with the methods used to conduct the ERA will be used in conjunction with the human health PRGs to guide remedial alternative development.

It is noted that the entire ecological system at the landfill may potentially be disrupted due to proposed future use and closure activities. Given this possibility, it may be necessary to incorporate this concept into the ecological risk assessment discussed above resulting in revised PRGs for the landfill. Revised PRGs will be a function of proposed future use/closure activities for the site presented prior to commencement of the ERA.

3.11.13 Task 11: Personnel Responsibilities

The Program Manager and the Project Manager will oversee the development of the Baseline Risk Assessment. Since various scientific and statistical disciplines are required for a sufficient risk assessment, the following expertise will be involved: Senior Ecologist, Technical Manager, Microbiologist, two Risk Scientist, Biologist/Ecologist, Health Physicist, Data Manager, and an Environmental Scientist. Clerical/Administrative staff will provide the word processing and desktop publishing. The Drafter will produce the figures to be incorporated into Baseline Risk Assessment.

An ITR on documents to be submitted to USACE will be performed by members of the ITR team experienced in this field of expertise as stated in Task 2. The Health Physicist will be a member of the ITR team that reviews this project document.

3.12 TASK 12: PREPARATION OF RI/FS REPORT

SAIC will use the USEPA publication, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA 1988b) and MARSSIM (DOD 1997) as preparation guidance for a draft and final RI/FS report for the Tonawanda Landfill Site. Outlines for both the RI Report and the FS Report are shown in the SOW (Appendix B) and in the USEPA RI/FS guidance document (Tables 3-13 and 6-5, respectively). The outlines for the RI Report and FS Report have been included as Figures 3-1 and 3-2, respectively.

RI REPORT FORMAT

Executive Summary

1.0 Introduction

1.1 Purpose of Report

1.2 Site Background
- 1.2.1 Site Description
- 1.2.2 Site History
- 1.2.3 Previous Investigations
- 1.2.4 Previous Remedial Action

1.3 Report Organization

2.0 Study Area Investigation

2.1 Includes field activities associated with site characterization. These may include physical and chemical monitoring of some, but not necessarily all, of the following:
- 2.1.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
- 2.1.2 Contaminant Source Investigations
- 2.1.3 Meteorological Investigations
- 2.1.4 Surface-Water and Sediment Investigations
- 2.1.5 Geological Investigations
- 2.1.6 Soil and Vadose Zone Investigations
- 2.1.7 Ground-Water Investigations
- 2.1.8 Human Population Surveys
- 2.1.9 Ecological Investigations

2.2 If technical memoranda documenting field activities were prepared, they may be included in an appendix and summarized in this report chapter.

3.0 Physical Characteristics of the Study Area

3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following:
- 3.1.1 Surface Features
- 3.1.2 Meteorology
- 3.1.3 Surface-Water Hydrology
- 3.1.4 Geology
- 3.1.5 Soils
- 3.1.6 Hydrogeology
- 3.1.7 Demography and Land Use
- 3.1.8 Ecology

Figure 3-1

4.0 Nature and Extent of Contamination

4.1 Presents the results of site characterization, both natural chemical components and contaminants in some, but not necessarily all of the following media:
- 4.1.1 Sources (lagoons, sludges, tanks, etc.)
- 4.1.2 Soils and Vadose Zone
- 4.1.3 Ground Water
- 4.1.4 Surface Water and Sediments
- 4.1.5 Air
- 4.1.6 Buildings and Structures

5.0 Contaminant and Fate Transport

5.1 Potential Routes of Migration (i.e., air, ground water, etc.)

5.2 Contaminant Persistence
- 5.2.1 If they are applicable (i.e., for organic contaminants), describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.

5.3 Contaminant Migration
- 5.3.1 Discuss factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of groundwater, etc.)
- 5.3.2 Discuss modeling methods and results, if applicable.

6.0 Baseline Risk Assessment

6.1 Human Health Evaluation
- 6.1.1 Exposure Assessment
- 6.1.2 Toxicity Assessment
- 6.1.3 Risk Characterization
- 6.1.4 Uncertainty Analysis

6.2 Environmental Evaluation
- 6.2.1 Exposure Assessment
- 6.2.2 Toxicity Assessment
- 6.2.3 Risk Characterization
- 6.2.4 Uncertainty Analysis

7.0 Summary of Conclusions

7.1 Summary
- 7.1.1 Nature and Extent of Contamination
- 7.1.2 Fate and Transport
- 7.1.3 Risk Assessment

Figure 3-1 (continued)

7.2 Conclusions
- 7.2.1 Data Limitations and Recommendations for Future Work
- 7.2.2 Recommended Remedial Action Objectives

Appendices

A. Technical Memoranda on Field Activities (if available)
B. Analytical Data and QA/QC Evaluation Results
C. Risk Assessment Methods

Figure 3-1 (continued)

FS REPORT FORMAT

1.0 Introduction

1.1 Purpose and Organization of Report

1.2 Background Information (Summarized from RI Report)
- 1.2.1 Site Description
- 1.2.2 Site History
- 1.2.3 Nature and Extent of Contamination
- 1.2.4 Contaminant Fate and Transport
- 1.2.5 Baseline Risk Assessment

2.0 Identification and Screening of Technologies

2.1 Introduction

2.2 Remedial Action Objectives – Presents the development of remedial action objectives for each medium of interest (i.e., groundwater, soil, surface water, air, etc.). For each medium, the following should be discussed:
- Contaminants of Interest
- Allowable exposure based on risk assessment (including ARARs)
- Development of remediation goals

2.3 General Response Actions – For each medium of interest, describes the estimation of areas or volumes to which treatment, containment, or exposure technologies may be applied.

2.4 Identification and Screening of Technology Types and Process Options – For each medium of interest, describes:
- 2.4.1 Identification and Screening of Technologies
- 2.4.2 Evaluation of Technologies and Selection of Representative Technologies

3.0 Development and Screening of Alternatives

3.1 Development of Alternatives – Describes rationale for combination of technologies/media into alternatives. Note: This discussion may be by medium or for the site as a whole.

3.2 Screening of Alternatives (if conducted)
- 3.2.1 Introduction
- 3.2.2 Alternative 1
  - 3.2.2.1 Description
  - 3.2.2.2 Evaluation
- 3.2.3 Alternative 2

Figure 3-2

3.2.3.1 Description
3.2.3.2 Evaluation
3.2.4 Alternative 3

4.0 Detailed Analysis of Alternatives

4.1 Introduction

4.2 Individual Analysis of Alternatives
4.2.1 Alternative 1
4.2.1.1 Description
4.2.1.2 Assessment
4.2.2 Alternative 2
4.2.2.1 Description
4.2.2.2 Assessment
4.2.3 Alternative

4.3 Comparative Analysis

Bibliography

Appendices

Figure 3-2 (continued)

3.12.1 Remedial Investigation (RI) Report

The RI Report will be produced for the review by USACE and for its use in preparing a risk assessment and also serve as documentation of data collection and analysis in support of the FS. The characterization of the Tonawanda Landfill FUSRAP Site will incorporate historical data and data acquired during the RI field investigation. Once characterization has been performed, areas of contamination (including volumes) will be delineated.

3.12.2 Feasibility Study (FS)

3.12.2.1 Purpose

The purpose of the FS is to develop and evaluate appropriate remedial alternatives for the Tonawanda Landfill FUSRAP Site OUs. The identified alternatives will be evaluated based on their ability to protect human health and the environment. The FS process consists of the following activities:

- development and screening of alternatives,
- detailed analysis of alternatives, and
- evaluation and selection of alternatives.

The remainder of this section describes the FS approach and its requirements.

3.12.2.2 Development and Screening of Alternatives

The alternatives for remediation are developed by assembling combinations of technologies, with the media to which they may be applied, into alternatives that address the contamination on an area-specific or site-wide basis. The required steps for the development of alternatives are described in Section 3.12.2.8.

3.12.2.3 Development of Remedial Action Objectives

The remedial action objectives (RAOs) consist of medium-specific or operable unit-specific goals for protecting human health and plants and animals in the environment. RAOs are developed for each COC. The RAO specifies the exposure routes and receptors and is synonymous with acceptable contaminant levels for each exposure route. The acceptable exposure levels are determined based on the Baseline Risk Assessment and the evaluation of the expected exposures and associated risks for each alternative.

For this site, RAOs are expected to be developed for soil, but may also be developed for groundwater, surface water, sediment, and air.

3.12.2.4 Development of General Response Actions

General response actions (GRAs) consist of medium-specific actions that will satisfy the RAOs. GRAs may include no action, treatment, containment, excavation, disposal, institutional actions, or a combination of these.

3.12.2.5 Identification of GRAs by Areas or Volumes of Media

The type of contamination previously detected at the Site has not been definitely identified as MED generated material. Contaminated material termed "MED-like" was identified in only two areas of the

landfill in previous reports. In addition, other contaminants not related to FUSRAP material have also been identified in other areas of the landfill site. Therefore, the GRAs will be identified primarily on an area specific basis and not site wide unless field investigation results indicate it necessary to broaden the limits of the focus areas.

3.12.2.6 Identification and Screening of Technologies

The technology types potentially applicable for use at this site are evaluated with respect to implementability. This is accomplished by using RI site characterization data on contaminant types and concentrations, and onsite characteristics to screen out technologies and process options that can not be effectively implemented at this site. The term "technology types" refers to general categories of technologies such as chemical treatment, thermal destruction, immobilization, capping, excavation, or dewatering. Technology types and process options that are deemed implementable are retained for further evaluation.

3.12.2.7 Evaluation of Technology Process Options

Technology processes considered to be implementable at this site are evaluated for effectiveness, practicality, implementability and cost.

Effectiveness:
The effectiveness of each process option is evaluated by ability to meet remediation goals, impacts to human health and the environment during implementation, and reliability of the technology when treating the contaminants.

Implementability:
The implementability of each process option is evaluated from both the technical feasibility and the administrative feasibility of performing the technology at the site.

Practicality:
Once a process has been identified, the procedural aspects of the option will be evaluated to determine if the alternative is practical for attaining long term project goals and makes sense to implement given existing site conditions.

Cost:
The cost of each process option is evaluated on a limited basis. Relative capital and operation & maintenance (O&M) costs (high, low, or medium) are determined based on other process options of the same technology type.

3.12.2.8 Development of Potential Alternatives

The GRAs and the process options retained for further analysis are combined for each medium or operable unit. These form the alternatives for the site as a whole. The alternatives are listed for each medium, and several alternatives can be chosen for the same medium. Each alternative selected is described in detail.

A range of treatment alternatives will be developed, varying primarily in the extent to which they rely on long-term management of residuals and untreated contaminated media. The upper bound of the range will be an alternative that would eliminate, to the extent feasible, the need for any long-term management (including monitoring) at the site. The lower bound will be an alternative that may involve treatment as a principle element, but would require some long-term management of portions of the site. Between the

upper and lower bounds of the treatment range, alternatives varying in the type and degrees of treatment and associated containment/disposal requirements will be developed. One or more containment option(s) involving little or no treatment will be developed as appropriate, and a no-action alternative will be developed to provide a baseline.

3.12.3 Alternative Screening Process

Before beginning screening, alternatives will be assembled primarily on medium-specific considerations and implementability concerns. Few details of the individual process options will be identified, such as sizing requirements, remediation time frames, interactions among media which may influence remedial activities, or site wide protectiveness. Therefore, at this stage, such aspects of the alternatives are conceptual and may need to be further defined to form the basis for evaluating and comparing the alternatives before their screening.

3.12.3.1 Evaluation of Potential Alternatives

Once the alternatives are defined, they are evaluated against the following criteria: short-term and long-term effectiveness, implementability, and cost.

3.12.3.2 Effectiveness

Each alternative is evaluated based on its effectiveness in protecting human health and the environment. This protection is typically measured by the alternative's ability to reduce toxicity, mobility, or volume in the characteristics of the hazardous material or contaminated media.

The short-term effectiveness evaluation includes the construction and implementation period for each alternative; the long-term effectiveness evaluation covers the period of time after the remediation is complete.

3.12.3.3 Implementability

The implementability of each alternative is evaluated in two ways: technical feasibility and administrative feasibility. Technical feasibility is the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete. It also includes operation, maintenance, replacement, and monitoring of technical components of an alternative. The determination that an alternative is not technically feasible will usually eliminate it from further consideration.

Administrative feasibility is the ability to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services and capacity, and the requirements for, and availability of, specific equipment and technical specialists.

3.12.3.4 Cost

Cost analyses for screening alternatives is based on a variety of cost-estimating data. These data may include cost curves, vendor information, or industrial cost-estimating guides, or be based on prior experience on similar projects. The need for accuracy at the screening stage is not critical. Therefore, the cost analysis for each alternative is performed using reasonable accuracy and includes a margin of error (i.e., +50 % to -30 %.). Cost estimates will be prepared using CostLink/MCACES software.

During the cost analysis, both capital costs and operation and maintenance (O&M) costs are evaluated. In addition, potential future remedial action costs are considered to the extent that they can be defined.

Present worth analyses are used, and all costs are discounted to a common base year, allowing for alternatives to be evaluated using a single cost figure for each.

3.12.3.5 Selection of Alternatives for Detailed Analysis

Alternatives are evaluated against the screening criteria, and screened out or retained for further consideration. Once the alternatives are selected, any additional investigations that may be needed are identified, and the detailed analyses can proceed. Additional post-screening tasks include determination of action-specific ARARs, initiation of any required treatability testing, and additional site characterization. A maximum of five (5) remedial alternatives will be evaluated for each OU.

3.12.4 Detailed Analysis of Alternatives

The detailed analysis of alternatives follows the development and screening of alternatives and precedes the actual selection of a remedy. The results of the analysis of alternatives are presented in the FS to provide the relevant information needed to allow decision makers to select a site remedy.

The detailed analysis consists of the following:

- further definition of each alternative,
- an assessment and summary profile for each alternative against the specific evaluation criteria, and
- a comparative analysis among the alternatives.

The specific statutory requirements, addressed in the Record of Decision (ROD) and supported in the FS, are as follows:

Remedial actions must:

- be protective of human health and the environment,
- attain ARARs,
- be cost-effective,
- utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and
- satisfy the preference for treatment that reduces toxicity, mobility or volume as a principal element (or explain in the ROD as to why it does not.)

Further statutory considerations (under CERCLA) include:

- long-term uncertainties associated with land disposal,
- goals, objectives, and requirement of the Solid Waste Disposal Act,
- persistence, toxicity, and mobility of hazardous substances and their constituents and their propensity to bioaccumulate,
- short- and long-term potential for adverse health effects from human exposure
- long-term maintenance costs,
- potential for future remedial action costs if the alternative remedial action in question were to fail, and
- potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment.

Nine evaluation criteria, which have been designed to address the requirements and considerations listed above, serve as the basis for conducting the detailed analysis.

3.12.5 Alternative Definition

The alternatives selected during the development and screening phase may need to be better defined during the detailed analysis. The information needed to further design the alternatives may consist of preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

3.12.6 Individual Analysis of Alternatives

During the individual analysis, each alternative is described and assessed on the basis of the following nine evaluation criteria:

- Overall Protection of Human Health and the Environment, including human health and environmental risks associated with each remedial alternative selected for detailed evaluation.
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State (Regulatory Agency) Acceptance
- Community Acceptance

The analysis is presented as a narrative discussion, accompanied by as a summary table. The discussion includes data on technology components, quantities of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. The narrative discussion presents the assessment of the alternative against each of the nine evaluation criteria.

3.12.7 Comparative Analysis of Alternatives

Once the alternatives have been described and individually assessed, a comparative analysis is conducted to evaluate the relative performance of each alternative against each of the nine evaluation criteria.

The comparative analysis includes as a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion, and how key uncertainties could impact relative performance. The differences among alternatives are assessed either qualitatively or quantitatively, as appropriate.

3.12.8 Recommended Alternatives

An alternative or combination of alternatives, are recommended for implementation at the site. The recommendation is the final step of the FS process and provides the basis for the ROD.

3.12.9 Task 12: Personnel Responsibilities

A large technical, clerical and administrative effort will be required to develop of RI and FS Reports. Again, the Program Manager and the Project Manager will oversee the development of both of these

reports. It will be a priority to use personnel who have been involve in earlier tasks (particularly the Acquisition of Field Data) to develop these reports. Expertise will include: Technical Manager, Data Manager, Data Validator, Regulatory Specialist, Radiation Protection Specialist, Environmental Engineer, Environmental Scientist, and hydrogeologists.

An ITR on documents to be submitted to USACE will be performed by members of the ITR team experienced in this field of expertise as stated in Task 2.

3.13 TASK 13: PREPARATION OF PROPOSED PLAN AND RECORD OF DECISION (OPTIONAL)

The Proposed Plan (PP) and Record of Decision (ROD) will be prepared for remedial action alternatives determined appropriate as a result of the RI/FS process. The PP summarizes the alternatives developed in the FS and presents the preferred alternative for public comment. The final remedy determination is then made and documented in the ROD. The ROD includes a responsiveness summary addressing comments on the PP. Remedial design and remedial action follow completion of the ROD. At the present time, it is assumed that both OUs will be addressed in the same PP and ROD.

The proposed plan and ROD will be prepared in accordance with USEPA guidance: *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decisional Document,* (USEPA 1999). The purpose of the proposed plan is to facilitate public participation in the remedy selection process, therefore the proposed plan will be prepared in "Fact Sheet" format. This format is concise and easy to read.

This task will not be performed until approval is obtained from the USACE – Buffalo District.

3.13.1 Task 13: Personnel Responsibilities

The personnel involved in the development of the RI Report, and especially, the FS Report will be used to develop the PP and ROD. They include the Senior Environmental Engineer, Technical Manager, Program Manager, Regulatory Specialist, and Project Manager.

Project documents and submittals under this task will be subjected to an ITR in accordance with Task 2.

3.14 TASK 14: COMMUNITY RELATIONS

The following activities will be performed to assist and support USACE in community relations activities:

- Individuals including the project manager, technical advisor, risk assessor, field manager, and others will be available to participate in public and project meetings; and assist in preparing written materials, presentation slides, and other requested materials in anticipation of implementing project specific public involvement programs and meetings;
- Copies of historical information, RI data, and relevant documents will be maintained so that requests for information from public groups can be met in a timely fashion.
- Graphic artists and personnel with experience in community relations support and computer aided design CAD operators will be available to assist in preparing displays and graphics.

All individuals working with the team will be kept appraised of the status of project activities, findings, and upcoming events. This will facilitate timely response to support requests from the USACE.

3.14.1 Task 14: Personnel Responsibilities

The personnel involved the most from the very start of the Tonawanda Landfill FUSRAP Site RI/FS will be the most well versed in participating in Community Relations tasks. They include the Technical Manager, Program Manager, and Project Manager. This task will likely entail several different trips to Buffalo, Albany, and the Tonawanda Landfill site.

3.15 TASK 15: TECHNICAL SUPPORT

The following activities will be performed by SAIC to assist and support USACE in technical support activities:

- Participation in project meetings by key project personnel;
- Interaction with regulatory agencies, other contractors, other USACE districts, and other organizations/individuals as requested by USACE;
- Maintain project files including historical information, RI data, and relevant documents so that a timely response to USACE requests for information from can be accomplished;
- Provide technical evaluation of site information and remedial alternatives from qualified specialists in the field of expertise required. SAIC will provide this support to USACE on an as needed basis.

3.15.1 Task 15: Personnel Responsibilities

The personnel involved the most for the Tonawanda Landfill FUSRAP Site RI/FS will support this task and likely include the Technical Manager, Program Manager, and Project Manager. This task will likely require a number of trips to Buffalo, Albany, and the Tonawanda Landfill site. In the event additional resources are required, SAIC will provide the appropriate qualified personnel to address specific issues associated with the project. Project personnel will likely include all those listed in previous task descriptions and others as requested by USACE.

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