



Technical Memorandum

Pre-Scoping and Cost-Estimation Memorandum— Grassy Island Remedial Investigation/Feasibility Study, Wayne County, Michigan

Final

December 2005

GSA Contract No. GS10F0208J
Task Order No. 314105X162



TETRA TECH EC, INC.

T E C H N I C A L M E M O R A N D U M

Pre-Scoping and Cost-Estimation for Remedial Investigation/Feasibility Study (RI/FS)

**Grassy Island
Detroit River International Wildlife Refuge
Wayne County, Michigan**

Final

December 2005

Prepared by:

Tetra Tech EC, Inc.
143 Union Boulevard, Suite 1010
Lakewood, Colorado 80228
(303) 988-2202
(303) 980-3539 (fax)

Prepared for:

United States Fish and Wildlife Service
Detroit River Sub-Office of the East Lansing Field Office
9311 Groh Rd.
Grosse Ile, Michigan 48138

Under Contract to:

United States Fish and Wildlife Service
East Lansing Ecological Services Field Office
2651 Coolidge Rd., Suite 101
East Lansing, Michigan 48823

GSA Contract No.: GS10F0208J
Task Order No. 314105X162

CONTENTS

Section	Page
EXECUTIVE SUMMARY.....	ES-1
1. INTRODUCTION.....	1
1.1 Purpose.....	1
1.2 Memorandum Organization.....	1
2. PROJECT BACKGROUND.....	1
2.1 Site History.....	1
2.2 Preliminary Assessment/Site Investigation Summary.....	2
2.3 Prior Studies.....	3
2.4 Goals for Grassy Island.....	3
3. REGULATORY FRAMEWORK.....	4
4. SCOPING ACTIVITIES AND DELIVERABLES FOR THE REMEDIAL ACTION PROCESS.....	4
5. FOCUSED REMEDIAL INVESTIGATION.....	6
6. FOCUSED FEASIBILITY STUDY.....	7
7. RI/FS COST ESTIMATE.....	7
7.1 RI/FS Tasks.....	9
7.2 Assumptions.....	11
7.3 Costs.....	13
7.4 Areas of Uncertainty.....	13

LIST OF TABLES

Table	Page
Table ES-1. Summary of Estimated Cost Ranges	ES-2
Table 1. Grassy Island Management Directives	16
Table 2. Summary of Rough, Order-of-Magnitude Cost Estimate	18
Table 3. RI/FS Cost Ranges.....	18

LIST OF FIGURES

Figure	
Figure 1. Major Steps of CERCLA Process	15
Figure 2. Phased RI/FS Process	15

ATTACHMENTS

Attachment

- Attachment A. List of Existing Documents
- Attachment B. Suggested Deliverable Formats
- Attachment C. Cost Estimate

LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
CCP	Comprehensive Conservation Plan
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Cl	Chlorine
CRP	Community Relations Plan
DOI	U.S. Department of Interior
DQO	data quality objective
DRIWR	Detroit River International Wildlife Refuge
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GSA	U.S. General Services Administration
HASP	Health and Safety Plan
MAC	Metropolitan Affairs Coalition
NAPL	Nonaqueous Phase Liquid
NCP	National Contingency Plan
NGO	Nongovernmental Organization
NPL	National Priority List
ODC	other direct charge
OSHA	Occupational Safety and Health Administration
PA/SI	Preliminary Assessment/Site Assessment
PCB	Polychlorinated Biphenyl
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act

Service	U.S. Fish and Wildlife Service
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WNWR	Wyandotte National Wildlife Refuge

EXECUTIVE SUMMARY

Grassy Island, a 72-acre artificial island in the Detroit River in Wayne County, Michigan, was constructed and operated between 1959 and 1987 to dispose of contaminated sediments dredged by the U.S. Army Corps of Engineers (USACE) from the Rouge River. In 1961, by an act of Congress, Grassy Island became part of the Wyandotte National Wildlife Refuge (WNWR) and in 2001 was incorporated into the Detroit River International Wildlife Refuge (DRIWR). The U.S. Fish and Wildlife Service (Service) manages the site, has investigated the nature and extent of contamination on and near Grassy Island in conjunction with the U.S. Geological Survey (USGS) since the early 1990s, and is now planning to conduct Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) response actions.

This technical memorandum outlines the steps and costs to plan and carry out a Remedial Investigation/Feasibility Study (RI/FS), pursuant to CERCLA and the National Contingency Plan (NCP), for Grassy Island. This document also includes cost estimates to support preparation of the Proposed Plan and Record of Decision (ROD), which will follow the RI/FS phase.

Pursuant to its CERCLA response authority, the Service conducted a Preliminary Assessment/Site Inspection (PA/SI), which determined that contaminant transport was likely through four pathways – groundwater (limited to seepage into surface water), surface water, air, and soil. It identified the need to take the following actions:

- Conduct an RI
- Perform baseline human health and ecological risk assessments
- Conduct an FS to evaluate remedial alternatives prior to selecting a remedial action.

Remedial action objectives for Grassy Island have not yet been established, but there are numerous existing management directives that are relevant and can be used to guide remedial planning. CERCLA provides broad federal authority to facilitate the cleanup of sites where there has been a release or threat of release of hazardous substances or pollutants or contaminants. Pursuant to its delegated CERCLA authority, the Service intends to follow EPA Superfund program methodology as established in EPA's guidance documents. To carry out this methodology, the Service will prepare several sets of documents including detailed plans – more specifically RI/FS Work Plans that will contain sampling and analysis, health and safety, and community relations plans; as well as several reports including an RI report, which will incorporate human health and ecological risk assessments, and an FS report that will describe and evaluate remedial alternatives.

The scope of the RI will include tasks that will:

- Evaluate existing data
- Address data gaps
 - Determine the dike integrity and whether contaminants are leaking through dike walls
 - Determine geotechnical properties of sediment, soil, and dikes needed to evaluate capping possibilities and temporary/permanent dock design/construction
 - Quantify volatile/semivolatile organic compounds and the potential effects on air quality
 - Collect data to support human health and ecological risk assessments
- Prepare a baseline human health risk assessment
- Support the completion of an ecological risk assessment.

The FS will evaluate alternatives for response actions. Some anticipated alternatives to be evaluated may include: no action (beyond maintenance), capping, consolidation and capping, aquatic capping, soil/sediment removal, groundwater extraction and treatment, soil vapor extraction and treatment, and shoreline/berm stabilization. Each alternative or a combination of alternatives will be evaluated relative to refuge management goals and screened against the nine CERCLA evaluation criteria:

- Overall Protection of Human Health and Environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Long-Term Effectiveness
- Reduction in Toxicity, Mobility, and Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Following completion of the FS, the Service will prepare a Proposed Plan to identify the preferred alternative for agency and public review. Comments received on the preferred alternative will be addressed and incorporated by the Service into the ROD.

A rough, order-of-magnitude cost estimate for the Grassy Island RI/FS was developed using experience and information from several recent projects. The cost information was derived from similar projects with comparable technical tasks and mobilization requirements and relevant remedial goals. To account for uncertainty factors, some of which could increase costs and some of which could allow cost savings, cost ranges were calculated around the estimated costs for each task. The RI/FS subtotal is estimated at \$795,038 within an uncertainty range from \$636,029 to \$1,033,549. The total costs, including technical support to the Service, which will prepare the Proposed Plan and ROD, are estimated at \$831,978 within a range from \$665,582 to \$1,081,571.

Table ES-1. Summary of Estimated Cost Ranges

Task Number	Task	Lower Range (Estimated Cost -20%)	Estimated Pre-Scoping Cost	Upper Range (Estimated Cost +30%)
100	Project Planning	\$70,342	\$87,927	\$114,305
200	Site Investigation— Assessment of Existing Data	\$34,850	\$43,563	\$56,632
300	Site Investigation— Field Sampling	\$378,939	\$473,674	\$615,776
400	Remedial Investigation	\$90,157	\$112,697	\$146,506
500	Feasibility Study	\$39,374	\$49,218	\$63,983
600	Project Management and Reporting	\$22,367	\$27,959	\$36,347
Subtotal RIFS Cost Estimate Ranges		\$636,029	\$795,038	\$1,033,549
700	Proposed Plan Support	\$19,576	\$24,470	\$31,811
800	Record of Decision Support	\$9,976	\$12,470	\$16,211
Total Estimated Cost Ranges		\$665,582	\$831,978	\$1,081,571

1. INTRODUCTION

1.1 Purpose

This technical memorandum is being prepared for the U.S. Fish and Wildlife Service (Service) to outline the necessary steps, and the associated costs, to plan and carry out a Remedial Investigation/Feasibility Study (RI/FS) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Contingency Plan (NCP) for Grassy Island (“Grassy Island” or “the Site”), a part of the Detroit River International Wildlife Refuge (DRIWR), Wayne County, Michigan. The memorandum also includes a cost estimate associated with preparation of the Proposed Plan and Record of Decision (ROD) that will follow the RI/FS. This memorandum was prepared by Tetra Tech EC, Inc. for the Service’s Detroit River Sub-Office of the East Lansing Field Office under U.S. General Services Administration (GSA) contract GS10F0208J, task order 314105X162, which is being administered by the East Lansing Field Office. When conducting a CERCLA response action at the Site, the Service must act consistently with CERCLA and NCP requirements.

1.2 Memorandum Organization

This technical memorandum includes a summary of background information to inform the reader of the current status of the remedial action process for the Grassy Island Site and describes the regulatory framework and a recommended technical approach for meeting regulatory requirements. Supporting information is provided for planning the overall scope and phases of the project, including estimates of cost ranges for the identified phases. The memorandum is organized as follows:

- Introduction
- Project Background
- Regulatory Framework
- Scoping Activities and Deliverables for the Remedial Action Process
- Focused Remedial Investigation
- Focused Feasibility Study
- Remedial Investigation/Feasibility Study (RI/FS) Cost Estimate

There are also three attachments with supporting information and documentation for those readers requiring additional details. The attachments are:

- Attachment A, List of Existing Documents
- Attachment B, Suggested Deliverables Formats
- Attachment C, Cost Estimates

2. PROJECT BACKGROUND

2.1 Site History

Grassy Island is a 72-acre artificial island constructed, maintained, and operated by the U.S. Army Corps of Engineers (USACE) between 1959 and 1987. Grassy Island was built specifically to dispose of contaminated sediments, dredged by the USACE, from the Rouge River. In 1961, Grassy

Island was designated by an act of Congress as part of the Wyandotte National Wildlife Refuge (WNWR) to be managed by the Service. As part of the Congressional designation, the USACE was allowed to continue to operate the Site for disposal of dredged sediments. In 2001, WNWR was incorporated into the DRIWR. The Service has been investigating the nature and extent of contamination on and near Grassy Island in conjunction with the U.S. Geological Survey (USGS) since the early 1990s.

2.2 Preliminary Assessment/Site Investigation Summary

Pursuant to its CERCLA response authority, the Service conducted a Preliminary Assessment/Site Inspection (PA/SI). The Service prepared a final PA/SI report (USFWS 2004) of its findings, which is available on the Region 3 U.S. Fish and Wildlife Service (USFWS) website (<http://www.fws.gov/midwest/GrassyIsland/index.htm>). The Service used the PA/SI to assess the release or threat of release of hazardous substances or contaminants at or from Grassy Island and to determine the need for further response actions. The PA/SI accomplished the following:

- Reviewed existing site information, including previous sediment, biota, and groundwater sampling on and near Grassy Island
- Evaluated the potential release of hazardous substances or contaminants via groundwater, surface water, and soils and air pathways
- Identified uncertainties about the nature and extent of potential, current, or threatened releases of hazardous substances or contaminants

The PA/SI presented the following conclusions regarding contaminant transport pathways and the need for further actions:

1. Groundwater—The groundwater on Grassy Island is likely isolated from the underlying aquifer. The most likely pathway for the release of contaminated groundwater from Grassy Island is by seepage through the dike walls into surface water. It is not expected that releases from Grassy Island would affect surrounding groundwater resources.
2. Surface Water—There are several pathways for release of hazardous substances into the surrounding surface water. There are numerous potential receptors along the Detroit River that may be adversely affected by exposure to hazardous substances. Limited groundwater data from Grassy Island indicate that many hazardous substances are at concentrations greater than drinking water criteria, groundwater surface water interface criteria, and/or environmental water quality criteria. Additional data collection is required to make more quantifiable statements regarding seepage of water and contaminants through the dike walls. Frequency and volume of releases from the weir may need to be determined along with concentrations of hazardous substances in runoff from the weir. Additionally, the structural integrity of the dike walls themselves should be assessed to determine their longevity and identify preventative maintenance requirements.
3. Air and Soil—Hazardous substances were detected above state of Michigan background levels in soils. Some hazardous substances were detected at concentrations above screening levels or some cleanup criteria, but not above Michigan's criteria for direct contact. There is

site-specific evidence of the presence of hazardous substances in earthworms, and these substances therefore become available to the terrestrial food chain.

4. Further Actions—The PA/SI recommended the following actions:
 - Conduct an RI that includes collection of additional site data and/or modeling contaminant mobility.
 - As part of the RI, perform baseline human health and ecological risk assessments to determine risks to public health, and resident and migrating wildlife that considers risks based on current conditions as well as risks under future refuge management and habitat restoration scenarios.
 - Conduct an FS to evaluate remedial alternatives prior to selecting a remedial action that is protective of human health and attains applicable or relevant and appropriate requirements (ARARs) at Grassy Island.

2.3 Prior Studies

For its PA/SI, the Service used sampling results and environmental and contaminant data from several prior studies. Those studies were conducted by numerous agencies, including USACE; U.S. Department of Health, Education, and Welfare; U.S. Environmental Protection Agency (EPA) and its predecessor agency (the Federal Water Pollution Control Agency); Michigan Department of Natural Resources; USGS; Environment Canada; and the Service itself. A full list of prior studies conducted to date including those cited in the final PA/SI report is included in Attachment A.

2.4 Goals for Grassy Island

Remedial action objectives for Grassy Island have not yet been established, but there are numerous general management directives stated in the enabling legislation for the WNWR and the DRIWR as well as the Comprehensive Conservation Plan (CCP) for the DRIWR that are relevant and can be used to help guide the remedial planning process. The currently available management directives are summarized in Table 1. Information contained within these directives, and other compliance requirements, may be used to support the detailed comparative analysis that is done as part of the CERCLA RI/FS process.

The current resource management goals establish preliminary objectives that the Grassy Island remedial action process should strive to meet. As information is gathered during the RI/FS, these goals will be refined, expanded, or clarified to comply with CERCLA and NCP requirements. Remedial alternatives will be identified during the FS, and input will be generated through consultations with cooperating agencies and organizations and comments from the interested public. The management directives (Table 1) reiterate existing goals that will translate into fundamental remedial action objectives and preliminary cleanup and performance standards to be augmented with action-specific, location-specific, and chemical-specific ARARs. In addition, Table 1 states the source of each goal, as well as pertinent background information about the context of the goal or how it was established.

3. REGULATORY FRAMEWORK

CERCLA provides broad federal authority to facilitate the cleanup of sites where there has been a release or threat of release of hazardous substances or pollutants or contaminants. Executive Order (EO) 12580 (52 Fed. Reg. 2923 (1987), as amended, delegates response authority to the U.S. Department of Interior (DOI) to address releases on or from land under its jurisdiction, custody, or control. The Service is conducting response action at Grassy Island, pursuant to this delegated CERCLA authority. The NCP, 40 Code of Federal Regulations (CFR) Part 300 serves as the implementing regulation for CERCLA and sets forth the procedures to be followed for selecting and conducting CERCLA response actions. The major steps taken, during the CERCLA remedial action process, to investigate and remediate hazardous substance releases are shown in Figure 1.

RI/FS is a methodology used for characterizing nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. The objective is to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site.

The methodology the EPA Superfund program has established for the RI/FS process is outlined in the EPA document "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA/540/G-89/004). Figure 2 illustrates the various phases and activities associated with the RI/FS process. It is important to note that the RI and FS are to be conducted concurrently and that data collected in the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and the scope of potential treatability studies and additional field investigations.

The Environmental Response Division of Michigan's Department of Environmental Quality has also established rules for the cleanup of hazardous wastes sites (Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451). Section 121 (d) (2) (A) of CERCLA specifies that more stringent state ARARs, that are identified in a timely manner by the state must be attained, absent a statutory waiver, by any remedial action selected.

4. SCOPING ACTIVITIES AND DELIVERABLES FOR THE REMEDIAL ACTION PROCESS

As shown in Figure 2, the CERCLA remedial process begins with development of a PA/SI. The Service submitted the final PA/SI for the Grassy Island in January 2005. Based on the results of the PA/SI, the Service recommended that an RI/FS be conducted for the Site.

Scoping is the initial planning phase of the RI/FS process, and many of the planning steps begun here are continued and refined in later phases of the RI/FS. Scoping activities typically begin with the collection of existing site data, including data from previous investigations such as the PA/SI.

In advance of the RI and FS, which can be combined into one report, several preliminary documents that are part of the scoping and planning process are required to plan and execute the RI/FS. Early deliverable documents include a RI/FS Work Plan, a Sampling and Analysis Plan (SAP), a Health and Safety Plan (HASP), and a Community Relations Plan (CRP). Following the

completion of the RI/FS report, which describes the results of the RI/FS, a Proposed Plan and a ROD are prepared that document the preferred remedial alternative, and the selected remedial action, respectively. Brief descriptions of each plan and report are provided below.

Work Plan

The work plan documents the decisions and evaluation made during the scoping process and presents the anticipated future tasks associated with the RI/FS. The basic elements of an RI/FS Work Plan are as follows:

- Introduction
- Site Background and Physical Setting
- Initial Evaluation
- Work Plan Rationale
- RI/FS Tasks

A copy of the suggested format for the RI/FS Work Plan is provided in Attachment B.

Sampling and Analysis Plan

The SAP consists of two parts: (1) a quality assurance project plan (QAPP) that describes the policy, organization, functional activities and quality assurance (QA) and quality control (QC) protocols necessary to achieve the data quality objectives (DQOs) dictated by the intended use of the data, and (2) a Field Sampling Plan (FSP) that provides guidance for all field work by defining in detail the sampling and data-gathering methods to be used on the project. A copy of the suggested format for the SAP is provided in Attachment B

Health and Safety Plan

The HSP is prepared to support the field effort and must conform to the agency's health and safety program, which must be in compliance with the Occupational Safety and Health Act (OSHA) requirements. The HSP should include at a minimum, the 11 elements described in Appendix B of the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA/540/G-89/004). The specific information required in a site specific HSP is listed in 29 CFR 1910.120.

Community Relations Plan

The CRP documents the community relations history and the issues of community concern as well as the steps that will be followed to solicit public input to the remedial process. The recommended format is provided in Attachment B.

Remedial Investigation Report

The RI report will document the nature and extent of contamination both onsite and offsite based on the comprehensive sampling and data collection conducted during the field program. In conjunction with the RI, a risk assessment will be performed to identify and quantify the risks that Grassy Island poses to human and ecological receptors. The human health risk assessment is used to identify and quantify the risks posed by the site to public health and welfare. The ecological risk assessment is used to evaluate whether the site poses a risk to the environment and ecology. In both

risk assessments, present and future risks are evaluated in the absence of any remediation and these potential risks are used to help determine the need for and extent of remediation required.

Feasibility Study Report

The FS Report is the document that uses the data collected during the RI to identify potential remedial alternatives for Grassy Island. The remedial alternatives are evaluated based on remedy selection criteria outlined in the NCP, including protectiveness, compliance with ARARs, long and short term effectiveness, reduction of toxicity, mobility, or volume, implementability, cost, and state and community acceptance.

Proposed Plan and Record of Decision

The Proposed Plan is a summary-level document prepared after the completion of the FS for review and comment by the public, stakeholders, and cooperating federal and state agencies. The Proposed Plan will give a synopsis of each remedial alternative that was evaluated for Grassy Island and describe the preferred alternative that the Service identified during the FS process. It will also summarize the relative advantages and disadvantages of each considered alternative as well as the risks identified at the Site. The Proposed Plan will be used in conjunction with the CRP to inform the public about the Site and the RI/FS process, and it is usually supplemented with other exhibits such as fact sheets, presentations during public meetings, and information posted on the Service's website. Following receipt and consideration of comments by the interested public and agencies, a ROD will be prepared for signature by the DOI Assistant Secretary for Policy, Management, and Budget. The ROD will describe the remedy selection decision for the Site, the public and agency input that was received on the preferred alternative presented in the Proposed Plan, and the basis for the selected alternative.

5. FOCUSED REMEDIAL INVESTIGATION

Based on the conclusions and recommendations of the PA/SI, a focused RI will be conducted. The anticipated tasks/activities associated with this investigation are listed below:

- Evaluation of existing data (PA/SI, other site investigations, design/construction reports/drawings, corrective action reports)
- Data gaps to be addressed
 - Integrity of dikes (obtain and review available design/construction documents from USACE)
 - Whether contaminants are leaking through dike
 - Geotechnical properties of sediment (data will be used to evaluate capping possibilities and temporary/permanent dock design/construction)
 - Volatile/semivolatile compounds and their potential effect on air quality (soil gas survey and ambient air sampling)

- Data to support human/ecological risk assessments
- Baseline human health risk assessment
- Ecological risk assessment (The Service will conduct an ecological risk assessment and prepare the report)

6. FOCUSED FEASIBILITY STUDY

Using the data collected during the RI, the remedial alternatives for response actions at the site will be identified and evaluated in a focused FS. These remedial alternatives may include, alone or in combination, no action (beyond maintenance), capping, consolidation and capping, aquatic capping, soil/sediment removal, groundwater extraction and treatment, soil vapor extraction and treatment, and shoreline/berm stabilization.

Each of these remedial alternatives or combination of remedial alternatives will be evaluated relative to refuge management goals and screened based on the nine evaluation criteria:

- Overall Protection of Human Health and Environment
- Compliance with ARARS
- Long-Term Effectiveness
- Reduction in Toxicity, Mobility, and Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Each of these evaluation criteria is defined in greater detail within the NCP and EPA guidance documents. Based on this evaluation, a preferred alternative will be identified. Following the completion of the focused FS, the preferred alternative will then be summarized for public and agency review and comment in a Proposed Plan. Comments will be addressed and incorporated into the ROD, which will document the selected alternative

7. RI/FS COST ESTIMATE

Grassy Island is a unique site with numerous challenging geographic and logistical characteristics because of its setting as an artificial island near a large metropolitan area, but with no human residents or current infrastructure. A rough, order-of-magnitude cost estimate for the Grassy Island RI/FS was developed using recent experience and information from several projects and approaches, including, but not limited to, projects for DOI bureaus and other Federal agencies. These cost estimates were based on evaluating the existing data set, in light of the requirements of CERCLA and the NCP, in comparison to other projects with comparable attributes. The cost information comes from several projects of similar size and type where technical tasks were comparable, mobilization requirements were analogous, and goals for remediation/restoration were

relevant. Specifically, the recent, similar projects that were used as sources from which to draw cost and scope information include the following:

- Dauids Island, New Rochelle, New York – The 80-acre island is located in Long Island Sound approximately 0.6 miles east of the mainland at New Rochelle, New York. The project involves mobilizing to an uninhabited island without dock facilities, actively maintained infrastructure, or serviceable utilities. The scope of work includes yearly mobilization/demobilization of materials and equipment necessary for the island staging area, construction of a permanent pier, asbestos abatement and removal, building demolition, and debris removal.
- Grand Calumet River, Northwest Indiana – This shallow river is part of the Great Lakes watershed and lies in one of its areas of concern. Its sediments and adjoining wetlands are contaminated with a complex assortment of industrial and municipal contaminants and dredging, sediment management and disposal, and habitat restoration options are being evaluated by a technical team supporting the Service and other natural resource Trustees. Scope included the sampling sediments, surface water, and groundwater, bathymetric and topographic surveys, collecting sediment samples and testing them for geotechnical properties, conducting a baseline human health risk assessment, supporting the determination of risk-based ecological preliminary remedial goals, a remediation/restoration feasibility analysis and evaluation of remedial alternatives, and support of public involvement activities.
- Thea Foss Waterway, Tacoma, Washington – This waterway discharges into Puget Sound where the main concern at the Head of the Thea Foss waterway is the existence of non-aqueous phase liquids (NAPL) in fine-grained sediments and an active NAPL seep from uplands into the waterway. The scope of work includes pre-design field investigations (sampling and analyses, a contaminant mobility study, bathymetric and topographic surveying), preparation of a focused design, and construction engineering services for remediation of NAPL-contaminated sediments. Design includes dredging impacted sediments in shallow intertidal water, transfer and disposal of dredged sediments to an approved upland facility, placement of an impermeable cap over NAPL seep areas, habitat improvement and capping of soft sediments.
- New Bedford Harbor Superfund Site, New Bedford, MA – This Superfund site consists of approximately 850,000 cubic yards of PCB-contaminated sediments over more than 18,000 acres. The scope of work included technical support in preparation of a ROD, extensive sampling and geostatistical analysis, focused feasibility studies, human and environmental risk assessments, remedial design (confined disposal facilities, dredging, sediment processing, water treatment, restoration), sediment removal actions, and wetlands restoration.

Information on the expected costs for Grassy Island and how they were derived is presented in the next four sections. Section 7.1 describes the specific tasks to be completed in the RI/FS. Section 7.2 lists important assumptions about those tasks that were used to develop the costs. Section 7.3, along with Table 2 and the details in Attachment C, presents the estimated costs for the RI/FS and for contractor assistance with a Proposed Plan and ROD. Finally, Section 7.4 describes the most significant areas of uncertainty in the cost estimates presented.

7.1 RI/FS Tasks

For planning and estimating, the Grassy Island RI/FS project was organized into seven tasks; each of which was further subdivided into several subtasks and/or work products to establish a manageable work breakdown structure and scope from which to develop a framework for estimated costs. More details on the scope of the work to be accomplished by these tasks can be found in Sections 4, 5, and 6.

Task 100 – Project Planning

Project scoping and planning, as described in Section 4, comprise early elements of the RI/FS process. Planning subtasks result in the preparation of several work products under Task 100 that include:

- Work Plan
- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Plan Finalization and Approval
- Community Relations Plan (CRP) (Agency Support)

Task 200 – Site Investigation, Assessment of Existing Data

Task 200 – Site Investigation, Assessment of Existing Data, conducted concurrently with Task 100 – Project Planning above, is another part of the scoping and planning process, details of which can be found in Section 4. Several subtasks and work products have been identified to accomplish this project element, which include:

- Gather, Review and Evaluate Existing Data
- Conduct Site Visit
- Establish Baseline Conditions
- Recommended Methodologies for Establishing Cleanup Values
- Develop Grassy Island Database
- Evaluate Current and Planned Site Uses
- Summarize Existing Data and Identify Data Gaps

Task 300 – Site Investigation, Field Sampling and Analysis

Task 300 – Site Investigation, Field Sampling and Analysis encompasses activities that will collect and provide the data necessary to address the data gaps as described in Section 5. Task 300 subtasks and work products include:

- Surveying and Mapping of the Site
 - Topographic Survey
 - Hydrographic/Bathymetric Survey
- Field Sampling
 - Groundwater Sampling
 - Groundwater Tracer Study (Dike wall integrity)
 - Surface Water Sampling/Modeling
 - Soil Sampling
 - Sediment Sampling

- Soil Gas Sampling
- Air Sampling
- Ecological Sampling
- Field Screening and Processing

- Data Analysis
 - Chemical Analyses
 - Geotechnical Analyses
 - Toxicity Analyses

- Data Review and Analysis

- Field Sampling Report
 - Prepare Report
 - USFWS Review & Comment
 - Finalize Report

Task 400 – Remedial Investigation

Task 400 – Remedial Investigation covers efforts related to preparation of some of report components that will make up the RI/FS report, and which will describe and interpret of the results from Task 300. Task 400 subtasks and work products include:

- Summary of Study Area Investigations
- Physical Characteristics of Site
- Nature and Extent of Contamination
- Contaminant Fate and Transport
- Baseline Risk Assessment
- Ecological Risk Assessment
- Prepare RI Report
 - Prepare Draft Report
 - Address Comments
 - Prepare Final RI Report

Task 500 – Feasibility Study

Task 500 – Feasibility Study covers efforts related to the engineering analyses and preparation of that portion of the RI/FS report that will address the remedial alternatives using the findings and output from Task 400. Feasibility Study subtasks and work products include:

- Identify, Review and Evaluate Remedial Alternatives
- Prepare FS Report
 - Prepare Draft Report
 - Address Comments
 - Prepare Final FS Report

Task 600 – Project Management and Reporting

Task 600 – Project Management and Reporting includes coordination, communication, scheduling, and financial management and reporting activities related to carrying out Tasks 100 through 500. Management subtasks and work products include:

- Project Kick-off Meeting
- Progress Reporting
- Meetings
- Financial Management and Invoicing

Task 700 – Proposed Plan Support

Task 700 – Proposed Plan support includes:

- Prepare materials for use by the Service in the Proposed Plan
- Prepare materials for the Service to use at public meetings on the Proposed Plan

Task 800 – Record of Decision Support

Task 800 – ROD support subtasks include:

- Prepare technical materials for use by the Service in preparing the ROD
- Provide technical assistance to the Service in addressing comments and preparation of the responsiveness summary in the ROD

7.2 Assumptions

The assumptions used, as well as the specific costs associated with the RI/FS, are presented in the following below. The following assumptions (presented by task) were utilized in developing the rough order of magnitude cost estimate for the RI/FS for Grassy Island:

General

- The average labor rate = \$100.00/hour
- The computer and information technology usage rate = \$8.00/hour

Task 100 Project Planning

- Labor hours and other direct charges (ODCs) are based on similar projects described in Section 7.

Task 200 – Site Investigation, Assessment of Existing Data

- Three people will attend the site visit
- Air travel for 2 people = \$500/person
- Car rental = \$75/day for 2 days
- Mileage = \$0.41/mile
- Transportation to and from the island = \$1,500/day
- Per diem (hotel and meals—Detroit) for 2 people = \$160/day/person

Task 300 – Site Investigation, Field Sampling and Analysis

- Subcontractor costs are based on similar projects described in Section 7.
- Hydrographic survey of island = \$8,000/day for 3 days

- Transportation for personnel and small equipment = \$1,700/day for 15 days
- Transportation for equipment/supplies necessary for fieldwork = \$6,000/day for 6 days
- For the site investigation phase, a temporary dock will make use of a barge that is spudded to the shoreline and can be used as a dock surface to load/unload supplies and personnel.
- All field work will be completed concurrently within 4 weeks
- Collect 20 groundwater samples
- There are sufficient existing wells suitable for sampling
- Analysis of 20 surface water samples at \$927 per sample
- Water samples will be analyzed for the following:
 - Volatile organics
 - Organochlorine pesticides
 - PCBs
 - Herbicides
 - Chloride
 - Cyanide
 - Fluoride
 - Nitrogen
 - Total dissolved solids (TDS)
 - Total suspended solids (TSS)
 - Organic carbon
 - Mercury
 - Metals
 - Halide, total organic as Cl
 - Total organic carbon
 - Nitrogen
 - Sulfate
 - Semivolatile organics
- Water samples will not be analyzed for dioxin/furans (but if dioxins/furans are required, add approximately \$595 more per sample for those analyses)
- Surface water will be sampled during three separate rain events
- Collect soil samples at a density of 1 sample per acre (10 samples, including QC samples)
- Collect 10 sediment samples
- Analytical costs for sediment/soil samples estimated at \$926/sample
- Soil/sediment samples will be analyzed for the following:
 - Volatile organics
 - Organochlorine pesticides
 - Polychlorinated biphenyls (PCBs)
 - Herbicides
 - Chloride
 - Cyanide
 - Fluoride
 - Mercury
 - Metals
 - Halide, total organic as Cl
 - Total organic carbon

- Nitrogen
 - Sulfate
 - Semivolatile organics
- Soil/sediment samples will not be analyzed for dioxins/furans (\$595/sample)
 - Collect soil geotechnical samples at a density of 1 sample per 10 acres of land (10 geotechnical samples, including QC samples)
 - \$650 per sample for geotechnical analysis (density, specific gravity, grain size, Atterberg Limits, triaxial shear, compression tests)
 - Analysis of 10 soil gas samples at \$325/sample
 - Analysis of 20 air samples at \$1,000/sample

Task 400 – Remedial Investigation

- Labor hours and ODCs are based on similar projects described in Section 7.

Task 500 – Feasibility Study

- Labor hours and ODCs are based on similar projects described in Section 7.

Task 600 – Project Management and Reporting

- Labor hours and ODCs are based on similar projects described in Section 7.
- Kick-off meeting to be conducted during initial site visit. Travel costs included in site visit task.

Task 700 – Proposed Plan/Record of Decision

- Labor hours and ODCs are based on similar projects described in Section 7.

7.3 Costs

A Summary of the rough, order-of-magnitude cost estimate for the Grassy Island RI/FS is provided in Table 2 and a complete cost estimate with back up for labor costs and ODCs is provided as Attachment C.

The estimated rough, order-of-magnitude cost for the RI/FS is \$795,038; \$831,978 if support to the Proposed Plan and ROD are included. This RI/FS costs include an estimated 5,190 hours (\$519,000) to complete the project planning, site investigations, RI, FS, and project management. Approximately \$276,038 of the estimated total RI/FS cost is for ODCs that include subcontractor costs, laboratory costs, equipment, and miscellaneous expenses (e.g., computer usage, travel, shipping, etc.). Preparation of the proposed plan and ROD following the completion of the RI/FS is estimated to cost approximately \$37,000.

7.4 Areas of Uncertainty

Approximately 60 percent (\$473,674) of the total estimated costs for the RI/FS are associated with site investigation activities (Task 300). Subcontractor and laboratory costs makeup \$264,874 of the total cost for Task 300, Site Investigations. Refining the scope and obtaining competitive procured costs for analytical services and services associated with this task, therefore, will significantly affect the overall cost of the RI/FS.

The cost of the other five tasks of the RI/FS combined make up approximately 40 percent (\$321,364) of the total estimated cost. The majority of these costs consist of labor hours. Only changes in scope or average labor costs, therefore, will significantly affect these costs. A change in the average labor rate of +/- 10 percent would result in a change in the overall cost for the RI/FS of +/- 6 percent.

To account for the factors of uncertainty, some of which may increase costs or allow for cost savings, we calculated a cost range around the estimated costs for each task (Table 3). The RI/FS subtotal is estimated to range from a low of \$636,029 to an upper range of \$1,033,549. The total costs of the RI/FS plus support of the Proposed Plan and ROD are estimated to range from \$665,582 to \$1,081,571. One element of uncertainty could be attributed to conducting a final RI/FS scope identified in the approved work plans that is different from the preliminary scope envisioned during this pre-scoping exercise. Other factors of uncertainty include cost growth or deflation that can occur for such costs as fuel, transportation, subcontracted services, and professional labor. The cost ranges that were calculated for the tasks use a 'minus 20-percent lower range' and a 'plus 30-percent upper range' to account for a larger degree of uncertainty for unknown items that can cause greater upward pressure on costs than the factors that tend to reduce costs, such as greater efficiency through synchronizing field or report activities, price competition in the subcontracted services marketplace, or cost deflation.

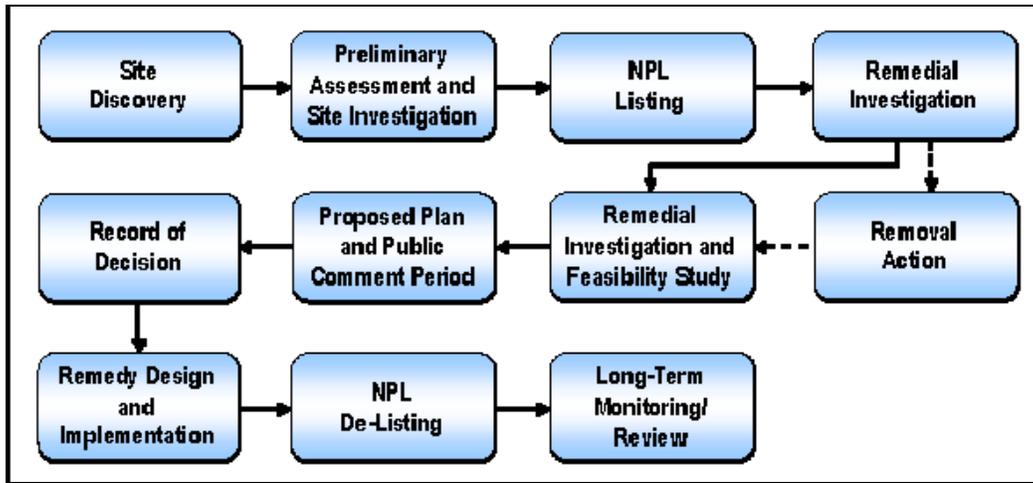


Figure 1. Major Steps of CERCLA Process

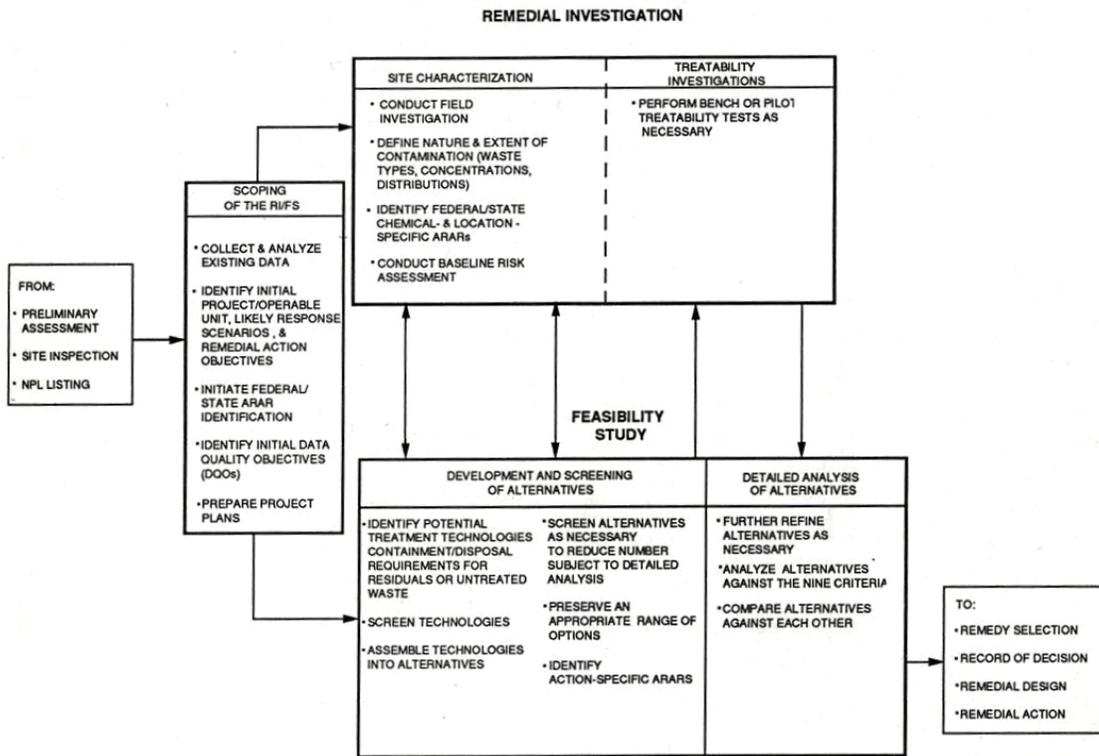


Figure 2. Phased R/FS Process

Table 1. Grassy Island Management Directives

Source	Goals	Background Information
From Wyandotte NWR enabling legislature	To be maintained as a refuge and breeding place for migratory birds and other wildlife	Wyandotte NWR, created in 1961, was incorporated into the Detroit River IWR in 2001
From Detroit River IWR enabling legislation	<p>The purposes for which the Refuge is established and shall be managed are as follows:</p> <ol style="list-style-type: none"> 1. To protect the remaining high-quality fish and wildlife habitats of the Detroit River before they are lost to further development and to restore and enhance degraded wildlife habitats associated with the Detroit River. 2. To assist in international efforts to conserve, enhance, and restore the native aquatic and terrestrial community characteristics of the Detroit River (including associated fish, wildlife, and plant species) both in the United States and Canada. 3. To facilitate partnerships among the United States Fish and Wildlife Service, Canadian national and provincial authorities, State and local governments, local communities in the United States and in Canada, conservation organizations, and other non-Federal entities to promote public awareness of the resources of the Detroit River. <p>(b) PRIORITY USES—In providing opportunities for compatible fish and wildlife dependent recreation, the Secretary, in accordance with paragraphs (3) and (4) of section 4(a) of the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd (a)), shall ensure that hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the priority public uses of the Refuge.</p>	Goals and purposes that were established by Congress during the legislative process, including the recognition of both the national and international significance of the natural resource potential of the local habitat which encompasses Grassy Island. Established on December 21, 2001 (Public Law 107-91), the Detroit River IWR is the first international refuge in North America. The refuge-establishing act redesignated islands that were once part of Wyandotte NWR – Grassy Island, Mud Island and Mamajuda Island, as part of the new international refuge.
From the Environmental Assessment and Comprehensive Conservation Plan (CCP) for Detroit River IWR (June 2005)	<p><i>Refuge Vision Statement</i></p> <p>“The Detroit River International Wildlife Refuge, including the Detroit River and Western Lake Erie Basin, will be a conservation region where a clean environment fosters the health and diversity of wildlife, fish, and plant resources through protection, creation of new habitats, management, and restoration of natural communities and habitats on public and private lands. Through effective management and partnering, the Refuge will provide outstanding opportunities for ‘quality of life’ benefits such as hunting, fishing, wildlife observation and environmental education, as well as ecological, economic, and cultural benefits, for present and future generations.”</p> <p><i>Refuge Goals</i></p> <p>The management alternatives presented in the environmental assessment will be measured and evaluated by their ability to meet the goals of the Refuge and address common issues. Eleven goals have been written for the Detroit River IWR and were adopted, in part, from the MAC Conservation Vision document and goals of other national wildlife refuges in the Midwest. The Vision document listed a number of “supporting elements” that easily become goal statements for the new Refuge:</p> <ul style="list-style-type: none"> • Establish functional partnerships involving communities, industries, governments, citizens, 	Developed during a planning effort that involved neighbors, non-government organizations (NGOs), local officials and many interested citizens as well as the Service and other cooperating agencies. The vision statement was adapted from the publication “A Conservation Vision for the Lower Detroit River Ecosystem,” published by the Metropolitan Affairs Coalition (MAC) in 2001. The MAC vision statement was the product of a bi-national collaboration of local governments, businesses, and organizations. The CCP planning team, along with the CCP workshop

Table 1. Grassy Island Management Directives

Source	Goals	Background Information
	<p>non-profit organizations and others to manage and promote the Refuge consistent with the plan's vision statement and the Act which created the Refuge. Provide an institutional framework to develop effective private or public partnerships for the purpose of sustainability.</p> <ul style="list-style-type: none"> • The Refuge will facilitate and promote hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation as wildlife dependent recreational uses. • Visitors and local citizens demonstrate a strong conservation ethic that supports the Refuge and broad based environmental awareness. • Future development that occurs within surrounding watersheds that may impact the Refuge is well planned, environmentally sustainable, and reflects known best management practices. • People living or working within the Refuge watersheds will understand and appreciate the importance and ecological value of the Detroit River and Western Lake Erie, and their contributing watersheds, to fish and wildlife and to human quality of life. • The hunting and fishing heritage, cultural resources and cultural history of the Refuge are valued and preserved, and connect Refuge staff, visitors, and the community to the area's past. • Fish and wildlife communities are healthy, diverse and self-sustaining. • Reduce levels of toxic substances to a threshold that does not threaten or harm or adversely affect wildlife, fish or human health. • Economic development and redevelopment is environmentally sustainable, well planned, and aesthetically pleasing. • Restore beneficial uses of water resources in the Refuge. • Lands and waters within the Refuge are responsibly managed to resolve potentially conflicting uses. 	<p>participants, wanted to recognize this broad vision for the Detroit River. They reviewed the existing vision statement and revised it to be more specific to the Detroit River IWR</p>

Table 2. Summary of Rough, Order-of-Magnitude Cost Estimate

Number	Task	Labor ¹	ODCs ¹	Totals ¹
100	Project Planning	\$86,000	\$1,927	\$87,927
200	Site Investigation—Assessment of Existing Data	\$39,600	\$3,963	\$43,563
300	Site Investigation—Field Sampling	\$208,800	\$264,874	\$473,674
400	Remedial Investigation	\$109,600	\$3,097	\$112,697
500	Feasibility Study	\$48,000	\$1,218	\$49,218
600	Project Management and Reporting	\$27,000	\$959	\$27,959
	Subtotal RI/FS Cost	\$519,000	\$276,038	\$795,038
700	Proposed Plan	\$24,000	\$470	\$24,470
800	Record of Decision	\$12,000	\$470	\$12,470
	Total Cost – RI/FS Plus Proposed Plan & ROD	\$555,000	\$276,978	\$831,978

¹ This summary table may include minor rounding errors.

Table 3. RI/FS Cost Ranges

Task Number	Task	Lower Range (Estimated Cost -20%) ¹	Estimated Pre-Scoping Cost ¹	Upper Range (Estimated Cost +30%) ¹
100	Project Planning	\$70,342	\$87,927	\$114,305
200	Site Investigation— Assessment of Existing Data	\$34,850	\$43,563	\$56,632
300	Site Investigation— Field Sampling	\$378,939	\$473,674	\$615,776
400	Remedial Investigation	\$90,157	\$112,697	\$146,506
500	Feasibility Study	\$39,374	\$49,218	\$63,983
600	Project Management and Reporting	\$22,367	\$27,959	\$36,347
Subtotal RIFS Cost Estimate Ranges		\$636,029	\$795,038	\$1,033,549
700	Proposed Plan Support	\$19,576	\$24,470	\$31,811
800	Record of Decision Support	\$9,976	\$12,470	\$16,211
Total Estimated Cost Ranges		\$665,582	\$831,978	\$1,081,571

¹ This summary table may include minor rounding errors.

This page intentionally left blank.

Attachment A
List of Existing Documents

- Beyer, W. N. and Stafford, C. J. 1993. Survey and evaluation of contaminants in earthworms and in soils derived from dredged material at confined disposal facilities in the Great Lakes regions. *Environ. Monit. Assess.* 24: 151-165.
- McCallister, P. 1972. Raising of dikes, Grassy Island disposal area (results of site inspection). Sent to U.S. Army Corps of Engineers (USACE) - Detroit District. August 3, 1972.
- U.S. Army Corps of Engineers (USACE). 1976b. Grassy Island confined disposal facility water quality monitoring, 1976. Detroit, MI; USA.
- USACE. 1979. 1979 water quality monitoring of the Grassy Island confined disposal facility. Detroit, MI; USA.
- USACE. 1980. 1980 water quality monitoring of the Grassy Island confined disposal facility. USACE-Detroit District. Detroit, MI; USA.
- USACE. 1981. 1981 water quality monitoring of the Grassy Island confined disposal facility. Detroit, MI; USA.
- USACE. 1982. 1982 water quality monitoring of the Grassy Island confined disposal facility. Detroit, MI; USA.
- USACE. 1982. Inspection of Grassy Island CDF (Confined Disposal Facility). Letter from Chief – Project Operations to Chief – Operations and Maintenance Branch. Sent by Jacek, S. R. to Chief Operations and Maintenance Branch. November 19, 1982
- USACE. 1984. Operations and maintenance manual confined disposal facility Grassy Island, Michigan. Detroit, MI; USA.
- USACE. 1986. Repair of the Grassy Island CDF Environmental Assessment and Section 404 (b) (1) evaluation. Detroit, MI; USA.
- USACE. 2003. Annual Report/Dredging Report for Grassy Island (1971-1982). Detroit, MI; USA.
- U.S. Fish and Wildlife Service (USFWS). 1992. Survey of contaminants in sediment and biota within the Grassy Island confined disposal facility, Wyandotte NWR. Prepared by Best, D. A., Kubiak, T. J., and Beollstorff, D. E of the USFWS; East Lansing Field Office. East Lansing, MI, USA.
- USFWS. 2004. Preliminary Assessment and Site Inspection Grassy Island Disposal Facility, Wayne County, Michigan. Final. Prepared by Stephanie Millsap, Ph.D., U.S. Fish and Wildlife Service, Region 3 Ecological Services, East Lansing Field Office. August 4, 2004.
- U.S. Geological Survey (USGS). 1999a. Contamination distribution and movement at Grassy Island. Prepared by Manny, B. A., U.S. Geological Survey, Biological Resources Division. Ann Arbor, MI; USA.

USGS 1999b. Contamination of surface soils and wildcelery tubers at Grassy Island in the Wyandotte National Wildlife Refuge in the Detroit River, Michigan. Prepared by Manny, B. A., U.S. Geological Survey, Biological Resources Division. Ann Arbor, MI.

USGS 1999c. Contaminant distribution in sediments and ground water on and near Grassy Island. Completion report. Prepared by Sweat, M. J., U.S. Geological Survey – Water Resources Division. Lansing, MI; USA.

USGS. 1999d. Continuous seismic-reflection profiling near Grassy Island, Wyandotte Unit of Shiawassee National Wildlife Refuge, Wyandotte, Michigan. Research completion report. Prepared by Sweat, M. J., U.S. Geological Survey- Water Resources Division. Lansing, MI; USA.

Attachment B
Suggested Deliverable Formats

Suggested RI/FS Work Plan Format

Executive Summary

- 1 Introduction
- 2 Site Background and Setting
- 3 Initial Evaluation
 - Types and volumes of waste present
 - Potential pathways of contaminant migration/preliminary public health and environmental impacts
 - Preliminary identification of operable units
 - Preliminary identification of response objectives and remedial action alternatives
- 4 Work Plan Rationale
 - DQO needs
 - Work plan approach
- 5 RI/FS Tasks
- 6 Costs and Key Assumptions
- 7 Schedule
- 8 Project Management
 - Staffing
 - Coordination
- 9 References

Appendices

Suggested Format for SAP (FSP and QAPP)

Field Sampling Plan (FSP)

1. Site Background
2. Sampling Objectives, Sample Location and Frequency
3. Sample Designation
4. Sampling Equipment and Procedures
5. Sample Handling and Analysis

Quality Assurance Project Plan

1. Project Description
2. Project Organization
3. QA Objectives for Measurements
4. Sampling Procedures
5. Sample Custody
6. Calibration Procedures
7. Analytical Procedures
8. Data Reduction, Validation, and Reporting
9. Internal Quality Control
10. Performance and System Audits
11. Corrective Actions
12. Quality Assurance Reports

Suggested Format for the Community Relations Plan

- 1.0 Introduction
- 2.0 Overview of the CERCLA Process
- 3.0 Site Description
- 4.0 Community Background
 - 4.1 Community Profile
 - 4.2 Key Community Concerns
- 5.0 Community Relations Activities and Timing
 - 5.1 Direct Mailings
 - 5.2 E-mail Notification
 - 5.3 Meetings with Local Officials and Concerned Groups
 - 5.4 News Releases
 - 5.5 Fact Sheets
 - 5.6 Public Meetings
 - 5.7 Other Potential Community Relations Activities
 - 5.8 Summary of Community Relations Activities
- 6.0 References

Suggested RI Report Format

1. Introduction
 - 1.1 Purpose
 - 1.2 Site Background
 - 1.3 Report Organization
2. Grassy Island Investigations
 - 2.1 Surface Features
 - 2.2 Contaminant Source Investigation
 - 2.3 Meteorological Investigations
 - 2.4 Surface-Water Investigation
 - 2.5 Groundwater Investigation
 - 2.6 Sediment Investigation
 - 2.7 Soil and Vadose Zone Investigations
 - 2.8 Human Population Surveys
 - 2.9 Ecological investigation
3. Physical Characteristics of Grassy Island
 - 3.1 Surface Features
 - 3.2 Meteorology
 - 3.3 Surface-Water Hydrology
 - 3.4 Geology
 - 3.5 Soils
 - 3.6 Hydrogeology
 - 3.7 Demography and land Use
 - 3.8 Ecology
4. Nature and Extent of Contamination
 - 4.1 Sources
 - 4.2 Soils and Vadose Zone
 - 4.3 Groundwater
 - 4.4 Surface Water
 - 4.5 Sediments
 - 4.6 Air
5. Contaminant Fate and Transport

- 5.1 Potential Routes of Migration
- 5.2 Contaminant Persistence
- 5.3 Contaminant Migration
- 6. Baseline Risk Assessment
 - 6.1 Human Health Evaluation
 - 6.2 Environmental Evaluation
- 7. Summary and Conclusions
 - 7.1 Summary
 - 7.2 Conclusions

Appendices

Suggested FS Report Format

1. Introduction
 - 1.1 Purpose and organization of Report
 - 1.2 Background information
2. Identification and Screening of Technologies
 - 2.1 Introduction
 - 2.2 Remedial Action Objectives
 - 2.3 General Response Actions
 - 2.4 Identification of Screening Technology Types and process options
3. Development and Screening of Alternatives
 - 3.1 Development of Alternatives
 - 3.2 Screening of Alternatives
4. Detailed Analysis of Alternatives
 - 4.1 Introduction
 - 4.2 Individual Analysis of Alternatives
 - 4.3 Comparative Analysis

Appendices

Attachment C
Cost Estimate

This page intentionally left blank.